# THE ROLE OF NON-HYDROCARBON MINERALS IN THE ARAB MIDDLE EAST; WITH SPECIAL REFERENCE TO THE USE OF INDIGENOUS MINERALS IN REGIONAL ECONOMIC DEVELOPMENT

by

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# ABSTRACT
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**Chapter One** provides an introduction to the thesis and outlines a theoretical model of an impact study which enables the economic role of mining to be studied in the subsequent chapters.

**Chapter Two** first analyses the geological formation of the Arab Middle East and then outlines the major non-hydrocarbon mineral deposits in the region.

**Chapter Three** provides a brief history of mining in the region before reviewing current mineral production in each country.

**Chapter Four** examines employment in the mining sector and highlights the differences between the countries of the region.

**Chapter Five** deals with the volume and direction of mineral trade including downstream mineral products.

**Chapter Six** uses the impact model to analyse the role of the mining sector in the national economies of the Arab Middle East. It shows that its role is significantly more important than it might initially appear.

**Chapter Seven** studies the role of mining in regional economic development. It concentrates on four regions in the Arab Middle East which illustrate the various stages of mineral development. These are the Algerian-Tunisian frontier region, central Jordan, northern Oman and the Red Sea Hills of Sudan.

**Chapter Eight** draws the strands of the thesis together and provides specific conclusions before suggesting future areas of research on non-hydrocarbon mining in the Arab Middle East.

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# CHAPTER ONE - INTRODUCTION

## 1.1. Aim and importance of thesis

For too long all of the countries of the Arab Middle East have been seduced by the lure of oil wealth. While this may not be surprising, given the transformation which has taken place in some countries as a result of oil revenues, it has tended to induce a case of collective myopia. Governments have ignored or under-valued the importance of the region's other natural resources. Amongst the most important of these are the large and valuable reserves of non-hydrocarbon minerals.

The aim of this thesis is to demonstrate the importance of both the existing and potential role of such minerals in the national and regional economies of the Arab Middle East. This is done in two stages. The first part of the thesis provides information about the minerals deposits and the mining industry. This enables its importance to both the national and regional economies to be analysed in the second part of the thesis.

The vast majority of theses and studies dealing with minerals and mining are either geological or mining engineering studies which have tended to concentrate on a single deposit or mine. Almost none have examined the macro-economic impact of the industry on more than

one region, let alone more than one country. This thesis is therefore amongst the first detailed but broad-based studies of the mining sector in the Arab Middle East.

By providing basic information about the region's mining sector in a coherent and systematic manner it can act as a reference work for future studies of more specific aspects of the subject. Although the collated information is not comprehensive it does include details of mineral reserves and production, employment and investment in the mining sector, as well as its contribution to regional and national economies.

Having collected the information the aim of the thesis is to choose specific regions which reflected the various stages of development of the mining sector. These range from very crude and simple exploration sites through to mature and fully integrated mining industries. The thesis then seeks to determine the full influence of these mining schemes on their regional and national economies. It is hoped that this will demonstrate the significance of the sector and thereby encourage future and more detailed research on the subject. Furthermore, it might help persuade regional and national governments to consider their non-hydrocarbon mining sector somewhat more seriously.

## 1.2 Methodology
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The first step was to check the available sources in the United Kingdom and to write to those companies and organisations in the Middle East mining sector. The majority of the U.K. sources were very detailed reports about the geology or mining techniques used in specific mines in the region. The companies and authorities were unhelpful and most simply provided their annual reports. What was lacking from any of the material available in the United Kingdom was information about the role of mining in the regional and national economies. In order to obtain such information it was obvious that it would be necessary to collect it from the region itself.

As will be seen, collecting data in the Middle East is very difficult because of the apparently widespread Arab attitude towards the gathering and subsequent use of data. In many countries government and company officials do not understand the academic nature of such research and are deeply suspicious of fieldwork, sometimes viewing it as spying. Besides the varying degree of access to information, another problem is the different quality of data in each country. While some countries have efficient and reliable statistics there is an alarming paucity of information in others.

The fieldwork covered as many countries as possible

although not all could be visited. The Gulf War and the consequent secrecy precluded a visit to Iraq, while the political situation in Lebanon was an equal hindrance. The hard currency regulations for Syria, North and South Yemen, as well as their small mining sectors, made it impossible to include these countries on the itinerary. Unfortunately the difficulties of obtaining a visa during the month of Ramadan made it impossible to visit Libya. This still meant, however, that the fieldwork covered ten countries and included about twenty five mines and quarries, and over twenty mining companies and authorities. In addition the Fifth Arab Congress on Mineral Resources was attended in Khartoum in February 1985 in order to obtain a regional perspective of the industry.

In each country visited the fieldwork was divided into three separate but related tasks. Copies of available data, in the form of books, reports, maps and theses, were obtained from national archives, libraries, government departments and mining companies. National and regional officials from both the responsible ministries and the companies were then interviewed whenever possible. In most countries at least one mining or quarrying operation was visited in order to interview officials and employees and to evaluate the impact on the regional economy. A number of cement and building

material plants, which dominate the mining sector, were also visited in the small Gulf states. While it was possible to interview many of the officials in English, in the Maghrebi countries this was done in French. Very rudimentary Arabic had to be used elsewhere, particularly when interviewing employees rather than expatriate or well educated bilingual managers and officials.

As had been expected, the extent and quality of the information which was obtained varied from country to country. Indeed, this had been one of the principal reasons for not "putting all my eggs in one basket" by studying a single country. In some, such as Egypt and Morocco, it was difficult to cut through the bureaucracy while there was a wealth of information in Algeria, Jordan and, once one had managed to get into the country, in Saudi Arabia.

Having returned to London the next task was to evaluate the quality and extent of the information and then try to fill in the gaps. It became obvious that the various mining projects which had been visited could be divided into four specific groups or categories which reflected their maturity or differing stages of development. There are the old mining projects, including many of those in the Maghrebi countries, which were located in relatively fertile areas and which were an important part of a

mature and predominantly agricultural regional economy.

Secondly there are the newer large-scale projects which totally dominate the regional economy. These include the majority of the phosphate projects in the Middle East, the iron ore mine in Egypt's Bahariya Oasis and one or two others. The third category are the new capital intensive projects such as those in the Gulf states, Jordan's Arab Potash Company and Iraq's natural sulphur plant at Mishraq. The economic viability from a purely mining perspective of some, although not all, of these projects is questionable but the often massive investment in regional infrastructure is obviously very significant. Finally there are the new "green-field" projects which, although normally having considerable economic potential, are often so under-capitalised that they are merely scratching the surface. While the most obvious of these are the Sudanese projects in the Red Sea Hills there are others in Egypt's Eastern Desert and in the Yemen Arab Republic.

It was decided that, besides providing as much information as possible about the mining sector in the Arab Middle East and its impact on national economies, the thesis should also include a more detailed analysis of the impact of specific examples of these four types of mining projects on their regional economies. The

Algerian-Tunisian border region, central Jordan, northern Oman and Sudan's Red Sea Hills were chosen as representative examples of the four stages of development.

The other major problem which had to be tackled was to identify and possibly quantify the full impact of the mining sector on a regional or national economy. It was obvious that the conventional measurement of its contribution to gross domestic product (GDP) is a significant under-estimation. The full extent of the economic and social linkages, including those both in upstream and downstream industries, therefore had to be identified.

A theoretical model, which had been advocated by Stauffer, Lennox and others when examining the oil industry, was modified to take account of the special factors involved in the non-hydrocarbon mining sector. It was obvious, however, that in order to apply the model to a specific country it would be necessary to gather considerable new and additional data which was beyond the scope of this study. It is hoped that this thesis will, however, provide the necessary background information to act as a launching pad for future more detailed studies of specific regions.

## 1.3 The Arab Mining Industry : Literature Survey

Comparatively little has been written in English or French about the mining industry in the Arab Middle East. The bibliography at the end of the thesis does, however, provide **full** details of those sources which have been used in this study. The only publications known to cover the whole region are - the **Arab Mining Journal** which is published by the Amman based multi-lateral Arab Mining Company; the various publications which are produced by the **Arab Organisation for Mineral Resources**, (e.g. **The Fifth Arab Congress on Mineral Resources : Abstracts**, Khartoum, 17-21 February 1985, AOMR, Rabat, 1985); F.Habashi and F.A.Bassyouni's atlas of **Mineral Resources of the Arab Countries**, (Chemcon Publishing Ltd, London, 1982); the U.S. Bureau of Mines' annual **Area Report** and **Mineral Production Yearbook**, (US Bureau of Mines, Washington D.C.); the British sister magazines **Mining Journal** and **Mining Magazine**, (Mining Journal Ltd, London, 1835-1988), and individual reports by **Fertecon** and the **British Sulphur Corporation**, (e.g **Raw Materials Report**, BSC, London).

Turning to individual countries the reading material is of a very mixed quality. Amongst the most prolific and useful national sources are - Saudi Arabia's **Deputy Ministry for Mineral Resources** and its various foreign consulting companies including BRGM, USGS, Riofinex and

British Steel; Morocco's **Bureau de Recherches et de Participations Minières**; the **Jordan Phosphate Mines Company** and **Arab Potash Company** from Jordan; and Tunisia's **Compagnie des Phosphates de Gafsa** and **Direction des Mines et de la Géologie.**

Important theses and reports on different aspects of the mining sector include - those by **Bousdira**, **Kerchachi** and **Temmer** in Algeria; **Allam**, **Eisa** and **Kroegar** in Egypt; **Amerah**, **Khalifeh** and **Odeh** in Jordan; and **Al-Husain**, **Hassanain** and **Khatrawi** in Saudi Arabia. In addition there are also company reports on specific mining and cement projects. Full details on these and all the other theses and reports cited in this thesis are included in the bibliography at the end of this thesis which is divided on a country by country basis. Unfortunately there is only limited information from some of those countries, such as Lebanon, Iraq, Syria and the two Yemens, which have relatively small mining sectors or are particularly secretive about official information.

## 1.4 Linkages in Regional Economic Development.

Before moving into the body of this study it is worth examining the central theme which will be running throughout the thesis - namely the true significance of the mining sector in the Arab Middle East. The first step in this process is to analyse the series of

linkages which are connected to each project or industry.

Hirschman first introduced the concept of "forward and backward linkages" in his book, **Strategy of Economic Development**, (Yale University Press, 1958), which sought to argue that "balanced growth", as first proposed by Rosenstein-Rodan, was not the only path to economic development. An industry is said to have strong forward linkages if it is likely to prompt the setting up of new industries using its output. An example of this might be iron ore mining which leads to the establishment of an iron and steel industry which, in turn, leads to the start of industries which use the metals. Backward linkages occur when investment in an industry gives rise to further investment in industries or resources which supply it with inputs. Obvious examples are the increase in the demand for inputs such as labour, raw materials, power and electricity when a new mining project begins. While an iron and steel industry has very strong forward and backward linkages, as Hirschman himself said, "development.....cannot be started everywhere with an iron and steel industry just because this industry maximises linkages", **[01]**.

It could and will be argued in this thesis that, even without an iron and steel industry, the mining sector

has strong forward and backward linkages and that this gives it the potential to play a leading role in regional and national economic development. Each mining scheme has a series of social, economic and physical interactions with its surrounding hinterland. When a new project is inaugurated in an area, the local population obtains access to new or additional services, facilities, infrastructure and economic activities. The creation of one new linkage often produces a cascade effect, making other activities and linkages possible. It is these linkages and others which form the basis of the model of the impact study which is presented later in this chapter. As **Table 1.1** below illustrates, they can be divided into seven major groups. These can be broadly termed - physical, economic, demographic, technological, social, service delivery and administrative linkages.

The most obvious type of linkage are the man-made and natural transportation networks. As will be seen in future chapters, new roads and railways are often constructed for mining projects. These can reduce travel time; lower transport costs; widen marketing, commuting and migration opportunities; provide greater access to non-agricultural employment; improve communications; and extend areas of service delivery. By linking rural and urban areas, greater marketing interaction and trade usually follow the construction of new transport links.

**Table 1.1 : MAJOR LINKAGES IN SPATIAL DEVELOPMENT**

| TYPE | ELEMENTS |
|---|---|
| Physical Linkages | Road Networks; River & Water Linkages Transport Networks; Railway Networks; Ecological Inter-dependencies. |
| Economic Linkages | Market Patterns; Raw Materials & Intermediate Goods Flows; Capital Flows; Production Linkages; Consumption & Shopping Pattern; Income Flows; Sectoral & Commodity Flows; "Cross Linkages". |
| Population Movement Linkages | Migration - Temporary & Permanent; Journey to Work. |
| Technological Linkages | Technological Inter-dependencies; Irrigation Systems; Telecommunications Systems. |
| Social Interaction Linkages | Visiting Patterns; Kinship Patterns; Rites, Rituals & Religious Activities; Social Group Interaction. |
| Service Delivery Linkages | Energy Flows & Networks; Credit & Financial Networks; Education, Training & Extension Linkages; Health Service Delivery Systems; Professional, Commercial & Technical Service Patterns; Transport Service Systems. |
| Political Administrative & Organisational | Structural Relationships; Government Budgetary Flows; Organisational Interdependencies; Authority-Approval-supervision Patterns; Inter-jurisdiction Linkages Transaction Patterns; Informal Political Decision Chains. |

**Source** : D.A.Rondinelli, **Applied Methods of Regional Analysis : The Spatial Dimensions of Development Policy**, Westview Press, 1985, Table 5.1, p.143

Every mining and quarrying project creates economic linkages. Each requires inputs of commodities, raw materials and manufactured goods to produce its mineral output. These include plant and machinery, fuel, raw materials used in mineral processing, vehicles, food and all the other requirements for the workforce and many others. Consequently there are a series of economic and marketing linkages between a mining project and both its immediate hinterland and the major urban areas. There can also be an important trading link with other countries. Mining plant and equipment is usually imported, while much of the output is exported either as primary or secondary products.

Although, as it will be seen, mining and quarrying are not major employers the projects do create demographic linkages. While the majority of the mining employees are usually local men who live nearby, many of the more senior posts are filled by graduates from the capital. In the Gulf countries, most of the workforce are "Third Country Nationals" or TCNs from Asia, while Western expatriates fill the more senior roles. In a number of mining projects, most of the employees are "bachelors" who spend months away from their families. It can therefore be seen that there are a number of forward and backward demographic linkages associated with most of the mining projects.

In such a modern and capital intensive industry as mining, it is obvious that there will be a series of technological linkages. This is particularly true in remote areas which have been largely unaffected by the process of modernity. Mining projects have often introduced modern equipment, procedures and methods of production to very under-developed regions where the local population is illiterate and has little or no experience of the modern world. Consequently such projects often act as a catalyst for the introduction of modern technology to such rural areas. Amongst the most important technological linkages which the mining projects bring to a region is telecommunications. Most at least have a radio system which links them to the capital city, while some have telephone and telex links.

Although mining projects do not produce very direct or important ones, another form of linkage are social interactions. As **Table 1.1** above showed, this includes visiting patterns to market towns, kinship patterns and various rites, rituals and religious activities. Widening the market area helps to extend the spatial range of social interactions and promote new kinship ties and visiting patterns. There are only two major social linkages which are directly related to the Middle East mining projects. One is the patterns of friendship and marriage between the families of miners. The other

is the expatriate workers' relationship with both their host community and their own countries.

Besides new transport links the other principal benefit which Middle East mining projects provide are the many services introduced for employees and their families. Usually a town has to be of a certain size before the economies of scale warrant the construction and running of clinics, schools, banks, shops and services. In order to attract workers to an often harsh environment, however, it is usually necessary for a mining company to provide some or all of these services. As will be seen in later chapters, many mining settlements become company towns. These linkages are therefore particular important when analysing the role of mining in the economic development of a region.

The final type of linkage which affects mining operations are administrative ones. These are the links between the project and the groups which control its operations and budget. These include its owners and administrators, whether a private company or public sector company, as well as the regional and national governments. In reality, they are the people who make the major economic and operational decisions which determine a project's future.

## 1.5 The Problems of Using an Econometric Model

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There are various ways of analysing the effect of an individual project or a particular sector on a national or regional economy. Increasingly sophisticated econometric models are now used by economists and development planners. There often appears to be a mistaken belief that the only valid model is one in which every factor is quantified. This can be sometimes taken to extreme lengths by those who consider that any figure, no matter how suspect, is preferable to more appropriate alternative which uses no figures.

When analysing developing countries the principal obstacle is the lack of accurate data from which to develop an econometric model. In most industrialised countries there is a sophisticated and experienced statistics collection service. National and regional governments, public and private sector companies, trade unions, academics and numerous other interested parties collect statistics. Their findings are widely disseminated and are usually available to the general public. For academic researchers the situation in the Middle East is very different. Consequently if the basic data are so difficult to obtain and so unreliable it is obvious that little trust can be placed in the results of analyses which use such statistics.

It has often been said that, "there are lies, damn lies and statistics". As in the case of most developing nations, the attitude of most of the governments of the Arab Middle East is that their statistics are for their exclusive use. These attitudes are exacerbated by the fact that statistics can demonstrate how rapidly a country is developing. The notion of academic enquiries for the sake of pure research is comparatively new and officials are often very suspicious of foreigners trying to obtain even the most innocuous statistics. In Saudi Arabia the most basic statistic, the true population of the country, is considered such a sensitive subject that it is kept secret. Consequently all of the country's statistics rated on a per capita basis can only be suspected as inaccurate.

From these simple examples it can be seen that an econometric model of the role of the mining sector even in one region is totally inappropriate. It was therefore decided to adopt a model which uses economic and regional geography rather than one which is heavily reliant on statistical and accountancy systems.

There are a number of advantages of such an approach. It enables this study to analyse the various stages of the development of a mining sector. These range from the small mining operations in Sudan, which are in their

infancy, to the vitally important Jordanian phosphate mining sector. A rigid econometric comparison of the two areas would currently be meaningless and totally inappropriate. As **Chapter Seven** will illustrate, however, a more descriptive analysis can provide useful comparisons. Consequently, although the text takes advantage of statistics where they are available, a rigid econometric model is not used in this study.

## 1.6 The formation of a "Regional Impact Study".

More appropriate than an econometric model in this study is a **regional impact study** of the mining projects in specific areas of a country. It is a development and modification of a model, first prepared in 1968, to analyse the economic impact of the oil industry, [02].

The word **impact** in this context is understood to mean the effect on the economy and society of a region of the development of non-hydrocarbon mining projects and industries. The economic impact can be divided into the primary or direct impact and the secondary or indirect impact. The **primary impact** can be defined as the effect on a specific region of a project's creation of and/or employment of local goods, services and personnel. The **secondary impact** is the set of indirect effects of a project or industry on the rest of the national economy. These will primarily include such elements as, export

earnings or import costs, the provision of raw materials for secondary industries, the generation of value added and the share of investment funds in development plans.

### 1.6.1 Primary Impacts.

As seen in **Table 1.2** there are many effects, or **primary impacts**, that a mining project or industry has on its immediate environment. While those included in the table are not universally applicable, many are common to most of the projects in the Arab Middle East. Some **primary impacts** will naturally be far more important in some areas than in others. The various effects are now briefly outlined below.

The total expenditure that a mining project incurs in its immediate environment is a very useful measure of its impact on the wider region. This would include its expenditure on employment and all the goods and services that it requires to run its operations. While such an important and precise statistic would be very useful it is normally, although not always, very difficult to obtain such information from a public or private mining company. As already noted in this chapter, governments and companies in the Arab Middle East are very secretive and are not prepared to divulge such information.

**Table 1.2 : A MODEL FOR A MINING REGIONAL IMPACT STUDY**

**Primary Impacts at a Local Level**

a. Total local expenditure;
b. The provision of employment;
c. The provision of pensions and social security;
d. The provision of subsidised food;
e. The provision of health facilities;
f. The provision of housing;
g. The provision of training and education;
h. The provision of utilities (electricity, water etc);
i. The provision of company roads and transport links;
j. The provision of emergency services;
k. The provision of company shops and services;
l. The provision of recreation and sports facilities;
m. The purchase of local goods;
n. The use of local contractors and services;
o. The use of local transport/communications facilities;
p. The use of local resources;
q. Assistance to local administration;
r. Assists in reducing rural-urban migration.

**Secondary Impacts at a National Level**

a. Contribution to GDP;
b. Mineral export earnings;
c. Import substitution savings;
d. Contribution to foreign exchange earnings;
e. A source of direct & indirect tax revenues;
f. A source of industrial raw materials;
g. Helps creates downstream industries;
h. Use and improvement of national infrastructure;
i. The construction of export terminals;
j. The effect on the national budget;
k. Impact on national and regional development plans;
l. Share of investment expenditure;
m. Share of national resources.

The most obvious primary impact that a mining project brings to a region is the provision of employment. Unlike the oil industry, which uses very capital-intensive methods, the non-hydrocarbon mining industry provides local men with many exploration, development and production jobs. The number of employees is

dependent on the scale and nature of the mining or quarrying operation and its capital-to-labour ratio. This subject will be examined in much greater detail in **Chapter Four**.

The employment that mining companies provide naturally brings income into the local economy in the form of wages and other non-salary benefits. As will be seen in **Chapter Seven**, wage levels tend to be higher than the national average. It is necessary to pay such wages in order to attract workers into the normally isolated and harsh environment in which most mining projects are located. High wage rates also act as a deterrent to the rural-urban migration which occurs in most of the countries in the region. Most of the mining companies are model employers and also provide their employees with various non-salary benefits.

Most of the larger companies provide some form of training which ranges from basic on-the-job training to very comprehensive education and training for their employees. This is in the company's own interests because a literate and numerate workforce is essential in any industrial project. Besides their own employees some companies, such as the Arab Potash Company (APC) in Jordan and Tunisia's Sotemin, also assist local children through the provision of primary schools.

Because of the isolated nature of most mining projects, many have company shops and services which can be used by the employees and their families. These can include supermarkets, restaurants, banks, hairdressers and others. National banks often need little encouragement to establish a branch at or near a project in order to handle the substantial wage packets of hundreds or even thousands of employees. These facilities are often open to non-employees while new privately owned shops and services are usually also established in the area. The organic growth of the classic company towns such towns as El Hassa in Jordan, or Ouenza and Bir El Atem in Algeria, has occurred because locals and outsiders have established shops and services to cater for the company employees and their families.

Mining companies with a large number of workers often provide sport and other recreation facilities for their employees and their families. These range from simple soccer pitches to clubs which have tennis courts, swimming pools and cinemas to attract Western expatriates. Projects with only indigenous employees are usually less well equipped. As in most industries the facilities provided by the mining sector tend to be divided between those available to senior staff and those for the majority of the workers. In some, although not all cases, these facilities are also open to non-

employees.

Many mining companies have their own emergency services which are primarily used to cope with fires and accidents at the mine or processing plant. They are also usually available to augment the local government's services in the event of an emergency in the region. Indeed, in some areas the company service is far better equipped and manned than the official rescue services. All of the underground mining companies have a mine rescue service which can be used in local emergencies. The importance of these company clinics and emergency services is naturally greater in the more isolated areas where the national and local government facilities are very limited.

Because many of the mining projects are located in these remote areas, which have little or no infrastructure, mining companies often have to develop the local infrastructure before they are able to begin production. This can include the construction of major new roads, railways and airfields, power stations, water pipelines, telecommunications facilities and even whole new towns. Naturally this is of considerable benefit to the local area. By improving the infrastructure of relatively underdeveloped regions they are made more attractive for the local population. This, in turn, helps reduce

migration to the major cities and may even attract new settlers from other areas.

The purchase of local goods and services by a mining company obviously has a direct effect on the local area. While some projects rely almost exclusively on supplies from the capital city, others are the principal clients for local farmers, merchants and services. This may range from the purchase of fresh and processed food to the use of local taxi services and garages. The breakdown in the nationality of the workforce often determines scale of local food purchases.

Some companies employ local contractors to undertake building work at the mine or processing plant and truck owners to transport goods while others are almost entirely self-sufficient. The relationship between the company and the local contractors tend to be closer at the larger established mines than in the newer projects located in remoter areas where there are limited numbers of local contractors. Besides transporting general goods, some truck owners are employed to carry phosphates or other minerals to the ports.

Besides the actual companies the mining employees are also an important market for local traders. Some companies, such as Ferphos in Algeria, OCP in Morocco and JPMC in Jordan, employ thousands of personnel who,

together with their families, represent a very large potential market for local shops and services. Together with the actual company, the employees are also often major users of the local transport and communications services. These includes bus and taxi services, post offices and telephone facilities.

The relationship between a mining company and the local government is usually very good. The companies are normally the largest employer and are often better equipped than the authorities. Consequently most companies assist the local administration whenever necessary. The author came across numerous examples of companies lending men and equipment to the local administration. In the more remote areas where local facilities are obviously limited the assistance which the mining companies can provide is particularly important.

The combination of these **primary impacts** is generally very beneficial for the local area. The effect is that remote areas, which previously had little or no infrastructure or alternative source of employment, have become vibrant self-sustaining communities. Not only have they helped to reduce rural-urban migration, which is often a major problem for local and national governments, but they also act as magnets for the

surrounding region. Besides providing employment the improved facilities also make such rural areas more attractive for the young men who would otherwise be tempted to migrate to the cities.

While the majority of the **primary impacts** are beneficial for the surrounding region mining projects can also produce some negative impacts. Two of the most obvious are their use of scarce natural resources and the creation of environmental pollution. Mineral processing requires large quantities of water which can deprive local agriculture which, in terms of supporting the indigenous population, is often more important than the mining operation. Besides water, other scarce resources which mineral production and processing competes for can include skilled labour, electricity and fuel supplies, and even wood for pit-props in the older mines. The competition for such resources, as well as goods and services, can lead to price increases which eventually only the mining company can afford to pay.

Mining and quarrying can also be a major source of air and water pollution. The removal of the top-soil during quarrying not only disfigures the land but also creates a great deal of dust. The accumulation of slag waste is another problem which is particularly acute in lead, zinc and other metallic mineral mines. The processing of such minerals usually creates air pollution in the form

of acidic smoke emissions. As in any other industry local water supplies are sometimes contaminated by mineral processing. The problem tends to be exacerbated by the remote location of many mining projects because pollution legislation is very weak or non-existent in most countries in the region.

This section has shown that, besides the employment that mining and quarrying brings to an area, there are also many other **primary impacts** on the region. In general the mining companies have been shown to be model employers providing many non-salary benefits to their employees. The companies and their employees are major clients for local shops and services and act as a catalyst for the growth of the local business community. In addition they also play a major role in the development of the region's transport links and utilities. These and other impacts of the mining industry in four specific regions will be discussed in far greater detail in **Chapter Seven**. Meanwhile, having examined the **primary impacts** of a project which affect a region, the **secondary impacts** of a mining industry on a country as a whole can now be examined.

### 1.6.2. Secondary Impacts

These **secondary impacts** are usually more easy to

quantify with precision than the more general local direct impacts on the regional economy. It should be noted that the statistics usually refer to the whole of the mining and quarrying sector rather than to a particular mineral. In some countries, however, one mineral does represent all or the vast majority of the industry. The **secondary impacts** are naturally more easily measured if the mining sector is particularly large and important such as the Moroccan, Jordanian and Tunisian phosphate industries.

Some of the **secondary impacts** of the mining industry can be seen in both the national budget and the economic development plans. In the former this could include the sector's proportion of total imports and exports, foreign currency earnings or savings, the level of the industry's profits or losses, its current and capital expenditure in local currencies, outstanding corporate debts and other factors. The development plans for the mining and quarrying sector also have a **secondary impact**. They illustrate the government's commitment to the sector and the priority that it is being given over a fixed period. It also indicates the proportion of financial and other resources that the sector will receive.

The most universal measurement of the **secondary impact** is the mining sector's contribution to a country's

gross domestic product, (GDP). This will include its contribution to employment, export earnings, taxes, value added, investment and most other elements of the economy. It will not, however, necessarily include or demonstrate the importance of its contribution to downstream industries. The statistics for the mining sector's share of GDP therefore tend to understate its contribution.

As it will be seen in **Chapter Six**, which examines the role of the mining sector in the national economies of the Middle East, its direct contribution to official GDP is very small. Even in Morocco, which has by far the largest mining sector in the area, the mining sector's share of GDP has never exceeded 4%, **[03]**.

Stauffer and others have pointed out that official GDP statistics take no account of wasting assets such as oil or other minerals, **[04]**. The agricultural and industrial sectors are able to continue to produce goods which can therefore be described as "renewable income". By contrast, while land, animals, plant and machinery can be used more than once, oil is a non-renewable resource and its use is therefore "capital depletion". Stauffer argues that corrections to GDP are needed because oil or mineral "income" is largely the consumption of capital and not really income. The economic rent generated in

the oil sector, which is value of the "wasting asset", must be subtracted and is the direct impact of oil on the economy. The indirect impact, which is the contribution of the oil revenues to the national economy, is reduced if they are not spent on the domestic economy but on imports or overseas portfolio savings. A revised specification of income, which takes these factors into account, permits a better and more realistic measure of a country's "wealth" and its economic performance, [05].

If oil income is taken out of the equation the role of the mining sector assumes a far greater importance. Saudi Arabia is probably the country with the most important oil sector. By 1980 the direct share of the oil sector, including refining, had risen to about SR320.4 bn or 68% of total GDP. Even this, however, understates its importance since the government budget is almost entirely financed by oil revenues. Stauffer has calculated that in 1980 the actual "oil-independent" GDP can be further reduced from SR152.4 bn to the range of SR37.8 bn - SR88.2 bn, [06]. This would mean that, rather than the conventional measured figure of 0.36%, the non-hydrocarbon mining and quarrying's SR1,696 mn contribution to GDP represents between 1.92% and 4.49% of GDP, [07].

These revised estimates of GDP are important but should

not be over-emphasised. The significance of the non-hydrocarbon minerals is increased when oil production and processing are taken out of the equation. Its share of GDP may rise but is still under 10% in every country in the region. In addition it should be noted that non-hydrocarbon minerals are just as much a non-renewable resource as oil. There are, however, major differences between the oil and mining sectors.

After the initial investment the cost of oil production is limited and is only a fraction the revenue received from its sale. As an example, the cost of oil production in Saudi Arabia is less than US$1.50 per barrel while the sale price has ranged from US$5.00 to US$40.00 a barrel during the past decade. By contrast, the difference between the production cost and sale price of other minerals is much smaller and considerable costs are incurred in the production area. In addition, unlike oil revenues which either tend to be frittered away on foreign imports or exported to foreign banks, a large proportion of mining revenues are usually spent within the domestic economy.

Mineral export earnings and import substitution savings are relatively easy to measure from customs data. These obviously can be a very significant secondary impact as in the case of the region's principal phosphate

exporters. Although the proportion has declined as world prices have fallen the Moroccan phosphate industry accounted for 56.8% of total exports in 1974, and 42.5% in 1984, **[08]**. In the same year phosphates were Jordan's largest export and the third largest in Tunisia, **[09]**. The importance of the downstream phosphate industries is demonstrated by the increasing role of phosphoric fertilizer exports. In Tunisia they are already four times the level of phosphate rock exports, **[10]**.

The significance of the foreign exchange costs of cement, building materials and other minerals imports to the Arab Middle East is considerable. In 1983 building material imports, which included cement, totalled US$2,110 mn, **[11]**. The 1970s construction boom sharply increased the region's imports of building materials. In 1983 the Middle East accounted for 49.1% of the world's total cement imports with Saudi Arabia alone accounting for 16.8%, **[12]**. These proportions would have been even greater were it not for the growth of the domestic building material sector. Servicing the latter during the construction boom reduces the requirement for imports and consequently saves foreign exchange.

The revenues generated and saved by mineral exports and import substitution, respectively, can have a major impact on the foreign exchange budget. This is one of the most important **secondary impacts** of the mining

sector, particularly in the poorer non-oil producing countries. The foreign exchange costs of importing cement and other building materials to the Gulf countries are not small but are insignificant when compared with the foreign exchange earnings generated by oil production.

By contrast, in Morocco, which has the largest and most diverse non-hydrocarbon mineral sector, the combination of export earnings and import savings are very important. In 1983 Morocco's total mineral exports, including processed phosphates and lead, were valued at Dhs7,625.103 mn or US$1,072.3 mn. In the same year the value of local sales of raw and processed minerals, which would presumably otherwise have had to be imported, was Dhs1,618.86 mn or US$227.65 mn, [13]. It can therefore be argued that in 1983 the combination of mineral exports and import substitution represented a net contribution to the Moroccan exchequer of almost US$1,300 mn or 9.77% of GDP, [14]. Although Morocco is atypical, this is an indication of the important impact that the mineral sector can play in a country's foreign exchange budget.

The major mining industries in the region are also major sources of direct and indirect tax revenue for the national government. Besides paying corporate taxes and

customs duties, they provide social security contributions for their employees from whom the government also receives income taxes. The dramatic increase in phosphate prices in the mid-1970s substantially increased the tax revenues that the companies paid. The phosphate sector's share of the Moroccan government's revenues rose from 13.6% in 1969 to 32.8% in 1974 before falling to 9.3% by 1977 as phosphate prices rose and then fell, [15]. Some governments, such as Jordan, also levied a substantial windfall tax as mining taxes were increased from JD6.0 to JD11.0 per ton, [16]. Between 1973 and 1974 the Jordanian government's income from phosphate, which is made up of its Jordan Phosphate Mines Company (JPMC) shares plus income and service taxes plus the mining fee, increased from JD81.4 mn to JD10,012.9 mn and then JD12,820.6 mn in 1975, [17]. Indeed, the phosphate sector is one of the largest sources of government revenue in Jordan and Morocco.

The mining sector's contribution to industry is an increasingly significant **secondary impact**. In the past minerals were usually produced for export in their unprocessed state. During the past twenty years, however, there has been an acceleration in the creation of downstream industries. These broadly fall into three categories; the chemical and fertilizer industry which processes phosphates, the metallurgic industry which

uses iron and some other metals, and the cement industry which requires limestone and gypsum as two of its principal raw materials. The mining and quarrying sector provides the raw materials for all of these industries and is therefore an essential component of a country's secondary manufacturing sector. Indeed, together with the petrochemical industry, they are currently the core of the Middle East's industrial sector. These industries, in turn, not only employ substantial numbers of personnel but also create their own primary and secondary impacts in other regions throughout a country.

The significance of these downstream industries can be gauged from the case of Tunisia. In 1984 phosphate exports were valued at TD30.4 mn while the export of phosphate based chemicals accounted for TD91.9 mn, [18]. Besides the trade benefits the downstream industries also act as employers. The Tunisian phosphate chemical and fertiliser industry employs about 6,000 personnel and supports thousands more, [19]. It should be noted, however, that the capital expenditure per man is very much higher in the downstream industries than in the mining and quarrying itself, but then so is the value added by the processing. The downstream industries also currently tend to be located in the coastal regions or near major urban centres rather than in the mining and quarrying region. Consequently it is obvious that the

mining sector creates **secondary impacts** both nationally and in other regions.

The development of new transport links and other infrastructure by mining companies naturally benefits the rest of the country. There are numerous examples of roads and railways which were constructed specifically for mining projects but which are now also used by general traffic. Similarly, national power and water supplies are augmented in some cases by mining companies.

Besides developing the necessary infrastructure for their own production, processing and transportation requirements, the mining companies often assist the region and therefore the nation in other ways. Their construction of hospitals, schools and other social services obviously reduces the government's own expenditure requirements. There are a number of examples of mining companies actually building schools which are then staffed by the government. These range from a tiny village school at Gebeit in Sudan to larger and more established schools in the Maghrebi mining towns such as Ouenza and Bir El Atem, [20].

Some of the larger mining projects have constructed their own export terminals at coastal ports. In some cases these terminals are also available for non-mineral

trade which has assisted the national ability to export and import goods. Some of the larger phosphate producers also run their own shipping fleets as well as having their own railway wagons to bring phosphate to the coast.

The potential importance of the mining and quarrying industry to the national transport sector can be illustrated by the case of Tunisia. The transport of minerals and building materials accounted for 52.7 % of national road freight and up to 96.7% in some governorates, [21]. Rail freight traffic is also dominated by the mining and quarrying sector. In 1984 iron ore, phosphates and cement alone accounted for 268.4 mn tonnes kilometres of freight traffic which was valued at TD5.86 mn. This represented 53.3% and 47.3%, respectively, of the total volume and value of rail traffic, [22]. In the same year 2.896 mn tonnes of phosphates, phosphoric acid and marine salt was exported which was 65% of Tunisia's total shipping exports, [23]. They are even more important for certain ports representing 94% of Sfax's exports, 78% from Gabes, and 83% from Sousse. As a direct result of the mineral exports both Sfax and Gabes export more than three times as much freight as Tunis, the capital and principal port, [24].

Besides the direct expenditure which has already been incurred in developing specific mining projects another secondary impact is the planned level of related investment in other sectors. An example of this might be a decision to invest in an export terminal which is constructed to export phosphates but which is also used for other general exports. Investment in other mineral related industrial, transport, infrastructural and other projects are important **secondary impacts** which must be taken into consideration.

In all the countries in the region, with the possible exception of the major oil producers before the recent decline in oil prices and revenues, there is always only a limited amount of money that can be invested in specific projects. The national development plans are supposed to act as a method of allocating these scarce resources to the various sectors of the economy. They also provide an indication of the priority that a government gives to each sector.

Investment in the region's mining sector can broadly be divided between three groups of countries - the major oil exporters, the non-hydrocarbon mineral exporters and the remaining countries. The oil producers have had sufficient funds for considerable investment in the mineral production and processing industries. Ironically, however, it currently appears that these

countries have only limited mineral deposits compared to some of the poorer countries in the region. Furthermore, although their investment may appear substantial when compared with what countries such as Sudan or the other poorer countries could afford, it is only a fraction of their total investment which is funded by oil revenues.

Saudi Arabia has been able to afford the most comprehensive mineral exploration programme in the region and twelve foreign companies are now working in the country. Some of the 3,433 mineral deposits which have been discovered are sufficiently large to develop economically, [25]. It can therefore be expected that, although all expenditure is now being reviewed much more carefully, Saudi Arabia will continue to invest in the development of the non-oil mining sector.

Other examples of such high levels of investment include Iraq's development of its building material sector, the numerous cement plants in the UAE and Oman's US$213 mn copper project near Sohar. Although in reality it will probably never use indigenous iron ore as originally planned, it could be argued that Libya's US$3,300 mn Misuratah iron and steel complex was envisaged as a major investment in the country's mineral as well as industrial sector, [26].

Turning to the poorer countries which are not major oil producers, besides the phosphate industry, the level of investment in the mining sector has been limited. Many of the smaller mines in the Maghrebi countries, as well as Sudan's chrome mines, are old, dilapidated and urgently in need of investment for their rehabilitation. Similarly, the poorer countries are not able to invest in potentially very promising mining areas because of the lack of available finance. As will be seen in **Chapter Seven**, while Oman has been able to invest US$213 mn in its copper project which, in purely mining terms, is probably uneconomic, Sudan does not have the resources to invest in development of much more promising mineral deposits in the Red Sea Hills.

The phosphate industry is the one part of the mining sector which has received substantial levels of investment during the past fifteen years. The unilateral price increases which Morocco announced in 1974 led to a surge of investment in phosphate production throughout the Middle East and elsewhere. Following the laws of supply and demand this increased level of production inevitably led to a subsequent fall in phosphate prices a few years later. The scale of investment in the phosphate sector can be gauged by examining a few countries. In Morocco 15% of all investment funds allocated in the 1978-80 development plan went to the Office Cherifien des Phosphates, (OCP), [27].

Besides Morocco, investment in the phosphate mining and processing industries has also been substantial in other countries including Tunisia and Jordan. While investment in phosphate production itself has been comparatively limited during the past decade, both countries have made substantial investments in downstream processing industries. This has been achieved with the partial assistance of the multi-lateral Arab Mining Company, (Armico), as well as the Kuwaiti government. Armico has a 10% share in the US$ 400 mn Jordan Fertiliser Industry Company, (JFIC). Like Kuwait it has also invested in Tunisia's fertiliser industry, [28].

It is obvious that there has been substantial indirect but related investment in the Middle East mining sector during the past decade. Naturally this has been a very important **secondary impact** for the region's national economies. The competition for scarce financial resources between the different sectors of the economy means that investment in the mining sector naturally limits the availability of resources for agriculture and other sectors of the economy. It is therefore very important to ensure that investment in mining or any other sector is going to be both economic and beneficial to a country in the long run.

### 1.6.3 Selective adverse impacts

So far it would appear from this analysis that mining projects are beneficial for both a region and a country. However, it should also be noted that the mining sector's use of the national infrastructure reduces its availability for other sectors of the economy. Although the impact of the mining sector does not have such detrimental effects as the Middle East oil industry, they are not negligible. As Paul Stevens has noted in his analysis of the impact of the Middle East oil industry, which is also partially applicable to the mining sector, there are selective adverse effects which should be considered, [29]. These can broadly be divided into three areas of negative impact - labour market distortions, the neglect of agriculture and the distorted expansion of public services. In addition there are also environmental problems which, although not having reached the same proportions as those in the industrialised countries, are undoubtedly a potential hazard.

The distortions in the labour market which are generated by the mining sector are not as strong as those of the Middle East oil industry. The rate of rural-urban migration is usually only increased if the government has some form of windfall revenue, such as that from oil in the Gulf countries, which it uses to finance

increased government expenditure in unproductive sectors of the economy. With the exception of a few brief years in the mid-1970s, when phosphate prices were unilaterally increased by Morocco, this has not occurred as a result of windfall revenue from non-hydrocarbon minerals in any country in the region. Consequently rural-urban migration has not been exacerbated by the mining sector.

There are, however, regional labour distortions which are created when mining projects compete with other sectors for local employees. As will be seen in **Chapter Four** and will be elaborated in **Chapter Seven** the wage rates offered by the mining companies tend to be much higher than those which are available in other sectors of the economy. While this is naturally beneficial in increasing the living standards of the employees and their families, it also tends to result in non-mining sectors being unable to compete for labour. It should be remembered, however, that each region and country is unique and there are no universal implications when a mining project is located in a specific region.

The second effect which Stevens identifies is the neglect of agriculture, [30]. Once again it is the sort of windfall created by sudden oil revenue generated wealth, rather than the comparatively modest mining

sector, that tended to exacerbate this neglect. Although there are exceptions governments throughout the region have tended to subsidise urban food prices at the expense of local farmers. At the same time the development plans have tended to neglect the agricultural sector while the secondary and tertiary sectors have been expanded.

There are a number of examples of the way in which the agricultural sector has been neglected in the Middle East. Algeria's push towards heavy industrialisation, which was centred on the indigenous iron and steel industry fed with iron ore from Ouenza and elsewhere, resulted in the neglect of agriculture. Although the current economic crisis has delayed its implementation, Libya's dreams of using iron ore from Wadi Ash Shati in the giant new Misuratah iron and steel complex would undoubtedly harm the fragile agricultural sector in the Sabha region, [31]. The short-lived major increase in phosphate prices in the mid-1970s led to substantial investment in Jordan's highly capital intensive chemical and fertiliser industries. It could be argued with some justification that, at a time when Jordan is importing over half of its food requirements and has substantial unemployment, investment in the agricultural sector might have been more beneficial, [32]. Therefore, while the neglect of agriculture should not be over emphasised it must be taken into consideration in any analysis of

the impact of the mining sector on both the specific regions and the countries of the Middle East.

The third selective adverse effect that Stevens identified is the excessive expansion of public services, [33]. By this he means the provision of public services being financed by oil revenues rather than directly productive activities. This usually means that the expansion is unsustainable in the long term when oil revenues are no longer available. There can be little doubt that there has been an unreal expansion of government expenditure in the Middle East oil producing countries.

The relevant question which has to be answered in this study is whether the non-oil mining sector has contributed to this unreal expansion of government expenditure. With the exception of a brief period in the mid-1970s, phosphate and other minerals have not created a windfall which would enable a government to finance such an expansion. There was, however, an ambitious revision of Morocco's 1973-77 development plan following the 1974/75 price increases. Budget allocations for the public and semi-public sector expenditure were revised sharply upwards from Dhs10,000 mn to Dhs29,300 mn, [34]. For a few years, before phosphate prices fell equally sharply, the Moroccan government indulged in

substantially increased expenditure including investment in capital intensive industrial plants. It could be argued that this and other similar examples in Jordan and Tunisia represented an unreal expansion of public expenditure.

Like most extractive industries, the mining sector does have an adverse impact on the environment of the Arab Middle East. The problem comes from two principal sources, the first being the collection of waste material from both underground mining and quarrying and mineral processing. The second is the loss of vegetation and top soil which occurs during quarrying operations.

The problem of mineral waste is particular important where metallic minerals are involved. Although the mining areas in the Middle East are largely uninhabited and waste materials can therefore be safely disposed of, this can often lead to the neglect of pollution control and the indiscriminate dumping of such dangerous waste products in uninhabited areas.

The widespread use of strip-mining and quarrying methods to obtain minerals, which is the standard extraction procedure in the large phosphate and iron ore mining operations, naturally disfigures the local landscape. The vegetation and top soil are removed so that the mineral below can be retrieved and this can lead to

serious air pollution as the wind sweeps up some of the loose mineral material. This is a major problem at the Rusaifa phosphate mine which is located right next to a major urban area near the Jordanian capital. Indeed a planned expansion programme at the mine was dropped largely because of the problem of air pollution. The pollution legislation which also includes the emission of smoke from processing plants, is not always enforced as tightly as they should be, particularly in the uninhabited desert areas.

## 1.7. The mining sector's unique economic contribution.

Besides the **primary** and **secondary impacts** of the mining projects on regional and national economies, the mining sector plays a economic role in the region. We saw earlier that the conventional measure of the contribution to a country's GDP which is made by the mining sector tends to under-estimate its true importance. It fails to take the large downstream industries into consideration or their share of export earnings, total investment or government taxes. The lack of data makes a calculation of their actual share of GDP impossible in most Middle East countries. However it is possible to illustrate the true importance of the mining sector to a national economy. It is first necessary, however, to understand why non-hydrocarbon mining plays

such a unique role in the national economies of some Arab Middle East countries. There are four principal factors which have to be taken into consideration.

The most obvious involves the environment and the paucity of natural resources in the region. Because of the harsh environment and the lack of water agriculture is confined to a comparatively very limited area in most Middle East countries. This has led to the concentration of population in coastal cities and the less arid regions of each country. Consequently the majority of the available development funds have usually been invested in the areas around the major urban centres. This has led to the creation of islands of relative development and prosperity in seas of absolute poverty and under-development. The result is that the hinterland usually remains an under-developed desert wasteland.

The discovery and development of crude oil, natural gas or non-hydrocarbon mineral reserves is one of the few ways, in the short term, in which such areas can enjoy any economic development. There is, however, a major difference between oil and other minerals. In the case of oil or natural gas it can be transported hundreds of miles by pipeline for export or refining. Therefore once the oil well and pipeline have been completed there are few jobs and little need to develop the surrounding area. By contrast, minerals have to be extracted and

brought to the surface and then transported by rail or truck rather than a pipeline. Therefore even the smallest gold mine requires a permanent workforce and consequently has to develop the immediate region to support its operation. The larger mining companies employ thousands of men and have built sizeable towns to house and support them. Therefore mining operations can play a unique role in developing regions where there is no alternative source of employment.

The second factor, which could be applied to other economic sectors, can be termed as the social benefit or social responsibility factor By this it means the indirect benefits which the mining companies bring to a country. These include the jobs they generate, education and training they provide, infrastructure they develop, foreign exchange they earn, and other factors. Perhaps the best way of illustrating this idea is to describe the two possible extremes.

The majority of the mining companies in the region - educate, train and employ large numbers of indigenous workers; develop the regional infrastructure; earn large amounts of foreign exchange for the country; and adopt a generally socially responsible attitude. On the other hand there are western oil and mining companies, operating in developing countries mainly outside the

Middle East, which are socially irresponsible in the host countries. They act as enclave industries, employing few if any indigenous workers, caring little for the environment, doing nothing to develop the local or national economy, and repatriating most of their profits.

The third factor which makes the mining industry so special are the strong links that it has with other sectors of the economy. In many countries minerals make up most of the rail freight and a sizeable proportion of road freight traffic. Major fertiliser and chemical, iron and steel, and metallurgical industries are entirely dependent on indigenous minerals. These in turn lead to the creation of more jobs as well as the services sector industries to support them. Valuable foreign exchange is earnt from the export of both basic minerals and higher value added processed minerals. In general minerals are even more important than oil in terms of linkages and the multiplier effect they create, if not in actual total monetary value.

Fourthly, as Stauffer and others have argued, both oil and non-hydrocarbon minerals have to be considered in a special way because they are wasting assets rather than a productive self-sustaining sector such as agriculture and industry. The scarcity value of the mineral, which Stauffer defines as its "economic rent", is the unit

price which can be obtained in the free market minus the operating costs and an imputed rate of return, or normal profit, on all capital investment. Because minerals, like oil, are a wasting asset they cannot be replaced. Producers therefore try to maximise the differential between the cost of production and the rent that they can earn. They can only successfully achieve this if they price makers rather than price takers. Unfortunately the Middle East is not a sufficiently large producer of any mineral, including phosphates, to enable it to fix the world price or the differential between the production cost and the selling price.

## 1.8 The mining sector's overall economic contribution.

Although the necessary data may not be available to work it out for any specific country, it is possible to formulate a general equation which will reflect the overall importance of the mining sector. The true value of oil or minerals is not only the actual economic rent that a producer can obtain through its sale. A dynamic adjustment also has to be made to identify the amount of the rent which accrues to the government and which is actually spent domestically by the government in each year. In addition the mining sector has a Keynesian multiplier effect which generates income in other

sectors of the economy.

For the purpose of our study, Stauffer's hypothesis is very useful in demonstrating a number of points. The first is that it shows us that true value of the mining sector is not simply calculation of its economic rent. When the dynamic factors are taken into consideration its importance is greatly enhanced. On the other hand it also shows that, like oil production, mining has to be viewed as the depletion of a non-renewable capital asset rather a renewable productive activity. Obviously in those countries which produce both oil and non-hydrocarbon minerals, such as Algeria, Tunisia and Egypt, the mining sector assumes a greater significance when the figure for oil-independent GDP is calculated.

The equation which can help us to estimate the true contribution of the mining sector to a national or regional economy is outlined below in **Table 1.3**. It can be applied to a single mining operation or to the summation of all the mining companies in a region or country. In the example below it is assumed that a proportion of the mineral production is exported as raw material while the remainder is used in the domestic economy for downstream industries.

As it can be seen from **Table 1.3**, the share of a country

**Table 1.3 : Calculation of mineral dependent GDP**

**Mineral dependent GDP = $GDP_{min}$ = R + G + D + K**

**R = Mineral Rent = [ Q ( V - C - D - P - E ) ]**

Q = Quantity of mineral production
V = Unit Value or Price
C = Operating costs excluding taxes
D = Depreciation
P = Normal Profit
E = Exploration Costs

**G = Government Revenues**
**G = Pg + Tp + Ti + Sc + Se + PD + Tx + Tw**

Pg = Profits from gov shares in mining companies
Tp = Taxes on mining company profits
Ti = Income tax collected from mining workers
Sc = Mining companies' contribution to social security
Se = Mining employees contribution to social security
PD = Port duties
Tx = Mining export taxes
Tw = Windfall taxes

**D = Domestic Sales = Dp + Ds**

Dp = Domestic sale of current mineral production
Ds = Domestic sale of stockpiled minerals

**K = Mining sector's total multiplier effect**
**K = kiI + ktT + kcC + kuU + kbB**

K = The overall multiplication effect
ki = The multiplication factor for the mining sector's contribution to the country's industrial sector.
I = Industry's total share of GDP
kt = The multiplication factor for the mining sector's contribution to the country's transport sector
T = The transport sector's total contribution to GDP
kc = The multiplication factor for the mining sector's contribution to the country's construction sector
C = The construction sector's total contribution to GDP
ku = The multiplication factor for the mining sector's contribution to the country's utilities' sector such as electricity, gas and water.
U = The utility sector's total contribution to GDP
kb = The multiplication factor for the mining sector's contribution to the business sector
B = The business or commercial sector's total contribution to GDP

or region's gross domestic product which is dependent on the mining sector is the sum of four elements. These are the mineral's economic rent or scarcity value, revenues received by the government, the income generated from domestic sales and the overall multiplier effect of the mining sector.

The economic rent represents the premium which reflects the scarcity value of the mineral which is a wasting asset which cannot be replaced. This will vary depending on a number of factors including the production to reserves ratio, the importance of the region or country in terms of overall world production of a particular mineral, and general world economic conditions. One of the best examples which can be used to illustrate this idea is the virtual monopoly that De Beers has on the diamond industry. Because the company controls such a large proportion of the world's diamond trade it is able to stockpile diamonds, thereby reducing available supplies and pushing prices upwards to an artificially high levels. Consequently the economic rent is very high and does not reflect production costs.

The second element in the equation is the revenues which the government receives from mining sector. These are the profits from the government's holdings in mining companies and all the taxes collected from both the companies and their employees. The government's holding

in mining companies varies from total ownership, where it indirectly receives all of the company's profits, to other mining operations which are entirely privately owned.

Although many mining industries in the region are exclusively export orientated, others sell a proportion of their overall production to domestic clients. Once again this will vary substantially from mineral to mineral. The most obvious examples of domestically orientated minerals are building materials which are used in the domestic construction sector. In some countries, however, mineral ores are used in the domestic fertiliser, iron and steel, and metallurgical industries.

The final factor in the equation is the overall multiplier effect of the mineral sector on the rest of the economy. This refers to the simple Keynesian concept of a multiplier whereby, for example, US$1.0 mn invested in a particular project or sector might generate US$1.25 mn of overall additional economic activity. This occurs because the US$1.0 mn is spent on the purchase of plant and equipment and on wages increases the demand for the plant and equipment and for the goods and services that the workers spend their wages on. This, in turn, generates economic activity in other industries which

then fuels further demand. There are, however, leakages from the system such as when the increased income is used to purchase imported goods or when it is saved and not spent. Consequently the overall multiplier effect of the original investment is eventually dissipated until it becomes negligible.

In the equation, five ways in which mining can affect other sectors of the economy and thereby create a multiplier effect have been identified. In some countries a large share of industrial production is directly dependent on the mining sector for its raw materials. Bulky minerals such as phosphates, iron ore and cement can also make up a large share of total road, rail and maritime freight traffic. Although their share is usually relatively small, when they build company towns such as Ouenza, El Hassa and Magan mining companies do account for a share of overall construction activity. Their installation and distribution of electricity, gas and water supplies also contributes to the national and regional utility sector. Finally, both the mining companies and their employees purchase goods and services from the shops and businesses which increases overall commercial demand.

Unfortunately it was not possible in this macro-orientated and international study to obtain the accurate statistics which would be necessary to

calculate a precise figure for that share of any country's GDP which is dependent on the mineral sector. It is hoped, however, that this initial work can act as the starting point for future studies which will be able to apply the equation to a specific country in a less wide-ranging analysis than this. It is obvious from the equation, however, that the mining sector's contribution to regional and national economy is far greater than it initially appears.

## 1.9 Structure of the Thesis

The thesis is organised to facilitate its dual purpose of providing information about the Middle East mining sector and analysing the role of the industry in the regional and national economies of the area. **Chapters Two** to **Five** therefore seek to provide basic information about the mining sector. They start with the general geological structure of the region and become progressively more detailed. The subjects covered include - the location and scale of the major mineral deposits, the history and development of the Middle East mining industry, its role as an employer and the international trade of both minerals and mineral products. It is hoped that these initial chapters will be useful in providing future researchers with the basic building blocks upon which they can construct their

further studies on the mining sector.

Having gathered the basic information about the sector, the second part of the thesis then attempts to analyse the impact of the mining sector on the national and regional economies of the Arab Middle East. **Chapter Six** deals with the impact on the national economies on a country by country by country basis. **Chapter Seven** deals with four specific areas which been chosen to represent the various stages of development of the mining sector. These range from the rudimentary "green-field" type of project to a large, mature and fully integrated mining industry.

The final chapter seeks to bring the strands of the thesis together, draw some conclusions and to point the way to potential future areas of interest and research.

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**********

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# CHAPTER TWO
**********

# NON-HYDROCARBON MINERAL DEPOSITS IN THE ARAB MIDDLE EAST
**********

## Introduction
**********

This chapter provides the foundations upon which an examination of the Middle East mining sector can be constructed. This is achieved by first analysing the geological formation of the Arab Middle East from the theory and application of plate tectonics to the later geomorphological processes which created the mineral deposits. Following a brief classification of the various types of non-hydrocarbon minerals, details of the most significant deposits are provided. Particular emphasis is placed on the phosphate and iron deposits which are by far the most important minerals in the Arab Middle East.

For the purposes of this thesis, the Arab Middle East includes the Maghrebi countries of North Africa. Although they are not all dealt with in detail, the countries under review are; Morocco, Algeria, Tunisia, Libya, Egypt, Sudan, Saudi Arabia, North and South Yemen, Oman, the UAE, Qatar, Bahrain, Kuwait, Iraq, Syria, Lebanon and Jordan.

There are problems in trying to define which countries

should be included in the Arab Middle East. Israel is specifically excluded from the study, as are both Iran and Turkey, because they are not Arab countries. The case of Mauritania, which is also excluded, is somewhat more problematic since it is a member of the Arab League and has a large iron mining industry. The Western Sahara, however, is included because its phosphate deposits at Bou Craa are under Morocco's "de facto", if not "de jure", control. This does not infer that Morocco's control is either permanent or legal.

## 2.1 The geological formation of the Arab Middle East

**********

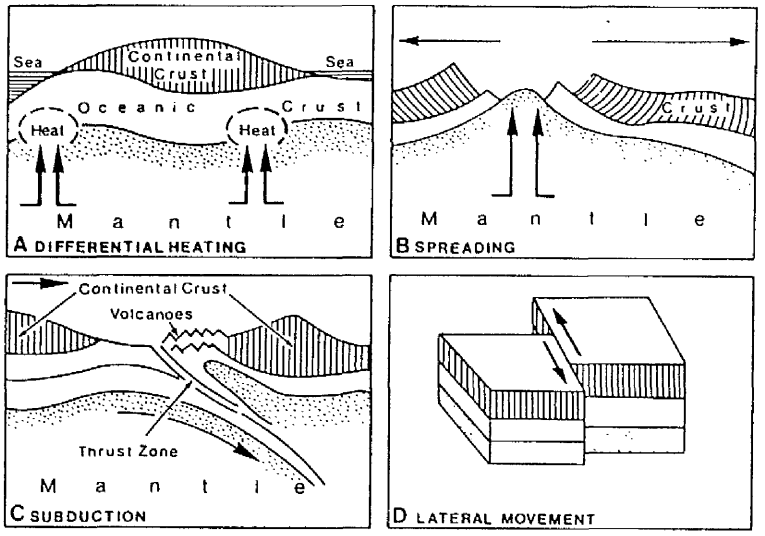
It is now accepted by most earth scientists that the formation of the world's continents was a result of plate tectonics and sea floor spreading. The former was developed as an extension of the earlier theories of continental drift. It postulates that the continental land masses are made up of less dense material which floats on a layer of denser material which form the ocean floors. Consequently the composition of the land masses and the oceanic deeps are very different in character. The continental plates travel very slowly across the surface of the earth as a result of convection currents created by differential heating. As the plates come into contact with one another, crush zones are produced which are, in turn, the principal

agents of mountain building. It is this breaking up movement and subsequent contact with other land masses which has created the current shape of the earth's continents, **(see Figure 2.1)**.

About 200 million years ago, during the Triassic and Jurassic periods, two large land masses had been formed in the northern and southern hemispheres, **(see Figure 2.2)**. The northern one, called Laurasia included the Eurasian and North American plates, while Gondwanaland was the southern continental land-mass. The latter included most of Africa, India, Australasia and South America. Between these two land masses was the very extensive Tethys Sea whose floor was covered with great sedimentary deposits which had been formed by materials eroded from Laurasia and Gondwanaland. The great petroleum deposits of the Middle East and elsewhere were formed in this sedimentary material, **(see Figure 2.3)**.

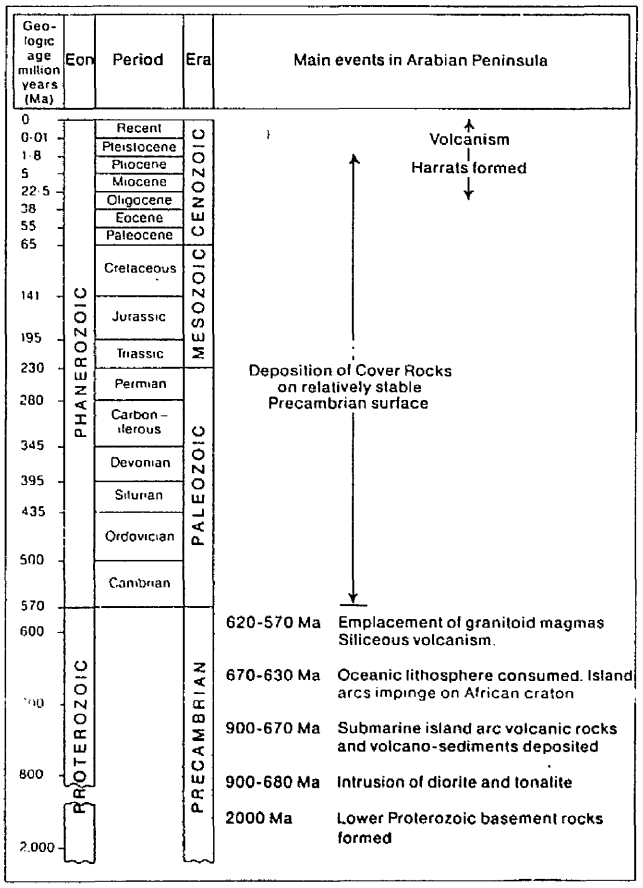
As others have indicated, the Middle East and North Africa is geologically particularly complex because a number of different continental plates come into contact with one another, **[01]**. During the Mesozoic period Gondwanaland began to split up into different plates which drifted northwards. By the Tertiary period this movement had reduced the width of the Tethys Sea and caused its younger sediments contort. This in turn

## Figure 2.1
## Formation and evolution of tectonic plates.



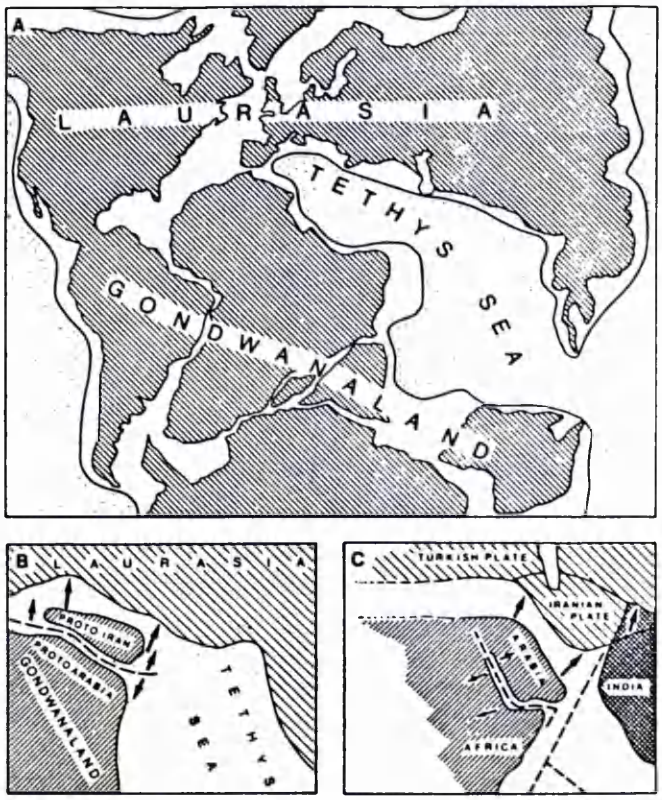

*Source: W.B Fisher. 'The Middle East' op cit.*

## Figure 2.2
## Main events in Arabian geological history shown in relation to the geological time scale.



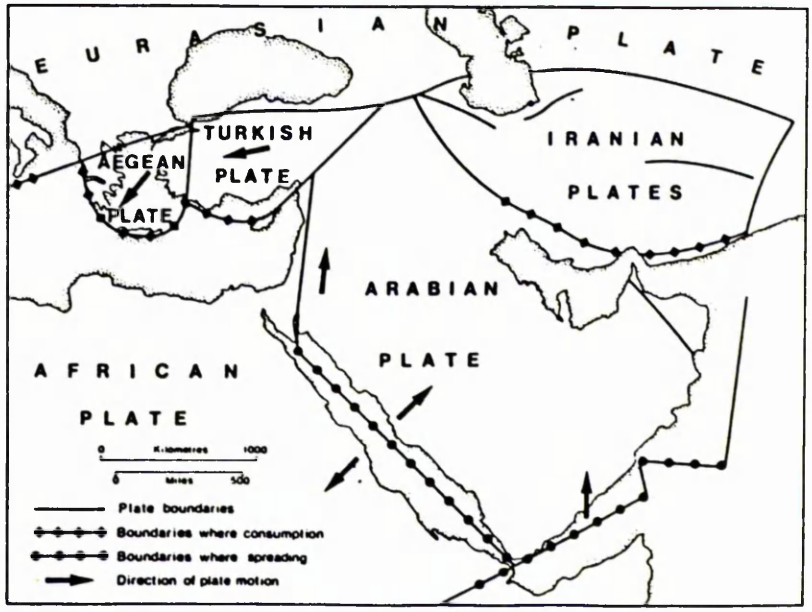

*Source: DMMR Saudi Arabia Mineral Resources Annual Report 1402-04, op cit.*

## Figure 2.3
## Development of the Tethys embayment in Triassic-Jurassic times and later.




*Source: W.B. Fisher. 'The Middle East' op cit.*

## Figure 2.4
## Formation and movement of the Tectonic plates comprising the Middle East area.




*Source: W.B. Fisher 'The Middle East' op cit.*

created a string of mountain ranges from the Atlas chain to the Himalayas.

The African, Arabian and Eurasian plates are the principal ones which can be identified in the region. In addition there are the Aegean and Turkish plates, which are smaller but more rapidly moving, which has made them seismologically more active than the others. Although they do not include large areas of the Arab Middle East they should not be ignored in any analysis of the region's geology. Similarly the Iranian plate which is in contact with the Arabian plate was significantly responsible for the formation of the Zagros Mountains, which effects Iraq, **(See Figure 2.4)**. Further south the Red Sea has been formed by the separation of the African and Arabian plates which is occurring at the rate of about one centimetre each year. This is of particular interest because of the very encouraging mineral sediments which have been found on the floor of the Red Sea, **(See Figures 2.5 & 2.6)**.

Once the basic shape of the region was created by plate tectonics the distribution of its rocks is, in general, relatively simple to explain. The oldest are the archaean shield cover rocks which are only exposed in isolated areas of North Africa and the Arabian peninsula. The younger pre-Cambrian rocks, which are also part of the basement complex, are exposed over a

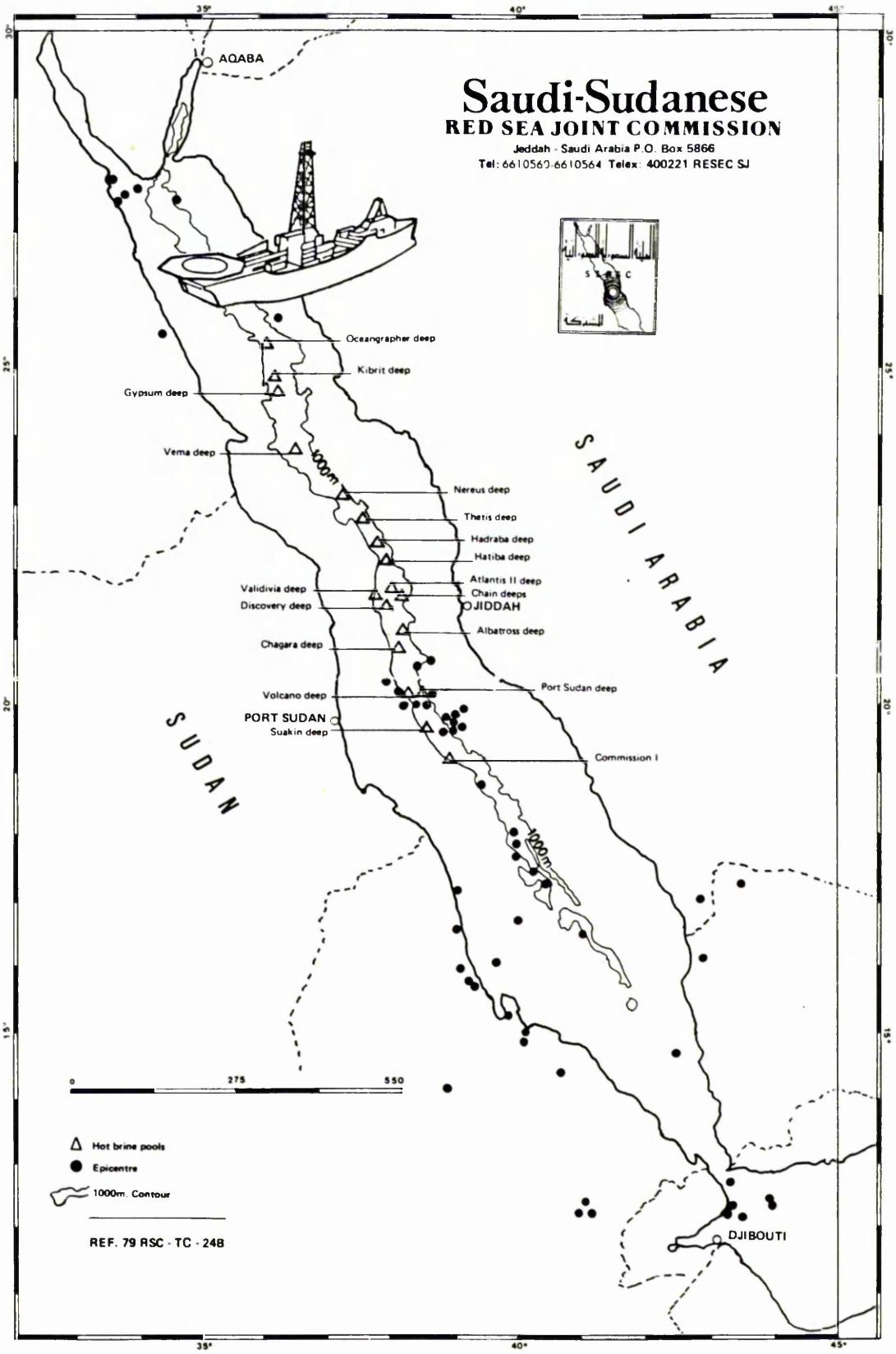



**Figure 2.5 Mineral exploration areas in the Red Sea.**

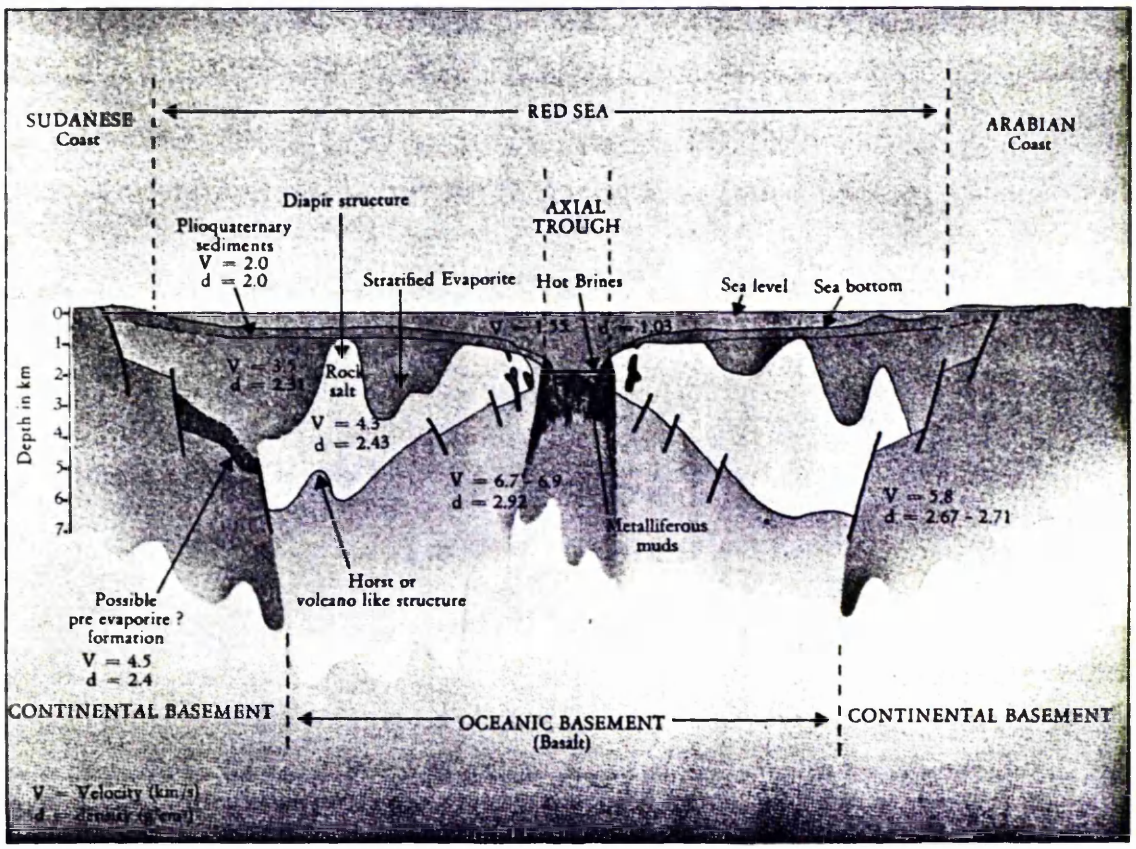
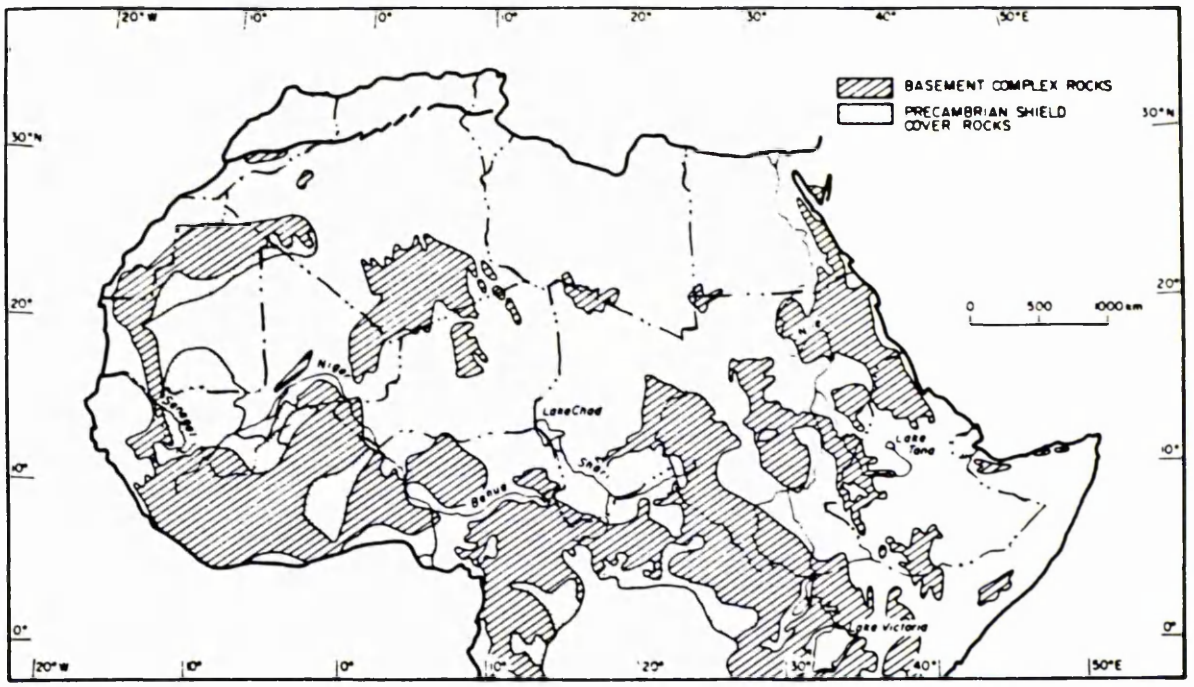



**Figure 2.6 Section through Red Sea illustrating mineral sediments.**
***Source: Saudi-Sudanese Red Sea Joint Commission.***

far wider area of the two plates. Unlike the archaean shield rocks these were strongly folded and metamorphosed on several occasions before being planed off by erosion, [02]. Both groups are covered by up to 10,000 metres of younger rock formations so that they are only exposed in limited areas. These include areas in southern Algeria, the Libyan-Chadian border, large parts of Sudan, the Eastern Desert region of Egypt, and the Arabian Shield area of western Saudi Arabia. These areas are of particular significance in the formation of metallic mineral deposits in the region. The attempts to date the exact geological events which created these structures and controlled the pattern of subsequent Saharan sedimentation during the past 570 million years have proved very difficult, [03]. Consequently large areas of both igneous and metamorphic rocks in the African and Arabian tectonic plates, spanning a time range of 3,000 million years, are usually lumped together as "basement complex rocks", **(See Figures 2.7 & 2.8).**

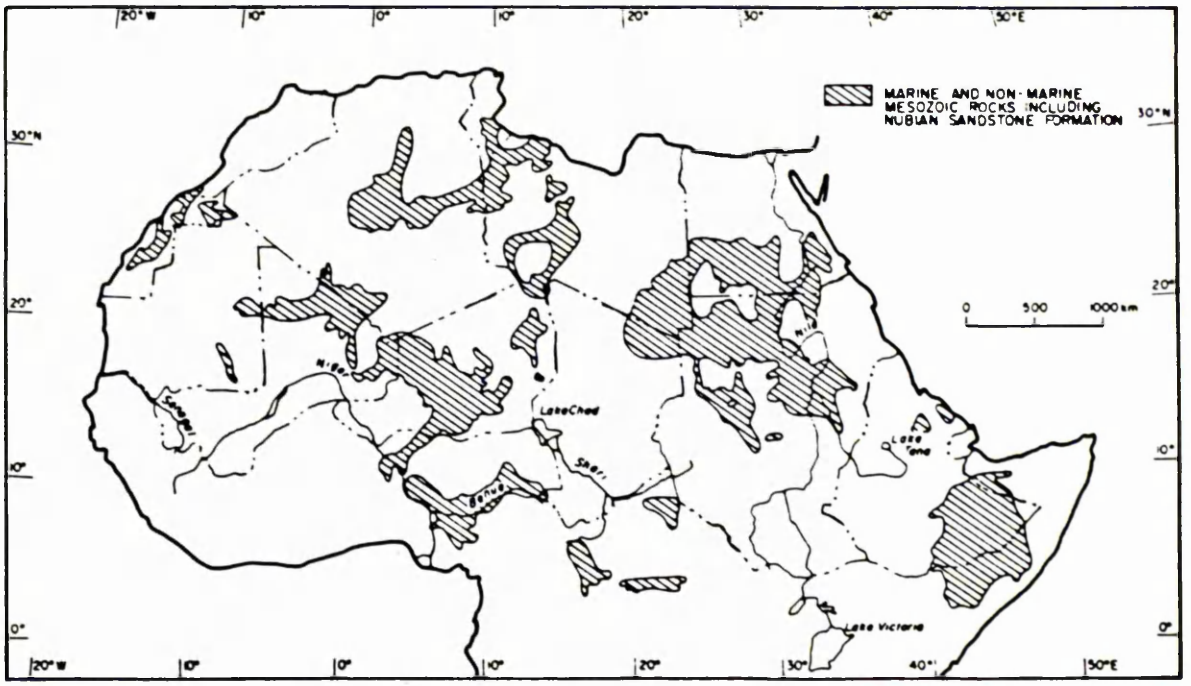
These are covered with younger sedimentary rocks, the oldest of which are of continental origin having been produced by the erosion of the basement complex rocks. The most famous and extensive of these are the Nubian Sandstones of North Africa which is a concretion of sand grains laid down by aeolian deposition at different geological periods, **[04]**. Because the individual sand

## Figure 2.7
## Geological structure of the Sahara.




Basement Complex rocks in and around the Sahara. Distribution of Basement Complex rocks and Precambrian shield ancient cover rocks generalized from 1:15 M Tectonic Map of Africa (Unesco, 1968). Political boundaries on this and later figures from Times Atlas (1972).

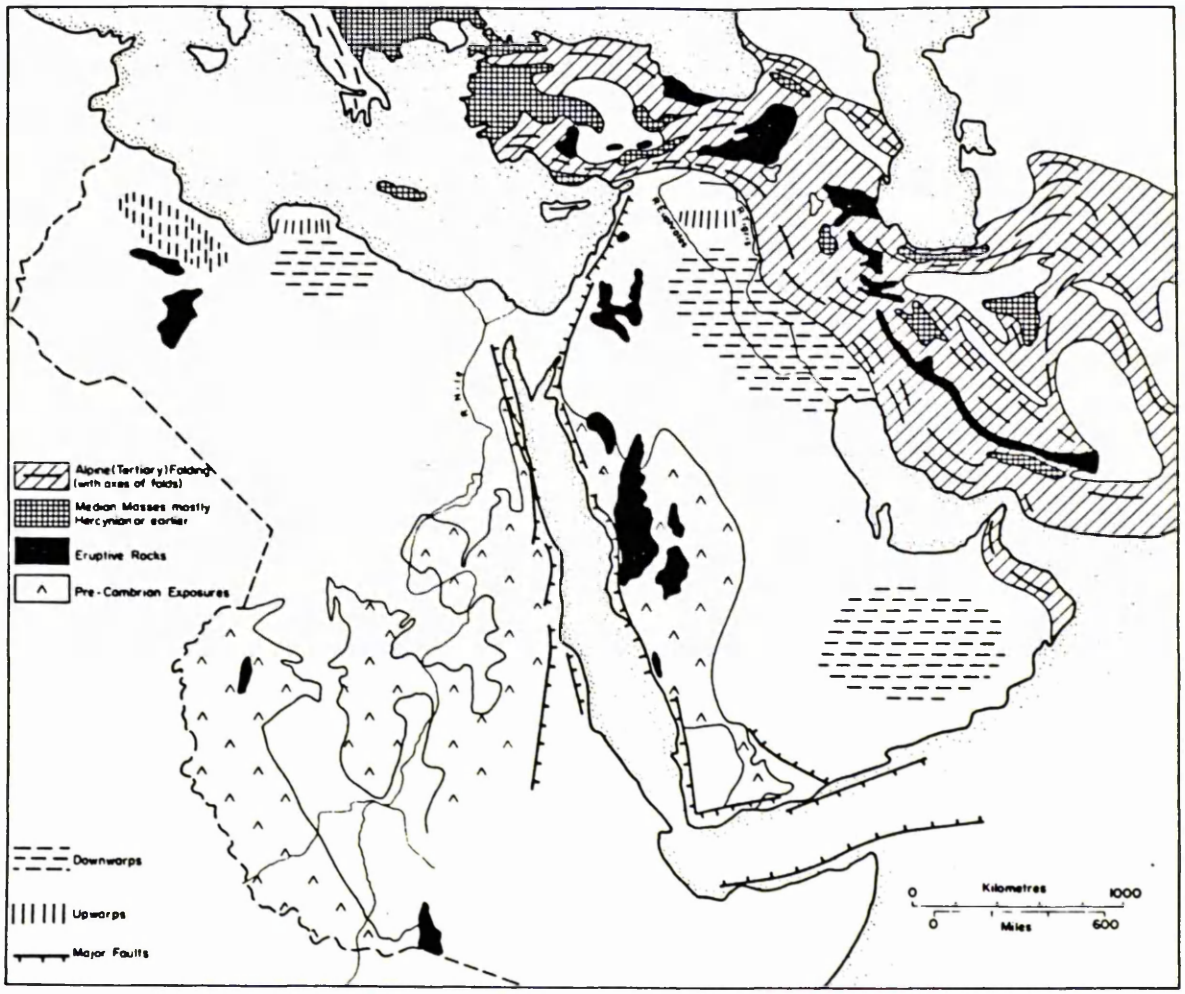
***Source: Cloudsly-Thompson (ed) Key Environments Sahara Desert. op cit.***




Mesozoic sedimentary formations of the Sahara. Distribution of marine and non-marine Mesozoic rocks, including the Nubian Sandstone Formation, generalized from 1:10 M preliminary geological map of Africa (Unesco, 1967) and from Vail (1978, Fig. 7).

***Source: Cloudsly-Thompson (ed) Key Environments Sahara Desert. op cit.***

## Figure 2.8
## Structural elements of the Middle East.




*Source: W.B. Fisher. 'The Middle East' op cit.*

grains are aligned along well defined axies, it is possible to determine the movement of the tectonic plates over time once the prevailing wind direction and the position of the geographical poles and equator at earlier geological times in the past is known.

Younger sedimentary deposition occurred when the African and Arabian tectonic plates down-warped and were overlapped as they moved northwards. These younger sedimentary rocks had formed in the shrinking Tethys Sea because of the erosion of the surrounding continental plates. This resulted in the deposition of large areas of sedimentary cover in the coastal regions of North Africa and the Middle East. These marine sediments were particularly significant in the formation of, not only the oil reserves but also, the very large deposits of phosphate in countries such as Morocco, Tunisia and Jordan. At the same time other eroded material formed in inland basin depressions such as the Libyan Basin and the White Nile drainage basin, [05]. While the marine deposits are predominantly formed in the Tertiary period, the thick continental deposits are mainly Quaternary sediments.

The Atlas mountain ranges in the Maghreb are an African extension of the Alpine system which was formed on the northern shore of the Mediterranean. The archaean core then folded upwards as the African plate pushed against

the Eurasian plate, [06]. These movements, which were particularly vigorous in the Atlas Mountains, occurred during the Hercynian period, between 350 and 200 million years ago. The only other area in the region where this happened was in north-eastern Oman and along the Iraq-Iran border when the Arabian plate pushed against the Iranian plate, [07].

While the major elements of the Middle East's geology had therefore been well established by the end of the Tertiary period, continuing desiccation and rapid climatic changes characterised the Quaternary period. In addition there has been continuing vulcanism, uplifting and faulting during the past two million years. This has continued to occur in areas adjacent to the major faulting zones such as the Dead Sea lowlands and Red Sea areas, including the western uplands of the Saudi Arabian Shield and the upper Jordan Valley, [08]. Other areas of vulcanicity include the Libyan plateau to the south of Tripoli, Jebel Marra in western Sudan and the Hoggar massif in southern Algeria.

The geological history of the Arab Middle East shows that there are distinctive areas and types of rocks. Besides the ancient basement complex there are; the continental and marine sedimentary cover; the areas of Tertiary Alpine folding; and the younger eruptive rocks,

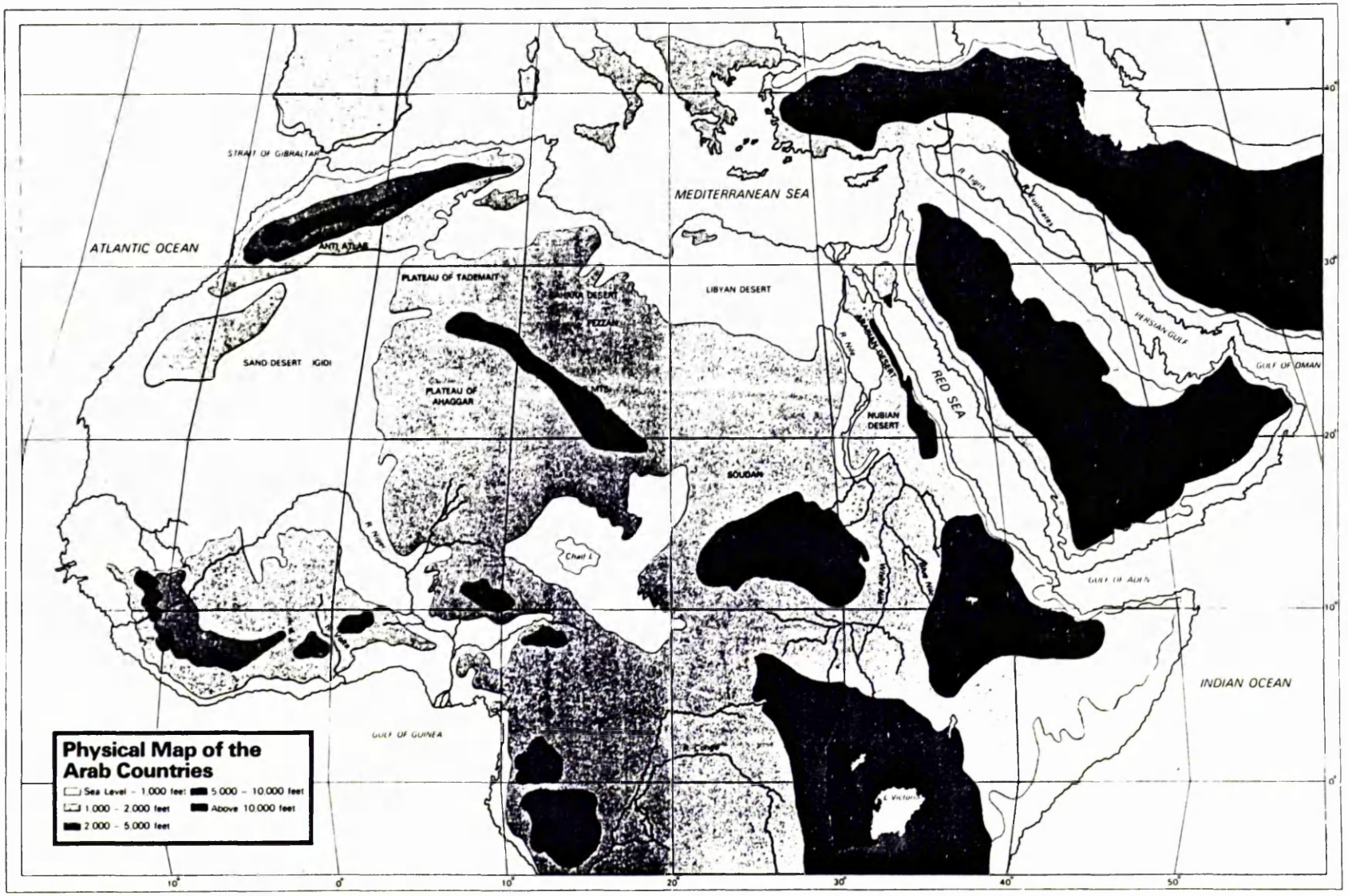
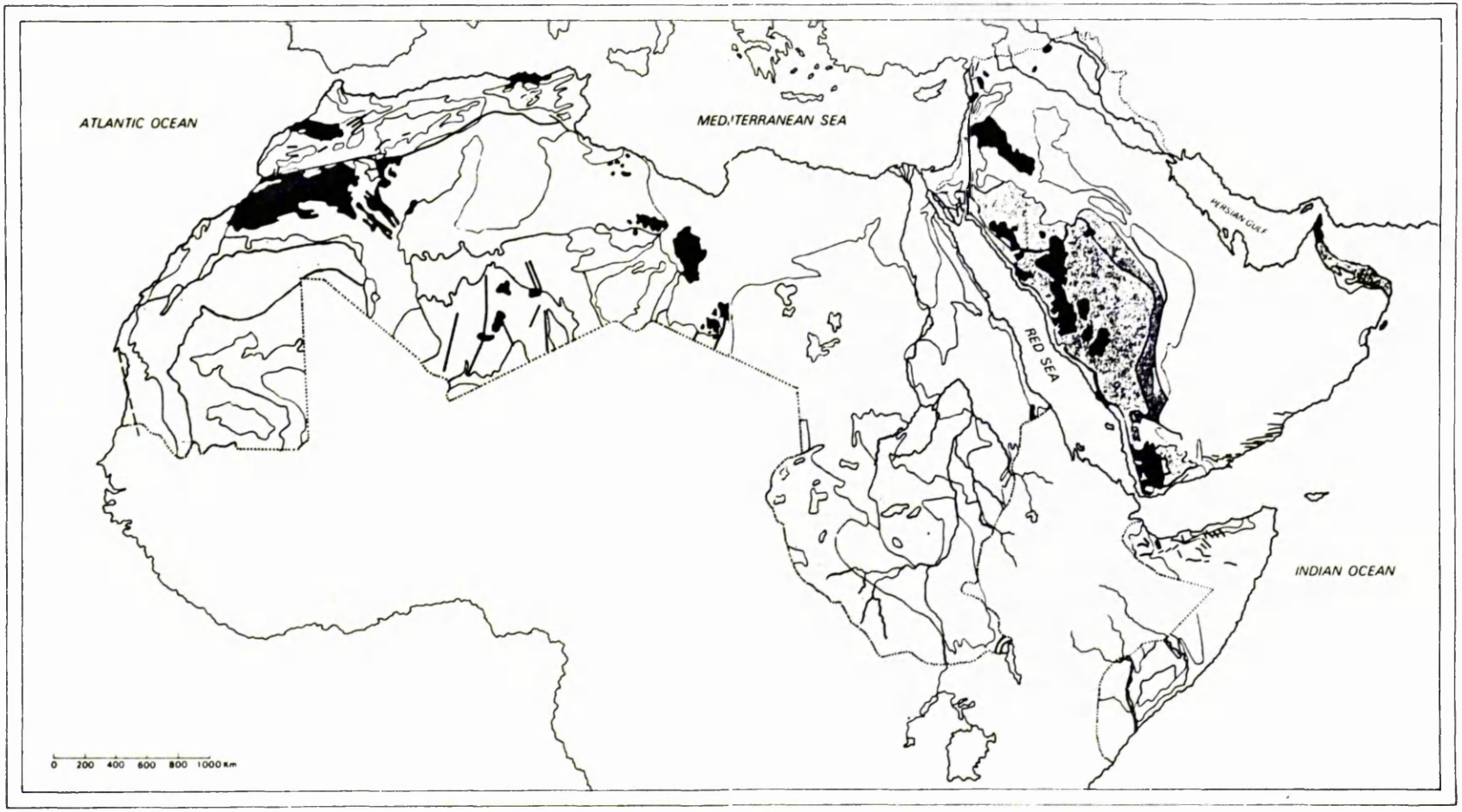



**Figure 2.9 Physical map of the Arab countries.**

***Source: Habashi & Bassyouni 'Mineral Resources of the Arab Countries, op cit.***




**Geological Map of the Arab Countries**

- Third and Fourth Era
- Second Era
- Rocks subjected to the Hercinian and Caledonian Movements
- First Era
- Precambrian
- Unaged basement rocks
- Basaltic volcanic lava of Cretaceous, Third and Fourth Eras
- Major Faults

**Figure 2.10 Geological map of the Arab countries.**

***Source: Habashi and Bassyouni 'Mineral Resources of the Arab Countries. op cit.***

(see Figures 2.9 & 2.10). Although currently of little practical importance, the bed of the Red Sea which divides the African and Arabian tectonic plates is potentially very rich in minerals. Like other areas of tectonic activity, the material which is brought to the surface contains a high proportion of mineral rich rocks which are now covering the sea bed as the plates move apart.

## 2.2 The Classification of Arab Mineral Resources

The numerous distinct geological areas in the Arab Middle East have led to the creation of over 8,000 non-hydrocarbon mineral deposits throughout the region. It is possible to divide them into two broad categories, the metallic and non-metallic minerals, which can then be further sub-divided into a number of other groups. In addition there are also the energy resource minerals which include not only the hydrocarbons but other minerals as well. The classification of the minerals is outlined below, [09].

### 2.2.1 The Energy Resources Group

Excluding petroleum and natural gas this group comprises the natural resources which can be used in generating energy and could be taken into consideration when

studying an energy resources strategy. These are listed below in their various categories :

a). Carbonaceous materials such as coal and coke.

b). Radioactive materials including uranium and thorium.

c). Rock hydrocarbons such as oil shale and asphaltic sands.

d). Geothermal energy resources.

### 2.2.2 Ferrous Metallic Minerals

These are composed of two main sub-groups whose minerals are mainly used in the manufacture of iron, steel and ferrous alloys :

a). Iron minerals which are very important in the Middle East in terms of both tonnage and value.

b). Ferrous alloys which are used as additives in steel making and the other alloys which introduce essential characteristics to iron, thereby multiplying its uses. The most important include manganese, silicon, nickel, cobalt, chromium, tungsten, molybdenum, vanadium, niobium, and tantalum. Because of their properties even small quantities of these minerals are valuable.

### 2.2.3 Non-Ferrous Metallic Minerals

These minerals, which have different characteristics and uses in industry, can be sub-divided in the following way :

a). Non-ferrous metals such as copper, lead, tin and zinc.

b). Light metals such as aluminium, titanium and magnesium.

c). Precious metals including gold, silver and platinum.

### 2.2.4 Non-Metallic Minerals

This large group of minerals can be divided into a number of important sub-groups. They are widely used in the fertilizer, construction, chemical and ceramic industries. Although they are less glamorous than the metallic minerals, they are economically far more important in the Arab Middle East.

a). Fertilizer minerals and rocks including phosphates and potassium, the former being by far the most important non-hydrocarbon mineral in the region.

b). Construction minerals and rocks including sands, gravel, clays, gypsum, limestones and building

stones.

c). Minerals and rocks which are used by the chemical industry such as natural sulphur, barytes, fluorspar, salts, natron and boron.

d). Minerals used in the ceramic industry including asbestos, mica, vermiculite and zircon.

e). Ornamental and gem stones including diamonds, rubies, lapis lazuli, topaz, amber etc.

## 2.3 Phosphate Deposits in the Arab Middle East

By far the most important non-hydrocarbon mineral deposits in the countries of the Arab Middle East are the phosphates. It is estimated that between them they account for 29.4% of the world's total phosphate reserves, [10], but this is probably a very conservative figure. Indeed, after oil and natural gas, phosphate is probably the region's most important natural resource. There are three principal phosphate deposits in the region - in Morocco and the Western Sahara; the Algerian-Tunisian border region; and the Arab Near East deposits which extend from northern Saudi Arabia through Jordan and into Iraq and Syria. In addition there are also significant deposits in Egypt, although they have not yet been fully developed.

### 2.3.1. Morocco & Western Sahara
**********

Morocco and the Western Sahara have the largest phosphate reserves in the world. The deposits are in the form of sub-horizontal sedimentary beds which were laid down between the Late Cretaceous and Middle Eocene periods. In Morocco itself they are found in a series of basins which extend from the Moroccan horst up to the High Atlas mountain range. In addition there are other deposits on the northern and southern borders of the Atlas mountain range, [11]. The most important deposits are in the Khouribga and Youssoufia areas, which are estimated to have reserves of over 13,000 million tonnes of 68.0%-71.0% TPL, [12].

The purity of phosphate rock is expressed in terms of its percentage of tri-phosphate of lime or TPL. Elsewhere the same percentage is referred to as the TCP (tri-calcium phosphate) or BPL (bone phosphate of lime) content. All of these terms refer to its fertilizer phosphate nutrient content and therefore its value. Raw phosphate rock usually has a $P_2O_5$ or phosphorous pentoxide content of 30%-35% and most commercial grades have a TPL content of at least 60% although this can be as high as 86%.

The site of two of the world's largest phosphate mines are Khouribga and Youssoufia, **(see Figure 2.11)**. They

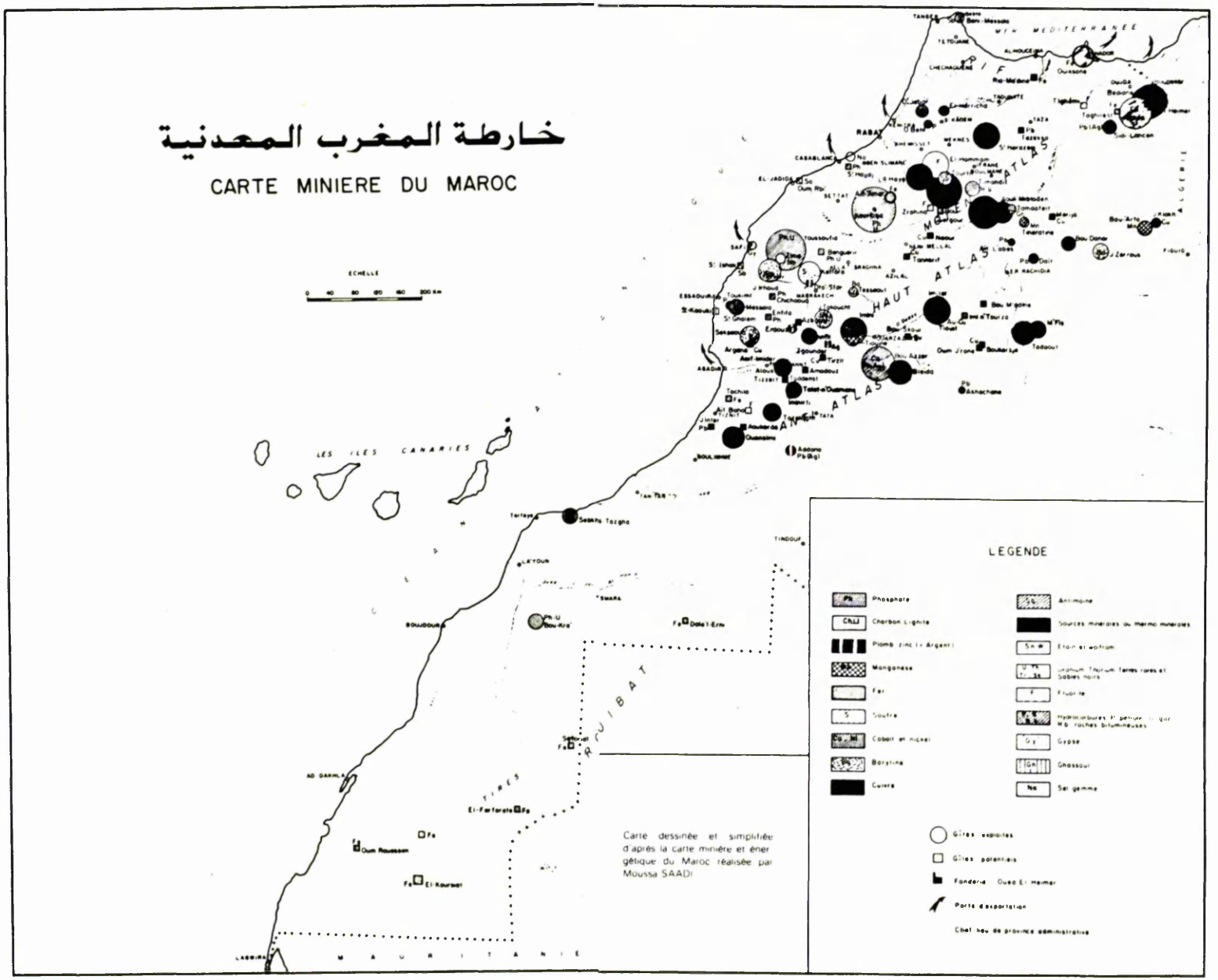



**Figure 2.11 Mineral map of Morocco.**

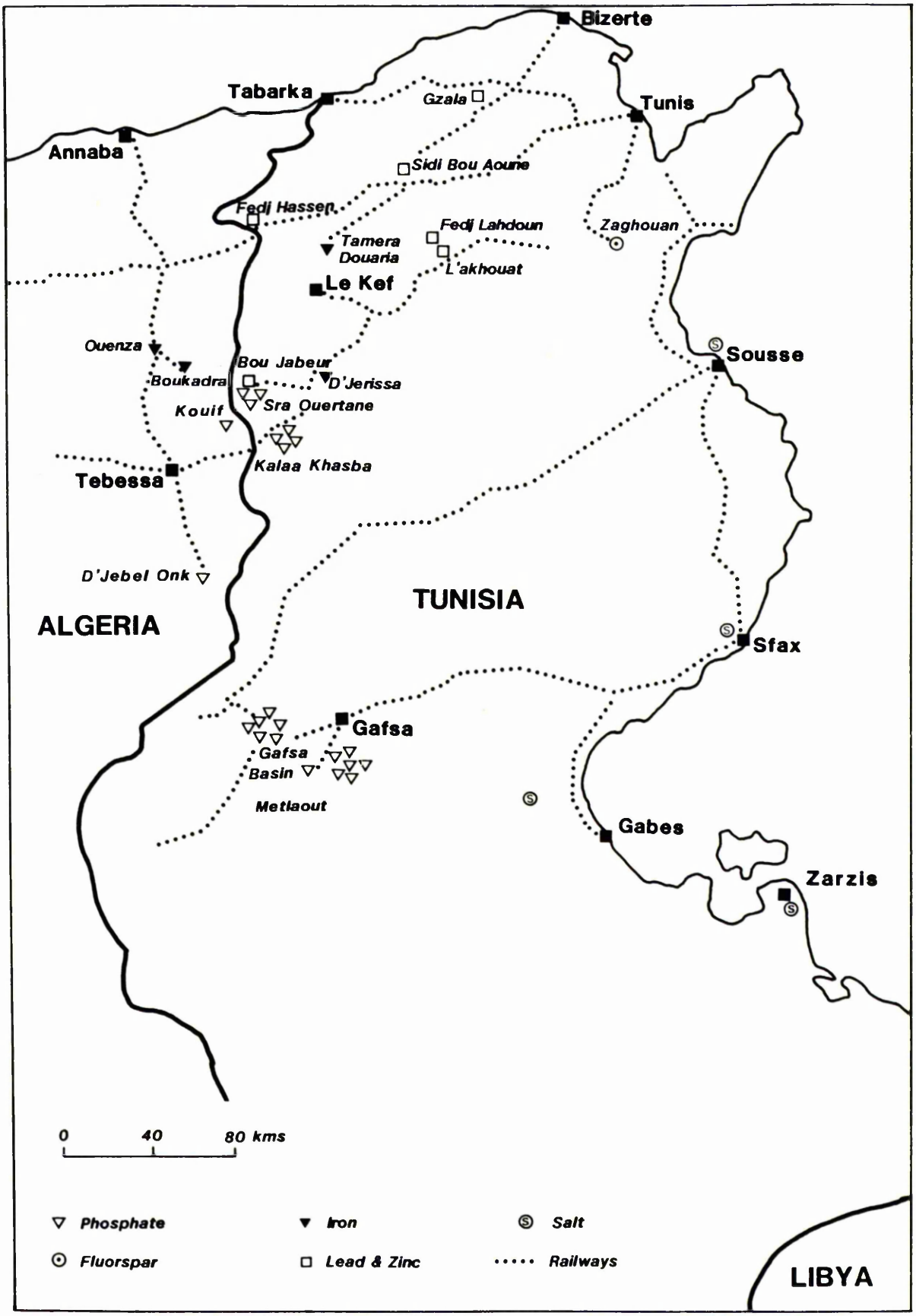
***Source: Bureau de Recherches et Participations Minières Activities 1983.***

are the cornerstone of the Moroccan phosphate industry, although there are a number of other smaller deposits. In the disputed Western Sahara, which is currently under Moroccan control, there are also major phosphate deposits. This is the principal economic reason for the Moroccan occupation. The most important deposit in the area is at Bou Craa, located 107 kms south-east of Al Aiun and 100 kms from the Atlantic Ocean. It is one of the richest deposits in the world, with estimated reserves of 1,700 mn tonnes of 32% $P_2O_5$ rock.

### 2.3.2 Tunisia and Algeria
**********

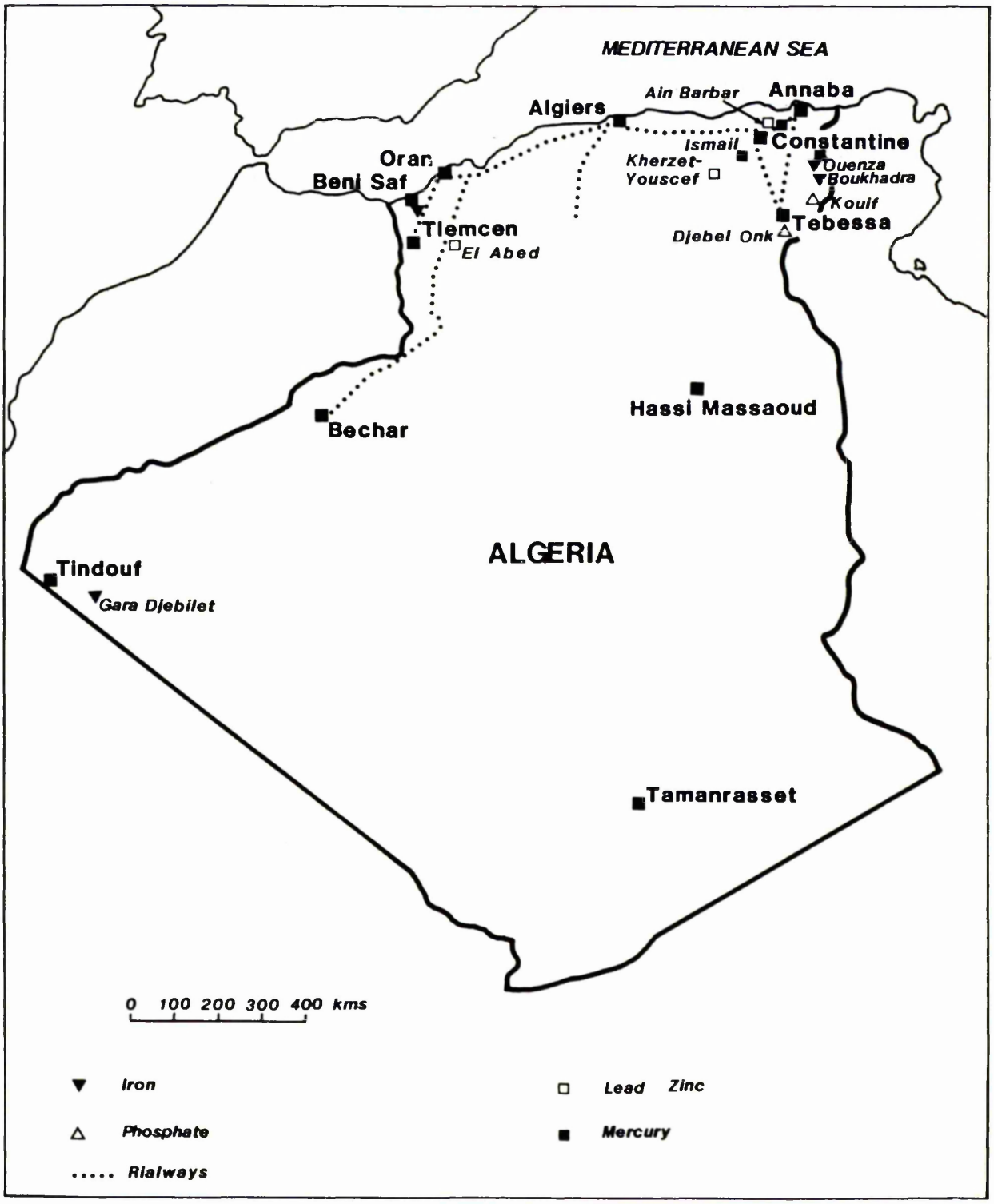
There are substantial phosphate deposits which lie on both sides of the Algerian-Tunisian frontier. The most important are those in Tunisia, which extend east from the border for up to 160 kms. They are concentrated near Gafsa, although there are minor deposits further north near Le Kef, **(see Figure 2.12)**. The Compagnie des Phosphates de Gafsa, (CPG), the government parastatal which is responsible for the vast majority of phosphate industry, estimates that there are total reserves of 812 mn tonnes of phosphate in the Gafsa basin, **[13]**. Of this total only 165 mn tonnes are currently considered economic, 479 mn may be economic in the future and 168 mn tonnes are of a very low grade. The average $P_2O_5$ content is only about 27% and therefore, like other producers, Tunisia is trying to process rather than simply export the raw phosphate.

## Figure 2.12 Tunisia's Mining Industry




*Base Source: Department of Geography, S.O.A.S.*

## Figure 2.13 Algeria's Mining Industry



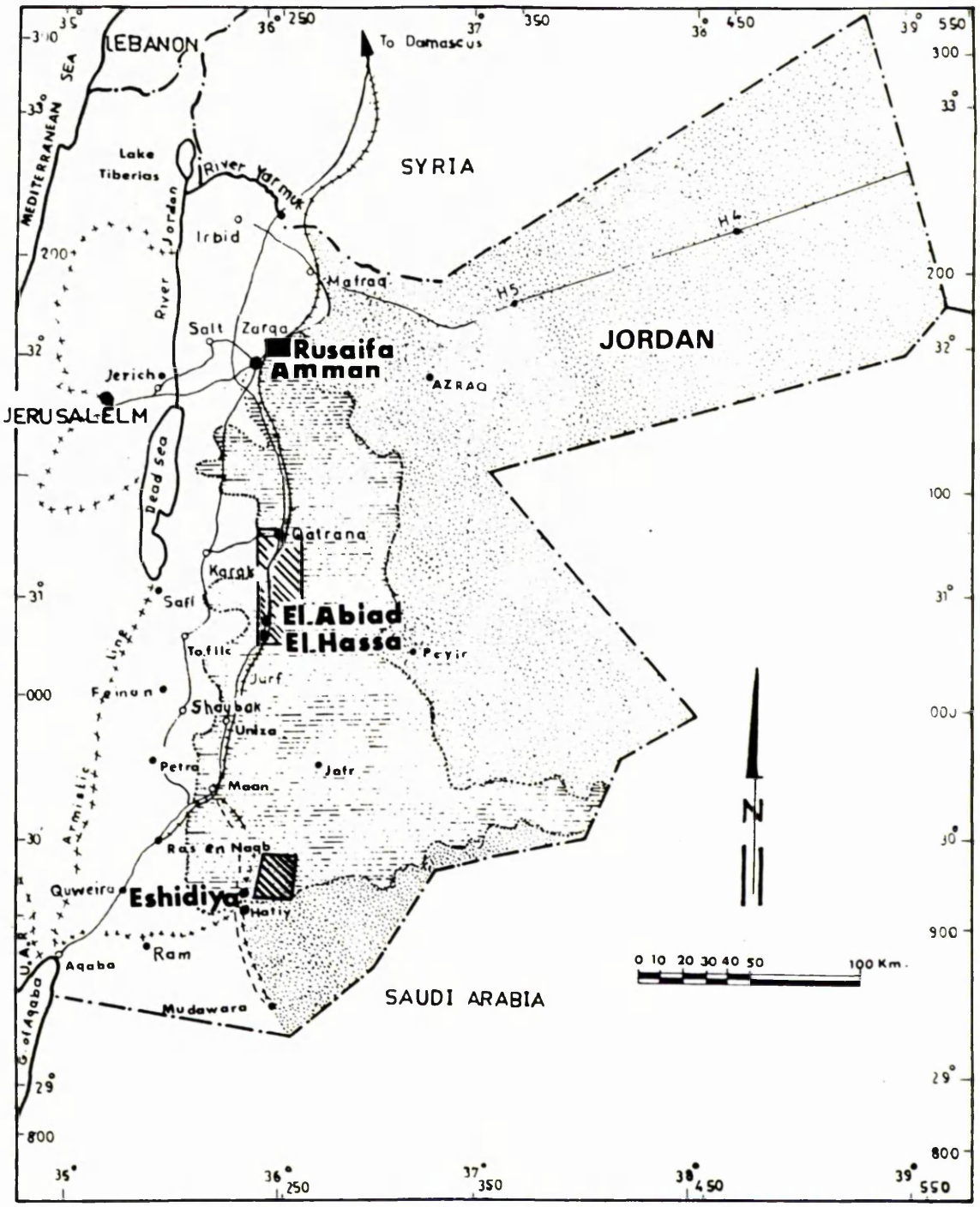

*Base Source: Department of Geography, S.O.A.S.*

The Algerian phosphate deposits are centred on Djebel Onk and Kouif which are close to the Tunisian frontier and are an extension of the Gafsa basin deposits, **(see Figure 2.13)**. Djebel Onk has total estimated reserves of about 540 mn tonnes of phosphate, of which 120 mn have a TPL content of 58.5% - 61.0% with the remainder being under 58%, **[14]**. There are nine phosphate bearing beds which are located in a 20 kms asymmetrical anticline. The much smaller Kouif deposit has reserves of under 10 mn tonnes and is far less important.

### 2.3.3 The Arab Near East
**********

After Morocco and the Western Sahara, the most significant phosphate deposits in the Middle East are those which extend in a belt from northern Saudi Arabia, through Jordan and into both Iraq and Syria. Of these the most important are in Jordan where there are three major deposits; at Rusaifa outside Amman, (which can also be spelt Ruseifa); the El Hassa - (Wadi) El Abiad area of central Jordan; and Es Shidiyah near the Gulf of Aqaba, **(see Figure 2.14)**. The phosphate formations lie near the surface throughout all of the area which is covered by the Upper Cretaceous material at a depth of between 15 and 39 metres, **(see Figure 2.15 & 2.16)**. The three areas have estimated reserves totalling 1,552 mn tonnes of which 1,042 mn are proved, 281 mn are indicated and 229 mn are inferred, **[15]**. Of this total

## Figure 2.14 Jordan: Phosphate deposits.

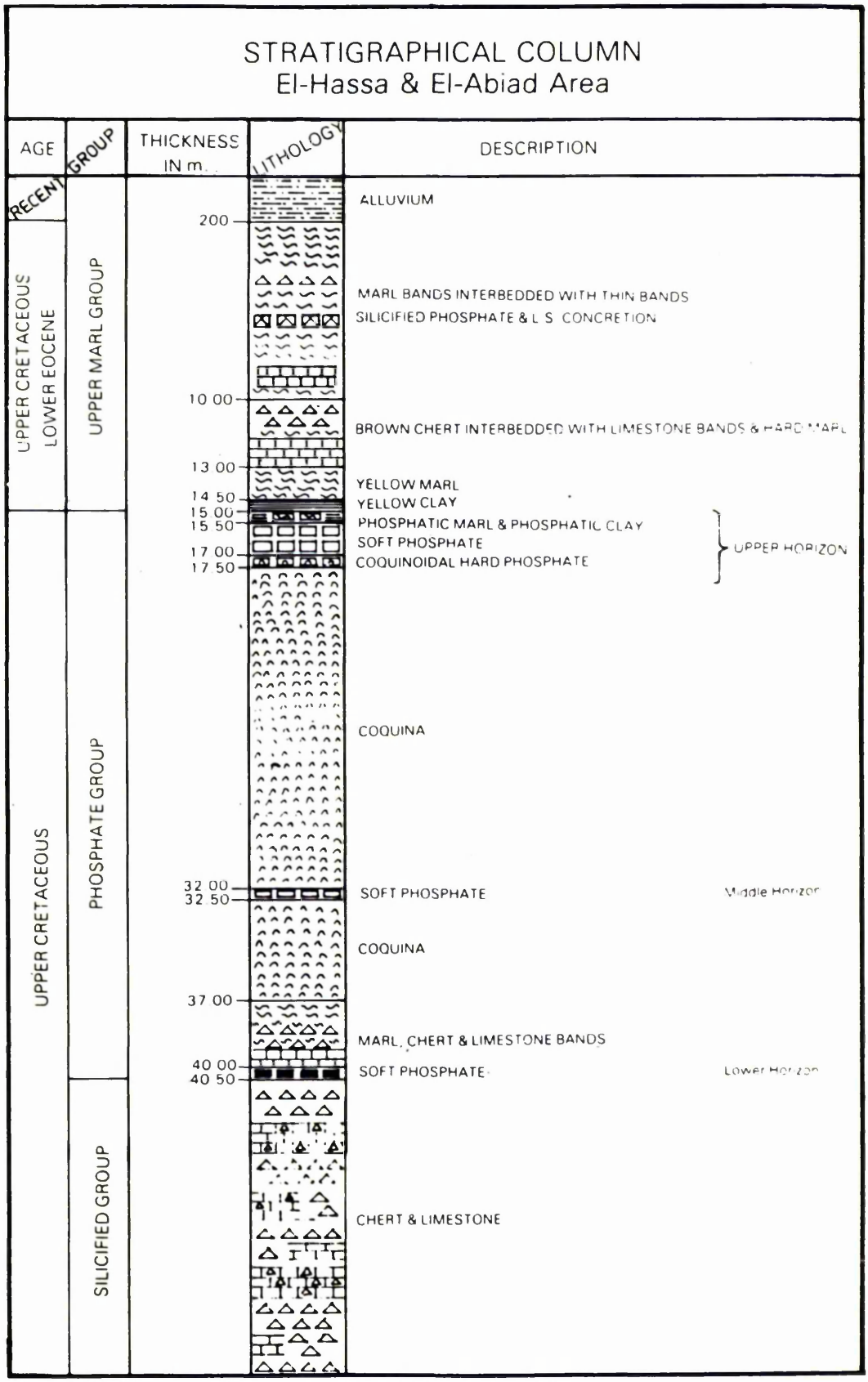



**LEGEND**

- City
- Town
- Village
- Asphalt road
- Road under construction
- Existing railway
- Potential near surface Phosphate Upper Cretaceous Formation.
- Potential deeper phosphate Eocene Formation
- Rusaifa Area Deposit
- El Hassa Area Deposit
- Eshidiya Area Deposit

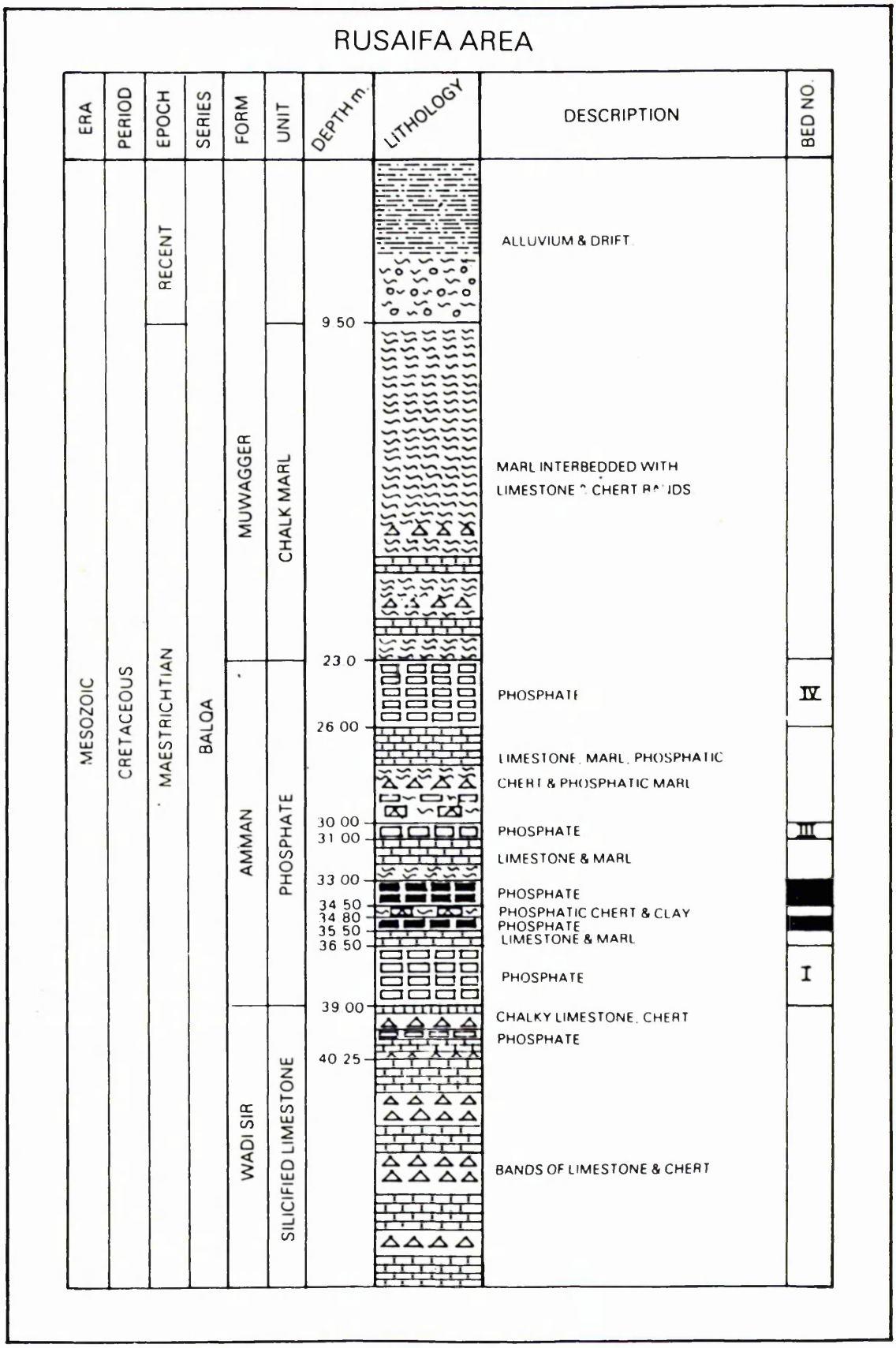
***Source: Jordan Phosphate Mining Company, Annual Report 1984.***

**Figure 2.15**
**Stratigraphical colomn, El-Hassa and El Abiad Area.**




***Source: Jordan Phosphate Mining Company, Annual Report 1984.***

**Figure 2.16**
**Stratigraphical colomn: Rusaifa area.**



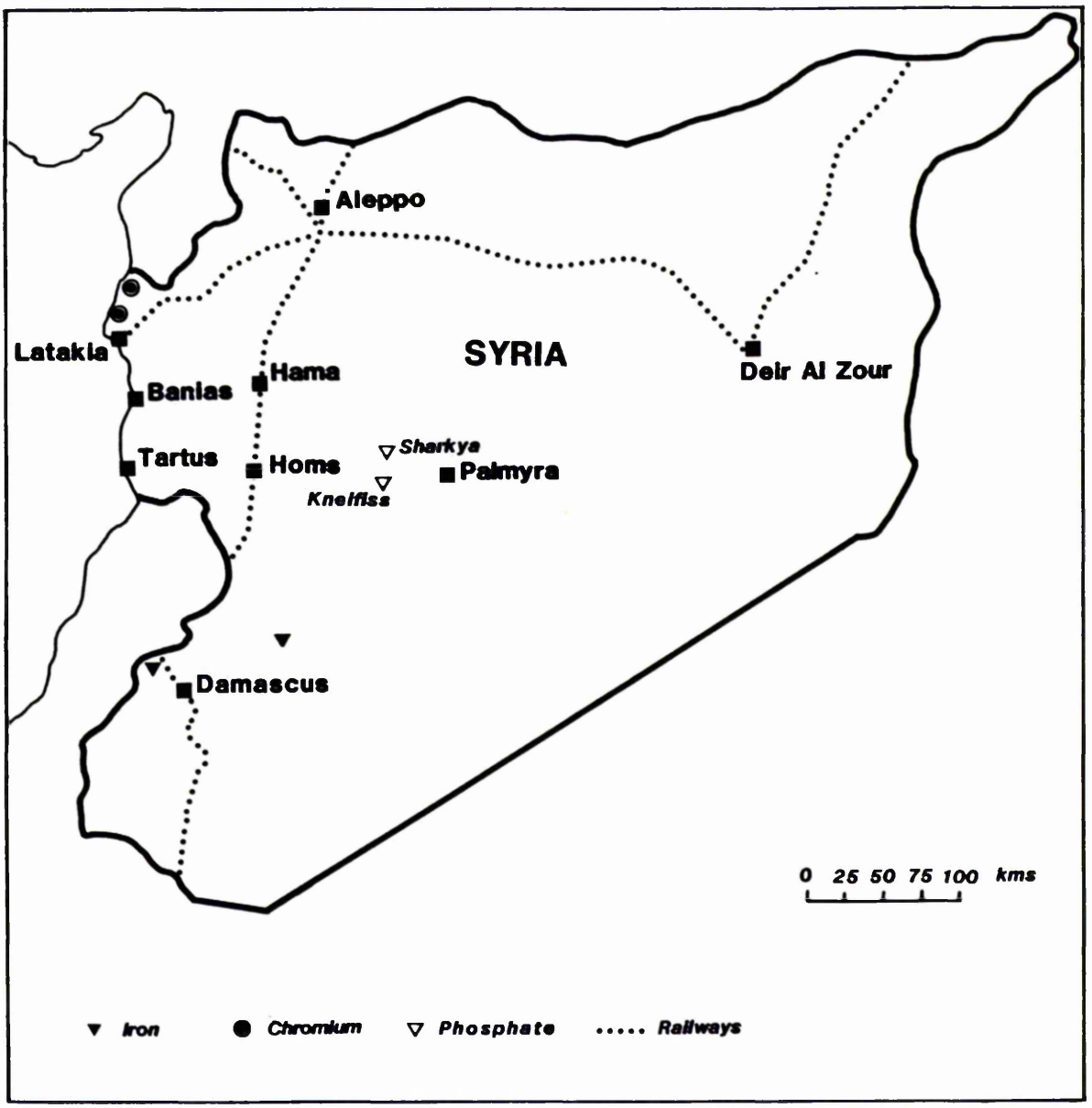

***Source: Jordan Phosphate Mining Company, Annual Report 1984.***

1,186 mn tonnes are at the new mine at Es Shidiyah which is currently being developed. The TPL content of the Jordanian phosphate range from about 60%-75%, while the $P_2O_5$ content is 27.5%-33.3%.

The phosphate deposits continue north from Jordan into both Syria and Iraq. In the former there are two principal deposits which are located about 45 kms east of Homs. It is estimated that the mines at Kneifiss and Sharkya have total reserves of about 557 mn tonnes of which the latter has 500 mn tonnes, **(see Figure 2.17)**. Like the Tunisian deposits, the TPL content is low at between 65% - 68%. The maximum overburden is only 13 metres at Sharkya compared to up to 40 metres at the Kneifiss mine, while the average depth of the phosphate beds are 12 and 7 metres respectively, [16]. Because of all these and other factors the Syrian phosphate industry is centred on the two mines at Sharkya.

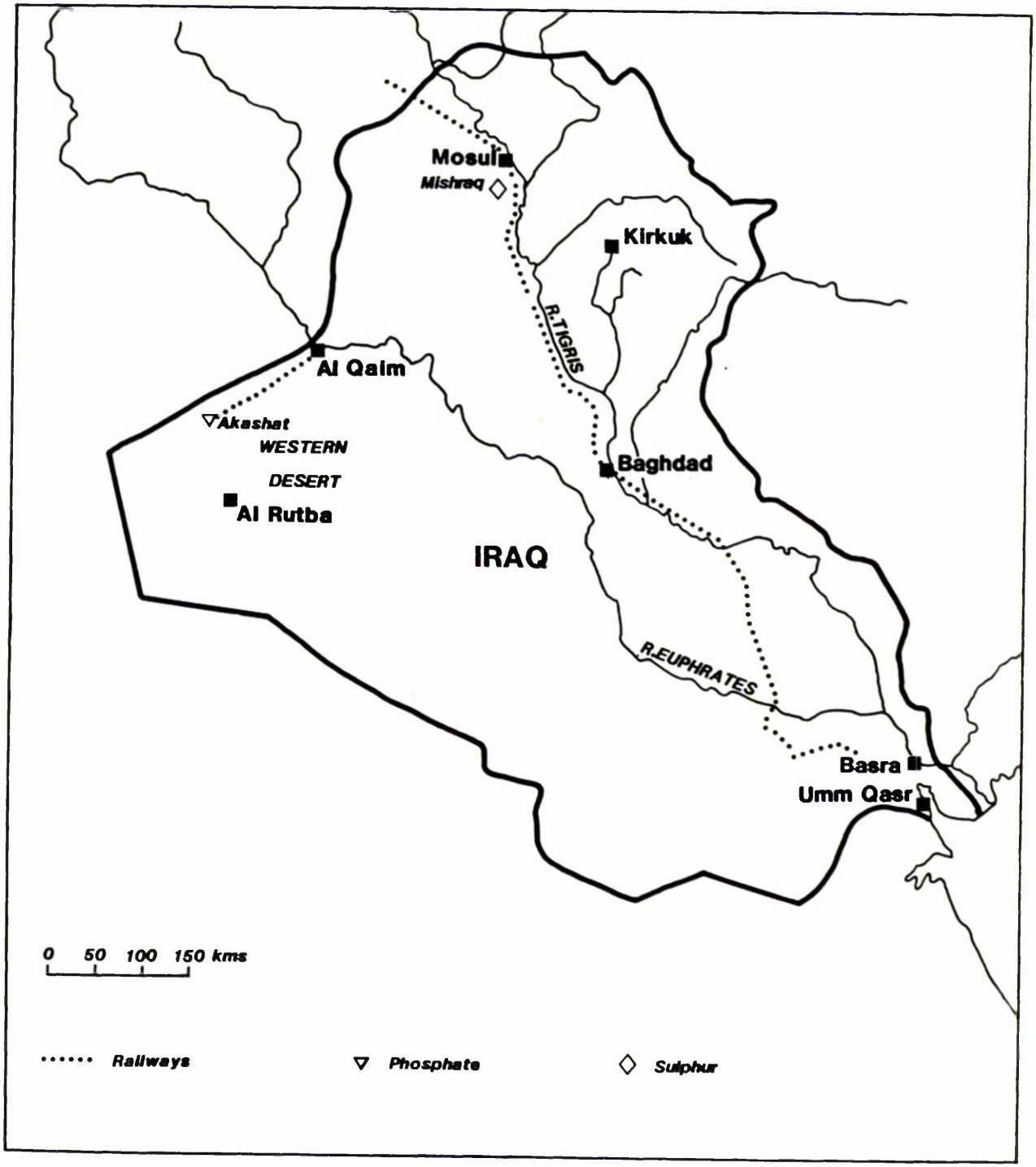
The main Iraqi phosphate deposit is at Akashat in the Western Desert, near to both the Jordanian and Syrian borders, **(see Figure 2.18)**. Together with two other minor deposits, it was discovered following geological investigations in the region in 1965. The phosphate beds which total 10.5 metres in thickness are covered by an overburden which ranges from 1 - 21 metres and averages 5.5 metres. The $P_2O_5$ content is very low, averaging only 21%, and ranging between a high of 33% to

Figure 2.17 Syria's Mineral Deposits.




*Base source: Department of Geography, S.O.A.S.*

Figure 2.18 Iraq's Mining Industry.




*Base source: Department of Geography, S.O.A.S.*

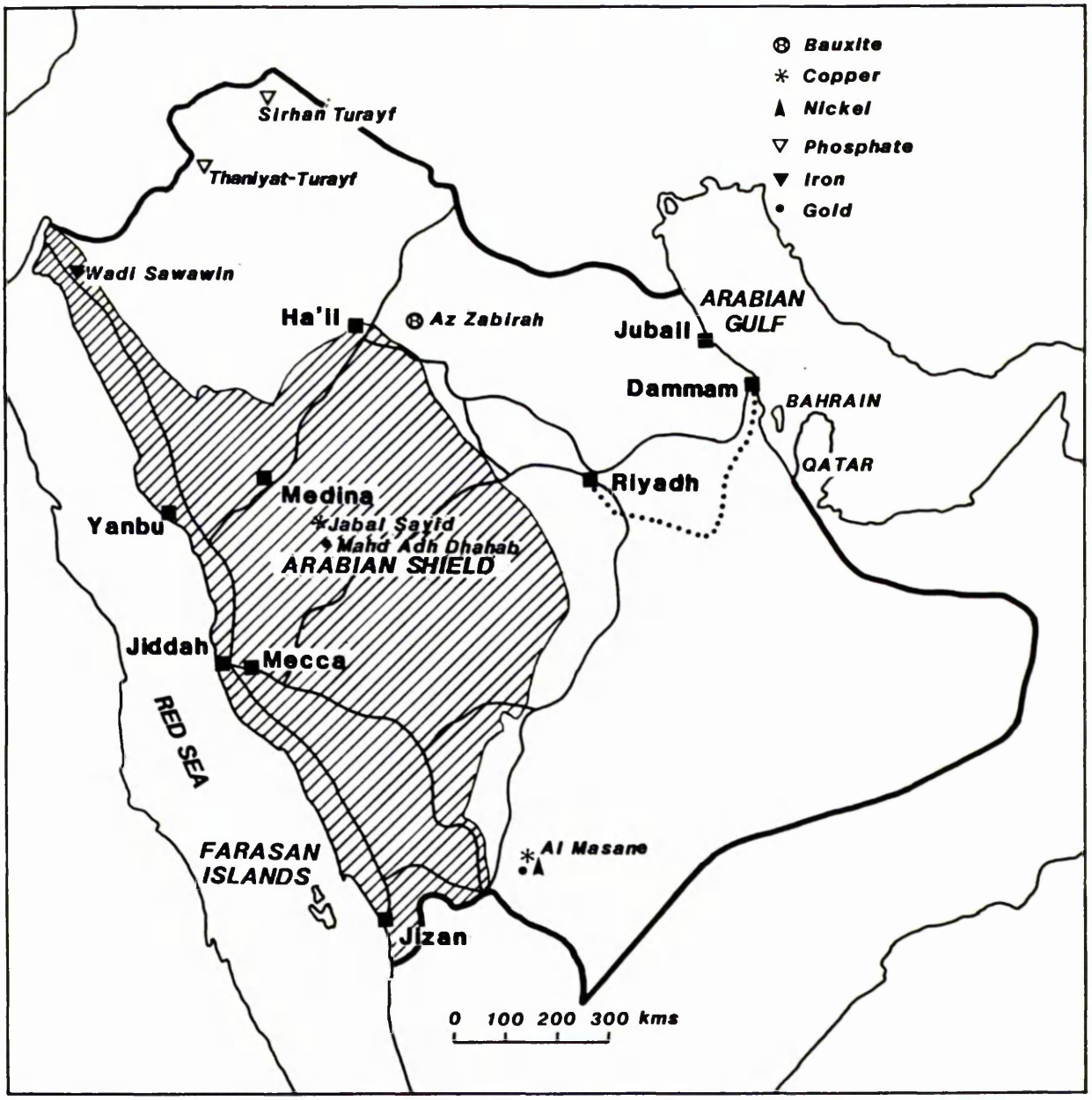
just a few per cent. The total phosphate reserves at Akashat are conservatively estimated to be about 450 mn tonnes, [17]. Recently, however, the government unexpectedly increased its estimate to 10,000 mn tonnes, which would be able to supply the Akashat phosphate fertilizer complex for 270 years at its current annual production rate of about 3.5 mn tonnes, [18]. Of this total the reserves which could economically be extracted is undoubtedly much smaller.

Although it is currently uncertain whether they will ever be developed, there are also phosphate deposits in northern Saudi Arabia, which are an extension of those in Jordan and Iraq. These sedimentary strata, which are of late Cretaceous to Middle Eocene age, underlie an area of about 100,000 sq.kms. in the Sirhan-Turayf basin, (see **Figure 2.19**). Over eight years of investigation work has been undertaken to evaluate the extent and richness of the phosphate. The most promising deposit, provisionally estimated at 1,000 mn tonnes, was discovered within an area of about 300 sq.kms north of Al Jalimid. Although it could be economically developed, it has a low $P_2O_5$ content of between 10%-30% in beds of up to eight metres, [19].

### 2.3.4. Egypt.
**********

There are two principal regions of Egypt in which

Figure 2.19 Saudi Arabia's Principal Mineral Deposits.



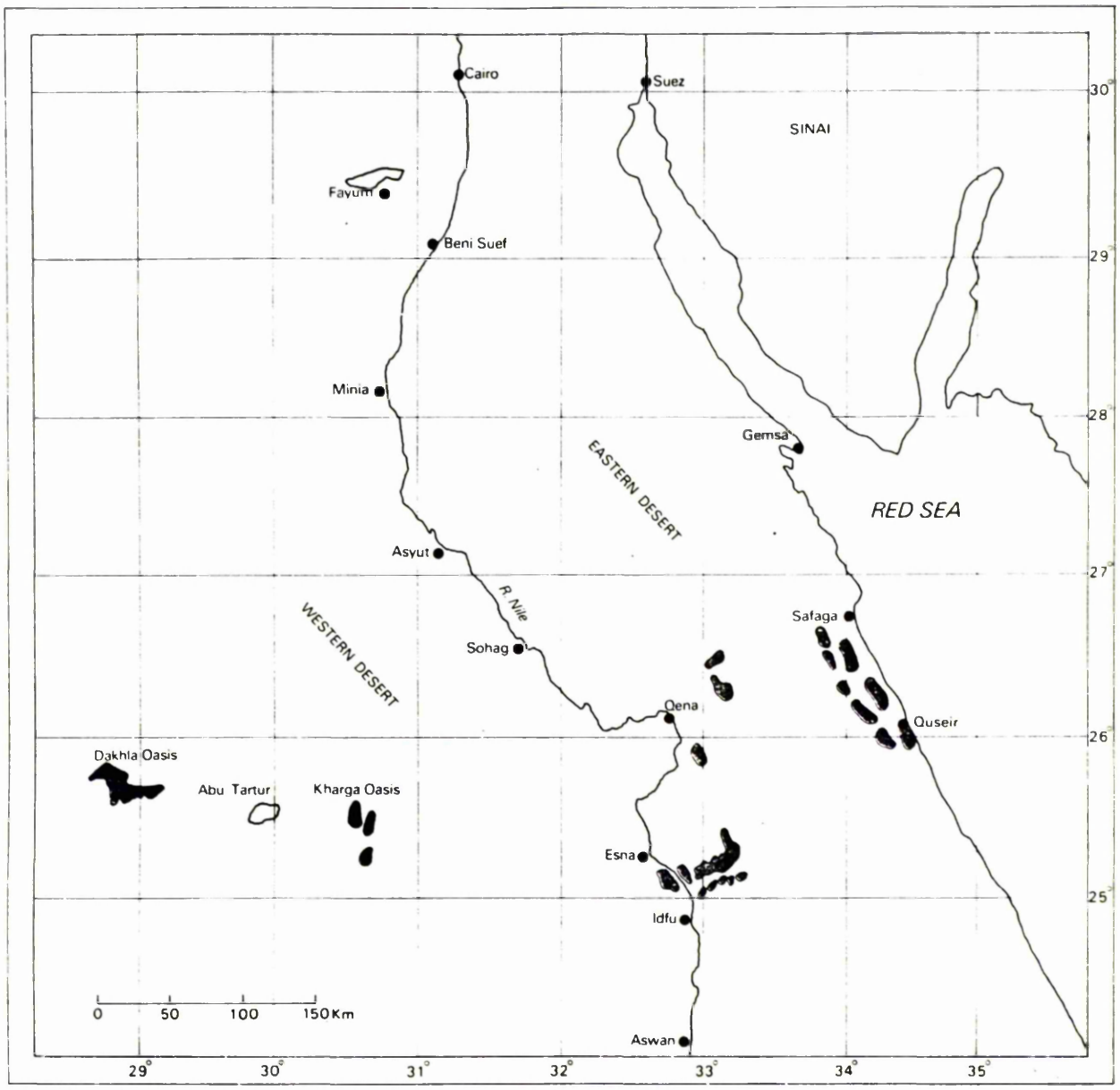

*Source: Department of Geography S.O.A.S. and D.M.M.R., Jiddah.*

phosphate deposits have been discovered. One is in the Western Desert along the scarp surrounding the Dakhla and Kharga depressions, **(see Figure 2.20)**. The other extends from the Nile to the Red Sea in a rough belt of Upper Egypt between about latitudes 25-27 degrees north. The largest and most important deposit is located in the Western Desert at Abu Tartur. With estimated reserves of 1,000 mn tonnes, it is almost larger than the total of Egypt's other phosphate deposits. Together with the estimated 500 mn tonnes at neighbouring Dakhla and 40 mn tonnes at Kharga, the Western Desert is one of the larger phosphate deposits in the Middle East, [20]. Because the $P_2O_5$ content only averages 25% at Abu Tartur, however, it has not yet been as fully developed as the other deposits in the region. Besides the Western Desert, the other phosphate deposits have estimated total reserves of 1,648 mn tonnes, although only 178 mn tonnes are believed to be worth extracting, [21]. Of this 64 mn tonnes are near the Red Sea coast and 114 mn tonnes are in the Nile Valley of Upper Egypt.

## 2.4 Iron Ore Reserves in the Arab Middle East

As **Table 2.1** below illustrates, there are a number of countries in the Arab Middle East which have substantial deposits of iron ore. Despite this the proportion of world iron ore reserves that are found in the region is

## Figure 2.20 Egyptian Phosphate Deposits.




## Phosphorite Occurrences in Egypt

Phosphorite

***Source: Habashi & Bassyouni, 'op cit'.***

only about 3.5%, [22]. Like all other estimates of mineral reserves it is possible to produce widely divergent statistics depending on whether or not they include possible and inferred reserves. Wherever possible the national statistics provided in this section of the chapter use the latest estimates from each country although these often differ significantly from compilation statistics such as those in **Table 2.1**.

**Table 2.1 : IRON ORE RESERVES IN THE ARAB COUNTRIES**

| Country | Reserves (mn mt) | % Iron | Altern.Estimate |
|---|---|---|---|
| Libya | 3,525 | 35-51 | 1,815 mn t **(a)** |
| Algeria | 3,212 | 40-57 | 5,120 mn t **(b)** |
| Jordan | 660 | 40-63 | 3 mn t **(b)** |
| Syria | 546 | 27-33 | 116 mn t **(b)** |
| Egypt | 525 | 43-58 | 900 mn t **(b)** |
| Morocco | 158 | 35-60 | 118 mn t **(b)** |
| Sudan | 86 | 37-62 | 116 mn t **(c)** |
| Iraq | 30 | 16-30 | - |
| Tunisia | 13 | 45-54 | 500 mn t **(b)** |
| Saudi Arabia | 3 | 25-46 | 246 mn t **(d)** |
| **TOTAL** | **8,758** | **= Approx 3.5 % world total** | |

**Principal Source :**
Arab Mining Company, **Arab Mining Journal**, Vol. 3, No.1, 1983, Amman, Jordan.

**Sources for Alternative Estimates :**

**(a)** Finnmap OY, **Sabha Region - Existing Conditions October 1981**, Helsinki, 1981, p.61.
**(b)** F. Habashi & F.A. Bassyouni, **Mineral Resources of the Arab Countries**, op cit, p.10.
**(c)** A.H. Ishag, **A guide to mineral investment in the Sudan**, Geological and Mineral Resources Department, Khartoum, 1980, p.6&7.
**(d)** British Steel, **Visit to Wadi Sawawin Project Site**, Jiddah, undated, p.4

### 2.4.1. Algeria.

The discrepancy between the statistics can often be explained by the inclusion or omission of those reserves which cannot be economically developed. An example of this can be seen in the statistics for Algeria's iron ore reserves. While the Arab Mining Journal produces a total of 3,212 mn tonnes in the table above with which Algerian commentators agree, [23], Habashi and Bassyouni insist that it is over 5,000 mn tonnes, [24].

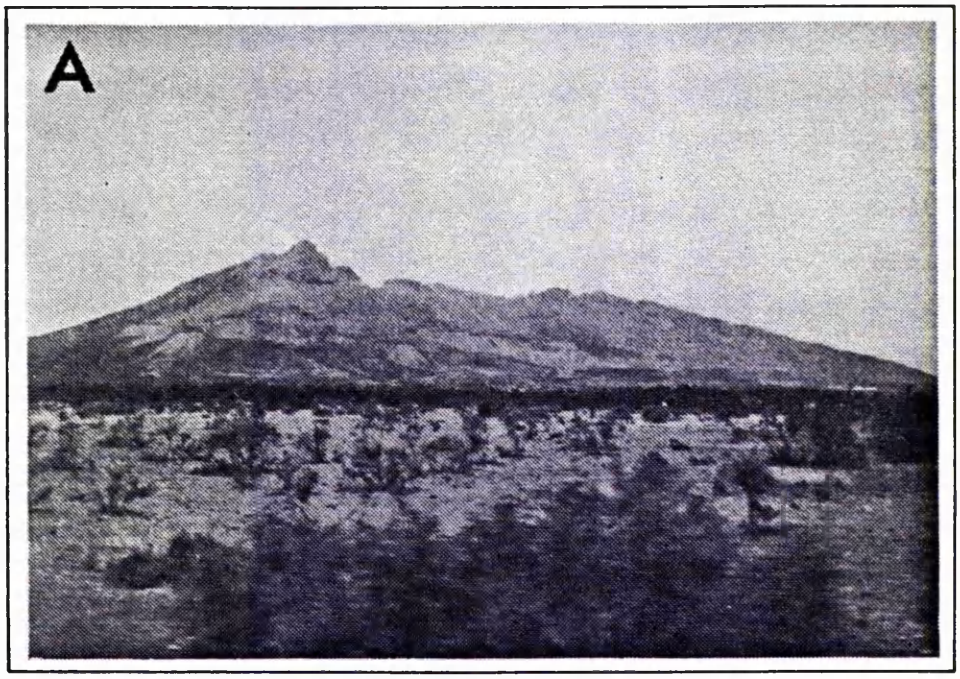
There are two principal regions in Algeria in which there are iron ore deposits; the Tunisian border region and the area to the south-east of Tindouf in the west of the country, **(see Figure 2.13)**. Although it has not yet been developed, the deposit in the latter area at Gara Djebilet is one of the largest in the world. There are estimated reserves of about 5,000 mn tonnes of oolitic ore, of which up to 3,000 mn tonnes could be mined economically having an iron content of 48% to 57%, [25]. Originally there was a were plan for a joint venture with Morocco to market 8 mn t/y via Morocco by 1980 and later another to transport the ore north to Algerian coast. Plans to develop the deposit as the centre of the heavy industry sector in western Algeria were also considered but these are still a long way off, [26].

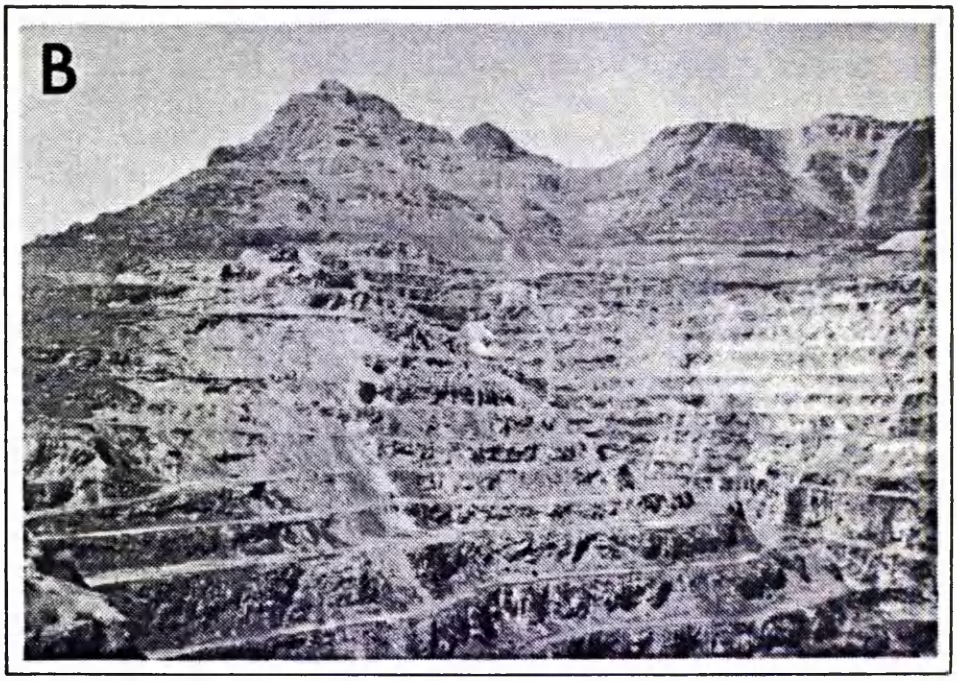
Meanwhile, the Tunisian border area will remain the heart of the Algerian iron ore mines. There are three mines at Ouenza, Boukhadra and Khanguet of which the first is by far the most important, being one of the largest iron ore mines in Africa. Their combined reserves are believed to total about 120 mn tonnes of siderite which is found within the surrounding Cretaceous limestone rocks. As the photographs in **Figure 2.21** illustrate, the Ouenza mine is a small mountain which is now gradually being worked out in a large scale operation. Besides the eastern border region the other iron ore deposits are at Beni Saf near Oran on the Mediterranean coast and Zaccar which is south-west of Algiers.

### 2.4.2 Libya.

One of the largest iron ore deposit in the Arab Middle East, and indeed in the world, is at Wadi Ash Shati in the Sabha area of Libya, **(see Figure 2.22)**. The iron-bearing beds are located in the exposure of haematite beds from the Lower Carboniferous period at the northern rim of the Murzuq Basin. They vary in thickness from two to eleven metres and persistently outcrop in a 2-3 kms band over a distance of 110 kms, **[27]**. Although there are silica and other impurities, the iron ore is of a high quality and the potential for its development could

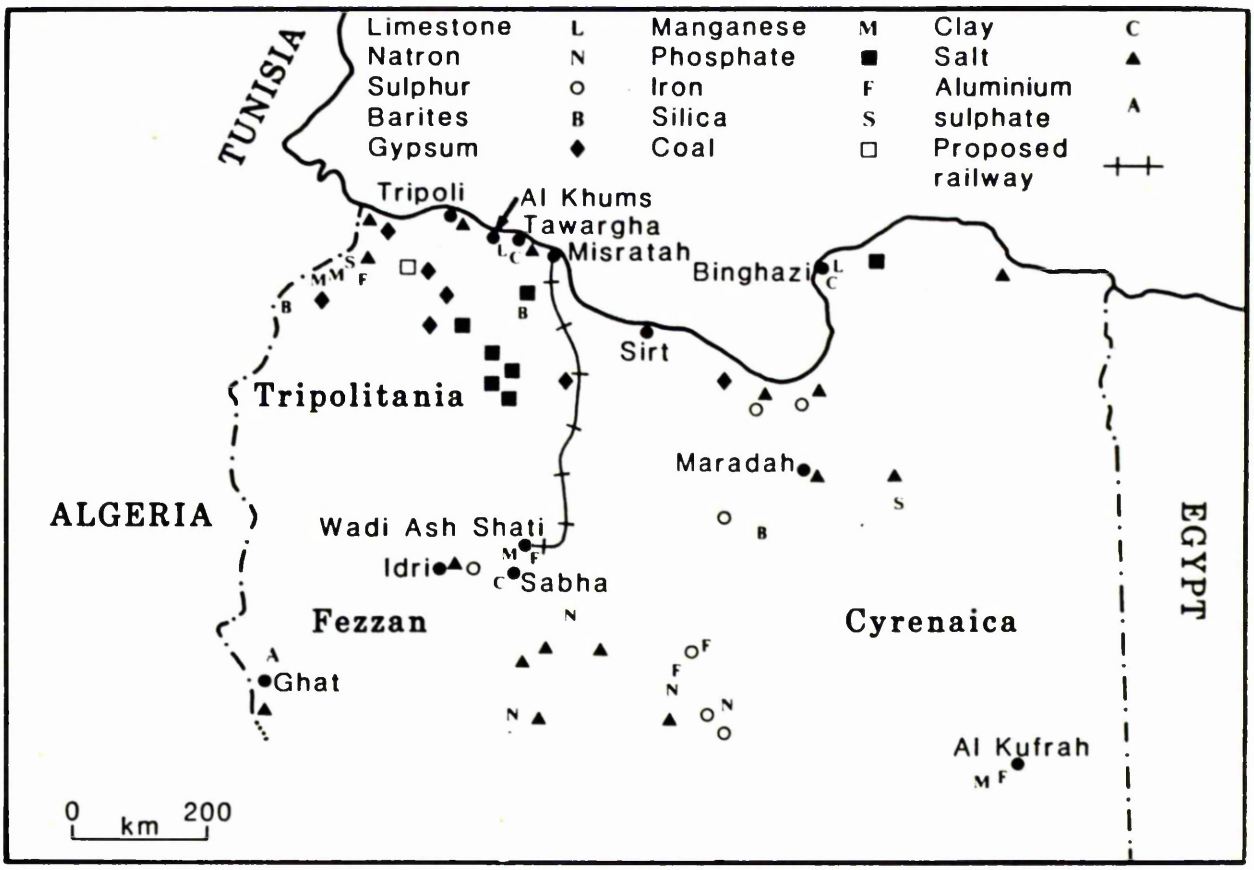
**Figure 2.21**
**Photographs of Ouenza iron mine, Algeria.**




*Source: C.G. Gurdon.*

## Figure 2.22 Libyan Mineral Deposits.




*Source: C.G. Gurdon, "Non-hydrocarbon minerals in Libya", op cit.*

be considerable. This would, however, depend on world market conditions which are currently very unfavourable. In addition the problems of transporting the iron ore to the Misuratah iron and steel complex on the coast are economically insurmountable at the moment.

**Table 2.2 : Indicated Reserves of Wadi Ash Shati, 1973**

| Area | Indicated Reserves | Av. Thickness | % Iron |
|---|---|---|---|
| South Tarout | 640 mn tonnes | 9.00 m | 50.00 % |
| Ashkidah | 475 mn tonnes | 6.65 m | 51.75 % |
| Ed Disah | 700 mn tonnes | 4.70 m | 45.00 % |
| **TOTAL** | **1,815 mn tonnes** | **6.78 m** | **48.92 %** |

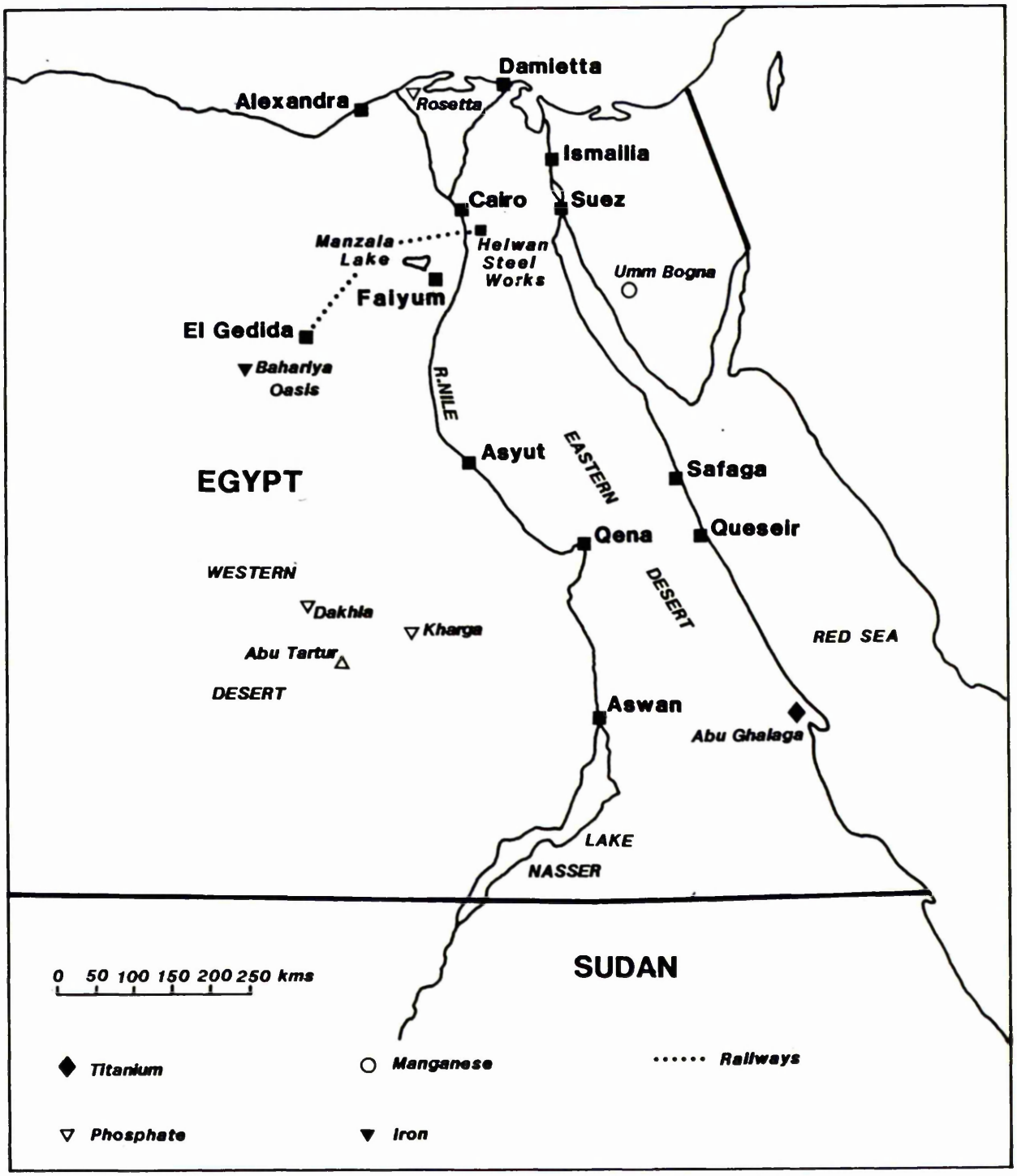
**Source :** Finnmap OY, **Sabha Region - Existing Conditions October** 1981, Finnmap OY, Helsinki, 1981.

### 2.4.3. Egypt

Although other countries have larger iron ore deposits, with the exception of Algeria, Egypt has the largest actual existing iron and steel industry in the region. The giant steelworks at Helwan outside Cairo uses domestic iron ore, which is transported on a special railway from the Bahariya Oasis. It has five deposits of which the richest is El Gedida with 134 mn tonnes of 55% iron ore, **[28]**, which is the only one being developed, **(see Figure 2.23)**.

Before the deposits at the Bahariya Oasis were discovered the area to the east of Aswan in Upper Egypt

## Figure 2.23 Egyptian Mining Industry.




*Base Source: Department of Geography, S.O.A.S.*

was the focus of the iron mining industry. Here the Late Cretaceous oolitic haematite is found in two horizons, separated by a layer of Nubian Sandstone. In addition there are also fourteen metamorphosed Pre-Cambrian deposits to the south-west of Queseir on the Red Sea coast, with total reserves of about 60 mn tonnes, [29].

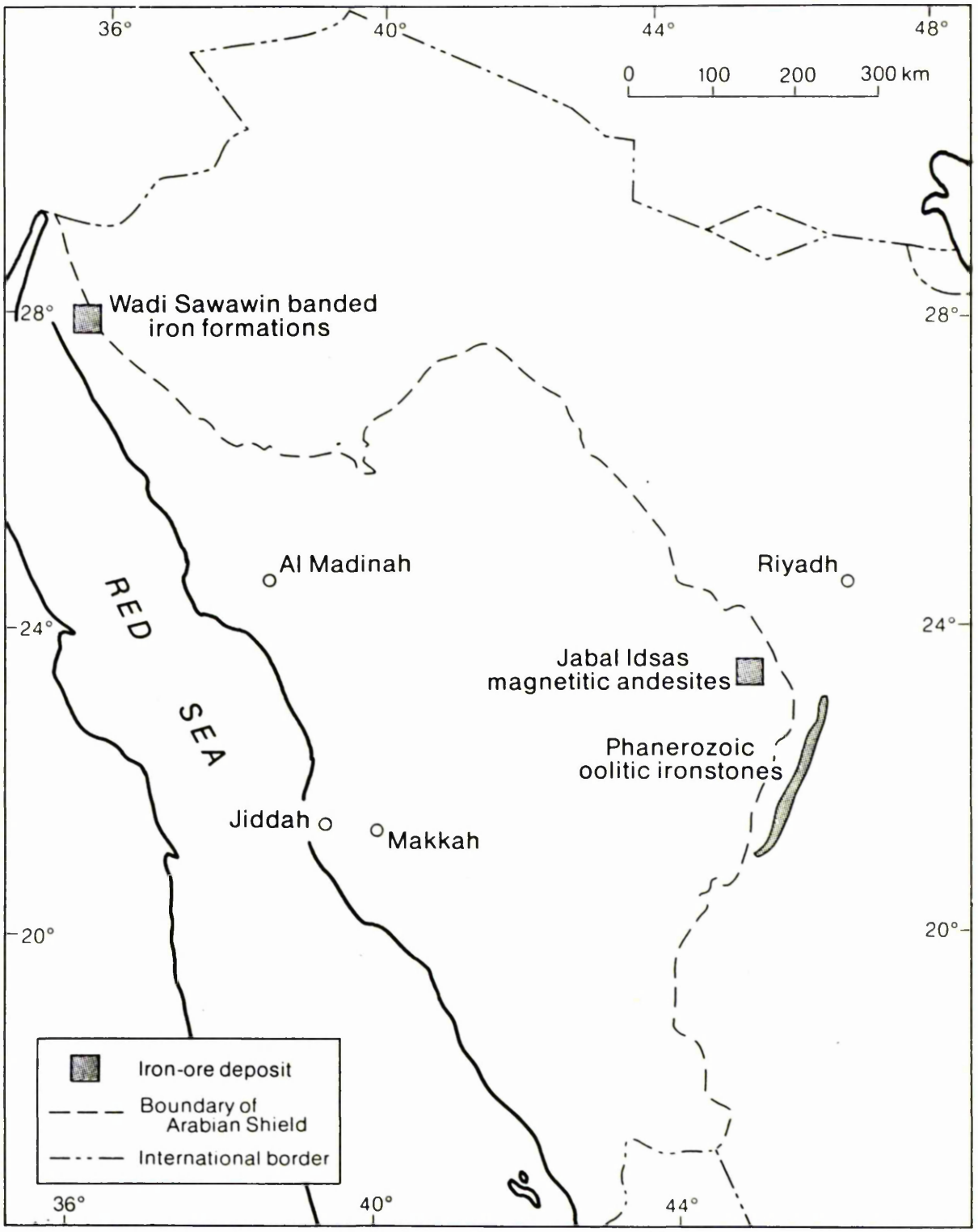
### 2.4.4. Saudi Arabia

Although it is not one of the largest in the region, the Wadi Sawawin iron ore deposit in north-western Saudi Arabia is one of the more interesting, **(see Figure 2.24)**. There are estimated to be about 246 mn tonnes of very fine grained Pre-Cambrian Banded Ironstone which has an iron and silica content of 42% and 28% respectively, [30]. There are serious problems with this low grade and impure deposit, and its development was consequently hampered until a suitable enriching process was found. The other major problem is the very small grain size of the ore which has made the grinding of the ore exceptionally difficult.

### 2.4.5. Other Countries

Besides these deposits, there are other iron ore deposits in the Arab Middle East. Of these probably the largest economically viable reserves are in north

**Figure 2.24**
**Saudi Arabian Iron ore deposits**




***Source: DMMR Saudi Arabia Mineral Resources Annual Report 1402-04, op cit.***

Morocco where there are numerous deposits. Of these the most important is at Nador on the Mediterranean coast where about 140,000 - 170,000 tonnes are mined each year by the Bureau de Recherches et de Participation Minières, (BRPM), [31].

Sudan has two different forms of iron ore deposit but neither is currently economically viable. There are vast laterite deposits, with thicknesses ranging from one to fifteen metres, covering an area of 200,000 -300,000 sq.kms of southern Sudan. Their iron content is between 37%-47%, making it an area for potential future development. In addition there is a 81 mn tonnes deposit of 50% ore at Abu Talu in Southern Kordofan, and two smaller deposits near Port Sudan, [32]. One of these smaller deposits is now being developed on a very small scale by a British haulage contractor.

In Tunisia there are iron ore deposits at Djerissa (or D'Jerissa as it can also be spelt) near the Algerian border and at Tamera Douaria in the centre of the country. The former has been mined for almost a century but its reserves are now almost depleted and Tunisia's iron and steel industry relies increasingly on imported iron ore. There are also relatively insignificant deposits in Jordan, Syria, Lebanon and South Yemen. There is, however, no reliable data on their exact scale of reserves and estimates vary considerably.

## 2.5 Other Ferrous Minerals

Other ferrous metals are used as additives by the iron and steel industry in order to produce certain characteristics in the finished product. Because of the importance of these properties even small deposits can be developed economically. The important ferrous alloy minerals are manganese, nickel, cobalt, chromium, tungsten, molybdenum, silicon, vanadium, niobium and tantalum. Small deposits of some of these minerals are located in the Arab Middle East, the most important of which are outlined below.

### 2.5.1 Manganese

Morocco and Egypt are currently the only countries in the region with economically viable manganese reserves, although there are also small deposits in Sudan, Jordan, Libya and Syria. The largest deposit in Morocco is at the Imini mine, to the south-east of Marrakesh, which has reserves of about 8 mn tonnes of high grade ore. There are other minor deposits but Imini is the only working manganese mine in Morocco although production of manganese concentrate has been falling in recent years and was only 59,000 tonnes in 1984, **(see Figure 2.11)**, [33].

Egypt's manganese deposits were centred in the Sinai peninsula which has reserves of over 5 mn tonnes of low grade ore, while there is a further 0.5 mn tonnes in the Eastern Desert. Production from the Um Bogma mine occasionally reached 250,000 tonnes but was curtailed after 1967 because of the Arab-Israeli wars and only recently resumed, **(see Figure 2.23)**, **[34]**.

### 2.5.2 Cobalt

Cobalt is an important metal which is mainly used to produce high temperature alloys. The only country in the region which has produced cobalt concentrate in recent years is Morocco, which contributed about 6% of world production in 1973. The cobalt-nickel deposit at Bou Azzer near Quarzazate, produced 1,517 tonnes of 14% cobalt ore in 1973 but production was suspended in 1982.

### 2.5.3. Chromium

With the exception of Syria which has very minor deposits, Sudan is the only country in the Arab Middle East which has a chromium ore deposit and which produces chromite concentrate. The reserves and mine are located in the Ingessana Hills in Blue Nile province near the Ethiopian border, **(see Figure 2.25)**. Estimated reserves total 952,000 tonnes, of which 731,000 tonnes is high grade ore with a chrome content of over 45%, **[35]**. More

than half the total reserves are located in the underground Jebel Gam mine, which is the only one in production. In addition there are small privately owned and rudimentary mines which surround the Jebel Gam mine and which intermittently produce very small quantities of chromium ore.

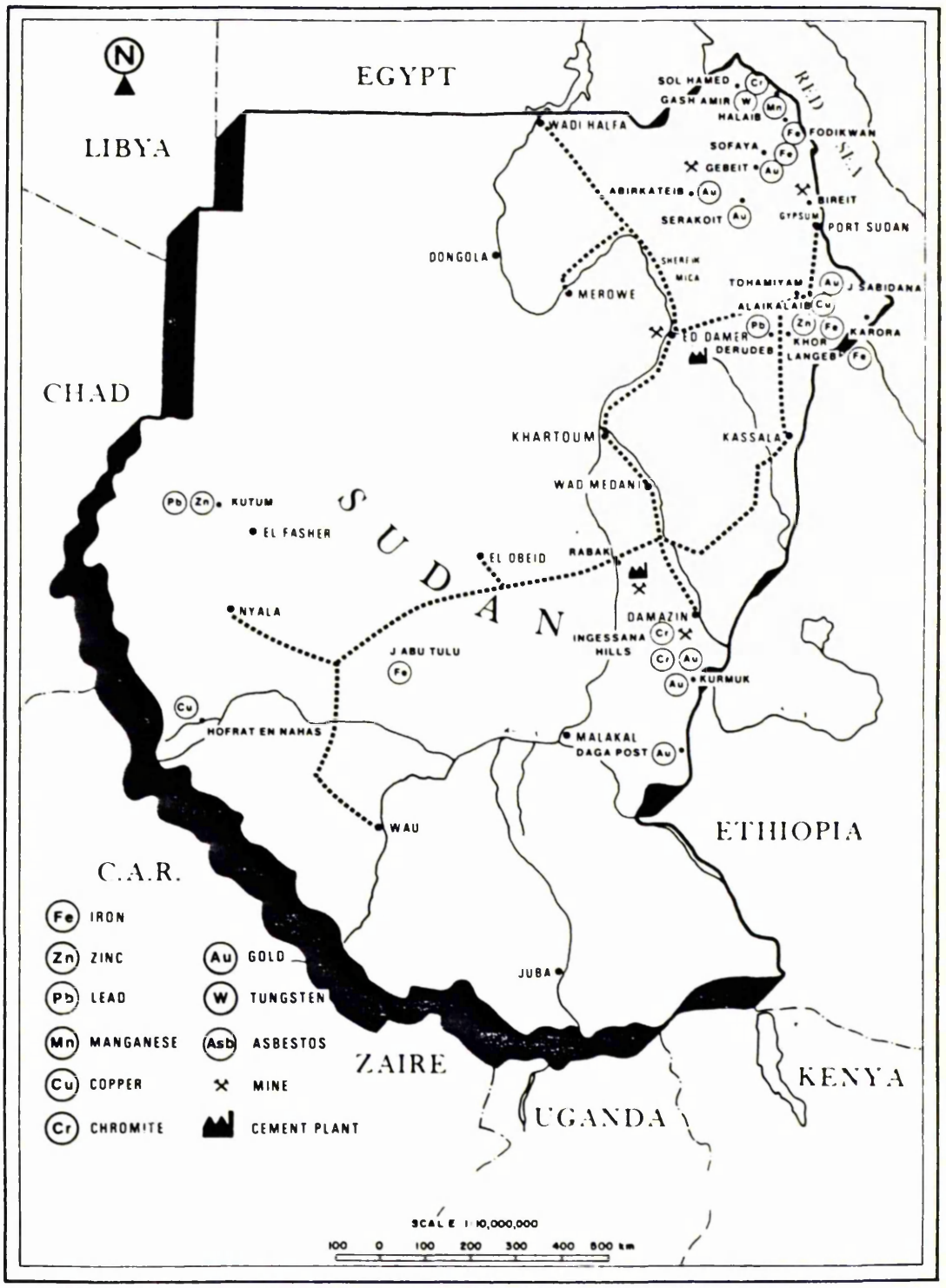
### 2.5.4 Others

There are no other large deposits of any other ferrous minerals although there are a few small deposits in some countries. Many of them are found in combination with other minerals such as nickel with copper and tungsten with tin. So far none are being commercially mined because the size and grade of the deposits are so low. It is possible that nickel may be mined at Al Masane near the Saudi Arabian - North Yemeni border when its massive sulphide deposits are developed.

## 2.6 Non-ferrous Metals

There are three types of non-ferrous metals; the major metals such as copper, lead, zinc and tin; precious metals including gold, silver and platinum; and the light metals such as aluminium, magnesium and titanium. The first group is usually mined on a large scale and it is uneconomic to develop each and every deposit. Lead and zinc are often found and mined together and while

## Figure 2.25 Mineral location map of Sudan.




*Source: Geological and Mineral Resources Department, Khartoum.*

there are copper deposits in the region, there are no economic tin deposits. The Middle East is rich in gold and silver deposits which are all small but of a high enough grade to make mining economically viable. While there is a large aluminium industry in the region, it is entirely dependent upon imported bauxite and therefore falls outside the scope of this study.

### 2.6.1. Lead & Zinc

These two metals are usually found together, although there are separate deposits of each in the region. By far the most important deposits are in the Maghreb, where there are mines in Morocco, Algeria and Tunisia. There are also minor deposits in Saudi Arabia, the Eastern Desert of Egypt, Sudan, Jordan and Syria, although none are currently being exploited.

**Table 2.3**
**LEAD ORE RESERVES IN THE ARAB COUNTRIES (in 000s tonnes)**

| Country | Proven | Indicated | Sub-Total | Pb. | Lead Total |
|---|---|---|---|---|---|
| Morocco | 14,129 | 30,942 | 45,071 | 6.0 % | 2,704.3 |
| Tunisia | 5,113 | 17,542 | 22,655 | 2.0 % | 453.1 |
| Algeria | | | 1,000 | 8.0 % | 80.0 |
| Saudi Arabia | | | 1,950 | 2.5 % | 48.8 |
| Egypt | | | 1,655 | 2.0 % | 32.5 |
| **TOTAL** | | | **72,331** | | **3,318.7** |

**Source :** Arab Mining Company, **Arab Mining Journal**, Vol. 3., No,2, Amman, Jordan, 1985, p.30

The largest lead deposit in North Africa, which is at Touissit 35 kms south-east of Oujda on Morocco's frontier with Algeria, is associated with smaller copper and silver deposits rather than zinc, **(see Figure 2.26)**. It is estimated to have reserves of up to 1.1 mn tonnes of lead, which represents about two-thirds of Morocco's total lead reserves, [36]. There are also lead deposits being mined at Zeida, Sidi Bou Othmane, Djebel Aouam and at Sidi Lahcen where the deposit is combined with zinc which is also found at Djebel Aouam. Although a number of smaller lead and zinc mines have recently been closed there are plans to develop a number of massive poly-metallic sulphides in the Anti-Atlas mountains.

In Algeria zinc is more common than lead. It is estimated that there are total reserves of about 2.6 mn tonnes of ore in 30 deposits, of which eight have more than 100,000 tonnes, [37]. The four productive mines which have reserves of about one million tonnes have an average zinc and lead content of about 55% and 3%, respectively, [38]. All of these deposits are located in the Alpine or tertiary aged mountains which run east-west along the length of the north of the country from the Moroccan to the Tunisian frontiers.

The lead-zinc deposits in Tunisia are located in similar high plateau areas as in Morocco and Algeria. There are about 35 deposits scattered in the north-west of the

## Figure 2.26 Location of Touissit Mine

MER MEDITERRANEE

Nador

Saïdia

ALGERIE

OUJDA

Moulouya

Touissit

Oued El Heimer

Jerada

Guercif

Vers Bou Arfa

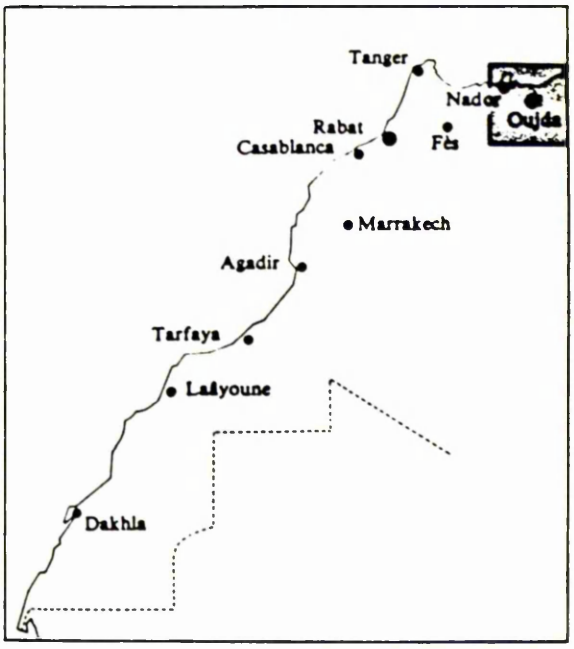
Mine

Route

Voie Ferrée

Usine

*Source: Compagne Minière de Touissit.*



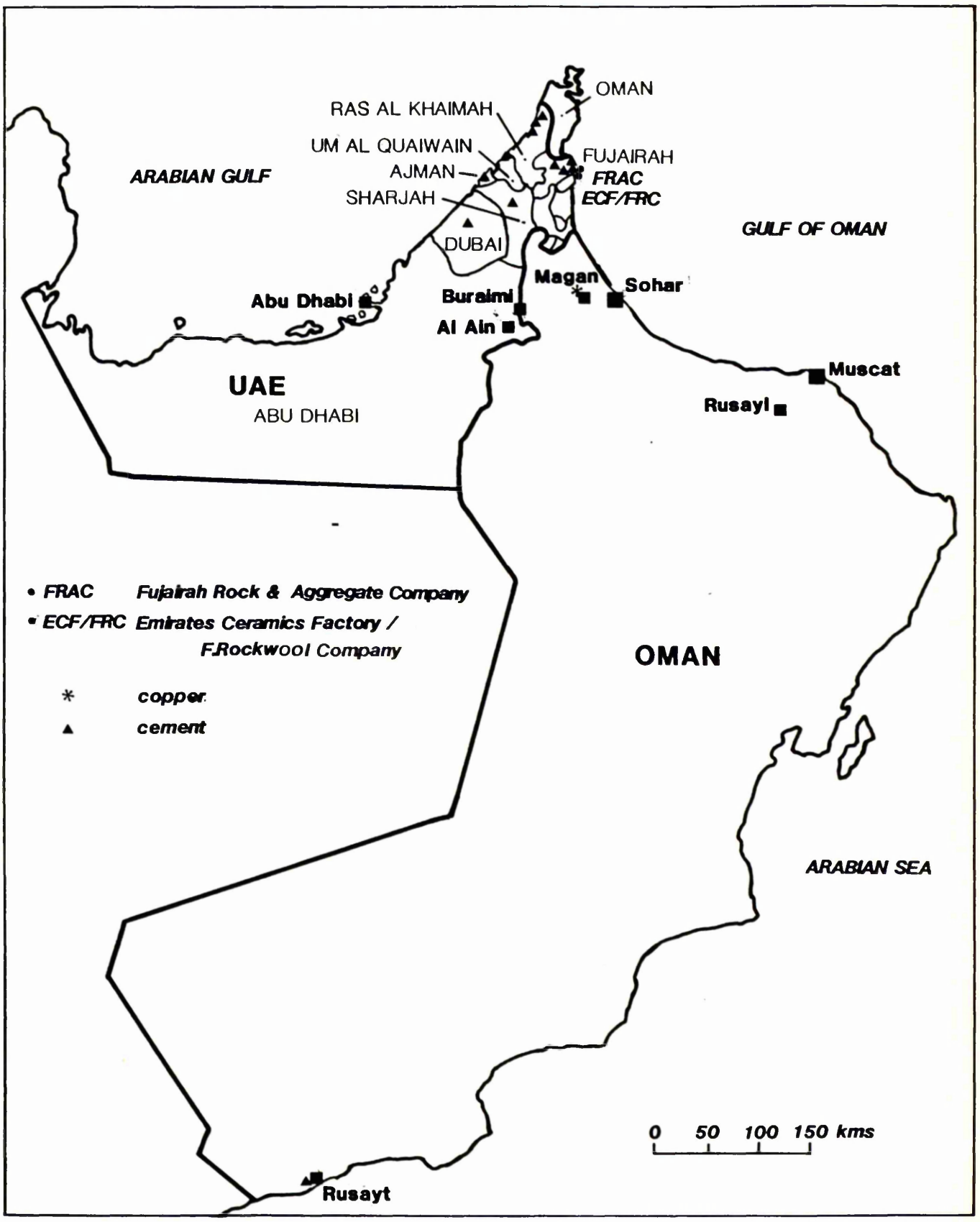
country, of which six have been mined for almost a century, **(see Figure 2.12)**. Of these the newest and most important is at Bou Jabeur which is located exactly on the border. Between them the six mines have estimate reserves of around 8 mn - 12 mn tonnes of ore. The lead-zinc content is no more than 15%, but Bou Jabeur's ore also contains 16.22% baryte and 8.7% fluorspar, **[39]**.

### 2.6.2 Copper

As with the majority of other non-hydrocarbon minerals, it is Morocco which has the most developed copper mining industry in the Arab Middle East, although it does not have the largest reserves. Despite the fact that there are deposits in a number of other countries, the only location where copper is currently mined by itself, rather than as a by-product of gold or other ores, is in northern Oman. In addition to Morocco and Oman, there are also copper deposits in Jordan, Saudi Arabia, Egypt and Sudan. The reason that they have not yet been developed is that the low world market price makes small scale production too expensive unless it is heavily subsidised, as in the case of Oman.

The copper deposit in Oman is located in the north of the country near Sohar, **(see Figure 2.27)**. There are three separate ore-bodies which are currently being mined and which have total estimated ore reserves of

## Figure 2.27 Gulf Mineral Industry.




*Base Source: Department of Geography, S.O.A.S.*

about 12 mn tonnes with an average copper content of 2.1%. It is believed that there are further reserves in the region but the low grade of the copper has been the principal problem which has inhibited its development. The Japanese government financed a two year exploration programme as part of an aid package. Meanwhile the Oman Mining Company, (OMC), which is undertaking the copper extraction and refining work, is also involved in exploration work for chromium ore in the same area. Since archaeologists have shown that the region has a history of mining which is over 5,000 years old, it is hoped that further deposits will be located in the future, [40].

**TABLE 2.4**
**COPPER ORE RESERVES IN THE ARAB COUNTRIES (in 000s tonnes)**

| Country | Proven | Indicated | Sub-Total | Copper |
|---|---|---|---|---|
| Oman | 11,417 (2.13%) | 80,000 (2.1%) | 91,417 | 1,923.2 |
| Jordan | 25,000 (1.36%) | 100,000 (1.0%) | 125,000 | 1,335.0 |
| Saudi | 15,250 (1.9%) | 33,133 (2.0%) | 48,383 | 968.9 |
| Morocco | 7,465 (1.8%) | 38,535 (1.8%) | 46,001 | 891.9 |
| Sudan | 5,000 (4.1%) | 4,170 (3.0%) | 9,170 | 371.5 |
| Egypt | 662 (0.8%) | 84 (2.8) | 746 | 7.7 |
| **TOTAL** | **64,794** | **255,922** | **320,716** | **5,498.2** |

**Source :** Arab Mining Company, **Arab Mining Journal**, Vol.3, No.2 - 1983, Amman, Jordan .p.29

The Moroccan copper deposits are predominantly located in the High and Anti-Atlas Mountains south of Marrakesh.

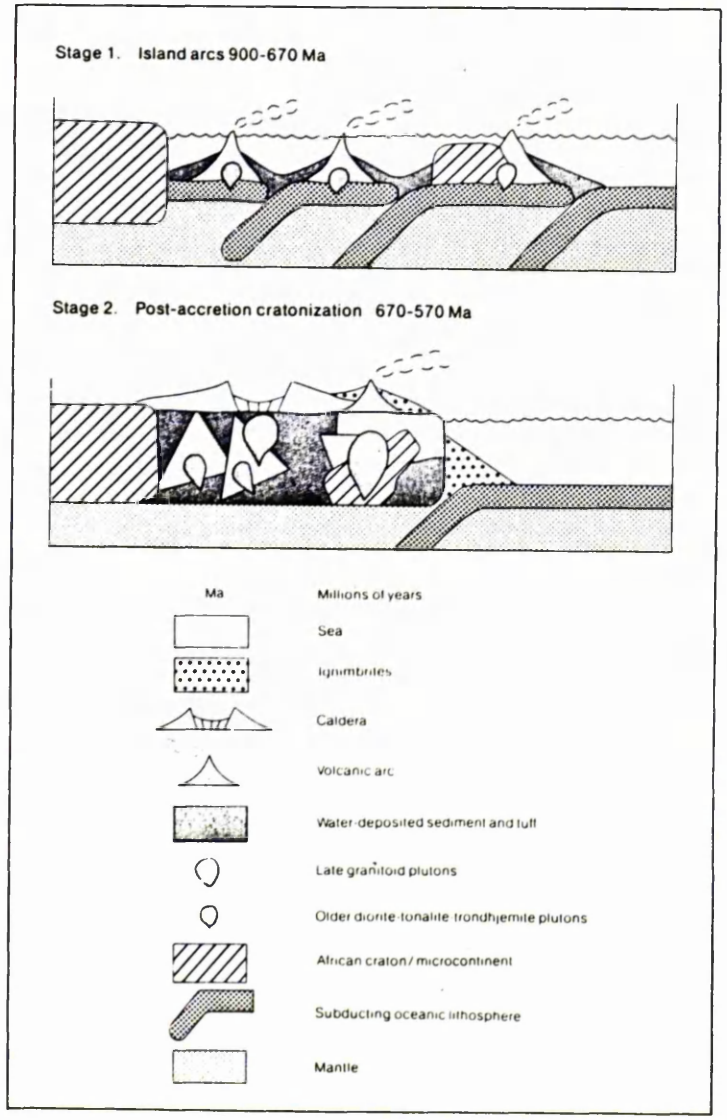
The largest and most important is at Bleida with several million tonnes of 2.5% copper ore, **(see Figure 2.11)**. Its production in 1984 was 49,062 tonnes of copper concentrate, while the Ouansimi mine produced 10,550 tonnes, **[41]**. This makes Morocco easily the largest copper producer in the region, with Oman and Algeria well behind. Algerian ore is only found with other minerals and is not mined separately.

### 2.6.3. Gold

Amongst the most interesting mining projects in the Arab Middle East are those which are rejuvenating ancient gold mines which have been worked intermittently throughout history. Although gold is produced as a by-product of cobalt in Morocco, the gold deposits in the region are centred on the Red Sea fault area. As the African and Arabian continental plates have been pulled apart by continental drift there has been considerable seismic activity in a belt stretching from the East African rift valley, through the Red Sea, to the north of the Jordan Valley. A mass of crystalline rock has been pushed up to the earth's surface and, like other pre-Cambrian shields, the rocks on both sides of the Red Sea are very mineral rich, **(see Figure 2.28)**. Besides minor deposits of copper, nickel, tin, tungsten and other minerals there are also gold and silver deposits in Saudi Arabia, Egypt and Sudan. Each has numerous gold

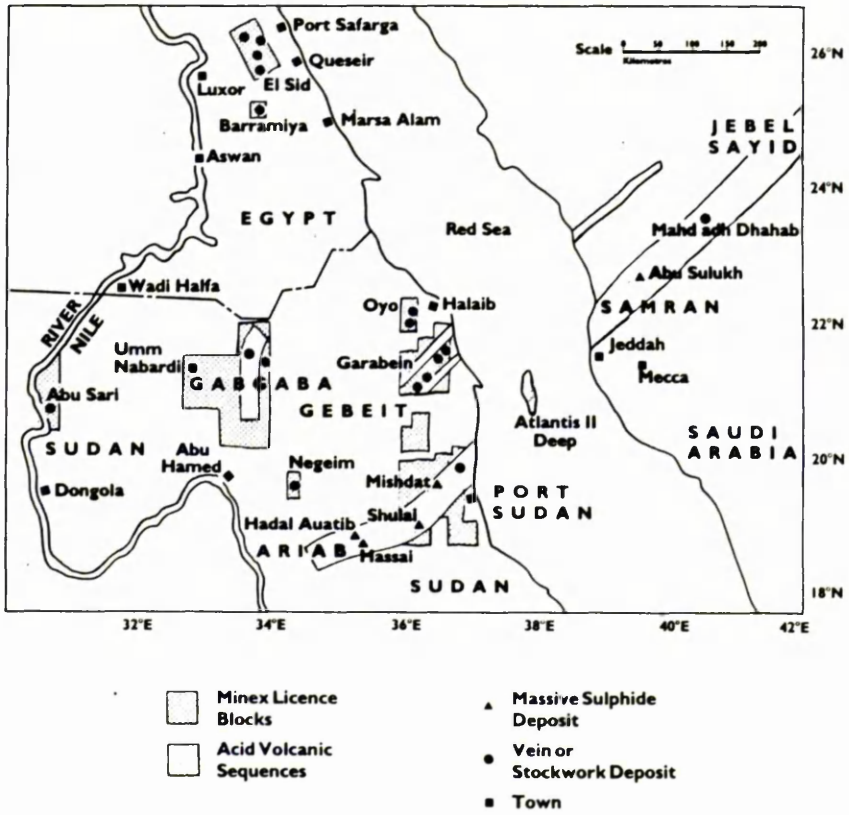
Figure 2.28

**Geological cartoon illustrating a hypothesis of a two stage evolution of the Arabian shield.**




*Source: DMMR Saudi Arabian Mineral Resources Annual Report 1402-04, op cit.*

Figure 2.29 Prospect location map, Sudan and Egypt.




*Source: Greenwich Resources plc Annual Report 1986.*

deposits which were worked by the region's ancient inhabitants, including the Pharaohs and King Solomon. Although none of them are large by world standards, many are believed to be economically viable because they are so rich. The result is that gold and silver are almost the only minerals which can be mined economically even if the deposit is very small.

The first deposit to be mined in recent years was in the Red Sea Hills of Sudan at Gebeit, although other mines are being developed, **(see Figure 2.29)**. The ore reserves are currently estimated to total 928,000 tonnes with an average gold content of 15.3 g/tonne. This includes 335,000 tonnes of low grade open cut reserves which are below the cut off point for economic viability. The most exciting area of the mine is Wadi lode which has 363,000 tonnes of ore has a gold content of 32.2 gms/tonne, **[42]**. Since few of the gold mines in South Africa have a gold content of over 15 gms/tonne, it is obvious that the Gebeit mine is exceptionally rich by world standards, **[43]**.

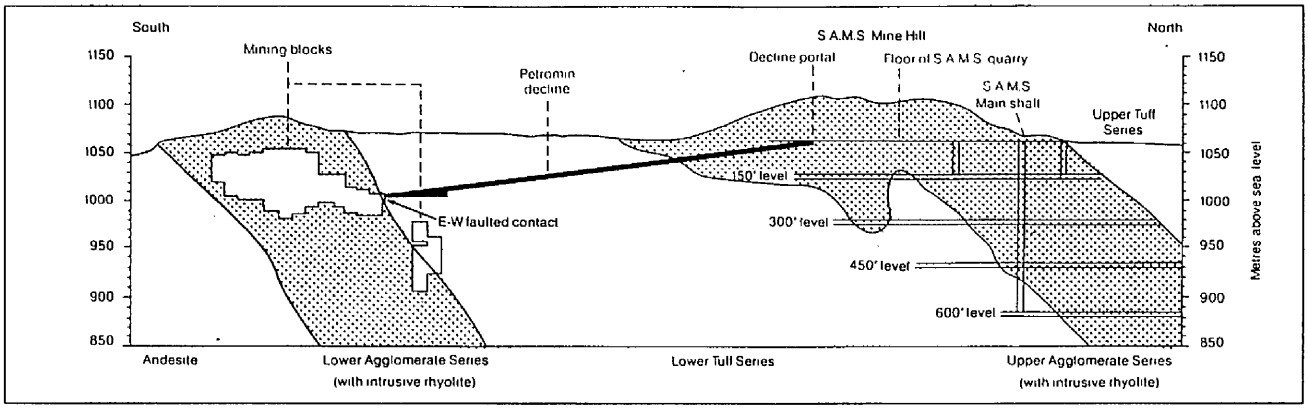
Besides Gebeit there are a number of other gold deposits in the Red Sea Hills. The company which is developing Gebeit has identified over fifty gold deposits in its exploration concession while other companies have identified a number of high grade gold and poly-metallic deposits. Because of these discoveries a number of other

companies have expressed an interest in the region. Other gold deposits have also been discovered in the Kurmuk area to the south of the Ingessana Hills.

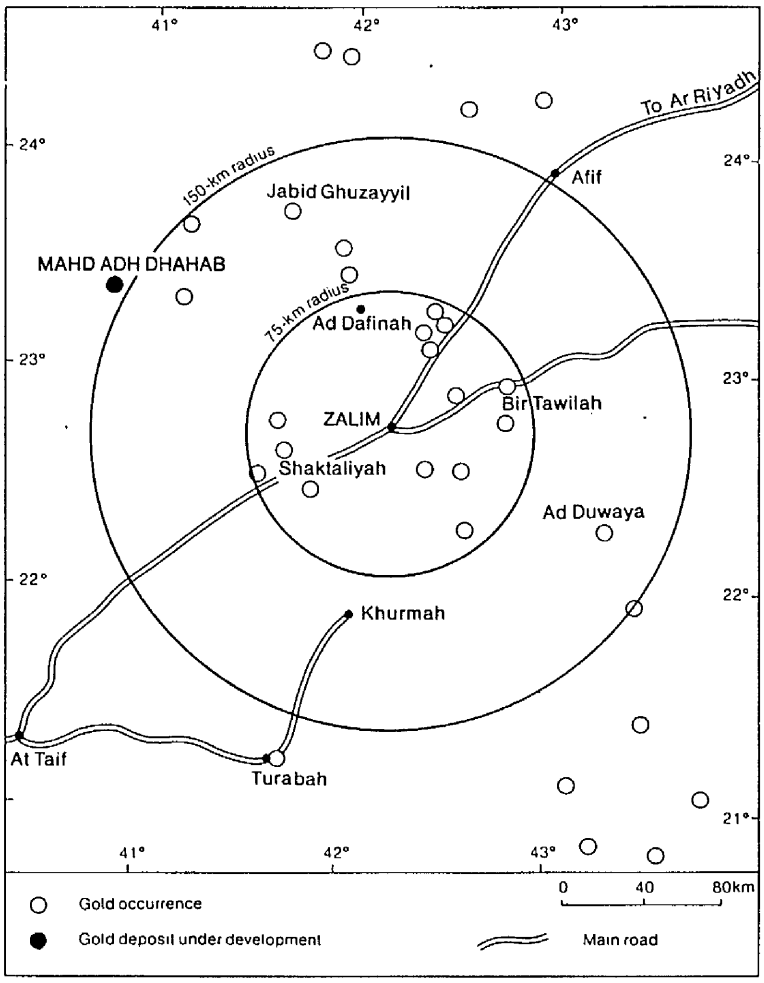
On the eastern side of the Red Sea in the Arabian Shield area of Saudi Arabia there are numerous gold deposits. In the area around Zalim, which is composed mainly of strongly folded volcanic sedimentary units intruded by granites, there are over 60 gold deposits but only one at Mahd Adh Dhahab is being developed, **(see Figure** 2.30), **[44]**. It is a government showcase project and after years of delay it eventually began production in 1988. Estimated reserves at Mahd Adh Dhahab, which means "cradle of gold" in Arabic, total about 1.2 mn tonnes of ore with an average gold content of 26 gms/tonne. In some areas of the mine this rises to 300 gms/tonne, making it an exceptionally rich little mine, **[45]**. The ore also contains silver (92 gms/t), copper (0.65%) and zinc (2.58%), **[46]**. Eventually the annual production is expected to be 120,000 t/y of sulphide ore which will produce around 8,500 tonnes of concentrate and 3,250 kgs of dore bullion.

It can be expected that the other promising gold deposits which have been discovered will soon be developed. One deposit at Al-Amar, 200 kms south-west of Riyadh, has reserves estimated at around 1 mn tonnes of

# Figure 2.30
# Gold deposits in Saudi Arabia.




Section through Mahd adh Dhahab gold deposit. Workings of the Saudi Arabian Mining Syndicate (1355-73; 1936-54) are on the right of the diagram. Another orebody, discovered by the Deputy Ministry and shortly to be mined by Petromin, is on the left of the diagram




Gold deposits in the central Arabian Shield around Zalim. The possibility of mining groups of small deposits using common facilities and infrastructure is being studied

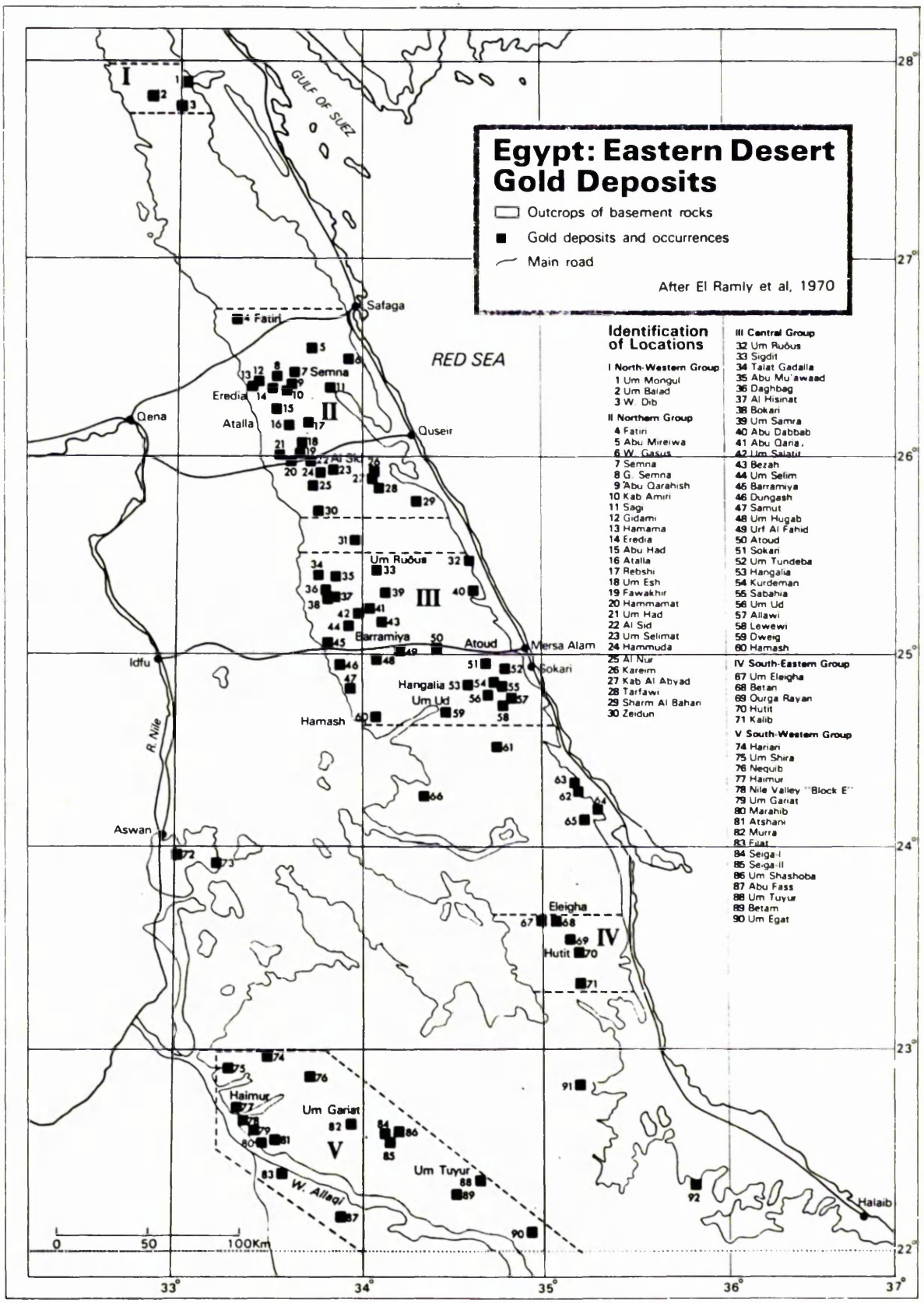
***Source: DMMR Saudi Arabia Mineral Resources Annual Report 1402-04, op cit.***

ore with grades of 20-30 g/t together with some silver, copper and zinc. The mineralisation is believed to be better than that at Mahd Adh Dhahab, **[47]**. Australia's Intermin Resource Corp. Ltd has discovered 60 old gold workings in the Zalim area which merit further investigations and the company is now developing one of them at Ash Shakhtaliyah. It has estimated reserves of 480,000 tonnes of ore grading 12.5 g/t gold using a 3 g/t cut-off grade. Potential open pit reserves are estimated at 738,000 tonnes at a grade of 5.2 g/t including 20% dilution and a stripping ratio of 10.5:1 waste to ore, **[48]**.

In the Eastern Desert of Egypt there are an estimated 90 gold deposits, most of which were worked by the ancient Egyptians, **(see Figure 2.31)**. Most of the deposits are small and are of a lower grade than those in Sudan and Saudi Arabia. While many have been virtually exhausted there are vast quantities of low grade tailings on the surface which can now be processed economically, **[49]**.

In September 1988 it was announced that Minex, which has been developing the Gebeit gold mine across the border in Sudan, has discovered gold in commercial quantities in its 5,000 sq.kms concession area in Egypt's Eastern Desert. The mine near Barramiya is estimated to have ore deposits with an average gold content of 11 g/t, together with traces of other associated minerals, **[50]**.

## Figure 2.31 Egypt: Eastern Desert Gold Deposits.




*Source: Habashi & Bassyouni 'Mineral Resources of the Arab Countries, op cit.*

### 2.6.4. Silver

Silver is usually found in the same type of rocks as gold and the two metals are often mined together. Although there are minor deposits in Saudi Arabia and Egypt, the major silver deposits are in the Maghreb. Those in Tunisia and Algeria are mainly found in association with lead and zinc deposits but there are a number of actual silver mines in Morocco. By far the most important and richest of these is at Imiter, in the High Atlas mountains, which has reserves of 250,000 tonnes of 800 gms/tonne silver ore, **(see Figure 2.11)**. There are nine other major deposits including those at Bou Madin and Al Zarahneh. Besides Imiter the country's silver production comes from the mines at Oued El Heimer and Zgounder near the Algerian frontier where in both mines is found in association with lead and zinc, **[51]**.

This is also the case with the Algerian and Tunisian silver deposits. The three Algerian deposits have estimated reserves of 18.5 mn tonnes of ore with a silver content of between 35 and 390 g/t, **[52]**. The most important are near the Tunisian frontier and at Al Abed on the Moroccan border. The ore in the Tunisian lead and zinc mines on the western high plateau contains relatively small quantities of silver which is extracted in the processing operation.

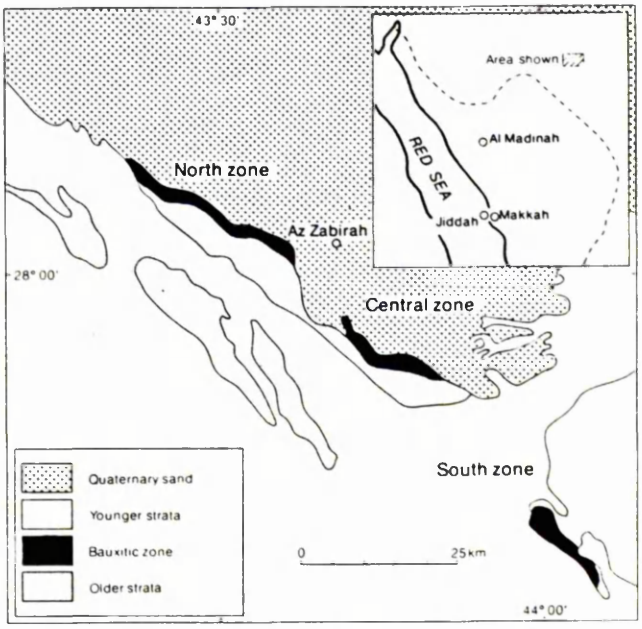
### 2.6.5. Light Metals

The Arab Middle East does not have any major deposits of the light metals such as bauxite, magnesium or titanium. There is a small bauxite deposit at Az Zabirah in central Saudi Arabia but the region's aluminium plants are fed with imported bauxite and there are no plans to develop the deposit, **(see Figure 2.32)**. The only titanium deposit of any note is at Abu Ghalaga in the Eastern Desert of Egypt. There are estimated reserves of about 27 mn tonnes of ilmenite with a titanium content of between 36-41%. There are other deposits of ilmenite in the area and in the black sands off the Mediterranean coast, **(see Figure 2.33)**.

## 2.7 Non-Metallic Minerals

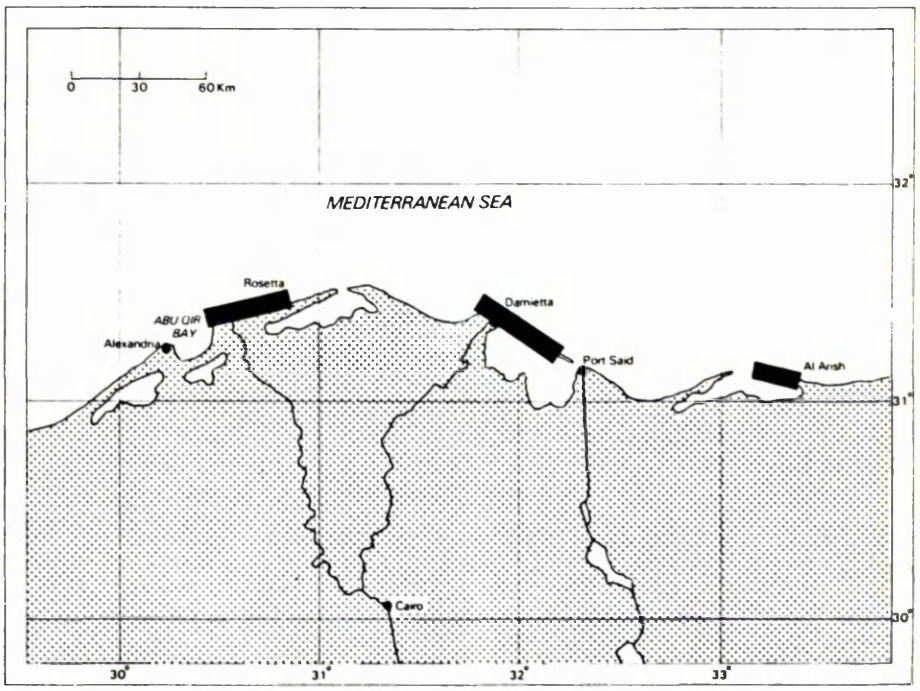
Although the term "minerals" normally refers to metals there are a number of very important non-metallic minerals. In the Arab Middle East phosphates are the region's greatest natural resource after crude oil and gas. There are major phosphate deposits in a number of countries, most notably in Morocco, Jordan and Tunisia. In addition there are other non-metallic mineral deposits. There are the ornamental or gem minerals and those used in the construction, chemical and ceramic industries. There are also potash deposits which, like phosphates, are used in the fertilizer industry. This

## Figure 2.32
## Bauxite Deposits in Saudi Arabia.




***Source: DMMR Saudi Arabia Mineral Resources Annual Report 1402-04, op cit.***

## Figure 2.33
## Location of Black Sands deposits in Egypt.




**Location of the Black Sands Deposits in Egypt**

Black Sands

***Source: Habashi and Bassyouni 'Mineral Resources of the Arab Countries. op cit.***

section examines each and outlines the most important deposits in the region.

### 2.7.1 Construction & Building Materials

This group of non-metallic minerals is more important than phosphates for the region as a whole. The construction sector has probably grown faster than any other in the past fifteen years following the oil price rises of the early 1970s. While some building materials, notably cement, have been imported, the vast majority of the regional construction boom used indigenous materials. Furthermore each country, regardless of whether it has enjoyed oil wealth or not, has expanded its programme of exploration and development of its building materials resources . Because they are so vast and widespread there is no accurate estimate of the total reserves of sand, stone, gravel, clay and other building materials. Most large towns and cities are ringed by quarries which supply these materials for the construction industry. The scale of the industry can be gauged from the fact that in 1981 there were 114 aggregate quarries within a 50 kms radius of Riyadh in Saudi Arabia, with an estimated annual production of 15.3 mn cubic metres of aggregate, sand and bulk material, [53].

Besides these the most important building materials are

limestone and gypsum which are both used in the production of cement. Because cement production is one of the key elements in the growth of region's industrial sector, these are crucial deposits. There are large reserves of limestone in most countries in the region, although some cement plants use imported gypsum. The most important gypsum deposits are in Egypt, Saudi Arabia, Jordan and Sudan. Given the lack of other minerals and the importance of cement production in the United Arab Emirates (UAE), the limestone and gypsum deposits in Ras Al Khaimah are of particular importance.

### 2.7.2 Chemical Industry Minerals

Although the majority of the chemical industry's raw materials are by-products of oil and gas processing, a number of natural minerals, including natural sulphur, barytes, fluorspar, salt, natron and boron, are used by the sector. Iraq is the only country with large deposits of natural sulphur, the other minerals are found in a number of countries in the Middle East.

The natural sulphur deposits in Iraq are centred around the northern city of Mosul, **(see Figure 2.18)**. Nearby there is a 4,000 sq.kms area where there are about fifteen geological formations containing natural sulphur. The richest are those at Mishraq, Lazakah and

Fatha of which the first is the most important. It has estimated reserves of between 15 mn and 20 mn tonnes of 99.8% pure sulphur, [54]. Total Iraqi sulphur reserves are estimated to be about 285 mn tonnes making it amongst the largest reserves of natural sulphur in the world.

Baryte (or barite as it is sometimes spelt) is a native sulphate which is a heavy spar used in the production of white paint. Fluorspar, which is a transparent or translucent mineral, is used as a flux in metallurgy. The two minerals are often found together in lead-zinc mines. In the Arab Middle East the principal deposits are in Tunisia, Algeria and Morocco.

There are two types of salt deposit - those which are produced by the evaporation of sea water and those found in inland sites. By its very nature the potential for the former is limitless provided a country has a coastline. Consequently almost every country in the region produces salt by the use of coastal evaporation pans. One of the few exceptions is Jordan which uses the already salty waters of the Dead Sea for salt production. Because it processes very few other minerals the production and export of salt is particularly important to South Yemen.

Natural salt is also found in inland dry lake beds in

many countries. These deposits are usually found in the form of natron or trona which is a natural hydrated mixture of sodium carbonate and other salts. The largest deposits are in the Sahara desert in the sand-seas of Libya, Algeria and Egypt. In other areas in the Arab Middle East salt is found in combination with gypsum and clay while in North Yemen it is extracted by open pit mining.

### 2.7.3 Potash

Besides phosphates one of the other principal raw materials in the fertilizer industry is potash. Like other salts it can be produced in a natural form on land or by refining saline water. In the Arab Middle East there are a few small natural deposits in parts of Egypt, Libya, Algeria and the Gulf countries. The most important potash project is in Jordan which has a large potash refinery on the southern shore of the Dead Sea. By the time the originally fresh water arrives via the Jordan River at the southern shore it is highly saline and potash can be extracted. The project duplicates the Israeli one which is just across the "truce channel", and both countries have become major potash producers.

### 2.7.4 Ornamental & Gem Stones

The Middle East has comparatively few gemstone deposits

although some alluvial diamonds have been discovered in the extreme south and south-west of Sudan. The ancient Egyptians mined many gemstones including lapis lazuli, turquoise and amber and some are still produced in the region. The region's ornamental stones are primarily confined to building materials such as marble and granite. Marble is found throughout large areas of the region although few countries have yet done very much to develop their reserves. There are small scale marble quarries in many countries but only Algeria and Jordan are producing large quantities. Granite is mainly found in the shield and volcanic rocks of Egypt, Sudan and Saudi Arabia.

## 2.8 Other Mineral Deposits
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This chapter has not provided details of each and every non-hydrocarbon mineral deposit in the Arab Middle East but has sought to detail the more important ones. The criterion which has been adopted is to highlight those deposits which are being developed and which are contributing to the economic development of a region. Other mineral deposits which could be important in the future are now described below.

The mercury deposit at Ismail in the east of Algeria is important because it accounts for about 6% of total

world production, [55]. Mercury is often found in association with lead and zinc or impregnated in Cretaceous sandstones and limestones. Once it is refined the mercury concentrate is 99.9% pure in which form most is then exported.

The region has a number of uranium deposits which are now receiving priority status in some countries. Those which have little or no oil want to develop an alternative source of energy, while there has also been considerable speculation about the development of an "Islamic nuclear bomb". Whether or not this is true the search for uranium deposits has accelerated in recent years.

Although none of them have yet been developed there are deposits in Algeria, Egypt, Libya, Morocco, Saudi Arabia and Sudan. It is estimated that there are definite reserves of 32,600 tonnes of uranium, or about 1.54% of total world reserves, and possibly a further 60,000 tonnes, [56]. The most exciting deposit is in the Hoggar region of southern Algeria where there are estimated reserves of 25,000 - 50,000 tonnes. It is a possible continuation of the large uranium deposits in the Arlit area of Niger. There are now plans to develop the deposit and extract about 1,300 tonnes/year. Besides the deposits in the basement rock areas, uranium can also be produced as a by-product of phosphoric acid which is

produced from phosphate. It is therefore possible that the Middle East could become a major uranium producer in the future.

Besides mercury and uranium there are a number of minor deposits of other minerals although none are of particular significance. They include; antimony in Algeria; molybdenum, beryllium, feldspar, mica, baryte and graphite in Egypt and Morocco; mica, wolframite, magnesite and asbestos in Sudan; and others. In addition the bottom of the Red Sea has been shown to contain large quantities of many minerals which could be extracted in the future. Consequently the Arab Middle East has considerable potential for non-hydrocarbon mineral production and the next step is to bring more of the deposits into production.

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*********

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# CHAPTER THREE
**********

## NON-HYDROCARBON MINERAL PRODUCTION IN THE
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## ARAB MIDDLE EAST
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This chapter analyses the production of non-hydrocarbon minerals in the Arab Middle East. It provides a brief history of mining in the region from the ancient Egyptians to the present day. Mining has been very intermittent and there were long periods of inactivity when it was impossible to continue production for either technical or economic reasons. The historical analysis is followed by a review of current mineral production in the region. It will be seen from this, that, with the exception of phosphates and building materials, mining activities are largely confined to the countries of the Maghreb. There has, however, been a major expansion of mineral exploration and development work since the first oil price explosion of the early 1970s. In order to try to provide as comprehensive a picture as possible of the regional mining industry the chapter provides a country-by-country review of the sector. As in the previous chapter, tables of statistics attempt to incorporate the latest available information from national and intra-regional sources.

## 3.1 An historical review of mining in the region.
**********

Mining and quarrying have been carried out in the Arab Middle East for thousands of years. Whether it was clay from the banks of rivers or stone quarried from the mountains, building materials were one of man's most essential natural resources in the region. As the brochure of an ancient mining exhibition in Tunis stated in 1985 :

> "Depuis les temps paléolithiques, l'homme a tiré de la pierre à peu près tout ce qui était possible d'en tirer. Pour une meilleure efficience, ilà prospecté et exploité les bancs rocheux, et souvent assez loin de ses campements, à la recherche de la meilleure matière première c'est à dire la plus résistante et la plus belle". **[01]**.

Later ancient Egypt was one of the first centres of mining and metal production. Indeed, the Egyptians and Sumerians appear to have been the world leaders for centuries or even thousand of years. The wall paintings in their tombs indicate that gold was mined in large quantities. Copper was also produced at least 6000 years ago and the numerous slag heaps, wall inscriptions and museum pieces testify to the leading role of the Egyptians, **[02]**. The iron age probably began at Merowe

in present day Sudan, from where it spread throughout the region and the rest of Africa. Later copper was produced and exported from Oman to the Sumerian empire in Mesopotamia between the third and first millennium BC, [03]. It is uncertain exactly where the famous King Solomon's gold mine was located, but it was probably one of the multitude of ancient mines spread throughout modern day Egypt, Sudan, Saudi Arabia and the Yemens. The slag heaps and the tailings from the deserted gold mines in each of these countries are vivid evidence of the scale and wealth of the ancient mining industries.

During the classical period the Greeks and Romans continued to develop the ancient mines and quarries, particularly in North Africa. They provided most of the marble and some of the metals which were used to create the splendours of the empires on the northern shore of the Mediterranean. The magnificent cities such as Leptis Magna, Cyrene and Cathage were built with local stone. Many were later sacked by the Vandals at the start of the Dark Ages which continued until the rise of the Arab empire in the seventh century. As the Arabs spread west to the Atlantic and into Spain new mines were opened throughout the region. In Morocco alone there were about twenty mines with numerous deposits, most of which were copper, lead, silver and gold, [04]. Sporadic mining and quarrying continued on a relatively small scale throughout the region until the middle of the

nineteenth century and the arrival of the European colonists.

Colonialism employed a mercantilist economic system in the Middle East as elsewhere. Agricultural and industrial raw materials were extracted and exported from the colonies which, in return, received the manufactured finished products. Amongst the raw materials which were exported by the region's colonial powers were the non-hydrocarbon minerals.

After their arrival in Algeria the French began to develop some of the ancient mines and explore the region for other mineral deposits. The iron ore mines at Ouenza and Boukhadra near the Tunisian frontier, which had been worked intermittently since the Roman occupation, were reactivated in 1913, when the Société de l'Ouenza was granted a concession. Production from Ouenza did not begin until 1921, when the replacement of the narrow-gauge railway from Tebessa to the coast by a standard-gauge line was completed. In 1906 the nearby phosphate deposit at Djebel Onk was discovered by Compagnie des Phosphates de Constantine (CPC), which was managing the mines at Kouif and M'Zarta, [05]. Across the border in Tunisia the phosphate deposits in the Gafsa region were discovered in 1885 by Philippe Thomas. Fourteen metallic deposits were also developed in Tunisia between 1881 and

1901, [06]. These included the Djerissa iron mine and lead-zinc deposits at Fedj el Adoun and L'Akhout.

The colonial period in Morocco was much shorter than in either Algeria or Tunisia, lasting only from 1912 until 1956. During that time much of the important mining sector was established. Phosphate production began in 1921 at Khouribiga and had reached over one million tonnes by 1931 when the Youssoufia deposits were first exploited. Production levels for the two areas continued to rise at the rate of about 400,000 t/y, reaching about 10 mn tonnes by 1964. When open-cast as well as underground mining was introduced production continued to rise, particularly after the dramatic price increases in the mid-1970s. The phosphate deposits at Bou Craa in the Western Sahara have been developed by the Moroccans since they occupied the country in 1976 after the Spanish withdrawal. Later, in 1980 the mine at Ben Guerir was developed in Morocco itself. These various schemes have boosted phosphate production to the current level of around 21 mn tonnes, [07]. The other metallic and non-metallic minerals have also been gradually developed during the past century.

In other parts of the Middle East, mineral deposits were being discovered and then developed, or reactivated in the case of some of the ancient mines. Western scientific methods were first introduced in Egypt by

Napoleon's French Military Expedition at the beginning of the 19th century. Their maps and observations were later used by foreign geologists such as Figari and De Bellefonds who were commissioned by the Egyptian government to continue the work. The Egyptian Geological Survey was established in 1896 and has since discovered the major mineral deposits in the country, including the important iron and phosphate reserves, [08]. Besides the quarrying of building materials and salt production the Egyptian mining sector remained relatively limited until after the Second World War. It was largely confined to manganese production which began in the Sinai in 1918 at Um Bogma. At its peak up to 200,000 tonnes of ore was being mined exclusively for export, [09]. Other mining was largely confined to the rehabilitation of various ancient gold mines in the Eastern Desert.

This was also true of neighbouring Sudan where there are many ancient gold mines in the Red Sea Hills. Commercial mining at the Gebeit mine, which has recently been rehabilitated, began in 1904 when the British owned Gebeit Mining Syndicate was established. It operated the mine until 1929 and produced 2,581 kgs of gold from 68,000 tonnes of ore in twenty years. The mine was reopened by Gebeit Gold Mines Ltd in 1933 and at its peak employed over 600 workers before it closed during the Second World War. Because of flooding subsequent

mining was limited and the mine was closed between 1953 and the 1980s when Minex Minerals (Sudan) Ltd began their rehabilitation work, [10].

Across the Red Sea in Saudi Arabia the emphasis was also on ancient gold mines of the Arabian Shield. The only one which has been mined in the twentieth century is at Mahd adh Dhahab which is also the current focus of attention. Thousands of years ago it had been worked to a depth of about 250 feet and was probably the largest and richest gold mine in the known world, [11]. Although there are numerous other contenders for the title, it is claimed that Mahd adh Dhahab was the famed King Solomon's mine. Between 1939 and 1954 a British company called the Saudi Arabian Mining Syndicate (SAMS) worked on recovering gold from the ancient mine. Its operating arm, the American Smelting & Refining Company (ASARCO) mined about 766,000 ounces of gold and more than a million ounces of silver from the mine until 1954 when the mine was once again closed, [12]. The company had extended the mine to a depth of 600 feet below the surface and had constructed 800 feet of tunnel, [13].

Besides the development of Mahd adh Dhahab and building material quarries, mining activities in Saudi Arabia were largely confined to exploration work until the 1960s. The search for water resources by the United States Geological Survey (USGS), which had begun in

1944, was extended to include minerals in 1950. During the past 35 years the USGS and other western specialists have undertaken exploration work throughout the country. Consequently Saudi Arabia's mineral deposits have been more comprehensively analysed than in any other country in the region.

Jordan's phosphate deposits were discovered in 1908 during the construction of the Hejaz Railway when they were exposed at both Rusaifa and El Hassa, [14]. It was not until 1937 that they were first developed when the Transjordan Phosphate Mines Company obtained a lease and started underground mining at Rusaifa. In 1953 the Jordan Phosphate Mines Company (JMPC) was formed with a capital of 1 mn Jordan Dinars (JD), of which 25% was owned by the government. In 1965 when its activities expanded to include El Hassa, the company's capital was expanded to JD3 mn and the government took a 63% interest. This was subsequently increased on a number of occasions so that by 1980 it reached JD20 mn, (US$7.26 mn), 90% being held by the government, [15]. By then a third mining site at Wadi El Abiad was producing phosphate and the huge Es Shiyadah reserves had been discovered in the south of the country.

It is obvious, that although the region has had a very long history of mining and quarrying, activity has been

very sporadic. After the ancient Egyptians, Sumerians, Greeks and Romans, there was a long dormant period when few minerals were produced. The Arab expansion throughout the Middle East and North Africa led to a revival in mining and quarrying. It was not until the European colonial period that scientific exploration work began to lead to the development of the region's mineral resources.

When the oil and gas industry began to dominate the region, there were only two principal areas of non-hydrocarbon mineral activity. The most extensive was in the Francophone countries where phosphates and some metallic minerals such as iron, lead and zinc were extracted. The other was the sporadic private sector mining of the ancient gold mines in the shield areas of Egypt, Sudan and Saudi Arabia. It should also be noted that the production of building materials has also been expanding rapidly throughout the region during the past century. It was not until the 1960s, or even the 1970s in some countries, that mineral production began to expand.

### 3.2 Non-Hydrocarbon Mineral Production.
**********

This section analyses non-hydrocarbon mineral production in the Arab Middle East country by country. It begins in Morocco, which leads all other countries, and gradually

works eastwards towards the small Gulf states and the two Yemens which currently produce very few minerals.

### 3.2.1 Morocco.

Morocco produces a wide variety of non-hydrocarbon minerals (as shown in **Table 3.1** below). Although the table does not provide comprehensive statistics over a number of years, it does illustrate the order of magnitude of the country's mineral production. It can be seen that by far the most important mineral is phosphate. In 1986 over 21 mn tonnes of phosphate were produced with a value of about US$536 mn. After

**Table 3.1 : MOROCCAN 1986 MINERAL PRODUCTION**

| MINERAL | VOLUME | | VALUE | |
|---|---|---|---|---|
| | (000s tonnes) | % change 1985-86 | Dhs mn | % change 1985-86 |
| Phosphates | 21,395 | +2.96 | 3,816 | +0.91 |
| Iron Ore | 196 | +8.65 | 17 | +2.65 |
| Lead Ore | 104 | -31.75 | 250 | -28.09 |
| Copper Ore | 55 | -8.61 | 138 | -10.87 |
| Zinc Ore | 24 | -13.08 | 37 | -17.27 |
| Manganese | 37 | -15.93 | 50 | +2.21 |
| Antimony Ore | 1 | -16.07 | 5 | -47.37 |
| Auriferous copper | 4 | +64.55 | 44 | -34.86 |
| Fluorspar | 83 | +11.63 | 63 | -6.25 |
| Barytes | 170 | -63.34 | 22 | -67.63 |
| Salt | 119 | +13.13 | 13 | -9.89 |
| Ceramic clays | 35 | +43.70 | 3 | +45.74 |
| Bentonite | 4 | +33.96 | 3 | +77.57 |
| Special muds | 4 | -7.37 | 3 | -7.38 |

**Note** : In 1986 US$1 = Dhs 8.26 (EIU Morocco QER)

**Source** : Economist Intelligence Unit, **Morocco : Country Profile 1987/88**, Economist Publications, London, p.17

phosphates the most important minerals in terms of value are lead and copper ore, followed by fluorspar, manganese, auriferous copper ore, zinc, barytes, iron ore and salts. The production value of each of the remaining minerals was below US$1 mn, [16]. It should be noted, however, that silver, lead and copper concentrates are produced from these ores : they are dealt with later in this section.

### 3.2.1a Phosphates

Moroccan phosphate production began in 1921 and since then has rapidly expanded. Today the country is one of the world's largest producers and is the pre-eminent phosphate exporter. As **Table** 3.2 shows below, the Arab world is very important in terms of world phosphate production and export. Its share of world phosphate production has remained consistent at about 20% while its share of world phosphate exports has ranged between 40 and 50% for the past twenty years.

Morocco is overwelmingly the largest phosphate producer in the Middle East, its output being greater than the combined total of all the other Arab producers (**Table** 3.3). Since 1966 it has grown from when under 10 mn tonnes to a stable level of around 20-21 mn tonnes annually, [17].

Table 3.2
ARAB PROPORTION OF WORLD PHOSPHATE PRODUCTION 1966-1987

| Year | World Prod | World Exports | Arab Prod | Arab Exports | Arab % of world Prod | Arab % of world Exports |
|---|---|---|---|---|---|---|
| 1966 | 71,308 | 31,383 | 14,253 | 12,633 | 19.97% | 40.25% |
| 1967 | 74,958 | 32,609 | 15,138 | 13,019 | 20.19% | 39.92% |
| 1968 | 78,742 | 36,941 | 16,084 | 13,684 | 20.61% | 37.04% |
| 1969 | 76,034 | 36,541 | 15,426 | 13,791 | 20.29% | 37.74% |
| 1970 | 79,991 | 38,172 | 16,393 | 14,793 | 20.49% | 38.75% |
| 1971 | 82,097 | 40,362 | 16,774 | 15,643 | 20.43% | 38.76% |
| 1972 | 87,674 | 43,111 | 19,573 | 17,397 | 22.32% | 40.35% |
| 1973 | 96,526 | 49,140 | 22,558 | 20,069 | 23.36% | 40.84% |
| 1974 | 108,465 | 54,569 | 26,681 | 23,512 | 24.60% | 43.09% |
| 1975 | 108,911 | 43,356 | 20,087 | 16,612 | 18.44% | 38.32% |
| 1976 | 108,032 | 41,005 | 22,162 | 19,322 | 20.51% | 47.12% |
| 1977 | 117,828 | 47,933 | 24,429 | 21,052 | 20.73% | 43.92% |
| 1978 | 126,592 | 50,887 | 27,731 | 22,128 | 21.91% | 43.48% |
| 1979 | 132,036 | 53,398 | 29,801 | 22,812 | 22.57% | 42.72% |
| 1980 | 139,388 | 52,083 | 29,632 | 23,330 | 21.26% | 44.79% |
| 1981 | 139,015 | 45,715 | 31,492 | 23,057 | 22.65% | 50.44% |
| 1982 | 123,465 | 43,395 | 29,029 | 20,267 | 23.51% | 46.70% |
| 1983 | 136,685 | 46,890 | 34,839 | 21,442 | 25.49% | 45.73% |
| 1984 | 150,119 | 47,716 | 37,299 | 22,452 | 24.85% | 47.05% |
| 1985 | 145,304 | 46,190 | 35,686 | na | 24.56% | na |
| 1986 | 139,051 | 44,265 | 37,654 | 22,207 | 27.08% | 50.17% |
| 1987 | 146,612 | na | 39,113 | 22,253 | 26.68% | na |

**Basic Source :** British Sulphur Corporation Limited, **Raw Materials Report**, 8th & 17th October, 1985, London.
**Source 1985-87 :** Mining Journal, **Mining Annual Review**, Mining Journal Ltd, London, 1988, p.109

The Office Cherifien Des Phosphates (OCP) group of companies administers all phosphate production and sales within Morocco itself and in the politically disputed Western Sahara. Phosphate production is divided between four areas - three in Morocco itself and Bou Craa in the Western Sahara. As the figures below illustrate, more than half of the total usually comes from the Khouribga area which is the oldest and largest producing area. The second and third areas are the Youssoufia and the newer

Table 3.3
PHOSPHATE PRODUCTION IN THE ARAB COUNTRIES 1966-1987

| YEAR | Morocco | Jordan | Tunisia | Algeria | Syria | Egypt | Iraq |
|---|---|---|---|---|---|---|---|
| 1966 | 9,425 | 900 | 3,190 | 189 | | 549 | |
| 1967 | 9,952 | 1,100 | 3,190 | 186 | | 710 | |
| 1968 | 10,519 | 1,162 | 3,361 | 361 | | 681 | |
| 1969 | 10,667 | 1,087 | 2,600 | 412 | | 660 | |
| 1970 | 11,415 | 891 | 3,024 | 493 | | 570 | |
| 1971 | 12,008 | 528 | 3,162 | 518 | | 558 | |
| 1972 | 14,467 | 700 | 3,297 | 527 | 70 | 512 | |
| 1973 | 16,564 | 1,086 | 3,460 | 608 | 300 | 540 | |
| 1974 | 19,327 | 1,599 | 3,903 | 802 | 500 | 550 | |
| 1975 | 13,548 | 1,353 | 3,481 | 669 | 500 | 536 | |
| 1976 | 15,285 | 1,702 | 3,294 | 820 | 511 | 550 | |
| 1977 | 17,027 | 1,782 | 3,614 | 1,001 | 425 | 580 | |
| 1978 | 19,278 | 2,303 | 3,712 | 996 | 800 | 642 | |
| 1979 | 20,036 | 2,826 | 4,040 | 1,084 | 1,169 | 645 | |
| 1980 | 18,024 | 3,927 | 4,768 | 1,036 | 1,219 | 658 | |
| 1981 | 19,696 | 4,244 | 4,596 | 916 | 1,320 | 720 | |
| 1982 | 17,060 | 4,301 | 4,195 | 947 | 1,455 | 708 | 363 |
| 1983 | 20,107 | 4,748 | 6,016 | 893 | 1,229 | 647 | 1,199 |
| 1984 | 21,133 | 6,263 | 5,346 | 1,000 | 1,514 | 1,043 | 1,000 |
| 1985 | 20,737 | 6,067 | 4,530 | 1,208 | 1,270 | 1,074 | 800 |
| 1986 | 21,178 | 6,249 | 5,346 | 1,203 | 1,606 | 1,272 | 800 |
| 1987 | 20,955 | 6,801 | 6,388 | 1,073 | 1,986 | 1,110 | 800 |

**Basic Source** : British Sulphur Corporation Limited, **Raw Materials Report**, 8th & 17th October, 1985, London.
**Source 1985-87** : Mining Journal, **Mining Annual Review**, Mining Journal Ltd, London, 1988, p.109

Ben Guerir mines which opened in 1980, **[18]**. Bou Craa is the smallest production area, although OCP hopes to expand production once the situation in the Western Sahara is more stable. In addition major phosphate reserves were discovered by Soviet geologists in the Meskalas area although, because of the world market conditions, they are unlikely to be developed until a long term supply contract has been signed with the Soviet Union or another client.

| Table 3.4 : MOROCCAN PHOSPHATE PRODUCING AREAS 1983-84 | | |
|---|---|---|
| AREA | 1983 Production | 1984 Production |
| Khouribga Total | 11,943,000 t | 12,618,000 t |
| Underground | ( 2,673,000 t ) | ( 2,285,000 t ) |
| Open Cast | ( 9,270,000 t ) | ( 10,332,000 t ) |
| Youssoufia Total | 5,403,000 t | 5,212,000 t |
| Underground | ( 5,241,000 t ) | ( 5,163,000 t ) |
| Open Cast | ( 163,000 t ) | ( 49,000 t ) |
| Benguerir Total | 3,007,000 t | 2,824,000 t |
| Open Cast | ( 3,007,000 t ) | |
| Bou Craa Total | 706,000 t | 863,000 t |
| Open Cast | ( 706,000 t ) | |
| TOTAL | 21,059,000 t | 21,517,000 t |

Source : A.Belkhadir & M.A.Chaoui, Phosphates in Morocco, op cit, p.18

Except for outcrops of phosphate rock all of the mining at Khouribga and Youssoufia was underground until 1960, after which open-cast mining was introduced. Open-cast has since been expanded and today accounts for around 62.5% of total production. The open cast method of mining uses draglines or dump trucks and loaders to extract the phosphate rock. After primary screening it is stockpiled before being transported to beneficiation plants. There the quality of the ore is upgraded by drying, washing and calcination processes. The Tri-Phosphate of Lime, (TPL), content is thereby increased to between 70% and 80 %. The beneficiated phosphate is then either exported as raw phosphate rock or is sent to government chemical and fertilizer plants for further processing, [19], (See Figure 3.1).

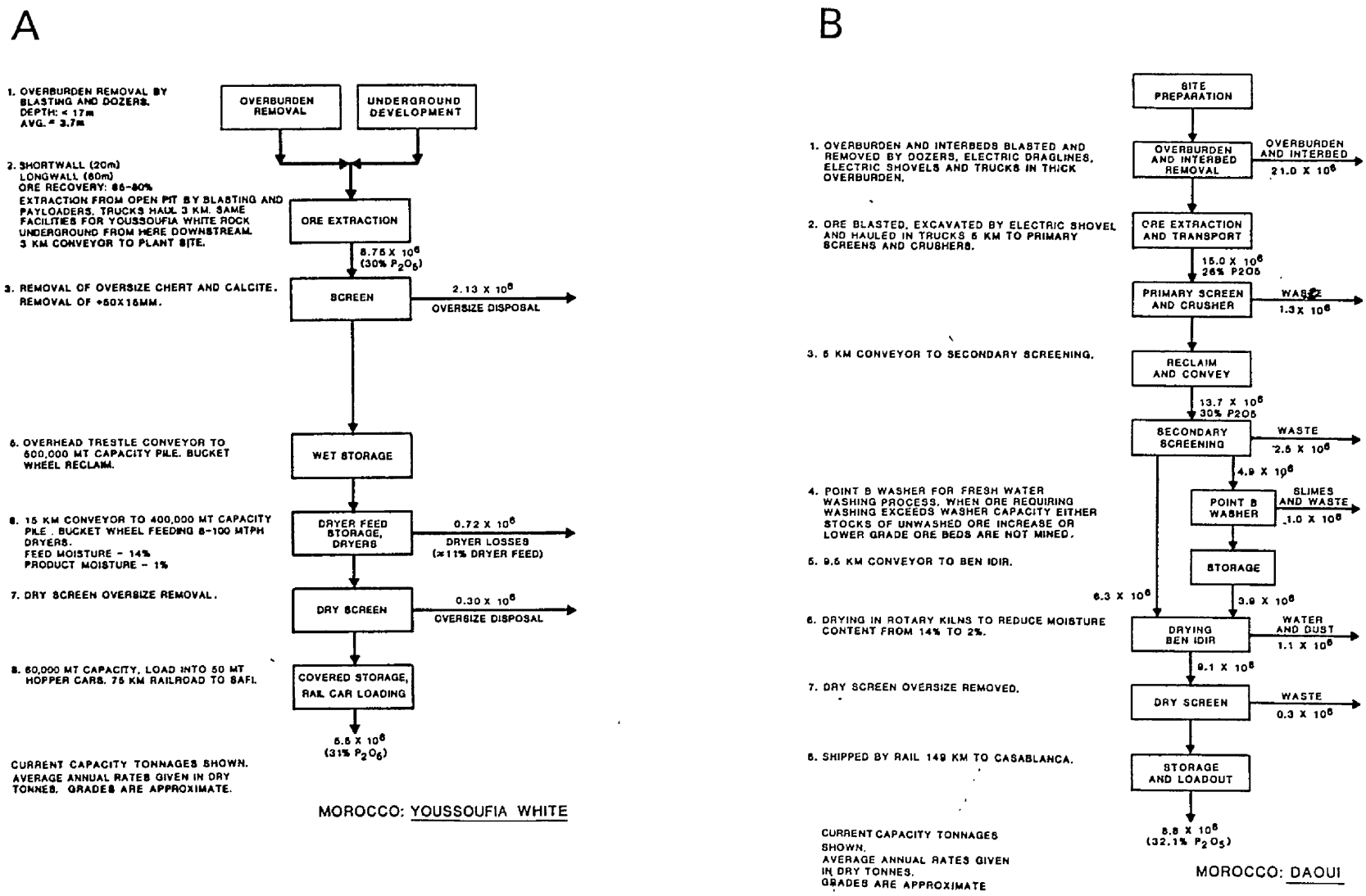



**Figure 3.1 Examples of Moroccan Phosphate Processing.**

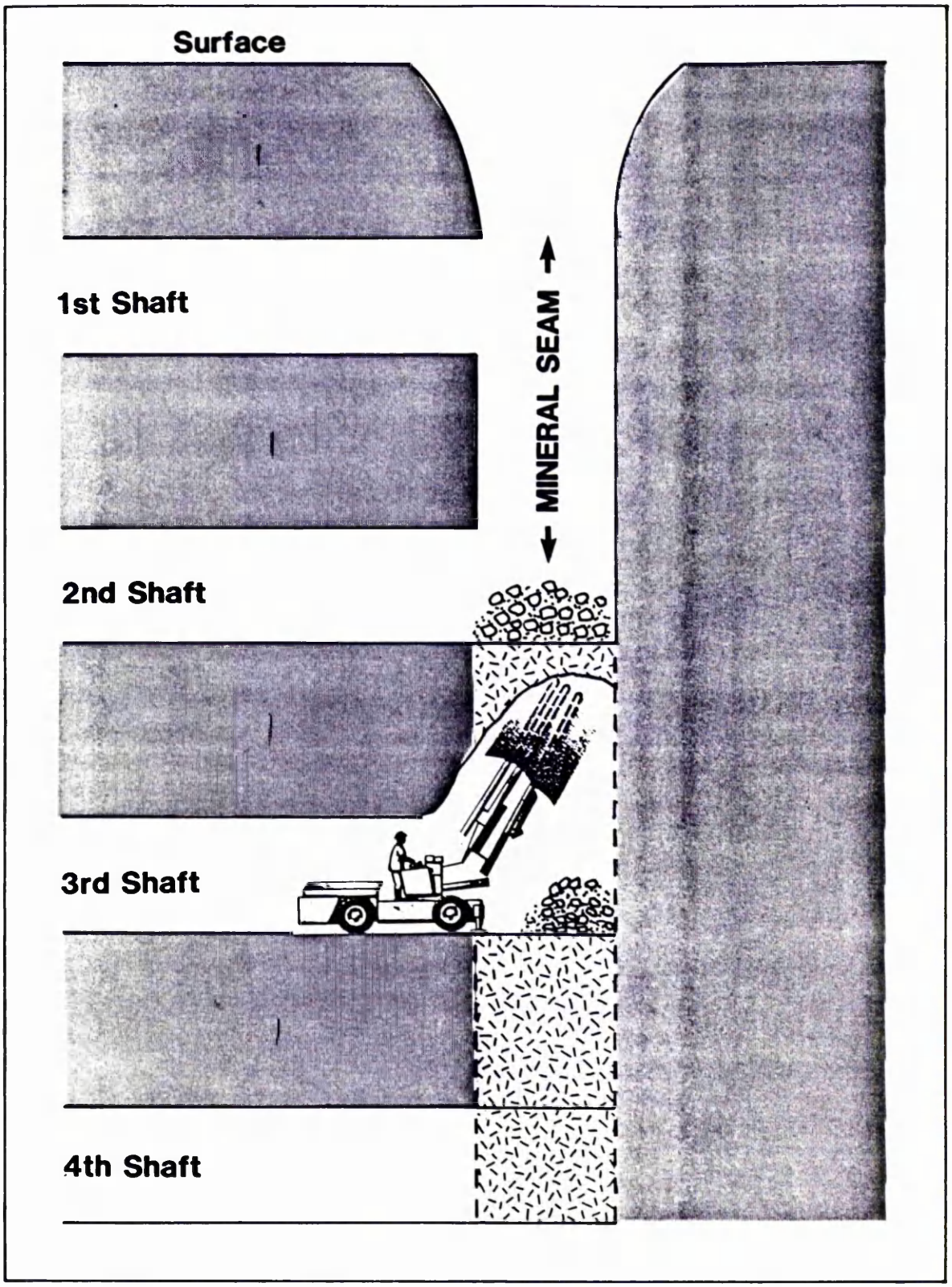
*Source: Fertecon Ltd. 1986.*

### 3.2.1b Lead.

Morocco is a major producer of lead ore and has been one of the principal suppliers for the European lead industries. In recent years production has fallen, partially because of world market conditions but also because of the state of some of the older and smaller mines. Between 1985 and 1987 lead ore production fell from 107,000 tonnes to 69,000 tonnes and this pushed Morocco down from eighth to tenth in the world league. The fact that it is exports which have been hit is illustrated by the fact that lead metal production has only fallen from 63,000 tonnes to 57,000 tonnes in the same period while consumption of refined lead hs fluctuated between 3,000 - 5,000 tonnes, [20]. The biggest and most important mine is at Touissit, near the Algerian border, which is the largest lead deposit in the Middle East. Other mines are located at Zaida, Jebel Aouam, Sidi Lachen and Aouli-Mibladen.

Touissit was first worked by a private company in 1921 but production was sporadic until 1946. In 1969 the mine was closed because of declining production levels, but was reopened in 1971 after new deposits were discovered. The Compagnie Minière de Touissit (CMT) which operates the mine is owned 51% by Compagnie Royale Asturienne des Mines and 49% by the Moroccan government. The mine uses sub-caving mining methods, **(See Figure 3.2)**, in a three

Figure 3.2 Sub-caving mining




*Source: C.G. Gurdon*

shift a day operation which aims at extracting up to 1,000 tonnes of ore a day. As it was seen during a visit to Touissit by the author, this is then turned on site into lead concentrate by grinding, separation, floatation and drying proccesses, [21]. It is then transported to the Fonderies de Plomb de Zellidja, (FPZ), seventeen kilometres away at Oued El Heimer where the lead concentrate is turned into metal. In 1987 output at Touissit totalled 443,000 tonnes of ore, averaging 12.7% lead, 0.36% copper and 75 g/t silver, which produced 77,200 tonnes of concentrate, [22].

Jebel Aouam mined 240,000 tonnes of ore grading 5.9% lead, 1.7% zinc and 11.5 g/t silver to produce 17,100 tonnes of lead concentrate and 5,400 tonnes of zinc concentrates. The mine is operated by the Société Minière du Djebel Aouam (SMA) which is owned by Asturienne, Vieille-Montagne and the government in equal proportions, [23].

Despite some lay-offs, the major mines have continued to function on a full time basis despite the stagnation in the world demand for lead. The principal reason is the presence of relatively rich silver deposits with the lead ore, particularly at Touissit, Jebel Aouam and Sidi Lachen. In 1983 the FPZ foundry at Oued El Heimer, which serves both the Touissit and Sidi Lachen mines produced 55,173 tonnes of lead, 2,544 tonnes of copper matte,

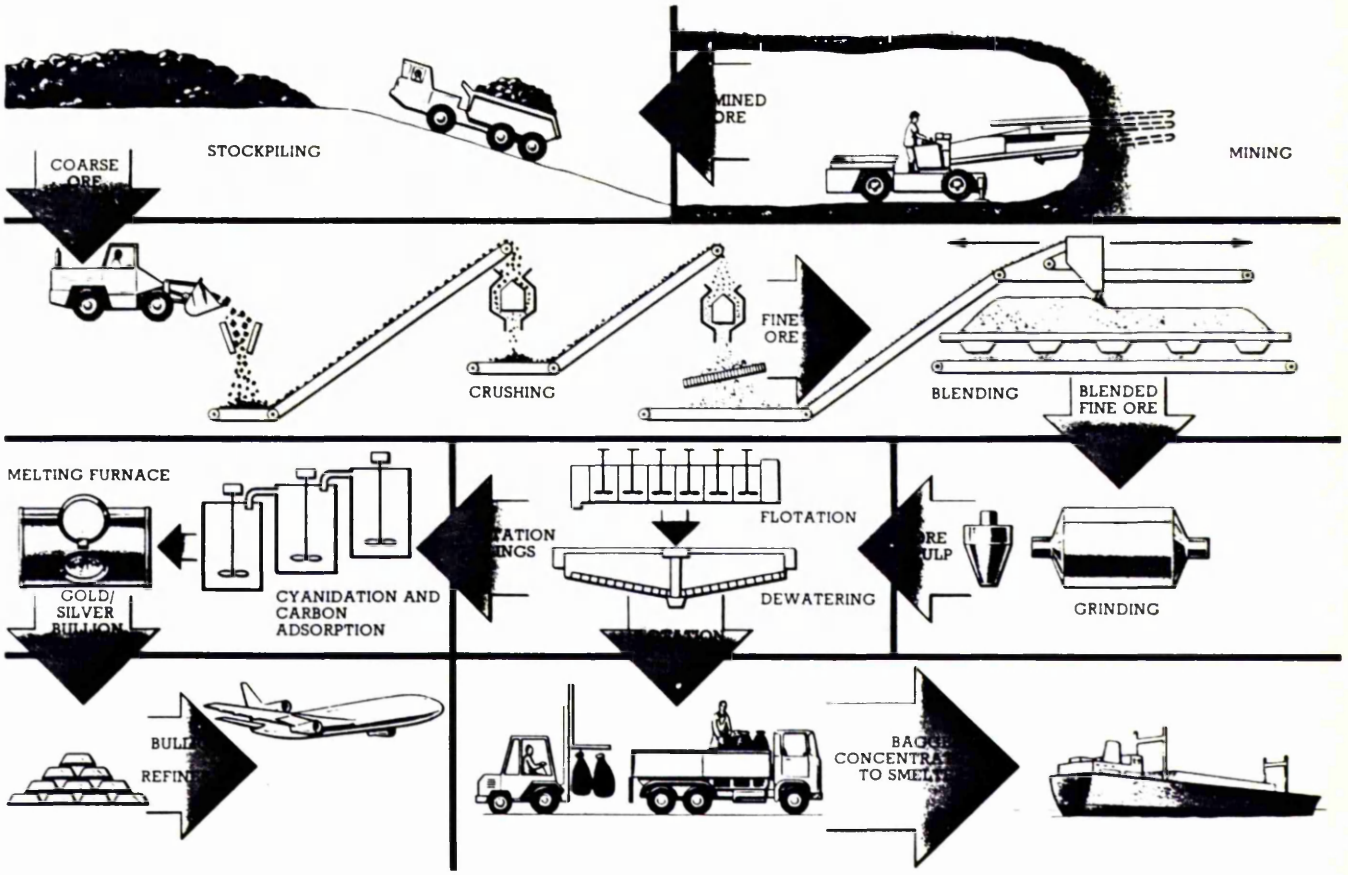
604.5 tonnes of antimony and 39,418 kgs of silver, [24].

### 3.2.1c Silver.

Silver is found in three forms in Morocco - either in association with lead or copper or in a volcano-sedimentary formation. In 1986 production of silver concentrates totalled 165.2 tonnes and fell slightly to around 162 tonnes in 1987, [25]. The FPZ foundry at Oued El Heimer produced 39,418 kgs of concentrate in 1983 while 2,000 kgs was extracted from auriferous copper from the Tiouit mine which is situated in the south of the country, 350 kms north east of Agadir. Production began in January 1982 after an investment of about 36 mn DH, [26]. The ore is treated by a simple flotation process which separates the copper, gold and silver. **(See Figure 3.3).**

The only mine which produces no other mineral except silver is at Imiter which is located in the centre of the Anti-Atlas Mountains and is Morocco's showcase example of a small but profitable mine. It produced 35,515 kgs of silver concentrate from 56,130 tonnes of ore in 1983, [27], although this has since risen. The daily output should increase as the processing plant's capacity rises from 200 to 400 and then 600 tonnes of ore in the future.

## Figure 3.3 Normal Metalic Mining Processing.




*Source: Gold Fields Mahd Adh Dhahab Limited.*

### 3.2.1d Copper.

After phosphates and lead, copper is the most important mineral with 55,000 tonnes of concentrate being produced at of about Dhs 138 mn in 1986, [28]. There are six mines the most important being at Bleida in the Anti-Atlas Mountains to the south of Imiter which at 45,000 t/y has about 75% of the Morocco's concentrate capacity. In 1983 it processed 53,822 tonnes of concentrate to produce 19,500 tonnes of copper metal, [29]. By 1986 copper production for the whole country had fallen to 18,500 tonnes and it appears to have fallen by 23% to around 14,250 tonnes in 1987, [30].

The other mines are at Ouansimi with a concentrate capactity of 9,000 t/y, Tazalaght (2,500 t/y), Tiouit and Bougaffer (both 1,300 t/y) and Tanfit (1,300 t/y). In addition the FPZ foundry extracts small quantities of copper from the lead ore from the Touissit mine. These smaller mines have become even more marginal operations since the fall in world copper prices. Some are only worked because the ore is auriferous, containing small quantities of both silver and gold. Unlike the Sohar copper mine in Oman the Moroccan mines were not developed simply as a focus for the economic development of a region. It is therefore possible that one or more of the mines might be forced to close in the future, because small copper mines are uneconomic.

### 3.2.1e. Barytes.

Until recently Morocco was the world's fifth largest baryte producer and a major exporter. In 1984 it produced a record 561,000 tonnes but this has since fallen to 463,000 tonnes in 1985, 190,000 tonnes in 1986 and an estimated 180,000 tonnes in 1987, [31]. This was caused by a downturn in the world market which led to the closure of small sites and an increase in the level of stocks at the export terminals. Production is centred on two mines at Zelmou in Figuig province, with a capacity of over 100,000 t/y, and at Djebel Irhoud near the Atlantic coast while the remainder is produced at numerous sites around the country.

### 3.2.1f. Iron.

In terms of tonnage and employees, but not value, iron ore is one of Morocco's most important metallic mining operations after phosphates and coal. It is mined near Nador on the Mediterranean coast where production fell from 223,820 tonnes in 1982 to 129,644 tonnes in 1984 and has remained at around 140,000 t/y since then, [32]. The principal reason for this dramatic fall has been the crisis in the European iron and steel industry which had been the principal market for Moroccan iron ore. The figures show that in 1977 production reached 407,000 tonnes but was only 50,000 tonnes in 1981, [33]. In

order to reduce the dependence on iron ore exports and to eventually develop a domestic iron and steel industry a bar and rod mill was opened in 1984 at Nador. Despite this the government is currently considering privatising the iron ore mine as well as many other state companies.

### 3.2.1g. Other Mineral Production.

As **Table 3.1** showed, Morocco produces relatively small quantities of a large number of other minerals throughout the country. These include manganese, fluorspar, zinc as well as small quantities of antimony, salt, bentonite, and special clays and muds. In addition there is large scale quarrying of building materials such as gypsum and limestone, which is used in Morocco's nine cement plants, as well as sands, aggregate, marble and other stone. Like most other countries, accurate statistics for Moroccan building material production are almost impossible to obtain because there are so many small private quarries.

One of the mining industry's principal objectives is to find deposits of natural sulphur which could be used to convert some of Morocco's huge phosphate reserves into phosphoric acid. Unlike oil producers, Morocco does not have the ability to produce sulphur from a petrochemical industry. The search for natural sulphur is centred on

the Rif, Guercif, Safi and Essaouira basins. An alternative would be to produce acid from the pyrite-pyrrhotite content of the polymetallic Guemassa ores, [34].

### 3.2.2. Algeria

In neighbouring Algeria, mineral production is more concentrated, with iron ore and phosphates taking "the lion's share" in terms of both tonnage and value. **Table 3.5** below provides the latest available statistics for mineral production in the past.

#### 3.2.2.a. Iron Ore.

Iron ore is by far the most valuable mineral which is produced in Algeria although, as **Table 3.5** below shows, production levels have fluctuated considerably during the past twenty years for a variety of reasons including changes in supply and demand. Iron ore production has a very long history in the country and the Romans were first to mine the area near the Tunisian border where today's production is centred. With the introduction of modern mining methods, the French colonists were able to expand production and make Ouenza and Boukhadra very profitable mines. After a long period under private ownership all of the country's mines were nationalised

in 1966. The following year underground exploration work began on the major iron ore deposit at Gara Djebilet near Tindouf in the south east of the country.

**Table 3.5 : ALGERIAN MINERAL PRODUCTION 1966-1987**
**(in 000s tonnes)**

| YEAR | Iron Ore | Phos | Zn | Pb | Cu | Baryte | Salt | Mercury# |
|---|---|---|---|---|---|---|---|---|
| 1966 | 1,800 | 189 | 30 | 8 | 4 | 30 | na | - |
| 1967 | 2,600 | 186 | 13 | 5 | 4 | 33 | na | - |
| 1968 | 3,000 | 361 | 31 | 7 | 3 | 36 | na | - |
| 1969 | 3,100 | 412 | 39 | 11 | 2 | 32 | na | - |
| 1970 | 2,900 | 493 | 33 | 10 | 2 | 50 | na | - |
| 1971 | 3,200 | 518 | 30 | 7 | 2 | 68 | na | na |
| 1972 | 3,600 | 527 | 33 | 8 | 2 | 70 | na | na |
| 1973 | 3,140 | 608 | 15 | 5 | 4 | 73 | na | na |
| 1974 | 3,990 | 802 | 20 | 3 | 7 | 72 | na | na |
| 1975 | 3,200 | 669 | 20 | 3 | 13 | 75 | na | 946 |
| 1976 | 2,800 | 820 | 14 | 2 | 8 | 76 | 133 | 1,065 |
| 1977 | 3,200 | 1,001 | 6 | 1 | 4 | 48 | 150 | 1,049 |
| 1978 | 2,750 | 997 | 5 | 3 | 4 | 73 | 171 | 1,055 |
| 1979 | 3,168 | 1,084 | 5 | 4 | 5 | 90 | 165 | 508 |
| 1980 | 3,500 | 1,036 | 11 | 3 | 8 | 91 | 172 | 842 |
| 1981 | 3,348 | 916 | 21 | 5 | 11 | 91 | 125 | 862 |
| 1982 | 3,456 | 947 | 21 | 5 | 11 | 102 | 145 | 379 |
| 1983 | 3,500 | 893 | 15 | 6 | 12 | 109 | 150 | 345 |
| 1984 | 3,500 | 1,000 | 15 | 6 | 15 | 109 | 175 | 345 |
| 1985 | 3,380 | 1,208 | 13 | 4 | na | 88 | 168 | na |
| 1986 | 3,360 | 1,203 | 14 | 4 | na | 60 | na | na |
| 1987 | 3,380 | 1,073 | 13 | 3 | na | 60 | na | na |

**Notes** : **#** Statistics for mercury are in tonnes
**Phos** = Phosphate, **Zn** = Zinc, **Pb** = Lead, **Cu** = Copper
**Principal Source** : United Nations, **Industrial Statistical Yearbook 1984**, Volume 2, United Nations, New York, 1986.
**Source 1985-87** : Mining Journal, **Mining Annual Review 1988**, Mining Journal Ltd, London, 1988
Various other sources gleaned by the author in Algeria

Algeria's largest iron ore mine, and one of the largest in Africa, is at Ouenza which in 1984 produced 2.94 mn, or 80.4% of Algeria's total output, of ore with an average iron content of 54.5%, [35]. In recent years it has been run by the Complexe Minier de l'Ouenza which is

a subsidiary of En-Ferphos, (Entreprise Nationale Fer et de Phosphates). It is one of the many new government parastatal companies which were created when the cumbersome and bureaucratic Sonarem was split up as part of the government's decentralisation process.

As the photographs in **Figure 3.4**, which were taken during the author's field-trip, illustrate, the mine is very large and the whole side of the mountain is being mined using open cast methods. Explosives are drilled and then set off and the ore which is released by each explosion is then transported in 20-50 tonne trucks to a crusher. The four quarries are being worked back in steps as the mountain is gradually removed. The crushed ore is carried more than a mile to the railway on a conveyor belt. Eight 1,500 tonne capacity trains a day transport the ore, along a railway which was purpose-built in 1920, to Annaba on the Mediterranean coast. Almost all the ore is used by the 4.2 mn tonnes a year capacity El-Hadjar iron and steel works outside Annaba which first opened in 1968. In the past about 10% was normally exported to Italy and Belgium but the 1980s slump in the world demand for iron and steel cut all exports, [36].

The other working iron ore mine at Boukhadra is 70 kms from Ouenza and 45 kms from the regional capital of

**Figure 3.4**
**Photographs of Ouenza Iron ore mine.**



***Source: C.G. Gurdon.***

Tebessa. The mine is the most important employer for the town's 8,000 inhabitants. In 1984 it produced 659,520 tonnes, or 18% of the total output, of brown hematite with an average iron content of about 55%. Like Ouenza it is connected by railway to the El Hadjar iron and steel complex. The construction of a new 2.2 mn t/y capacity steel complex at Bellara, which is dealt with in greater detail in **Chapter Six** and **Chapter Seven**, will provide a major new market for both Ouenza and Boukhadra. It will also concentrate Algeria's iron and steel industry still further in the east and end any immediate plans to develop the western deposits at Gara Djebilet. The Beni Saf mine near Tlemcen on the north-west coast has been producing very little iron ore since the early 1980s and by 1984 its oputput was only 36,640 tonnes or 1.6% of the total, [37].

### 3.2.2b. Phosphate.

Besides iron ore, phosphates are the most important Algerian mineral. It is produced in two mines in the east of the country at Djebel Onk and Kouif, of which the former is by far the larger. Like the iron ore mines in the region, both are administered by En-Ferphos, which is responsible for all iron and phosphate production in the country. The company's head office and Director General are based at Tebessa which is both the regional capital and is almost equidistant between

Djebel Onk and Ouenza.

The large phosphate deposit at Djebel Onk was discovered in 1915 by Maurice Gingembre who was the owner of the mine at Kouif. Although phosphate mining began in 1924, production did not begin until 1962 when the technical processes were sufficiently advanced to make its extraction economically viable. The Societe de Djebel Onk, began to develop the mine in January 1961 and then started building the processing plant in 1963 at the nearby isolated desert village of Bir el Ater and production began in March 1966. The company was officially absorbed into Sonarem in February 1971 but this was not implemented until February 1975. En-Ferphos took over when Sonarem was broken up into smaller and more manageable units, [38].

As it was seen during a visit by the author to Djebel Onk, the phosphate rock is extracted by open cast methods. These are very similar to those used at Youssoufia in the Moroccan phosphate mines as shown in **Figure 3.1**. The rock is then crushed, dried, washed and redried in order to increase the TPL content to between 75% and 77%. The treatment plant, which is still in good working order was enlarged in both 1973 and 1976.

In 1965 Djebel Onk was linked to the coast when the

Annaba to Tebessa railway was extended south to the mine. Three daily 1,500 tonne trainloads of the enriched phosphate are transported 339 kms to Annaba. About two-thirds of the phosphate, or 800,000 tonnes of the highest grade rock, was exported in 1987 with Yugoslavia, Poland, France, Finland and now Indonesia being the major clients, [39]. The remainder is used by the Algerian fertilizer industry which started in 1972 and now uses around 200,000 tonnes of indigenous phosphate thereby ending the need for phosphate imports. The second Five Year Plan (1985-1989) proposed the construction of a 200,000 tonnes/year phosphoric acid plant in the Djebel Onk area although this is still really only in the planning stage, [40].

The phosphate deposit at Kouif is situated almost on the Tunisian frontier near Tebessa. It was discovered in 1830 and was worked by a number of French and British companies until Algerian independence. Its production was initially very important and phosphate was exported to fourteen European countries. Its reserves were almost exhausted but Sonarem's exploration work then revealed new reserves. Despite this the maximum annual production level is only about 150,000 tonnes, [41].

### 3.2.2c ENOF

Most of Algeria's other mines are adminstered by Enof

which is the Entreprise Nationale des Produits Minièrs Non-Ferreux et des Substances Utiles. The mines which it administers produce non-ferrous metals and "useful" substances which include barytes, clays, aggregate and feldspar. Although its authority covers most non-ferrous metals, production is really limited to lead, zinc, copper and mercury. Enof's headquarters are at El Harrach outside Algiers from where it controls 22 production units and the 3,700 compant employees, [42].

Three mines at El-Abed, Kherzet-Youscef produce lead-zinc ore, as does Ain-Barbar the ore from which also contains some copper. The most important lead-zinc mine in the country is at El-Abed, located 95 kms west of Tlemcen on the Moroccan border, which produces about 60% of Algeria's zinc and almost all its lead. The development of the deposit began in 1925 but was interrupted between 1932-35 and 1940-45, after which production steadily increased. The estimate of El-Abed's reserves have been increased as further exploration work has been undertaken. It is now believed that there are 19.4 mn tonnes of ore with a zinc and lead content of 3.85% and 1.46%, respectively, [43]. Reserves are believed to be sufficient to maintain production until the end of the 20th century.

The 2,000 tonnes/day capacity modern flotation

processing plant produces a 61%-65 % lead concentrate and a 53%-55 % zinc concentrate. While the former is then exported the latter is sent to l'Unité d'Electrolyse de Ghazaouet. The production and consumption of both lead and zinc have remained relatively stable in recent years. In 1987 it produced 3,000 tonnes of lead and consumed 12,000 tonnes of the refined metal while the figures for zinc were 13,000 tonnes and 21,000 tonnes, respectively, **[44]**.

It has been estimated that Algeria has 10% of the world's mercury reserves and about 17% of world mercury production, **[45]**. It is the second largest producer in the West and, together with Spain and Turkey, account for about 85% of the total. Large mercury deposits were discovered following exploration of the Azzaba area in the coastal hinterland in eastern Algeria in 1966. They are located near Ismail where a processing plant was constructed in 1971. It produces "prime virgin mercury" which is usually more than 99.99% pure and which is stored and transported in the industry's standard 34.5 kgs bottles. Reserves in the region are believed to be about 435,000 bottles. Domestic Algerian demand for mercury, which is used by the chemical, pharmaceutical and other assorted industries, is under 500 bottles a year. The remaining production which currently averages about 30,000 bottles is exported to industrial countries throughout the world. Together with Spain and Turkey,

which are the other major non-Communist producers, Algeria has succeeding in increasing the world price of mercury from US$210 per flask in September 1986 to a minimum of US$300 and with a stated aim of US$400, [46].

Besides the Ismail mercury plant and the three lead-zinc mines, Enof is also responsible for three baryte mines, five clay and eight aggregate quarries. Baryte has numerous applications in the oil and glass industries and is used in the production of putty, paints and concrete. The three mines at Ain Mimoun, Bou Caid and Sidi Kamber do not produce enough baryte to match domestic demand and this has to be met by imports, [47].

Kaolin for the ceramic industry is produced in two quarries while another two produce bentonite which is used by the oil sector as a component of drilling mud. A fifth quarry extracts kieselguhr which is a diatomaceous earth with numerous industrial uses. There is also a major building material industry in Algeria which produces marble, aggregates, sands, limestone and gypsum. Salt is produced, for both household and industrial use, in the form of both rock salt and as a precipitate. In addition a future priority will be to extract uranium from the large deposits in the Hoggar massif of the southern Sahara. In the meantime in terms of tonnage, value and employment Algerian mineral

production will continue to be based on the important iron and phosphate industries near the eastern frontier with Tunisia.

### 3.2.3. Tunisia
**********

Like Morocco and Algeria, mineral production in Tunisia is dominated by phosphates but there is also lead, zinc, fluorspar, iron, silver, copper, baryte and salt production. Although it is not comprehensive **Table 3.6** below provides the majority of the Tunisian mineral production statistics for the past twenty years. It shows the scale of the phosphate industry and the relative decline of iron, lead and zinc production. The cement statistics are included to show its increasing importance, although there are no figures for limestone and gypsum which are the principal components in cement production. The rise in the production of fluorspar and barytes in recent years is also illustrated by the table. Although it has been produced for decades, the figures for marine salt are highly inadequate.

Like both Algeria and Morocco, the organisation of the Tunisian mining industry is divided into a number of parastatal companies which have responsibility for particular minerals. The eight are named below together with their area of jurisdiction, **[48]**. Information is then provided about the activities of the four which are

**Table 3.6 : TUNISIAN MINERAL PRODUCTION 1966-1987 (in 000s tonnes)**

| Year | Phos | Iron | Lead | Zinc | Cement | Fluor | Bar | Salt |
|---|---|---|---|---|---|---|---|---|
| 1966 | 3,216 | 1,287 | 24.5 | 5.1 | 477 | | | |
| 1967 | 2,810 | 1,003 | 21.8 | 5.6 | 473 | | | |
| 1968 | 3,368 | 1,016 | 24.1 | 7.2 | 510 | | | |
| 1969 | 2,599 | 945 | 38.1 | 16.7 | 603 | | | |
| 1970 | 3,021 | 773 | 35.5 | 21.5 | 546 | | | |
| 1971 | 3,162 | 943 | 34.7 | 20.8 | 584 | | | |
| 1972 | 3,387 | 890 | 32.1 | 20.7 | 619 | | | |
| 1973 | 3,474 | 809 | 25.0 | 15.7 | 529 | | | |
| 1974 | 3,826 | 818 | 20.2 | 11.4 | 540 | | | |
| 1975 | 3,512 | 616 | 17.0 | 8.7 | 620 | | | |
| 1976 | 3,301 | 493 | 17.0 | 13.4 | 478 | | | |
| 1977 | 3,615 | 343 | 16.5 | 12.9 | 629 | | | |
| 1978 | 3,712 | 339 | 12.8 | 13.4 | 882 | 29 | 14 | |
| 1979 | 4,154 | 394 | 15.4 | 15.7 | 1,403 | 37 | 18 | |
| 1980 | 4,503 | 389 | 13.9 | 16.8 | 1,781 | 39 | 26 | |
| 1981 | 4,995 | 400 | 10.2 | 14.9 | 2,024 | 35 | 25 | 468 |
| 1982 | 4,745 | 275 | 8.6 | 15.2 | 1,834 | 37 | 34 | 421 |
| 1983 | 5,924 | 313 | 7.9 | 13.7 | 2,526 | 39 | 23 | 375 |
| 1984 | 5,346 | 309 | 6.5 | 12.1 | 2,677 | 45 | 20 | 350 |
| 1985 | 4,530 | 310 | 4.0 | na | na | 38 | 8 | na |
| 1986 | 5,951 | 310 | 2.0 | 5.0 | na | na | na | na |
| 1987 | 6,388 | 300 | 2.0 | 5.4 | na | na | na | na |

**Sources** :
Institut National de la Statistique, **Statistiques Financieres**, No.71, Mai 1985. & Mining Journal, **Mining Annual Review 1988**, London, 1988, pp.418-419
**Note** : The lead and zinc statistics are concentrates not ore. Phos = Phosphate, Fluor = Fluorspar, Bar = Barytes

actually involved in mining.

1. Compagnie des Phosphates de Gafsa - CPC - Phosphates

2. Société Tunisienne d'Expansion Minière - Sotemin - Lead and zinc mines and their associated minerals.

3. Société Miniere de Spath Fluor et Barytine - FLUORBAR - Production of fluorspar and barytes at Zriba.

4. Société des Mines de Jebel Jerissa - Iron ore mining at Jerissa and Tamera Douaria

5. Office National des Mines - ONM - Prospecting and research.

6. Société Sra-Ouertane - Study and development of Sra-Ouertane phosphate deposit

7. Société de development des industries chimiques du Sud-SDICS - Study of salt deposits in south Tunisia.

8. Compagnie Generale des Salines de Tunisie - COTUSAL - Exploration of saline deposits at Sousse and Sfax.

### 3.2.3a Compagnie des Phosphates de Gafsa, (CPG).

Since the 1960s the government-owned CPG has had overall responsibility for all vitally important phosphate production in the country, which is concentrated in the Gafsa basin. In recent years the Société Sra-Ouertane has been involved in exploration work and feasibility studies of a major deposit of low grade phosphate in the north west of the country.

Production began in 1897 and grew rapidly until Tunisia became the world's fourth largest phosphate exporter. The majority of Tunisian phosphates are low quality and the government therefore invested heavily in downstream chemical and fertilizer industries which now consume the largest share of Tunisia's phosphate rock production. Therefore, although oil revenues totally eclipse those from phosphate rock exports, it remains one of the most important sectors of the Tunisian economy.

The phosphate mines in the Gafsa region are divided into the eastern, western and central sectors. In 1984

production was 2,548,000 tonnes in the eastern, 2,864,000 tonnes in the central and 2,463,000 tonnes in the western sector. The company also produced 306,000 tonnes at Kalaa Khasba outside the Gafsa basin. Since it began in 1972, opencast mining has gradually risen in importance until it now accounts for about 60% of total production.

The company has nine enrichment plants of which four are at the large Metlaoui mine. They have a combined capacity of 6,810,000 tonnes of which 86% was utilised in 1983. Phosphate rock is transported from the mines and quarries to the enrichment plants where the TPL content is upgraded. It is then either exported as phosphate rock or used by the domestic fertilizer and chemical industries. The proportion of Tunisian phosphate which is used by domestic industry has risen from 23% in 1970 to nearly 80% in recent years, **[49]**.

### 3.2.3b Sotemin

The Société Tunisienne d'Expansion Minière, (Sotemin), which is based at Le Kef near the Algerian border in north-west Tunisia, is responsible for all the country's lead and zinc mines. There are six mines which are spread throughout the north-west, three of which produce both lead and zinc, one produces only lead and another

**Table 3.7 : Sotemin mines' 1984 reserves & production**

| Mine | Ore Reserves 1 | Production 2 | Employees |
|---|---|---|---|
| Sidi Bou Aoune | 700,000 t | 3,500 t Pb<br>2,600 t Zn | 666 |
| L'Akhouat | 100,000 t | 840 t Pb<br>3,100 t Zn | 311 |
| Fedj Lahdoum 3 | 2,000,000 t | 1,260 t Pb<br>4,260 t Zn | 332 |
| Gzala Jalta | 300,000 t | 900 t Pb | 228 |
| Fedj Hassen 3 | 300,000 t | 1,690 t Zn | 182 |
| Bou Jabeur 3 | 5,000,000 t | 670 t Zn/Pb<br>1,140 t Fluorspar<br>6,000 t Baryte | 260 |

**Source :** Interviews by author at Sotemin in Le Kef 1985
1 = Ore content is 3-6% Pb/Zn.
2 = Lead and zinc concentrate,
3 = Mine under Development

only zinc. The largest mine is at Bou Jabeur which is situated less than a kilometre from the Algerian border. Besides lead and zinc concentrate, it produces fluorspar and baryte which is also the responsibility of Sotemin. **Table 3.7** above provides further information about the six mines.

The mine at Fedj Lahdoum is situated in the high plateau region near the Le Kef to Tunis road. It is one of the oldest mines in Tunisia having begun production in 1891, although this was interrupted during the Second World War. Only about 60,000 tonnes of ore is produced each year because of the problems caused by its highly

complex geological structure. Of its 332 staff, 194 are underground employees while the remainder work in administration, transport and treatment. The concentrate is produced by a differential floatation process in the very old and decrepit treatment plant. Both the 60% lead and the 50% zinc concentrate are then transported by truck to Tunis. The former is used by domestic foundries while the latter is exported to Europe, [50].

### 3.2.3c Société des Mines de Jebel Jerissa.

Tunisia's iron ore production is run by the Société des Mines de Jebel Jerissa which takes its name from the mine which, until relatively recently, was the only iron ore mine in the country. It is also situated near Le Kef on the high plateau near the Algerian frontier. Production at Jebel Jerrisa began at the turn of the century making it one of the oldest iron ore mines in the Middle East. The 50% iron ore is mined in two forms, as carbonate and haematite, in a ratio of about 6:1. It is estimated that the reserves can produce haematite and carbonate for a further two and 17 years, respectively.

As **Table 3.7** above showed, production has been steadily falling during the past 20 years and only 313,000 tonnes of ore was produced in 1983. This decline is being partially offset by the Tamera Douaria iron ore mine in the centre of the country. Over two thirds of the ore

from both mines is taken to the El-Fouladh iron and steel plant which also uses imported iron ore. The Société de Fonderie et de Mecanique, (Socomeca), runs an iron and steel foundry which uses indigenous iron ore. It is being expanded with the help of the Amman based multilateral Arab Mining Company, (Armico), which also has a shareholding in other mining projects, [51].

### 3.2.3.d. Fluorbar.

The Société Miniere de Spath Fluor et Barytine, (Fluorbar), was established in 1981 in order to develop the Tunisian reserves of fluorspar and baryte. There are three mines which are situated in the Zaghouan region to the south of Tunis. They supply the Gabes aluminium fluoride plant which is run by the Société des Industries Chemiques de Fluor, (ICF), in which Armico has a 26.67% holding. Following its investment of US$5 mn Armico also has a 53.5% stake in Fluorbar, [52].

### 3.2.4. Libya

Compared with its Maghrebi neighbours, Libya's mineral industry is both very small and under-developed. It does not have the long history of mining and quarrying that the former French colonies enjoyed. Indeed with the exception of a major iron mining project which it is

hoped will eventually be brought on stream, it is almost solely confined to the quarrying of building materials and the production of salt. The iron ore project at Wadi Ash Shati is not covered in this chapter because it will not come into production in the immediate future.

**Table 3.8 : Libyan Building Material Production 1980-85**

| Industry | 1980 | 1985 | Index 1980=100 | Annual Compound Growth Rate |
|---|---|---|---|---|
| Cement | 1.9 mn t | 4.6 mn t | 242.1 | 19.3 |
| Lime | 73,000 t | 270,000 t | 370.0 | 29.9 |
| Red Bricks | 113,000 t | 300,000 t | 265.5 | 21.5 |
| Eternit | 33,700 t | 68,800 t | 204.2 | 15.3 |
| Gypsum | 3,000 t | 5,000 t | 166.7 | 10.8 |
| Ceramics | 5,640 t | 10,600 t | 187.9 | 13.4 |

**Source** : Alan George, **Industry Review : Libya**, in Arab Industrial Review 1985, Falcon Press, Bahrain, p.272.

### 3.2.4a. Building Materials.

Of the two mining and quarrying industries, the building materials sector is by far the larger. As the table below illustrates there has been substantial growth in the production of all building materials. It should be noted that lime and gypsum are the two major raw materials used by the cement industry. There are two cement plants at Homs and one each at Benghazi, Souk al Khamis, Zawiya, Derna and Zilten. The last two plants, which were opened in 1984, are the largest in the country, each having a capacity of one million tonnes. Two further cement plants are planned for the south of

the country, although they are now awaiting an upturn in the national economy, [53].

### 2.2.4b. Salt.

The production of salt is currently the only other non-hydrocarbon mineral extraction industry. This is despite the fact that total annual production is under 50,000 tonnes. Of this about 30,000 tonnes are produced in the 12 acre saline in the Mellahat depression near Tripoli which is fed directly from the sea by a canal, [54]. There are also other salt works along the coast near both Tripoli and Benghazi and a number of inland salt deposits are being worked.

### 3.2.5. Egypt

In terms of mineral production Egypt is, in many ways, the exact opposite of Libya. While production in the latter is still in its infancy, Egypt has a large and very varied mining industry. For thousands of years precious metals were the principal minerals that were produced in Egypt but now building materials, iron ore and phosphate are of greater value. As the tables below illustrate, in terms of value, building materials in general, and gypsum and limestone in particular, are the most important minerals, [55].

### 3.2.5a Iron Ore.

The Egyptian iron and steel industry began when the Helwan plant to the south of Cairo was opened in 1954. Initially it used iron ore from the deposits to the east of Aswan but by 1960 the larger and more convenient Bahariya Oasis deposits became predominant. The open-pit mine at the Barhariya Oasis now supplies all of Helwan's ore requirements by means of a 350 kms purpose built railway line.

The first and second high furnaces started production in 1958 and 1960, respectively, thereby increasing steel production to about 250,000 tonnes. A third and fourth furnace were added in 1973 and 1979, thereby increasing the annual capacity of the Helwan plant to 1.5 mn tonnes, [56]. Its capacity will be raised to 2.0 mn t/y by 1992 with a US$250 mn World Bank loan. The Austrian company Voest-Alpine has signed a contract with the plant operators, Egyptian Iron and Steel Company (Hadisolb), to install a steel slab caster thereby reducing the number of stages in the steel making process by doubling the slab output to 600,000 t/y.

Egypt's largest private-sector venture is the Alexandria National Steel Company's 716,000 t/y capacity direct-reduction plant at El Dikheila near Alexandria. The current expansion programme will increase capacity to

Table 3.9a

**EGYPTIAN MINERAL PRODUCTION - 1974-1981 (000s tonnes)**

| MINERAL | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|
| Iron | 1,302 | 1,087 | 1,243 | 1,409 | 1,468 | 1,435 | 1,776 | 2,130 |
| Phosphate | 612 | 518 | 500 | 563 | 439 | 623 | 679 | 691 |
| Manganese | 4.7 | 3.6 | 4.0 | 3.6 | 0.2 | - | - | - |
| Kaolin | 28 | 35 | 30 | 45 | 56 | 42 | 45 | 50 |
| Quartz | 9.7 | 8.0 | 8.0 | 9.7 | 11 | 10 | 10.5 | 13 |
| Bentonite | 2.8 | 3 | 4 | 6 | 5 | 5 | 4 | 3 |
| Talc | 5.4 | 5.1 | 4 | 7 | 6 | 5 | 5 | 83 |
| Feldspar | 2.1 | 0.9 | 2 | 6 | 3 | 3 | 3.5 | 8.5 |
| Clay | 0.8 | 0.3 | 0.5 | 0.6 | 0.1 | - | - | - |
| Fluorspar | 1.2 | 2.7 | 1.6 | 2.4 | 2.3 | 0.8 | 0.5 | 0.1 |
| Asbestos | 0.1 | - | 1.4 | 0.9 | 9 | 0.8 | 1.2 | 0.3 |
| Magnesium | 0.8 | 0.8 | 0.6 | 0.8 | - | 0.4 | 0.5 | 0.2 |
| Chromium | 0.3 | 0.1 | 0.5 | 2.2 | 0.1 | 5.0 | - | - |
| Pyrites | 0.4 | 0.7 | 0.2 | 0.7 | 1 | 2.3 | 1.7 | 3.1 |
| Graphite | - | 0.5 | 0.1 | 0.2 | 0.1 | - | - | - |
| Colcother | - | 0.3 | 0.1 | .08 | 0.3 | 0.1 | 0.1 | 1 |
| Mica | 0.9 | - | - | - | - | - | - | - |

**Source :** State Information Service, **Industry & Mineral Resources in Egypt**, Cairo 1984, p.13.

Table 3.9b

VALUE OF EGYPTIAN MINERAL PRODUCTION 1974-81 (£E 000s)

| MINERAL | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|---|
| Iron | 7,813 | 6,521 | 7,458 | 7,870 | 8,235 | 7,900 | 9,767 | 11,767 |
| Phos | 3,874 | 5,086 | 4,400 | 4,691 | 5,110 | 6,025 | 7,567 | 9,330 |
| Manganese | 197 | 137 | 128 | 104 | 8 | - | - | - |
| Kaolin | 291 | 486 | 395 | 725 | 779 | 561 | 667 | 911 |
| Quartz | 85 | 52 | 50 | 8 | 112 | 85 | 95 | 172 |
| Bentonite | 57 | 63 | 82 | 123 | 91 | 102 | 82 | 76 |
| Talc | 220 | 205 | 160 | 352 | 367 | 350 | 306 | 705 |
| Feldspar | 42 | 15 | 45 | 148 | 105 | 125 | 159 | 253 |
| Clay | 6 | 5 | 11 | 10 | 3 | - | - | - |
| Fluorspar | 52 | 139 | 78 | 135 | 126 | 42 | 24 | 4 |
| Asbestos | 6 | - | 54 | 7 | 93 | 61 | 121 | 20 |
| Magnesium | 16 | 16 | 13 | 16 | - | 13 | 17 | 9 |
| Chromite | 6 | 6 | 13 | 27 | 12 | 1 | - | - |
| Pyrites | 14 | 23 | 7 | 29 | 59 | 159 | 122 | 155 |
| Graphites | - | 23 | 7 | 5 | 2 | - | - | - |
| Colcother | - | 11 | 2 | 2 | 5 | 3 | 3 | 3 |
| Mica | 6 | - | - | - | - | - | - | - |

**TOTAL VALUE**
**1974 = £E 12,685,000**
**1975 = £E 12,788,000**
**1976 = £E 12,903,000**
**1977 = £E 14,252,000**
**1978 = £E 15,107,000**
**1979 = £E 15,423,000**
**1980 = £E 18,929,000**
**1981 = £E 23,405,000**

**Source :** State Information Service, **Industry & Mineral Resources in Egypt**, Cairo 1984, p.13.

**Table 3.10 : EGYPTIAN QUARRY PRODUCTION 1976-1981**

| MATERIAL | | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | |
|---|---|---|---|---|---|---|---|---|
| Limestone | Q | 5,825 | 5,157 | 5,671 | 5,930 | 5,319 | 7,037 | cm |
| | V | 1,695 | 1,580 | 1,739 | 1,805 | 1,623 | 2,111 | |
| Gypsum | Q | 743 | 721 | 793 | 796 | 690 | 845 | mt |
| | V | 2,798 | 4,086 | 4,385 | 6,715 | 7,537 | 12,934 | |
| Basalt | Q | 320 | 298 | 327 | 328 | 302 | 90 | cm |
| | V | 859 | 1,016 | 1,118 | 1,956 | 1,864 | 321 | |
| Marble | Q | 8.5 | 21 | 23 | 26 | 36 | 52 | cm |
| | V | 425 | 1,108 | 1,219 | 1,378 | 2,402 | 3,357 | |
| Crushed Marble | Q | 6 | 5 | 5.6 | 12 | 6.5 | - | mt |
| | V | 36 | 35 | 40 | 168 | 90 | - | |
| Granite | Q | 3 | 3 | 3.2 | 2.7 | 6.4 | - | cm |
| | V | 120 | 120 | 132 | 117 | 294 | - | |
| Crushed Granite | Q | 21 | 15 | 17 | 10 | 18 | - | mt |
| | V | 62 | 45 | 50 | 60 | 248 | - | |
| White Sand | Q | 120 | 105 | 115 | 147 | 133 | 147 | cm |
| | V | 180 | 431 | 474 | 662 | 592 | 1,142 | |
| Foundries Sand | Q | 25 | 21 | 22 | 8 | 8 | 8 | cm |
| | V | 15 | 12 | 13 | 5 | 5 | 5 | |
| Common Sand | Q | 3,500 | 6,360 | 6,996 | 6,000 | 5,673 | 6,727 | cm |
| | V | 175 | 369 | 406 | 1,800 | 1,702 | 2,018 | |
| Stone | Q | 1,500 | 1,917 | 2,098 | 3,370 | 4,634 | 6,400 | cm |
| | V | 375 | 479 | 527 | 1,007 | 1,361 | 1,920 | |
| Clay | Q | 1,000 | 986 | 1,085 | 950 | 988 | 975 | mt |
| | V | 1,000 | 986 | 1,085 | 950 | 1,540 | 1,845 | |
| Sandstone | Q | 120 | 120 | 111 | 787 | 787 | 785 | cm |
| | V | 36 | 36 | 33 | 236 | 236 | 236 | |
| Dolomite | Q | 110 | 118 | 130 | 504 | 458 | 414 | mt |
| | V | 160 | 170 | 187 | 756 | 731 | 793 | |
| **TOTAL VALUE (including others)** | | **7,636** | **10,477** | **11,412** | **17,623** | **20,235** | **26,699** | |

**Source :** State Information Service, **Industry & Mineral Resources in Egypt**, Cairo 1984, p.16.

**Notes :** Value in 000s Egyptian Pounds. Units of Quantity as indicated.

745,000 t/y of bars and rods, thereby increasing Egypt's total capacity to 1 mn t/y which is still only half the annual demand, [57]. Meanwhile production from the Aswan iron ore deposits has been suspended, although at one time there were plans to construct a small local steel plant. The table below shows the growth of Egypt's iron ore production since the Helwan plant was inaugurated in the 1950s.

**Table 3.11 : Egyptian Iron Ore Production**

| Year | Iron Ore Production |
|---|---|
| 1955 | 50,000 t |
| 1960 | 239,000 t |
| 1965 | 507,000 t |
| 1970 | 451,000 t |
| 1975 | 1,087,000 t |
| 1976 | 1,243,000 t |
| 1977 | 1,409,000 t |
| 1978 | 1,468,000 t |
| 1979 | 1,435,000 t |
| 1980 | 1,776,000 t |
| 1981 | 2,130,000 t |
| 1982 | 2,000,000 t |
| 1983 | 2,223,000 t |
| 1984 | 2,500,000 t |
| 1985 | 2,140,000 t |
| 1986 | 2,000,000 t (approx) |
| 1987 | 2,000,000 t (approx) |

**Sources :**
Egyptian Geological Survey & Mining Authority, **Mineral Map of Egypt**, op cit, p.43.
State Information Service, **Industry and Mineral Resources in Egypt**, op cit, p.13;
Economist Intelligence Unit, **Country Profile : Egypt**, London, Economist Publications, 1984-87

### 3.2.5b Phosphates

Egyptian phosphate production began at the turn of the century and has until now been centred on two areas. One is the Red Sea coast between Quseir and Safaga, and the other is Upper Egypt's Nile Valley. Historically the latter has supplied the domestic fertilizer industry while the Red Sea phosphates have been exported. **Table 3.12** below shows the growth of Egyptian phosphate production and the split between domestic and foreign sales during the past twenty years. The Red Sea deposits

**Table 3.12**
**Egyptian Phosphate Production and Exports 1966-1987**

| Year | Production | Domestic Sales | | Exports |
|---|---|---|---|---|
| 1966 | 549,000 t | 207,000 t | (37.7%) | 319,184 t |
| 1967 | 710,000 t | 190,000 t | (26.7%) | 459,281 t |
| 1968 | 681,000 t | 207,000 t | (30.4%) | 416,008 t |
| 1969 | 660,000 t | 210,000 t | (31.8%) | 386,302 t |
| 1970 | 570,000 t | 285,000 t | (50.0%) | 268,437 t |
| 1971 | 558,000 t | 300,000 t | (53.8%) | 247,545 t |
| 1972 | 512,400 t | 330,000 t | (64.4%) | 174,906 t |
| 1973 | 540,146 t | 330,000 t | (61.1%) | 142,024 t |
| 1974 | 550,000 t | 342,000 t | (62.2%) | 111,624 t |
| 1975 | 536,274 t | 380,000 t | (70.9%) | 104,663 t |
| 1976 | 550,000 t | 435,000 t | (79.1%) | 115,000 t |
| 1977 | 580,000 t | 464,000 t | (80.0%) | 196,800 t |
| 1978 | 642,000 t | 481,400 t | (75.0%) | 192,300 t |
| 1979 | 645,100 t | 392,800 t | (60.9%) | 187,300 t |
| 1980 | 658,300 t | 324,400 t | (49.3%) | 218,700 t |
| 1981 | 720,300 t | 423,400 t | (58.8%) | 154,600 t |
| 1982 | 707,600 t | 467,600 t | (66.1%) | 186,500 t |
| 1983 | 646,700 t | 533,100 t | (82.4%) | 299,100 t |
| 1984 | 1,043,400 t | 794,100 t | (76.1%) | 230,100 t |
| 1985 | 1,074,000 t | 925,000 t | (86.1%) | 149,000 t |
| 1986 | 1,272,000 t | 1,088,100 t | (85.6%) | 183,400 t |
| 1987 | 1,110,000 t | na | | na |

**Source** : British Sulphur Corporation Limited, **Raw Materials Report**, op cit, p.7-10; 1985-87 statistics supplied to the author by Fertecon Ltd of London

are now almost exhausted and therefore the discovery in 1961 of the huge phosphate deposits at Abu Tartur in the Western Desert was very significant, [58].

Following an investment of LE594 mn it had been hoped that production would begin in 1988 but it is unlikely that commercial operations will begin before the early 1990s. The ore will be beneficiated and then transported by a new railway line to the Red Sea coast where it will be exported. Studies show that the Abu Tartur reserves could produce between 7-10 mn t/y but 2.0-3.5 mn t/y is more likely. The former level would put it on the same scale as the large Moroccan mines and make it one of the largest in the region. The Abu Tartur project should also make a substantial contribution to the regional economic development of the Western Desert, [59].

One of the principal reasons for the dramatic rise in domestic phosphate sales since 1966 has been the growth of the Egyptian fertilizer industry. Trends in fertilizer consumption in the Arab countries show that Egypt consumes more chemical fertilizer per hectare of agricultural land than any other country in the region, [60]. The shortage of suitable agricultural land and the population density have forced Egypt to adopt very intensive farming methods and the domestic fertilizer industry has grown substantially and it is now using over 85% of Egypt's phosphate production. Unlike most

of the region's other phosphate producers, Egypt's huge domestic agricultural sector provides a vast market for the phosphoric fertilizer industry.

### 3.2.5c Building Materials.

As **Table 3.10** showed, the value of production of building materials in general, and of gypsum and limestone in particular, is greater than that of all the other minerals. Population pressure and growing urbanisation has led to a dramatic increase in the demand for building materials in the past few decades. Despite this, the level of production of many products has been declining. The reasons include the shortages of skilled labour and of foreign currency for new investment, lack of productivity and inadequate transport infrastructure, [61].

The building material industry is divided between the dominant public sector and many smaller private companies. While some products are produced by both, cement tiles and red bricks are almost exclusively the preserve of the private sector. Meanwhile cement and cement based products, flat glass, refractories, sand and lime bricks, and synthetic floor covering are mainly manufactured by the public sector.

Limestone and gypsum are used in the cement, construction, iron and steel, fertilizer and medical industries. Gypsum is produced in twelve quarries in West Alexandria, Cairo, and the Ismailia, Faiyum and Manzala Lake areas. The huge reserves of limestone are quarried in 350 locations throughout the country. Clay from the Nile Valley is produced in 70 quarries and has been used in the manufacture of cement, bricks, refractories, pipes, paints and drilling mud. About 45 quarries in the Aswan area produce sandstone for local consumption, while a further 30 quarries produce granite in the area. Other building materials are quarried throughout the country including dolomite, (a double carbonate of lime and magnesia), in seven quarries, white sand (10), basalt (8), marble (35), sand (160) and gravel (180), [62].

The first Egyptian cement factory was built, with a capacity of 100,000 tonnes/year of portland cement, by the Société Anonyme des Ciments d'Egypte at Maasarah in 1900. The company, which later merged with the Tourah Company in the 1920s, opened another factory in Alexandria in 1911. It closed during the First World War because of the interruption of raw material supplies from Yugoslavia. It then continued operations until 1935 when it was replaced by a new plant at Tourah. A second 90,000 tonnes a year cement factory was built outside Cairo by the Helwan Portland Cement Company. In 1948 the

Alexandria Portland Company plant was built with a production capacity of 150,000 tonnes/year. The three companies were nationalised in 1961, while the National Cement Company which had been established in 1956 remained private with a minority government shareholding, [63].

While **Table 3.13** below shows that cement production increased substantially between 1951 and 1964, it also shows the volatile nature of cement production, consumption and trade. Since 1964 production has increased to about 9 mn tonnes while consumption is about 11 mn tonnes. The government now intends to reach self-sufficiency by 1990 with a production target of over 20 mn t/y by 1990. There are six major cement plants, each being self sufficient in raw materials; three in Cairo and one each in Alexandria, Suez, the north-west coast, and Asset in Upper Egypt. The 9 mn tonnes of cement which is imported each year to supplement local production mainly comes from Greece, Italy and France.

The production of red bricks has been essential for the housing sector but it is now being phased out. The predominantly private red brick producers were competing with the agricultural sector for the fertile clay in the Nile Valley. Under new laws which came into effect in

Table 3.13 : EGYPTIAN CEMENT STATISTICS 1951-1964

| Year | Consumption | Total Sales | Imports | Exports | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|
| 1951 | 1,127,108 | 1,117,581 | 14,006 | 4,479 | 100 | 100 | 100 |
| 1952 | 945,242 | 946,774 | 11,850 | 13,382 | 84 | 101 | 121 |
| 1953 | 944,765 | 1,080,732 | 7,388 | 143,355 | 84 | 103 | 113 |
| 1954 | 1,096,529 | 1,242,947 | 7,143 | 153,561 | 97 | 105 | 119 |
| 1955 | 1,325,075 | 1,371,581 | 8,201 | 54,707 | 118 | 106 | 119 |
| 1956 | 1,403,692 | 1,339,437 | 76,996 | 12,740 | 125 | 123 | 108 |
| 1957 | 1,257,700 | 1,464,642 | 21,295 | 228,237 | 112 | 131 | 111 |
| 1958 | 1,280,189 | 1,489,869 | 9,526 | 219,206 | 114 | 142 | 112 |
| 1959 | 1,294,727 | 1,769,124 | 6,692 | 418,089 | 115 | 159 | 111 |
| 1960 | 1,408,902 | 1,833,778 | 6,999 | 632,041 | 125 | 169 | 111 |
| 1961 | 1,625,634 | 2,135,355 | 984 | 510,705 | 144 | 171 | 109 |
| 1962 | 1,881,062 | 2,290,088 | 1,695 | 410,721 | 167 | 202 | 110 |
| 1963 | 2,388,028 | 2,559,556 | 12,768 | 184,296 | 212 | 212 | 109 |
| 1964 | 2,512,423 | 2,516,097 | 129,375 | 133,049 | 223 | 239 | 102 |

**Notes** : 1 = Domestic Consumption Index 1951 = 100
2 = Production Consumption Index 1951 = 100
3 = Price Index 1951 = 100

**Source** : El Askalani, N.A., **Estimate of Future Demand for Cement in the UAE**, Unpublished M.A. thesis, American University of Cairo, Cairo, May 1967, p.51-52.

August 1985 the government attempted to encourage the producers to switch to shale, sand and cement bricks. The red brick kilns were not removed provided the owners switched to the new products and their area was reduced to 1.5 feddans, (0.63 ha). The remaining land is being returned to cultivation, thereby substantially increasing the agricultural land along the crowded banks of the Nile flood plain. However since 6,000 mn red bricks were being used each year and the annual production capacity of the alternatives was only 2,350 mn bricks, the conversion has not been easy. It is hoped that the output of the alternative bricks will rise by 2,200 mn bricks as new factories are

established. This is to be supplemented by 500 mn lime bricks which are to be produced in new plants. Eleven new quarries have been opened in recent years to supply the brick works with cheap shale, [64].

### 3.2.5d Other Minerals

Besides building materials, iron ore and phosphates the production of other minerals is very small. Manganese ore was mined from the Um Bogma deposit in Sinai at the rate of about 300,000 tonnes a year until the 1967 Arab-Israeli war. Production, which only restarted a few years ago, has not yet reached its pre-war levels. The political stalemate with Israel during the 1980s also prohibited the operation of a 10,000 tonnes/year ferro-manganese plant near Abu Zenima, [65].

**Table 3.14 : PRODUCTION OF SALTS 1976-1981**

| Salt | | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|---|
| Sodium Chloride | Q | 606 | 664 | 709 | 721 | 756 | 869 |
| | V | 2,156 | 2,809 | 3,929 | 4,656 | 5,546 | 6,509 |
| Sodium Carbonate | Q | 4 | 4 | 4 | 4 | 4 | 4 |
| | V | 17 | 17 | 17 | 17 | 17 | 17 |
| Sodium Sulphate | Q | 408 | 2 | 3 | 9 | 1.8 | 10 |
| | V | 67 | 28 | 17 | 89 | 18 | 96 |
| **TOTAL VALUE** | | **2,240** | **2,854** | **3,963** | **4,762** | **5,581** | **6,622** |

Quantity in 000s tonnes. Value in 000s Egyptian Pounds at local current prices.

**Source :** State Information Service, **Industry & Mineral Resources in Egypt**, Cairo, 1984, p.14.

As **Table 3.14** above illustrates, Egypt also produces large quantities of various types of salt with a total 1981 value of LE6,622,000. Sodium chloride or common salt is produced by the evaporation of sea water in salines along the Mediterranean, Suez Gulf and Red Sea coasts. Besides being used for culinary and preservative purposes, it is also used in the manufacture of soap, glass, paper, ceramics, oils, textiles and in dying and tanning. Sodium carbonate or natron is quarried at Harara and is used in soap, glass and paper making. Sodium sulphate which is produced at Wadi Natrun is used for similar purposes, [66].

### 3.2.6 Sudan
**********

The Anglo-Egyptian Condominium government, which ruled Sudan from 1899 until independence in 1956, gave mining concession rights to a number of companies. The most important of these were South Africa's Anglo-American Corporation and Tanganika Limited. They applied modern mining methods to some of the old gold mines which were mainly located in the Red Sea Hills area of north-east Sudan. These included the Gebeit gold mine which operated sporadically between 1904 and 1953. The foreign companies were replaced by unqualified Sudanese private enterprises which operated the mines with very limited success until 1969, [67].

Following the coup which brought former president Nimeiri to power in May 1969 a systematic mapping and geological survey was conducted with east European assistance. This was continued with French, West German, Chinese and Japanese help after the 1971 attempted communist coup. As a result of this programme, the government's Geological & Mineral Resources Department, (GMRD), succeeded in establishing a dedicated staff of professional geologists who have contributed greatly to Sudan's mineral exploration and development work. Following their geological mapping work more than ten companies obtained mineral exploration concessions during the 1977-1982 period.

The Sudanese Mining Corporation, (SMC), was incorporated as a state owned enterprise in September 1975. Its functions include, the exploitation, processing and marketing of economically viable ore deposits, and assisting smaller Sudanese private mining companies through the provision of technical consultants. The SMC is also the Sudanese government's representative and shareholder in mining joint ventures with foreign firms and governments. Its production units, which account for most of the country's mineral production, include the Ingessana Hills Mines Corporation, a joint venture with Minex Developments (Sudan) Ltd and a gypsum quarry at Khor Eit in the Red Sea Hills, [68].

**Table 3.15 : SUDANESE MINERAL PRODUCTION 1967-87 tonnes**

| Year | Chromite | Salt | Gypsum | Gold (oz) | Cement |
|---|---|---|---|---|---|
| 1967 | 25,000 | 57,457 | 3,732 | 200 | - |
| 1968 | 24,346 | 50,000 | 10,776 | 29 | - |
| 1969 | 28,895 | 52,441 | 10,018 | - | - |
| 1970 | 29,393 | 62,355 | 1,637 | - | - |
| 1971 | 25,444 | 57,663 | 2,000 | - | - |
| 1972 | 26,060 | 61,060 | 1,535 | 95 | 211,000 |
| 1973 | 22,762 | 78,763 | - | 54 | 209,000 |
| 1974 | 30,000 | 73,103 | 9,993 | 17,001 | 218,000 |
| 1975 | 10,873 | 95,584 | 9,831 | 25,405 | 158,000 |
| 1976 | 17,273 | 92,710 | 744 | 30,490 | 178,000 |
| 1977 | 20,608 | 92,000 | 10,000 | na | 142,000 |
| 1978 | 19,134 | 72,000 | 10,000 | na | 185,000 |
| 1979 | 23,500 | 82,000 | 10,000 | na | 173,000 |
| 1980 | 16,200 | 80,000 | 10,000 | na | 150,000 |
| 1981 | 16,682 | 64,00 | 10,000 | 352 | 169,000 |
| 1982 | 10,074 | 28,000 | 6,000 | 423 | 232,000 |
| 1983 | 15,076 | 73,000 | 10,000 | 1,409 | 199,000 |
| 1984 | 15,000 | 73,000 | 10,000 | 1,057 | 146,000 |
| 1985 | 16,000 | 60,000 | 25,000 | 1,832 | 150,000 |
| 1986 | 18,000 | na | 20,000 | na | na |
| 1987 | 15,000 | na | 16,000 | na | na |

**Sources :**
United Nations, **Industrial Statistical Yearbook 1984**, Volume 2, United Nations, New York, 1986.
Additional sources and interviews collected by author in Sudan.

Mineral production in Sudan is currently confined to these few small projects. For many years the most important of these was the Ingessana Hills chrome ore mine near the Ethiopian border. The only other existing mining operations are sporadic and small scale private-sector gypsum, salt, mica, manganese, alluvial gold and diamond, and building materials projects. Recently, however, there has been considerable interest in a new gold mine at Gebeit in the Red Sea Hills and this area is now the principal focus of attention. **Table 3.15**

above provides some mineral production statistics and the following sections analyse the only commercial projects. It should be noted that the table is incomplete and that it is compiled from a number of different sources.

### 3.2.6a Chromite

It was seen in **Chapter Two** that there are reserves of about one million tonnes of high grade chromite ore in the Ingessana Hills of Blue Nile Region near the Ethiopian border. A very unsophisticated form of mining began in early 1962 in the southern hills and then in 1964 underground mining began at the Gam mine which has remained the focus of attention. The SMC also has a number of other smaller local mines at Kurba, Chikan and Gamak. In addition other small mines have been opened by the company in the Rumeilik area.

The privately owned Nile Chromium Company operates the neighbouring Gebanit open cast mine. At the latter about 5,000-10,000 tonnes a year of chromite ore has been mined since 1969 by about 40 men who only work during the dry season. Like the SMC chromite it is then transported by truck to Damazine and then to Port Sudan by rail from where it is exported to Switzerland, [69].

The Ingessana Hills Mining Corporation, (IHMC), was

nationalised by the new Nimeiri government in June 1970. It began its 1971 production season as a subsidiary of the Grouped Industries Corporation until 1975 when the SMC took the company over. Production is concentrated at the Gam mine which has reserves of about 600,000 tonnes of ore in a 25 sq kms area. The high quality ore has a chrome content which averages 50.1% and does not fall below 45%. Studies by both Chinese and Japanese teams of geologists confirmed that there are almost one million tonnes of ore reserves in the area which, given sufficient investment, could be mined out both economically and profitably, [70].

As **Table 3.15** showed, the production of chrome has been highly erratic, has declined substantially and still fails to match the 1967 levels. There are a variety of reasons for the poor performance including low labour productivity, dilapidated equipment, and high transport costs. It is hoped that the planned rehabilitation scheme will eventually enable annual production to more than double from its average of around 15,000 tonnes during the 1980s.

### 3.2.6b Gypsum

There has been sporadic production at the Khor Eit gypsum deposit to the north of Port Sudan on the Red Sea coast. Estimates of the reserves vary from between 200-

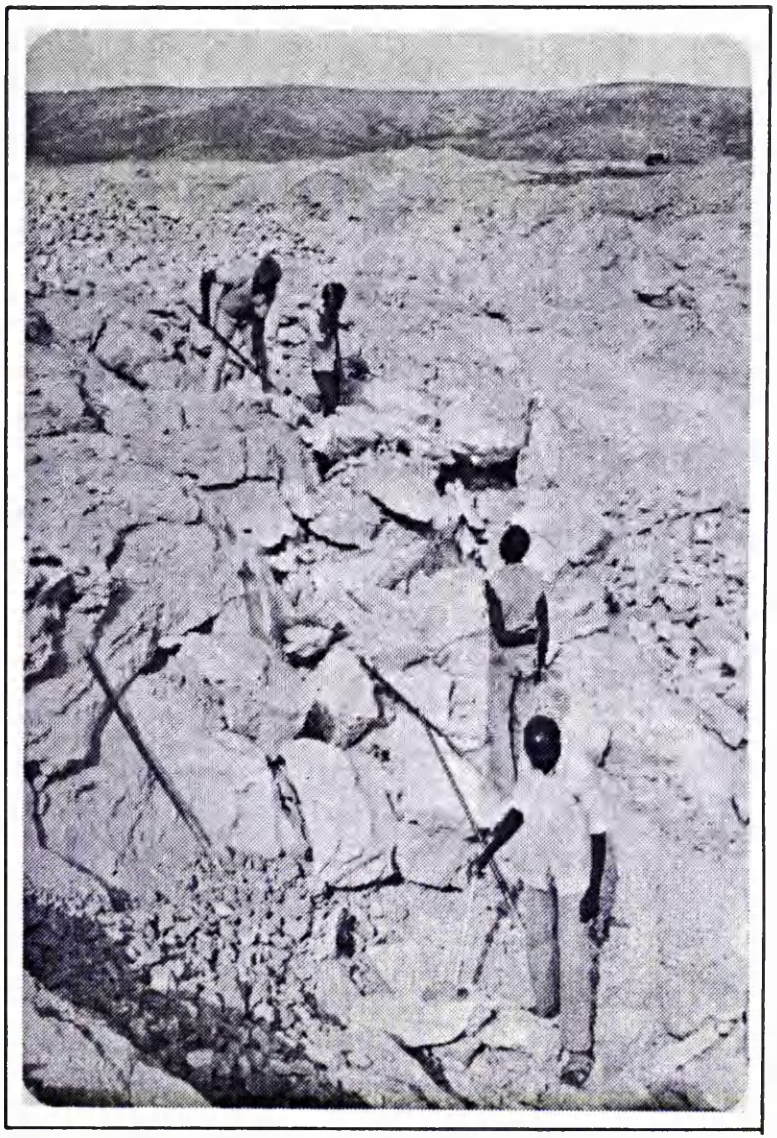


**Figure 3.5 Gypsum Production at Bir Eit, in Sudan's Red Sea Hills.**

***Source: C.G. Gurdon.***

400 mn tonnes of almost pure gypsum. Despite these very substantial reserves, production levels are very low and the mining methods are crude and rudimentary. The gypsum rock is blasted using dynamite and then the 30 permanent employees load it by hand onto trucks which transport it Port Sudan and other markets **(See Figure 3.5)**.

The major market for the gypsum is the Maspio cement works at Atbara on the Nile which annually uses 15,000 tonnes. The Rabak cement factory near Kosti takes a further 3,000 tonnes, the Port Sudan chalk factory buys 2,500 tonnes and other small consumers a further 1,000-2,000 tonnes. It had been hoped that production levels would increase to 30,000 tonnes/year but the lack of foreign exchange has made investment in new equipment impossible. There were also plans for Saudi Arabian and Swedish companies to export gypsum from the coast which is only few kilometres from the quarry. The production operation and its effect on the regional development of the area are examined in greater detail in **Chapter Seven, [71]**.

### 3.2.6c Gold

It is known that there are also substantial gold reserves in the Red Sea Hills and that small-scale mining is both possible and economical. The Gebeit mine

which Minex Minerals (Sudan) Ltd, a subsidiary of the London-based Greenwich Resources plc, is operating resumed operations in 1983 and, with recovered grades very conservatively estimated at 10 gms/tonne, annual gold production was expected to reach 30,000 ounces in 1988, [72]. The project is examined in **Chapter Seven** which analyses its role in the regional economic development of the Red Sea Hills.

The success of the Gebeit rehabilitation project encouraged other companies to undertake exploration and development work at other sites in the Red Sea Hills. The French government's Bureau de Recherches de Géologie et Minière, (BRGM), has been working in the area for over a decade. It has identified many economically viable polymetallic deposits and a few small gold mines are expected to be developed in a joint venture with the Sudanese government and Total Compagnie Minière. Indeed, in March 1987 following a one year construction period and a four weeks' heap leaching the first 6,800 gms gold bar was cast at the Hassai mine. It was expected that production at the mine, which has proven reserves of 1.8 mn tonnes containing nearly 13,000 kgs of gold, would reach 300 kgs in 1988, [73].

Meanwhile Ireland's Kenmare Resources is now exploring for gold in a 25,000 sq kms desert area and is developing the ancient Aberketeib gold mine. Located 210

kms north-west of Port Sudan the mine was last worked in the 1950s when annual production only totalled about 3,000 ounces of gold. Initially Kenmare is establishing a leaching operation to treat 30,000 tonnes of tailings which contains an average of 6 gms/tonne. The mine is owned by the Eastern Sudan Mining Company which is joint venture between Kenmare (49%) and the private-sector Central Desert Mining Company (51%), **[74]**. Therefore by the early 1990s it is hoped that as many as five gold mines could be operating in the Red Sea Hills which would have very beneficial effects for regional economic development.

Despite the considerable mining potential in the Red Sea Hills, with the exception of chrome, gypsum and gold, there are currently no other mining operations in Sudan and only limited quarrying operations. Although they are not dealt with in detail, the building material sector is analysed in later chapters.

### 3.2.7 Saudi Arabia
**********

Across the Red Sea in Saudi Arabia mineral production is currently almost exclusively confined to building materials. As it was seen in **Chapter Two** there has been extensive exploration work which has resulted in the discovery of numerous mineral deposits in the Kingdom.

Despite considerable efforts and financial investment only one of the projects has finally come into production. There had been an unofficial race between the government owned Mahd adh Dhahab gold mine and the private Al Masane polymetallic mine to see which could come on stream first. Because Al Masane's start-up has always been dependent on a government mining licence and additional financial assistance it was obvious that Mahd adh Dhahab would win the race. Because of unfavourable world market conditions, the small size of the deposits and the fall in oil revenues, the development of other metallic minerals is unlikely to go ahead before the 1990s.

Mining operations at the Mahd adh Dhahab gold mine eventually began in April 1988 and the processing plant is now being commissioned. Since February 1987, when a subsidiary of the UK's Consolidated Goldfields was dismissed, the mine is being managed by Sweden's Boliden Contech which is also working with Petromin on the Sukhaybarah gold project. It is expected that Mahd adh Dhahab will be capable of producing and processing 120,000 t/y of sulphide ore containing an average of 26 gms/tonne of gold as well as silver (92 g/t), copper (0.65 g/t) and zinc (2.58 g/t). The yearly production of concentrate to be exported will be around 8,500 tonnes and 3,250 kgs of dore bullion containing gold, silver and copper, [75].

The building material sector is particularly important in Saudi Arabia because of the scale of the construction industry. Each major town is surrounded by quarries which produce the majority of its requirements. As an example, in the Jiddah area there are over 100 aggregate quarries within a 10-15 kms belt outside the city which produced 9.9 mn cubic metres in 1980, [76]. The majority of these small quarries are privately owned and operated by numerous companies. The Deputy Ministry for Mineral Resources (DMMR) is, however, involved in a programme of exploration, production and marketing of local ornamental stone. These granites, anorthosites, marbles and limestones are transported from the quarries to two dressing plants near Jiddah where they are cut and polished. In 1983-84 they produced 66,815 square metres of cut slabs and 41,344 square metres of polished slabs of stone, [77].

Being located near the principal towns and cities, the quarries do not have a major impact on the local economy. By contrast most of the mining projects are located in remote areas where there is little or no alternative economic activity. Consequently it is these which are dealt with in greater detail in future chapters. The significance of building materials in general and the cement industry in particular should not, however, be overlooked.

### 3.2.8 Jordan

While Saudi Arabia's mining industry is still in its infancy, Jordan has had a major phosphate industry for more than 30 years. Although it is no longer pre-eminent it continues to play a very important role in both the national and regional economies. The other major mineral project is the Dead Sea potash plant which has only been in production since 1983. The country also has a very large cement industry which uses indigenous raw materials, although this is not analysed in detail in this study. **Table 3.16** below provides the production statistics for phosphates, cement and potash during the past thirty years.

#### 3.2.8a Phosphates

As seen in **Chapter One**, there are three principal Jordanian phosphate deposits. They are located at Ruseifa outside Amman, El Hassa and El Abiad in central Jordan, and Es Shidiyah near the Gulf of Aqaba. Although the latter is eventually expected to become the future focus of the phosphate industry it has not yet come into production. All of the mines are administered by the Jordan Phosphate Mines Company Ltd, (JPMC), which is now 90 percent government owned.

**Table 3.16 : Jordanian Mineral Production 1954-87**

| Year | Phosphates | Cement | Potash | Fertilizer |
|---|---|---|---|---|
| 1954 | 75.0 | 86.0 | - | - |
| 1955 | 164.0 | 95.0 | - | - |
| 1956 | 208.4 | 79.3 | - | - |
| 1957 | 261.9 | 107.2 | - | - |
| 1958 | 293.9 | 114.2 | - | - |
| 1959 | 337.6 | 110.3 | - | - |
| 1960 | 361.8 | 164.8 | - | - |
| 1961 | 422.5 | 223.1 | - | - |
| 1962 | 681.0 | 235.3 | - | - |
| 1963 | 614.4 | 285.3 | - | - |
| 1964 | 564.5 | 307.8 | - | - |
| 1965 | 837.9 | 305.1 | - | - |
| 1966 | 1,035.9 | 374.2 | - | - |
| 1967 | 1,082.3 | 320.6 | - | - |
| 1968 | 1,156.3 | 381.2 | - | - |
| 1969 | 1,089.0 | 480.6 | - | - |
| 1970 | 912.7 | 377.5 | - | - |
| 1971 | 565.6 | 375.1 | - | - |
| 1972 | 709.0 | 661.3 | - | - |
| 1973 | 1,080.9 | 616.8 | - | - |
| 1974 | 1,674.8 | 614.7 | - | - |
| 1975 | 1,352.5 | 598.2 | - | - |
| 1976 | 1,701.8 | 582.4 | - | - |
| 1977 | 1,769.4 | 537.6 | - | - |
| 1978 | 2,320.2 | 553.0 | - | - |
| 1979 | 2,828.1 | 623.2 | - | - |
| 1980 | 3,911.3 | 912.7 | - | - |
| 1981 | 4,243.0 | 964.7 | - | - |
| 1982 | 4,390.5 | 788.4 | 15.0 | 116.4 |
| 1983 | 4,745.5 | 1,269.0 | 282.8 | 301.6 |
| 1984 | 6,263.0 | 2,026.3 | 486.0 | 541.0 |
| 1985 | 6,067.1 | 2,022.9 | 908.2 | 510.5 |
| 1986 | 6,249.2 | 1,794.7 | 1,102.0 | 551.1 |
| 1987 | 6,801 | na | 1,200.0 | na |

**Note** : Figures in 000s of tonnes
**Sources** : Jordan Department of Statistics, **Statistical Yearbook**, 1954-1971, Appendix 5.; Central Bank of Jordan, **Yearly Statistical Series (1964-1984)**, Table No.41.; EIU, **Jordan - Country Profile 1987/88**, Economist Publications, London, 1987, p.21

The Ruseifa area, which is located 22 kms north-east of the capital, has been mined since 1934 but remained relatively small until 1970 when open-cast mining was

introduced. There are currently five mines at the site, although the reserves of the two underground ones are almost exhausted. Until recently annual production was around 700,000 tonnes and this was eventually expected to increase to 850,000 tonnes or more, [78]. Instead the mine has been closed since 1987 and is now unlikely to reopen. Its lower grade 70%-72% TPL rock is no longer required because it is the higher grade 73%-75% TPL phosphate that is in short supply.

Even if the expansion had been possible the production at Ruseifa would still have been less than 20% of that in the central Jordan mines. Being located so close to a built up urban area is a major handicap to any expansion. Besides the problem of purchasing the neighbouring land which is predominantly privately owned, air pollution from the open-cast mining and the processing plant had already proved very controversial.

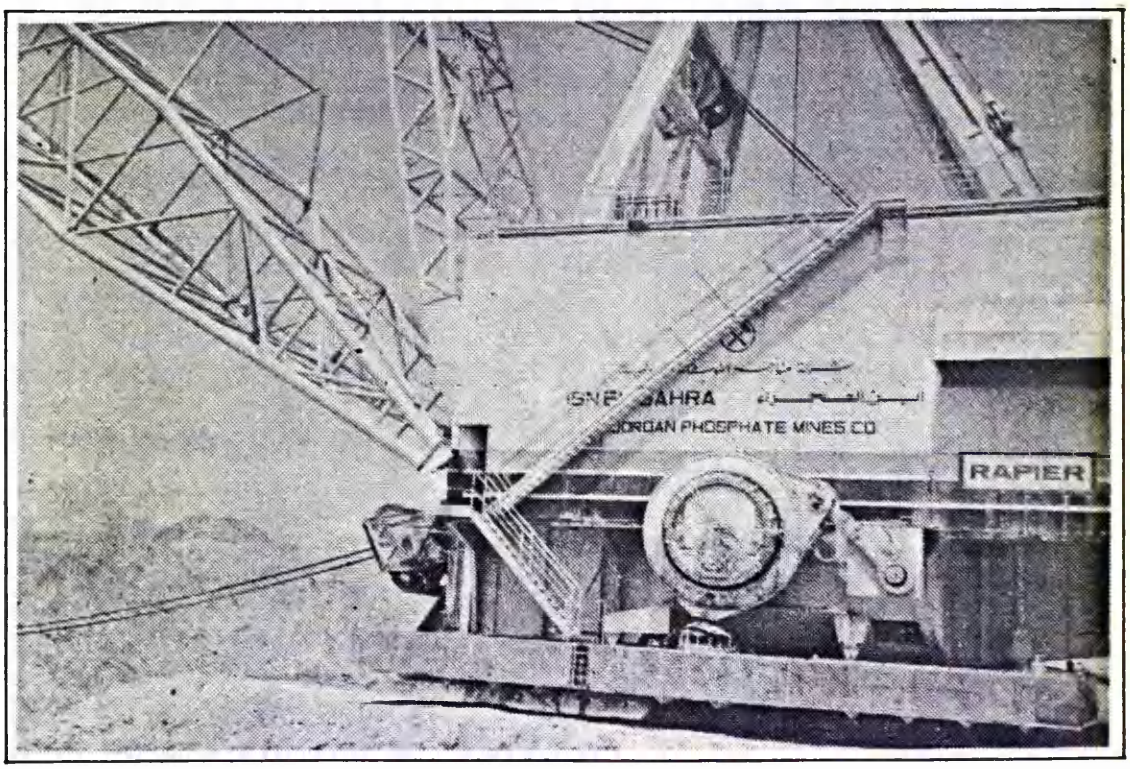
Until the mine closed the phosphate rock was transported to the processing plant where it was crushed, screened, washed, beneficiated and then dried. The majority of the stockpiled phosphate was then transported in private trucks to Aqaba to be exported. The JPMC received very advantageous rates from the truck owners who make most of their money by carrying goods from Aqaba to Amman. Consequently in 1985 the Ruseifa mine was paying JD2.2 per tonne which was less than the El Hassa mine paid for

its rail transport to Aqaba despite the fact that it is 136 kms closer to the port, [79].

The El Hassa mine has been the heart of the phosphate industry since it began production in 1962, while the neighbouring Wadi El Abiad started in 1979. Production at the former now exceeds 3.3 mn tonnes of which two-thirds are concentrated grade, (73%-75% TPL), and one third standard grade, (70%-72% TPL). The method of production is exclusively open cast mining with the over-burden being drilled, blasted and then removed. This is achieved using a huge dragline, **(see Figure 3.6)**, which has a 95.6 metre boom and a 30.6 $m^3$ bucket with a capacity of about 25,000 $m^3$ per day, [80]. The first electrically powered walking dragline, which uses 1 mn kw/hrs of power a year and came into operation in 1981, has now been followed by two others which began operations at El Hassa and Wadi El Abiad in 1987.

The phosphate rock is then transported to the processing plant which operates 24 hours a day. From there it is transported to Aqaba, 75% by rail and 25% by private trucks. A 22 kms spur-line links the El Hassa - Aqaba railway to the Wadi El Abiad mine, the annual production of which has risen since it began in 1979 and has ranged between 2.0 - 2.5 mn tonnes.

**Figure 3.6 Phosphate production at El Hassa in central Jordan.**


*Source: C.G. Gurdon.*

The focus of attention is now turning towards the US$300-US$350 mn project to develop the phosphate reserves at Shidiyah which is much closer to Aqaba's port and fertilizer plant. The US$70 mn first phase of the project, which is partially financed by a US$31 mn World Bank loan and by a JPMC share issue, is underway and production totalling 800,000-1,000,000 tonnes should begin in 1989. The second phase, which will increase production to 3 mn t/y and will be finished in 1991, is being financed by loans from the World Bank and Arab development funds, suppliers' credits and local sources. The whole project is mainly intended to replace the more costly northern operations rather than expand overall production, **[81]**.

### 3.2.8b Potash

The Arab Potash Company (APC) constructed and now operates a highly sophisticated plant which literally harvests the mineral rich waters of the Dead Sea to produce potash. It is located 1,300 m below sea level on the south-eastern tip of the Dead Sea which is the lowest point on earth. A 100 metres "truce channel" divides its evaporation pans from those of an older Israeli potash project just across the border.

The Arab Potash Company was established in 1956, with an equity of JD4.5 mn, thereby creating the first Pan-Arab

joint venture in contemporary history. It was given a 100 year concession to exploit the minerals of the Dead Sea, but it was not until 1975 that the Jordanian government decided to revive the plan. A US$10 mn feasibility study, which was partially financed by the World Bank and USAID, was conducted by the US based Jacobs Engineering and appeared to show that the project was viable with the cost being estimated at US$420 mn.

It was decided to base the capital on a formula of 45% equity and 55% loans. The JD63 mn (US$207 mn) equity was split between the Jordanian Government (51%), the multilateral Arab Mining Company (25%), the Islamic Bank (6.34%), Iraq (5.64%), Libya (5.092%), Kuwait (5%), Saudi Arabia (0.397%), the Jordan Post Offices Saving Fund (0.635%), and the founding shareholders (0.88%). The loans were provided by the Austrian government, USAID, Kuwait Fund, the World Bank and other institutions, [82].

The project was revived in 1975, the plant construction began in 1976 and was completed in September 1982 when production began. The mineral rich Dead Sea contains an estimated 43 bn tonnes of salt including 2 bn tonnes of potassium chloride. The potash is produced by first pumping the Dead Sea's already highly saline water into salt pans. During the next three months it is allowed to

evaporate as it passes very slowly through about five kilometres of salt, pre-carnallite and carnallite pans. The carnallite solution is then vacuumed up by four "harvesters" which were especially designed and constructed for the project at a cost of US$4 mn each, **(see Figure 3.7)**. It is then transported by pipeline to the nearby refinery.

The capital intensive plant was constructed by Austria's state owned Voerst Alpine and has a capacity of 240 tonnes/hour or 1.2 mn tonnes/year. This was eventually reached in 1987 and exceeded in 1988 when about 1.3 mn tonnes was produced, **[83]**. The major deterrent to increased production had been the corrosion caused by the extreme salinity of the Dead Sea's water, which is eight times more salty than the oceans, and the sea air. A number of pipes and valves had to be replaced with basalt lined pipes because of the corrosion.

The refinery produces three grades of potash which is stored in a large warehouse. It is then transported 200 kms to Aqaba in 37 specially constructed 50 tonne trucks. **(See Figure 3.8)**. In 1984 a total of 449,602 tonnes of potash was exported from Aqaba with the most important clients being India, Indonesia, China and Malaysia, **[84]**. This has since risen sharply and in 1988 it exported 390,280 tonnes in the first quarter alone, which was 14% higher than the exports during the first

**Figure 3.7 Potash Harvesting.**

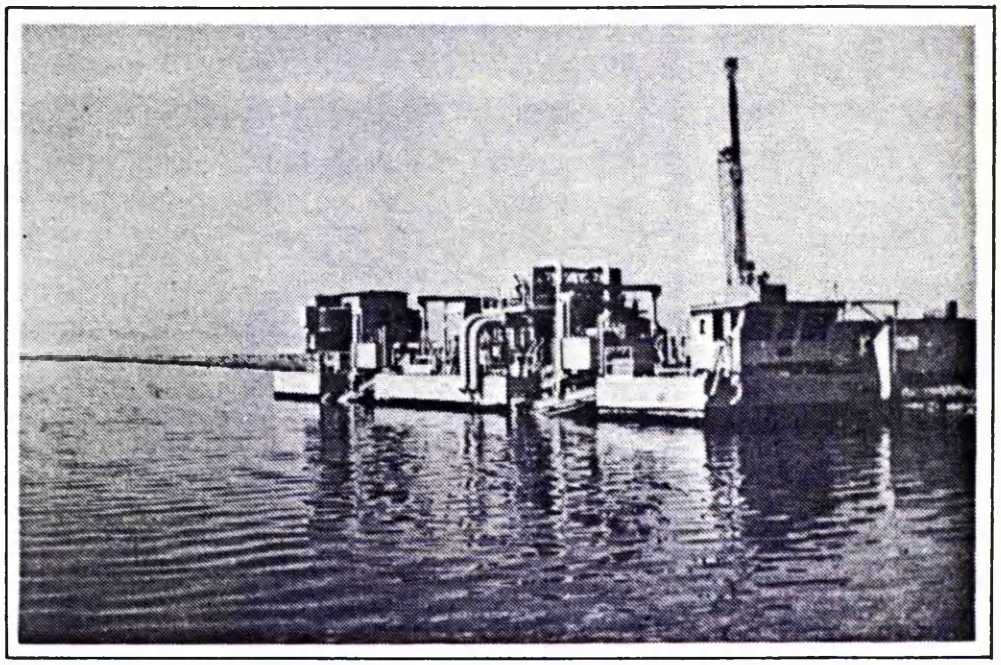
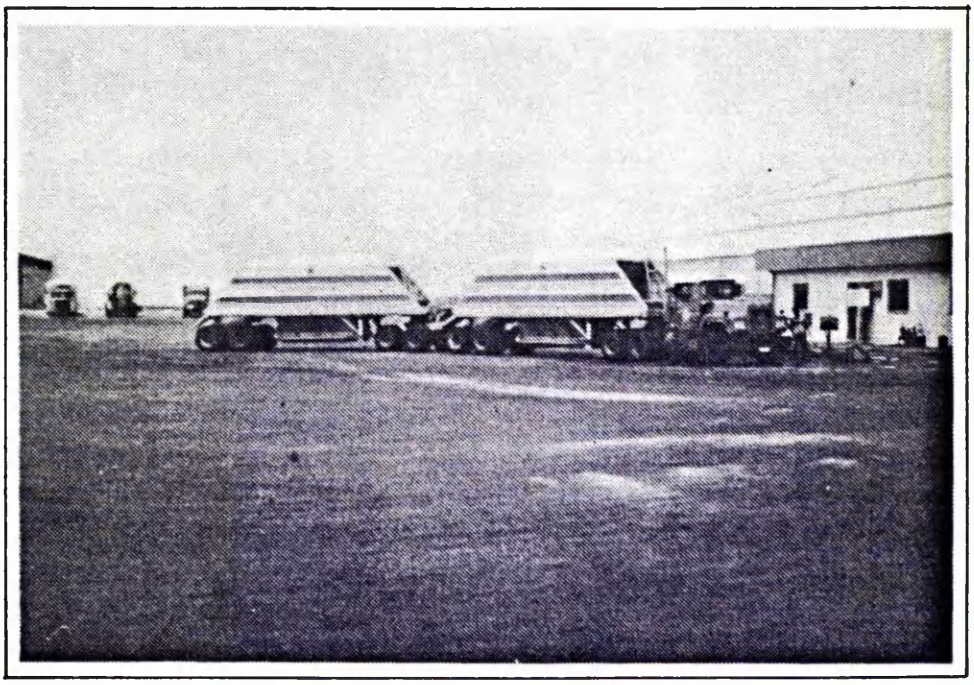


**Figure 3.8 APC Potash Transporters**



***Source: C.G. Gurdon.***

quarter of 1987. Like JPMC, the company believes that south and south-east Asia are both a natural and obvious market for both Jordanian potash and phosphate. In addition APC also sold 10,123 tonnes of industrial salts, which were produced as a by-product of the refining process, to the local market in 1984.

Although it is relatively capital intensive the potash project is a highly important element in the economy of central Jordan. APC is the second largest single employer in the region although agriculture remains the major sector in the fertile Jordan Valley. Its role in the regional economic development of central Jordan is analysed in detail in **Chapter Seven**.

### 3.2.9 Syria
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Mineral production in Syria is largely confined to phosphates and salt. In addition there is also a building material sector which includes a large cement industry which uses indigenous raw materials. By comparison with Jordan, the Syrian mining industry is both small and in its infancy. This section deals primarily with phosphate production which is the major component in the non-hydrocarbon mining sector. **Table 3.17** below provides some of the available mineral production statistics.

**Table 3.17 : Syrian Mine & Quarry Production 1979-87**

| Year | Phosphate | Salt | Sands | Gypsum | Stone | Semi-Marble |
|---|---|---|---|---|---|---|
| 1979 | 1,170 | 75 | 7,870 | 177 | 2,013 | 71,562 |
| 1980 | 1,319 | 90 | 7,787 | 173 | 1,991 | 84,860 |
| 1981 | 1,319 | 85 | 8,536 | 163 | 1,194 | 63,646 |
| 1982 | 1,461 | 102 | 15,903 | 168 | 869 | 82,957 |
| 1983 | 1,231 | 88 | 15,795 | 189 | 650 | 71,574 |
| 1984 | 1,515 | 38 | 14,283 | 191 | 496 | 49,655 |
| 1985 | 1,270 | 106 | 14,077 | 255 | 576 | 53,543 |
| 1986 | 1,606 | na | na | na | na | na |
| 1987 | 1,986 | na | na | na | na | na |

**Sources** : 1979-83 Dr. N. Samman, **Industrial Review : Syria**, in Arab Industrial Review 1985, **op cit**, p.250 ; 1984-1987 EIU, **Country Profile 1987/88**, Economist Publications, London, 1987, p.26

### 3.2.9a Phosphates

The two Syrian phosphate deposits at Kneifiss and Sharkya are near the historical city of Palmyra about 45 kms east of Homs. Kneifiss came into production in 1972 and had a 1981 current annual capacity of about 300,000 tonnes. The phosphate which is produced at Kneifiss is of a low grade with a 31%-32% $P_2O_5$ and 65%-68% TPL content. It is an open-cast mine which removes the overburden which can reach 40 metres to reach the phosphate beds which have an average thickness of seven metres. The standard method of extraction and processing is used at both the Kneifiss and larger Sharkya mines.

The latter has two mines, Sharkya A and B, which began in 1974 and had a 1981 annual production capacity of

900,000 tonnes. The TPL content is similarly low but the overburden is thinner, the stripping ratio better and the phosphate beds thicker than at Kneifiss. The phosphate rocks from all the mines were transported exclusively by truck to the port at Tartus, 110 kms away. The government owned General Company for Phosphates and Mines, (Gecopham), which administers the industry has its own truck fleet for the transportation. Since 1981 an increasing proportion of Syria's phosphate production has been transported by rail, [85].

There are two major problems for the Syrian phosphate industry. It is a comparatively wet phosphate with a moisture content of about two% even after it has been dried. It also has a high chlorine content of 0.15%-0.25% which also makes it less desirable for the export market than its Jordanian and North African competition. Despite the market glut and the depressed market prices, Syria has succeeded in increasing production to 1,986,000 tonnes in 1987 of which 1,604,000 tonnes or 81.47% was exported. Although, because of its low grade, much of the phosphate is exported as part of barter arrangements rather than cash deals to Eastern Europe, the countries of Western Europe have become an increasingly important market.

In 1987 about 368,000 tonnes out of a total of 1,986,000 tonnes was used by the domestic fertilizer industry,

[86]. The majority goes to the 450,000 t/y capacity triple-super-phosphate (TSP) plant at Homs which produces fertilizer for the important Syrian agricultural sector. The production of phosphoric fertilizers has risen from 68,000 tonnes in 1981 to 163,000 tonnes in 1985. The phosphate industry remains an vitally important part of the economy, but it remains dwarfed by oil and petro-chemical, agricultural and textile sectors.

### 3.2.10 Iraq

Iraq's non-hydrocarbon mineral production is focused on natural sulphur and phosphate as well as a large building materials industry. **Table 3.18** below provides the latest available production figures for natural sulphur, phosphate and cement. This is followed by an analysis of the production of both as well as that of the building material sector.

#### 3.2.10a Phosphate

The Iraqi phosphate industry began production only in 1982 but is considered by the Iraqi government to be an integral part of the regional economic development of the sparsely populated Western Desert. The Akashat Phosphate Project consists of three parts; the mine

itself, the Al-Qaim chemical complex and its water supply facilities which links the two. In addition two towns were built at Akashat and Al-Qaim linked by a 150 kms railway, a 230 kms road, oil and gas lines.

**Table 3.18 : Iraqi Mineral Production 1976-87**

| Year | Sulphur | Phosphate | Cement |
|---|---|---|---|
| 1976 | 610,000 | - | 2,728,000 |
| 1977 | 605,000 | - | 3,170,000 |
| 1978 | 610,000 | - | 5,696,000 |
| 1979 | 610,000 | - | 5,900,000 |
| 1980 | 450,000 | - | 6,100,000 |
| 1981 | 150,000 | - | 5,600,000 |
| 1982 | 240,000 | 363,000 | 5,600,000 |
| 1983 | 340,000 | 1,199,300 | 5,600,000 |
| 1984 | 460,000 | 1,000,000 | 5,600,000 |
| 1985 | 470,000 | 800,000 | na |
| 1986 | 490,000 | 800,000 | na |
| 1987 | 500,000 | 800,000 | na |

**Sources :**
United Nations, **Industrial Statistical Yearbook 1984**, Volume 2, United Nations, New York, 1986.
Statistics for sulphur and phosphate from **British Sulphur Company**, and **Fertecon** of London 1986

The Akashat area's phosphate deposit, with proven reserves of about 450 mn tonnes, were discovered in 1965. It was not until the late 1970s that the low grade phosphate, with an average $P_2O_5$ content of 21%, began to be developed. The reason was the creation of a huge new domestic chemical and fertilizer industry based at Al-Qaim about 400 kms west of Baghdad.

The two mines at Akashat use open cast methods which are almost identical to those in Jordan, Syria and

elsewhere. A dragline with ten cubic yard bucket removes the overburden to reveal the phosphate which is then loaded and transported to the crushing plant. The two 1,300 ton/hour capacity gyratory crushers reduce the rock to a maximum size of 250 mms. This is then transported by rail to the Al-Qaim complex which uses all of Iraq's phosphate production, [87].

Akashat has a maximum annual production capacity of 3.4 mn tonnes working a twelve hour day or 6.8 mn tonnes if it works around the clock. Iraq has similar problems to those of Syria and producers of low quality phosphate for which there is relatively little demand. In addition the Iraq-Iran war placed severe constraints on the phosphate sector as well as all the other mineral industries. Akashat did have the advantage of being located far from the principal war areas and close to the Jordanian border so that spare parts could be obtained via Aqaba. It is hoped that the phosphate industry will play a leading role in increasing the non-oil exports by bringing in badly-needed foreign currency.

### 3.2.10b Sulphur

The other major mining scheme is the natural sulphur project at Mishraq which has made Iraq the world's eighth largest sulphur producer. Located near Mosul in

northern Iraq, the project began in 1971 after a Polish company had designed and constructed the mine. The major deposit is extracted by the Frasch underground melting process. This involves heating water to a temperature above that of sulphur's melting point. The water is then pumped into wells penetrating the sulphur layer, thereby making the sulphur melt in the ground. The critical factor is the water ratio - the quantity of hot water required to mine each tonne of sulphur - which is dependent on the scale and nature of the deposit. At Mishraq between 1,000 and 2,000 gallons per tonne are required and this is heated using the abundant supply of cheap natural gas from the nearby oil and gas fields around Mosul. The molten sulphur is then drawn to the surface by the use of compressed air. It is stored in reservoirs from where it is pumped to the refining area. The pipes through which it travels are wrapped in running steam pipes in order to maintain the sulphur's liquidity.

Production at the mine, which has an annual capacity of 1 mn tonnes, rose from 156,000 tonnes in 1972 to a maximum of 692,000 tonnes in 1979. The start of the Gulf War had an immediate effect and production fell to 145,000 tonnes in 1981 before recovering steadily to about 500,000 tonnes in 1987. Because it is located away from the war front, production was able to continue,

though exports by sea were stopped by the closure of the port of Umm Qasr. Until the start of the war Iraq was exporting sulphur to about fifteen countries, with Poland, India and China being amongst the largest clients. They had long-term annual trade agreements to buy between 100,000 - 200,000 tonnes, some of which were barter deals for other goods and it currently exports about 220,000 t/y to Jordan and Egypt, [88].

The importance of the sulphur project is considerable and will increase. The government envisaged that Mishraq would become the northern core of Iraq's industrial development. It is intended that the sulphur will be used as feedstock for the new petro-chemical and fertiliser plants that were built in the region. Iraq now needs all the foreign currency that it can earn in order to finance the massive reconstruction programme that it has initiated. Sulphur exports as well as its use for feedstock will therefore be a vital element in the coming years.

In 1987 a new US$55 mn sulphur/sulphuric acid production plant was commissioned at Mishraq. It has a design capacity of 153,000 t/y of sulphur for export and 60,000 t/y of sulphuric acid of which 10,000 t/y will be exported. The plant is designed to extract 90% of pure sulphur from the residual foam and cake deposits which have been accumulated in the past few years from the

Frasch process, [89].

### 3.2.10c Building Materials

Until the begining of the war, Iraq's economy was growing at a faster rate than any other country in the Middle East (including Saudi Arabia). The construction sector was one of the most important elements in this growth and the government put great emphasis on the establishment of a large building materials industry. There was a major investment programme which began in the mid-1970s and which was designed to lead to self-sufficiency in most materials and export capacity in some. This was overseen by the State Organisation for Construction Industries, (SOCI), the government parastatal which is responsible for all building materials including cement. Between 1970 and 1977 the production of cement and other building materials more than doubled and this growth has since been accelerated.

By the end of 1986 the annual cement production capacity reached 22 mn tonnes when eight new plants finally came on stream. This is more than double Saudi Arabia's capacity which is probably the second largest producer in the region. In 1984 alone, Iraqi capacity was increased by about 8 mn tonnes as some of the new plants started production. The government's policy of cement

self-sufficiency is intended to end Iraq's costly cement imports and build up an export trade in the region.

Similarly, brick production capacity reached 4,174 mn in 1986, having expanded rapidly in recent years and by 600 mn in 1984 alone. Although traditional methods are still used in some areas near the Tigris and Euphrates rivers, a new generation of modern plants has been constructed. One West German company built four major factories in recent years with annual capacities ranging from 30 mn to 160 mn bricks. The world's largest sand-lime brick plant has been built in Iraq by another West German company. Like Egypt, there has been a definite policy of encouraging the production of non-clay bricks in order to keep the most fertile areas of the country for agriculture.

Besides cement and bricks, the investment programme has also greatly expanded the production of asbestos products, tiles, mosaics and glass, all of which use predominantly indigenous raw materials. Eight new gypsum plants have also been built since 1979 in order to provide the cement industry with one of its basic ingredients. In addition the government invested in four new thermostone factories to help meet its target of 3.5 mn new homes by the year 2,000, [90].

It can be seen from this evidence that Iraq has placed

great emphasis on the building materials sector. In terms of its contribution to the economy, employment, trade, regional development and other factors, it is far more important than either the sulphur or phosphate industries. There are, however, a number of major problems in analysing the construction sector in this study. The dividing line between non-hydrocarbon minerals and general construction and industry becomes very unclear. Despite its importance in Iraq and other countries, the building material industry is peripheral to this thesis.

### 3.2.11 Other Countries
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With the exception of building materials, the non-hydrocarbon mining sector in the remaining countries in the Middle East is very limited. With the exception of limestone and gypsum for cement production, and salt which is evaporated from the sea, it is really confined to the copper mining project in northern Oman. This section briefly deals with this and the limited mining and quarrying in Kuwait, Lebanon, Oman, Qatar, the UAE. and the two Yemens. **Table 3.19** provides some of the statistics for these countries although the copper project is dealt with separately. It should be noted, however, that the table is incomplete because of the paucity of the available statistics.

### 3.2.11a Kuwait

Of all the countries in the Middle East the tiny city state of Kuwait probably has the smallest non-hydrocarbon mineral deposits and industry. It is totally confined to salt and a few building materials. The former is obtained by the evaporation of the salty waters of the Arabian Gulf in salt pans along the coast. There is also a small building materials industry although the majority of its raw materials are imported.

During the construction boom of the 1970s there was a substantial increase in the production of building materials. Like all the other Gulf states Kuwait has since suffered a substantial downturn in building activity. This was exacerbated by the Gulf war which removed the important Iraqi export market. If this were not enough, the 1982 Al Manakh stock exchange crash and subsequent scandal led to large numbers of empty property. Consequently there was substantial over capacity and many building material firms faced bankruptcy. There are major opportunities for Kuwaiti companies to take part in the massive reconstruction work that will be necessary in Iraq and possibly Iran as a result of the Gulf War.

Table 3.19 : Salt & Cement Production (000s tonnes)

| YEAR | Kuwait | Lebanon | Oman | Qatar | UAE | YAR | PDRY |
|---|---|---|---|---|---|---|---|
| **Salt** | | | | | | | |
| 1971 | 5 | 35 | na | na | na | na | 66 |
| 1972 | 5 | 40 | na | na | na | na | 71 |
| 1973 | 10 | 40 | na | na | na | 50 | 43 |
| 1974 | 15 | 37 | na | na | na | na | 34 |
| 1975 | 18 | 35 | na | na | na | na | 7 |
| 1976 | 15 | 36 | na | na | na | 61 | 37 |
| 1977 | 17 | 35 | na | na | na | 58 | 101 |
| 1978 | 19 | 12 | na | na | na | 73 | na |
| 1979 | 20 | 10 | na | na | na | 154 | na |
| 1980 | 20 | 12 | na | na | na | 64 | na |
| 1981 | 19 | 15 | na | na | na | 70 | na |
| 1982 | 20 | 10 | na | na | na | 151 | na |
| 1983 | 20 | 5 | na | na | na | 145 | na |
| 1984 | 20 | 5 | na | na | na | 150 | na |

| YEAR | Kuwait | Lebanon | Oman | Qatar | UAE | YAR | PDRY |
|---|---|---|---|---|---|---|---|
| **Cement** | | | | | | | |
| 1975 | 281 | 1,656 | - | na | na | 65 | - |
| 1976 | 351 | 1,704 | - | na | na | 60 | - |
| 1977 | 329 | 1,360 | - | na | na | 60 | - |
| 1978 | 621 | 1,381 | - | 264 | 915 | 66 | - |
| 1979 | 1,041 | 2,031 | - | 255 | 1,715 | 68 | - |
| 1980 | 1,308 | 2,200 | - | 257 | 2,489 | 81 | - |
| 1981 | 1,549 | 2,391 | - | 258 | 2,932 | 81 | - |
| 1982 | 1,549 | 2,000 | - | 272 | 2,990 | 85 | - |
| 1983 | 1,533 | 1,000 | - | 275 | 4,005 | 243 | - |
| 1984 | 1,183 | 800 | - | 275 | 4,000 | 623 | - |

**Source** : United Nations, **Industrial Statistics Yearbook 1984**, Volume 2, United Nations, New York, 1986

### 3.2.11b Lebanon

While war in a neighbouring country has affected the Kuwaiti building material sector, it is its own civil war which has devastated Lebanon's small mining sector. Like Kuwait it is largely restricted to salt, which is produced in coastal salines between Tripoli and Gobail,

and gypsum, limestone and clay which are used in the cement industry. The cement plant at Chekka on the Mediterranean coast uses gypsum and limestone which is quarried nearby, while clay comes from a site 15 kms away. Despite the problems facing the country, building materials, non-metallic mineral products and black cement constituted 35.7% of industrial exports in 1981, [91]. Indeed it is perhaps because the sector is not urban based and does not require highly sophisticated or capital-intensive inputs that it is able to overcome the country's problems. By contrast the textile sector, for example, has been devastated by the irregular electricity supply and the lack of spare parts for machinery. If the civil war ends the building material sector will become vitally important to in the massive reconstruction programme that will be necessary.

### 3.2.11c Oman

The government of Oman is rightly proud of the fact that, despite Saudi Arabia's greater wealth and mining potential, the first metallic mineral mine to be re-opened in the Arabian peninsula is in northern Oman near Sohar. Located about 230 kms north-west of Muscat, the three separate ore bodies have estimated reserves of about 12 mn tonnes of 1.5%-2.0% copper ore. The area was a major regional copper producer for over 3,000 years

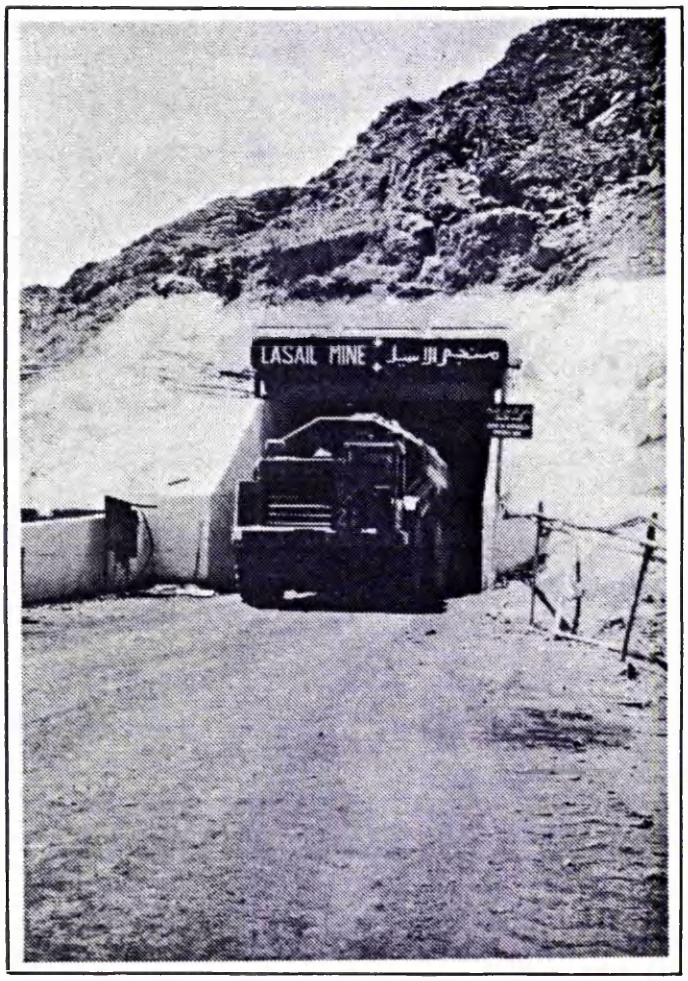
until about 940 AD. About 100,000 tonnes of slag were produced at Lasail which is now the site of the larger of the Oman Mining Company's, (OMC), two new mines.

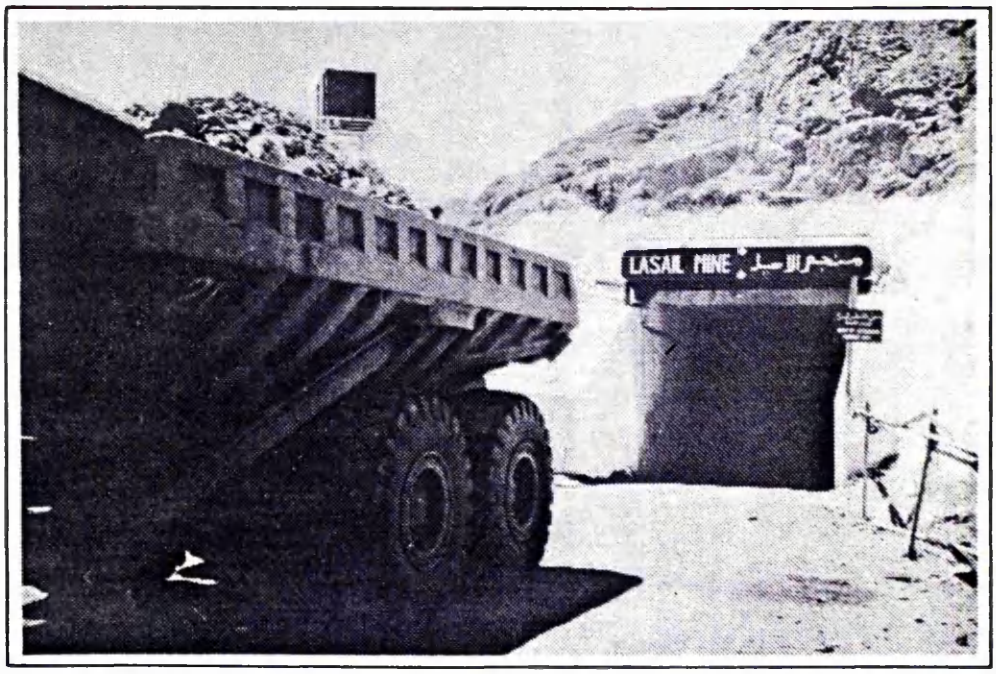
Exploration work in the mid-1970s was followed by a feasibility study for a mining-concentrator-smelter complex, to which an electrolytic refinery was later added. The cost of the project was US$213 mn of which the Saudi Development Fund, (SDF), provided US$100 mn with the remainder coming from the Omani government. The OMC was created in early 1981 to administer the mining, processing and marketing of the copper reserves.

Mining which began in the same year uses the standard sub-caving method to produce about 3,000 tonnes of ore each day, **(See Figure 3.2)**. Like all modern underground mines the Lasail and Bayda mines have large diameter incline ramps rather than shafts, **(see Figure 3.9)**. In this way bulldozers can load the ore onto 30 tonne articulated trucks which then drive directly out of the mine via the ramp portal to the processing plant.

The ore from the stockpile is first crushed to less than 250 mms pieces which are fed into the concentrator. This uses autogenous milling and sea water, which has been piped 34 kms from the coast, to produce 250 tonnes of 22% concentrate each day. This is then pelletised, dried and fed into the smelter which, together with

**Figure 3.9 Lasail Copper Mine, Oman.**



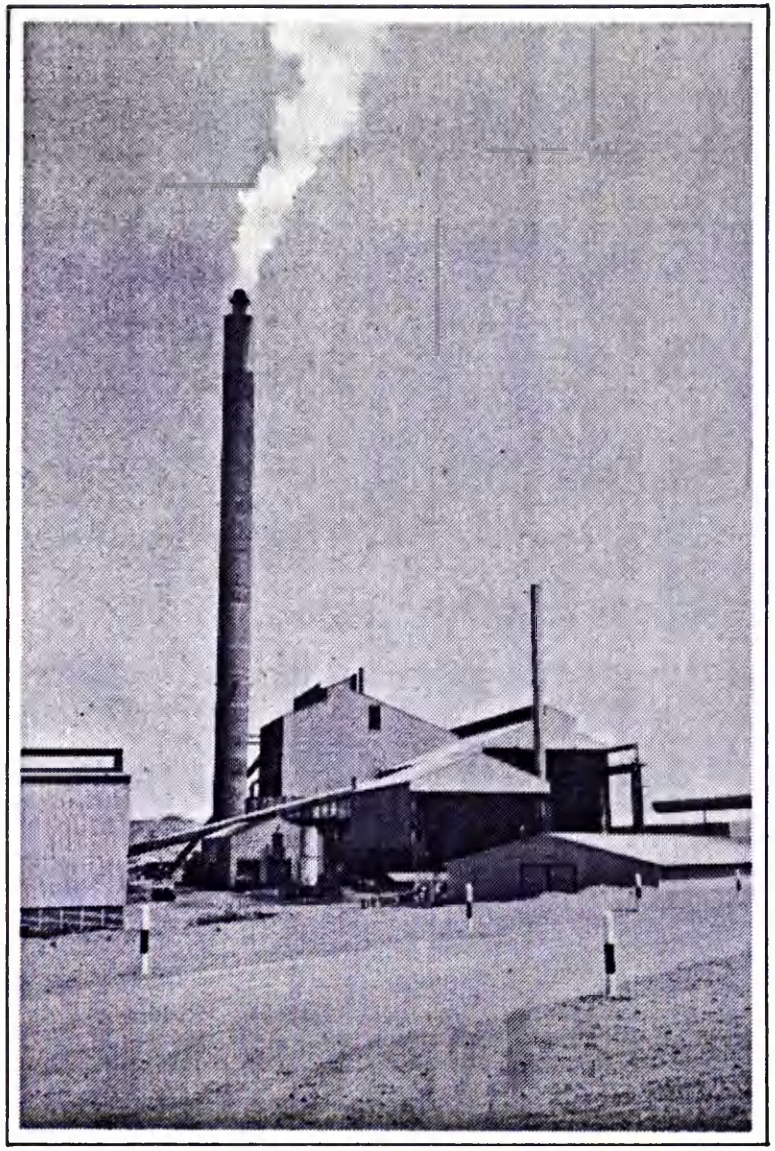




*Source: C.G. Gurdon.*

local limestone and silica flux, produces copper matte and slag. The neighbouring refinery processes the matte to produce 99.75% pure copper anodes and finally 99.98% pure copper cathodes. These are then transported to the port of Mina Qaboos near Muscat from where it is exported. Because of the high level of purity of the OMC's copper cathodes it receives a premium price for its product on the London Metal Exchange, [92], (See Figure 3.10).

In 1984, which was the first full year of production, 15,060 tons of refined copper valued at US$21 mn, as well as 5,900 tons of chromite, 1,600 kgs of silver and 52.5 kgs of gold with a total value of US$1.65 mn, were produced by OMC, [93]. Since then production has fluctuated between 15,000 and 20,000 tonnes which it is unlikely to exceed. By world standards it is therefore a very small copper mining and processing operation.

There are a number of problems with the project. The most important of these include the low price of copper on the world market which makes its operation economically unprofitable. Secondly the copper content of the ore which is being mined has not been as high as was expected. In the long term the most urgent problem is the fact that the reserves currently have such a short life. Further exploration work is therefore being carried out to try and increase the total reserves.



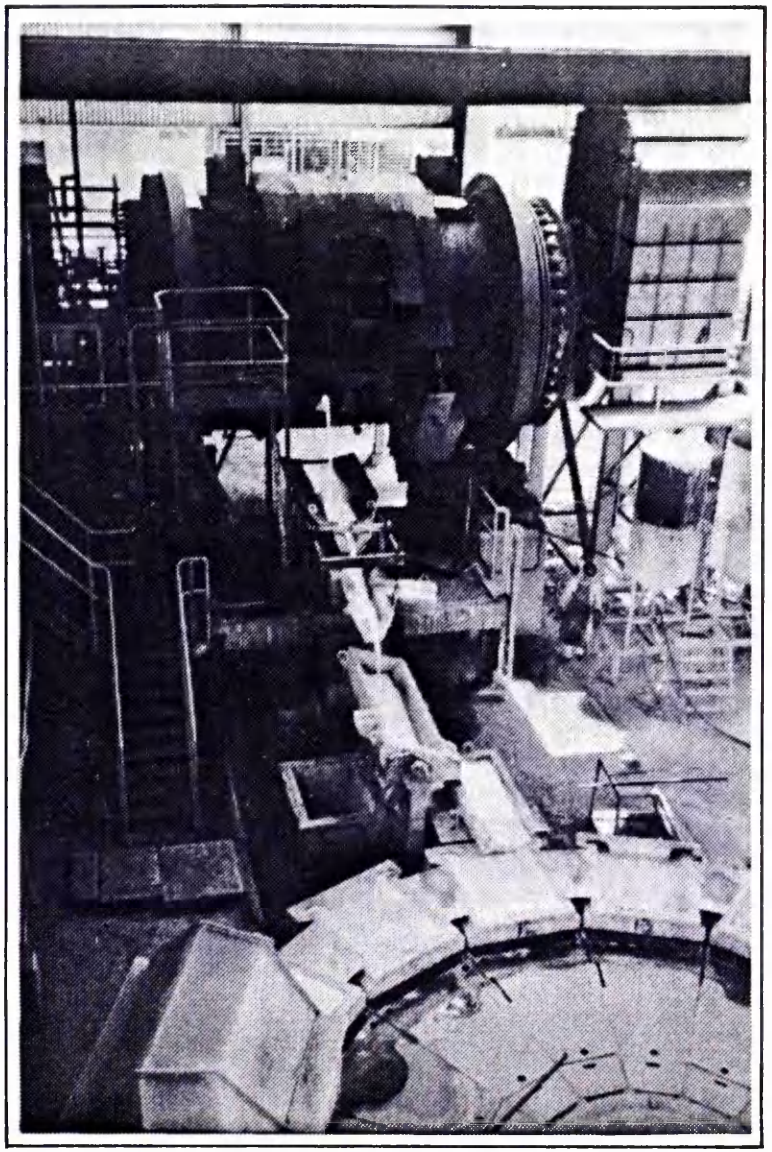


**Figure 3.10 Oman Mining Company, Copper Refinery.**

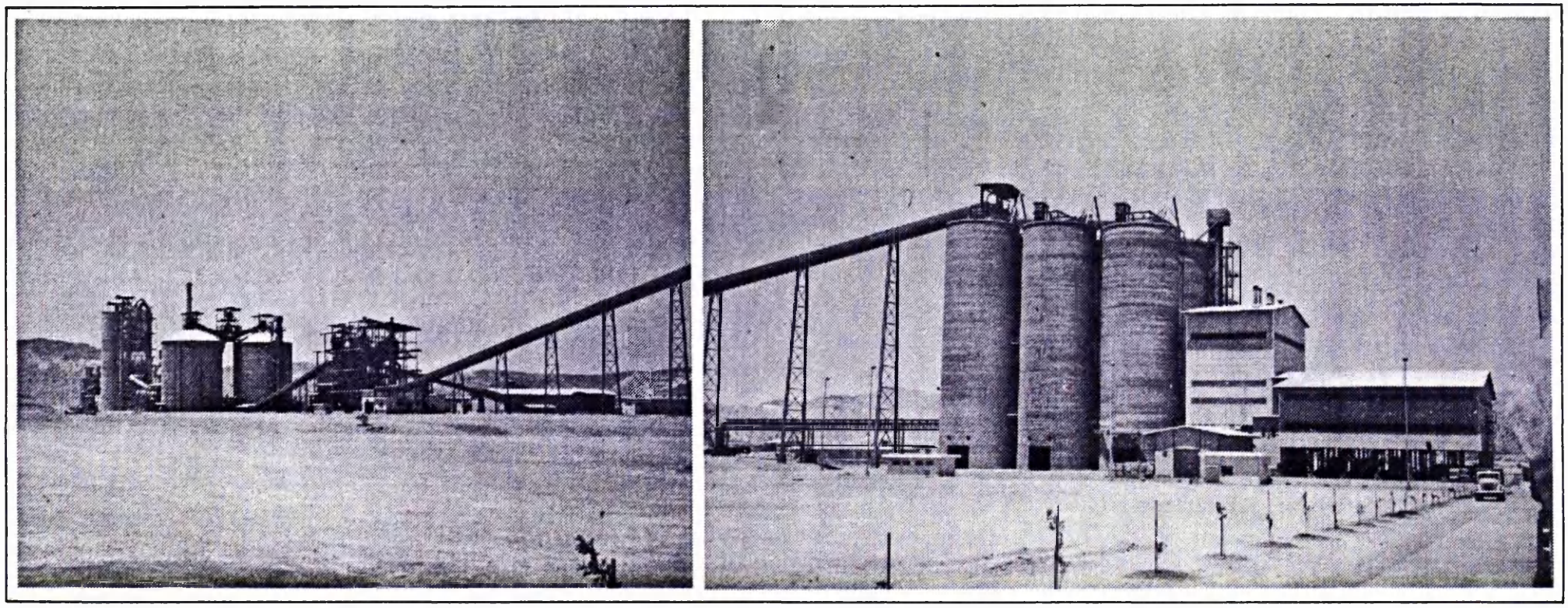
***Source: C.G. Gurdon.***

Unless this is successful OMC are considering refining imported copper concentrates, [94].

The government is determined that the copper project should succeed. It is seen as the focus for the regional economic development of northern Oman and further industry is planned in the area. These issues are analysed in greater detail in **Chapter Seven**.

Oman's only other major non-hydrocarbon mineral project is the cement industry which uses indigenous limestone, silica and quartz, but imported gypsum. The Oman Cement Company, (OCC), has a 600,000 tonne capacity plant at the Rusyal Industrial Estate outside Muscat, **(See Figure 3.11)**. It began operations in November 1983 and is already operating at 110 percent of its original intended capacity. The company owns some of the various quarries which are located a few kilometres away and leases others from the government. It uses 800,000 tonnes of local limestone and about 100,000 tonnes of quartz. There is a limitless supply of limestone because most of the country is composed of limestone which is also used by the hundreds of private building material companies. Besides the Rusyal plant there is also a privately owned 200,000 tonnes/year cement plant at Raysut in southern Oman which is administered by the UK-based Blue Circle Cement Company, [95].

**Figure 3.11 Oman cement company, Rusyal Industrial Estate, Muscat.**



*Source: C.G.Gurdon.*

### 3.2.11d Qatar

Although it is not a city state like Kuwait, in many ways Qatar is similar in its paucity of non-hydrocarbon mineral resources. The Qatar National Cement Company, (QNCC), is almost the only user of the limited deposits - the vast majority of the other building materials being imported by Qatari merchants. The QNCC is one of the oldest cement companies in the Gulf, having been established in 1965. It is a share holding company with a 43 per cent government holding and the remainder being privately owned.

The plant is located at Umm Bab on the south-west coast of the Qatar peninsula, about 80 kms from Doha. It has an annual rated capacity of 300,000 tonnes of cement, 30,000 tonnes of calcinate lime and 19,750 tonnes of hydrated lime. The plant has been operating at full capacity since 1983 but it cannot meet Qatar's 380,000-450,000 tonne cement requirement. All of its raw materials are locally produced at QNCC's quarries. The project is totally self supporting, having its own power and water supplies, a small modern village with shops, cinema, restaurants and clinics. Together with the other cement industries in the Gulf, it is analysed in greater detail in later chapters, [96].

### 3.2.11e United Arab Emirates

The non-hydrocarbon mineral industry of the United Arab Emirates, (UAE), is dominated by the cement industry. Indeed, except for some other building materials, the limestone and gypsum which are used by the cement plants are its only minerals. The most important statistic about cement in the UAE is that while, as the table below shows, the combined capacity of the plants is 8.9 mn tonnes the total domestic demand is only 1.8 mn tonnes. This is naturally a major problem and most of the plants are now operating at well below capacity.

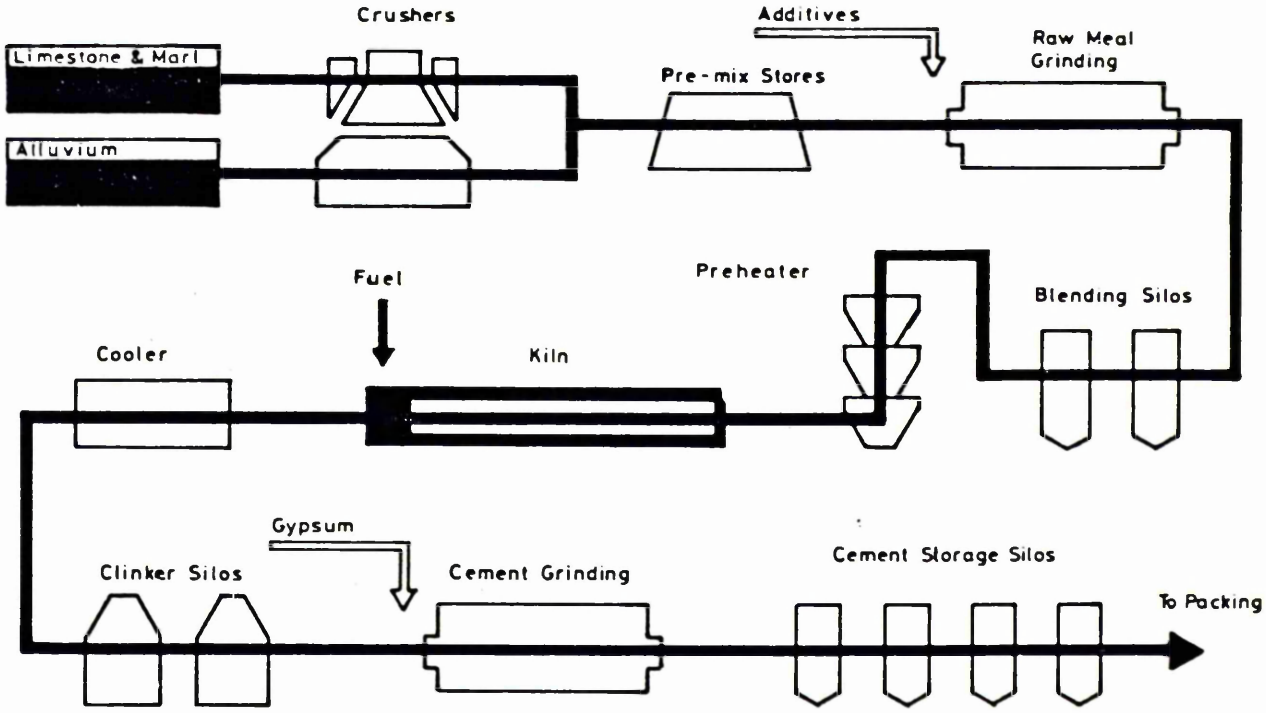
**Table 3.20 : Capacity of UAE Cement Plants (000s t/y)**

| Company | Emirate | Clinker | Grinding |
|---|---|---|---|
| Union Cement Company | Ras Al Khaimah | 950 | 1,330 |
| Gulf Cement Company | Ras Al Khaimah | 935 | 1,300 |
| Fujairah Cement Industries | Fujairah | 530 | 790 |
| National Cement Industries | Dubai | 500 | 2,000 |
| Sharjah Cement Company | Sharjah | 265 | 1,330 |
| Al Ain Cement Company | Abu Dhabi | 800 | 1,200 |
| Ajman Cement Company | Ajman | - | 950 |
| **TOTAL** | | **3,980** | **8,900** |

**Source** : C.G.Gurdon, **Cement : Is there a way out of the UAE enigma ?**, Arab Industrial Review 1985, **op cit**, p.109-112.

Clinker is produced by combining crushed limestone, marl and alluvium in a pre-heater and kiln. Small quantities of silica, bauxite, iron ore and other additives are also used in the making of special types of cement. The clinker is then ground with gypsum to produce Ordinary

**Figure 3.12**
**Flow diagram: Dry process cement plant.**




# Flow diagram - dry process

The basic chart shows the dry process of cement manufacture used at Dibba. In this process the raw materials - limestone, marl, alluvium are ground and blended as dry powders. They then pass through the preheater and kiln where they are converted to cement clinker. This clinker is then ground with gypsum to form Portland Cement.

***Source: Fujairah Cement Company***

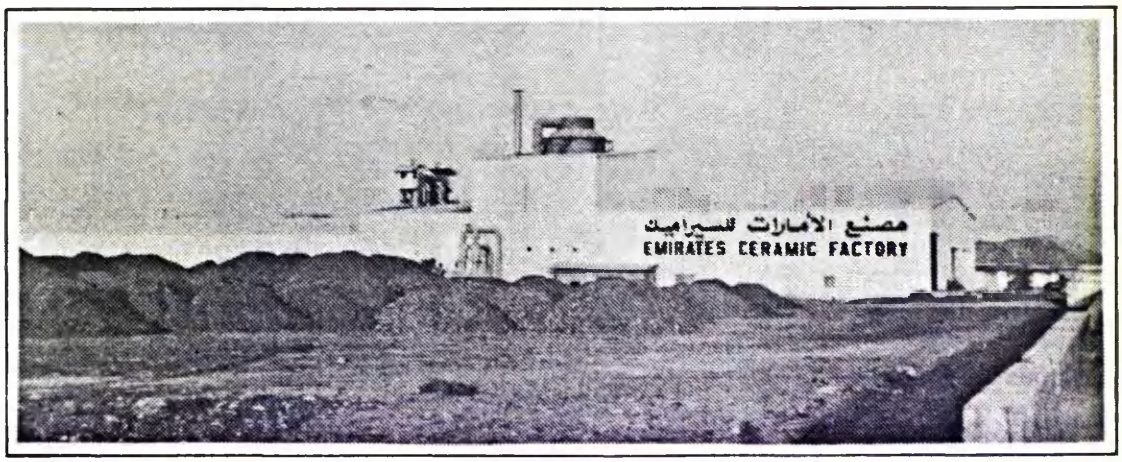
Portland Cement, (OPC), or Sulphur Resistant Cement, (SRC), which is used in offshore and harbour work, **(See Figure 3.12)**.

There are a number of reasons for the abundance of cement plants in the UAE. During the 1970s construction boom, it was an important and obvious import substitution industry which could act as a catalyst for other industries. In addition the political and economic competition between the various Emirates led to major and unnecessary duplication of airports, harbours and numerous other items including cement plants. On the supply side the other major reason was the availability of huge quantities of limestone which constitutes about 80% of cement's raw materials. The problem is that while Ras Al Khaimah and Fujairah have local supplies, the other Emirates do not and are therefore at a distinct disadvantage.

Besides cement the only other mineral industries in the UAE are the neighbouring Fujairah Rockwool Factory (FRF) and Emirates Ceramic Factory (ECF) as well as the Fujairah Rock & Aggregate Company (FRAC). The first two are wholly owned by the Fujairah government and are administered by the Belgium-based Geoconsult. They started in 1982, with capacities of 5,000 tonnes of rockwool and 600,000 square metres of ceramic tiles, and reached full production in 1985, **(See Figure 3.13)**.

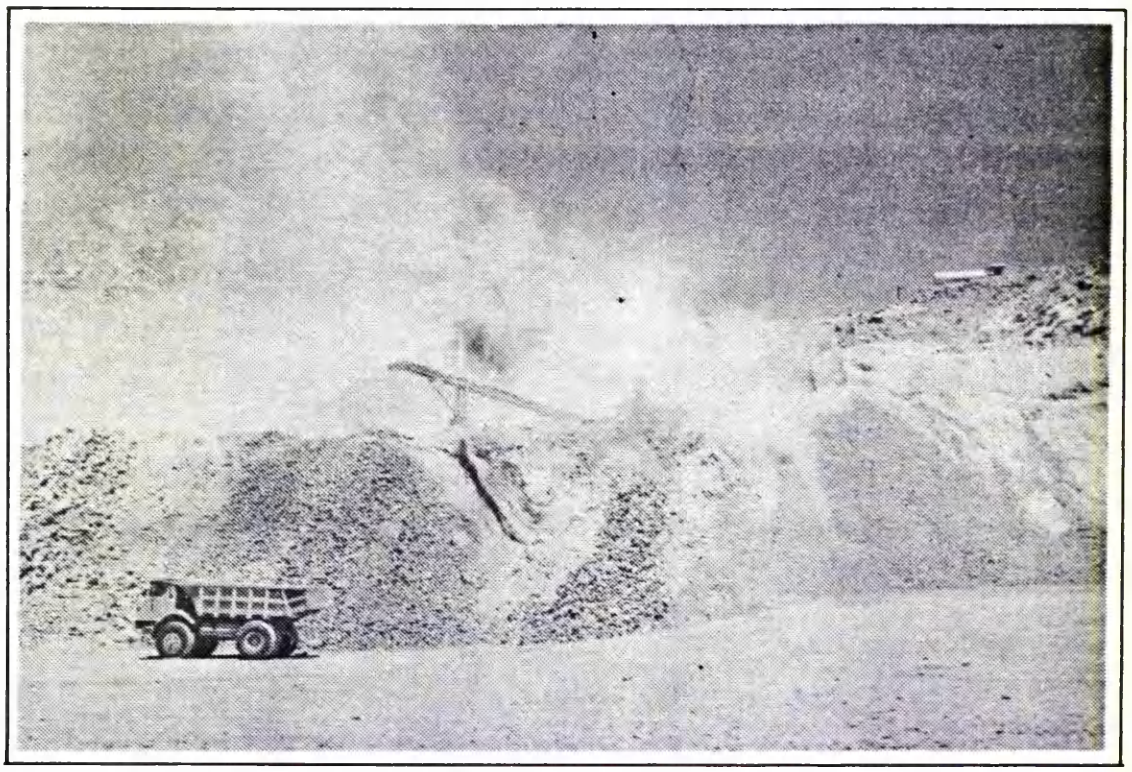
**Figure 3.13 Fujairah Rockwool Factory and Emirates Ceramic Factory.**

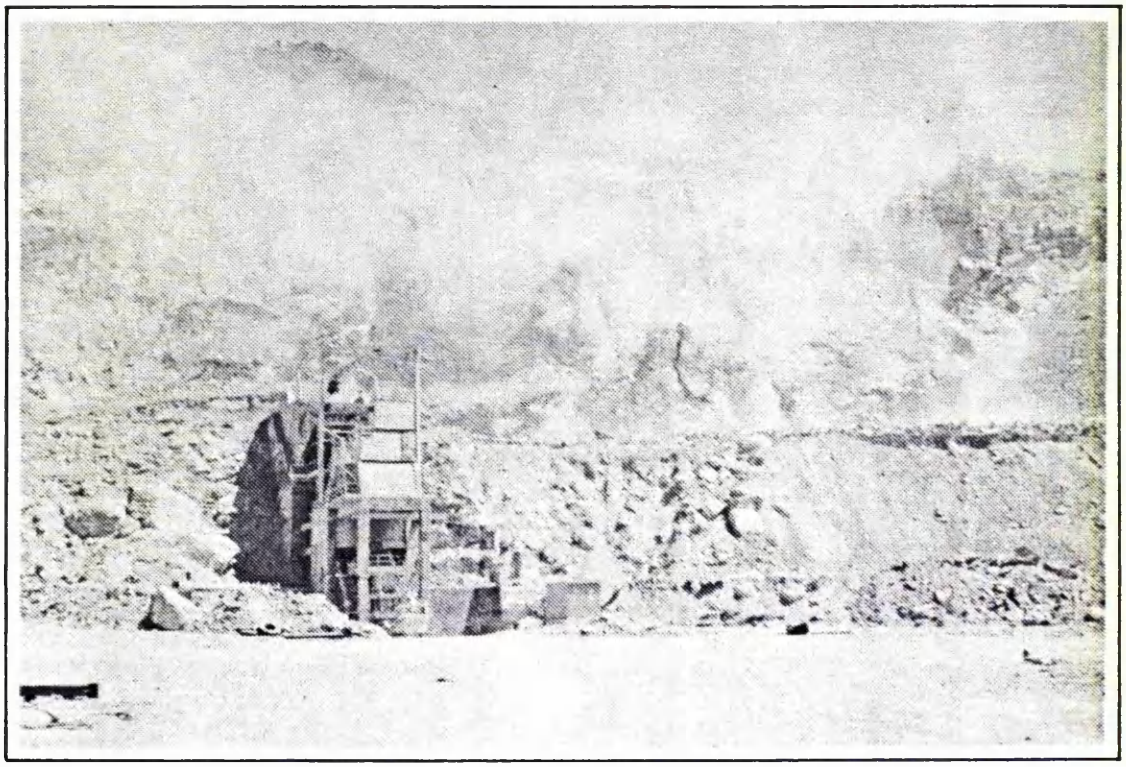





***Source:* C.G. Gurdon.**

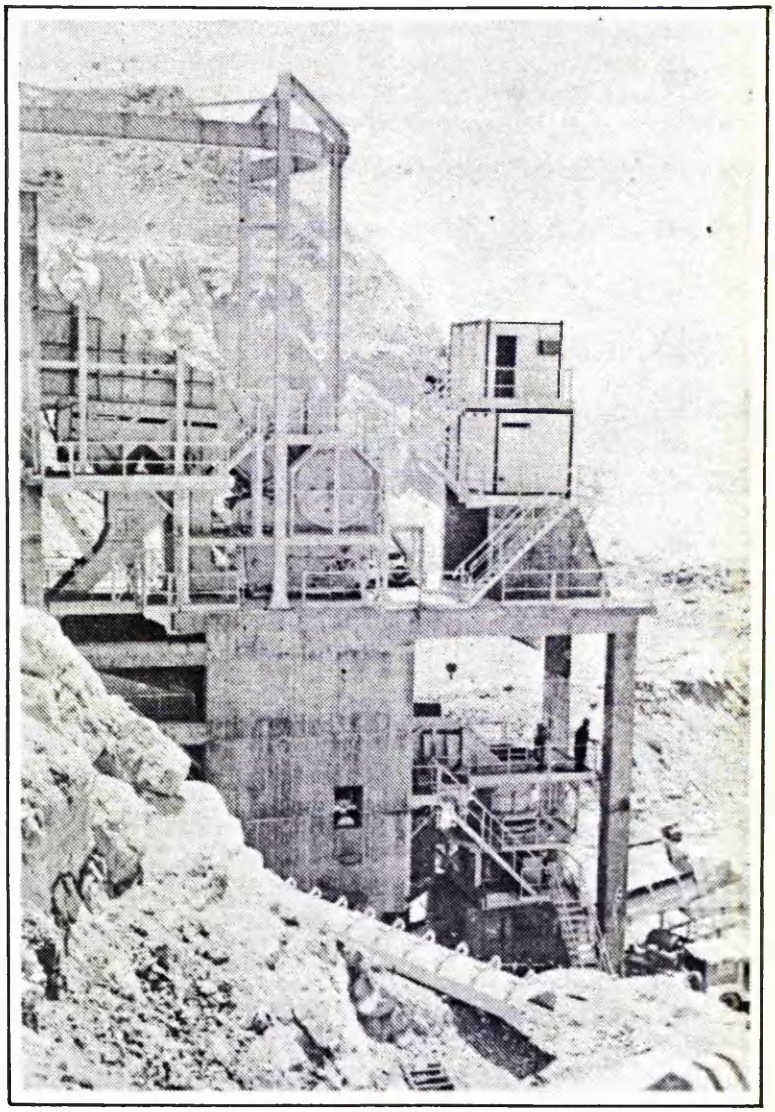
**Figure 3.14 Fujairah Rock and Aggregate Company.**

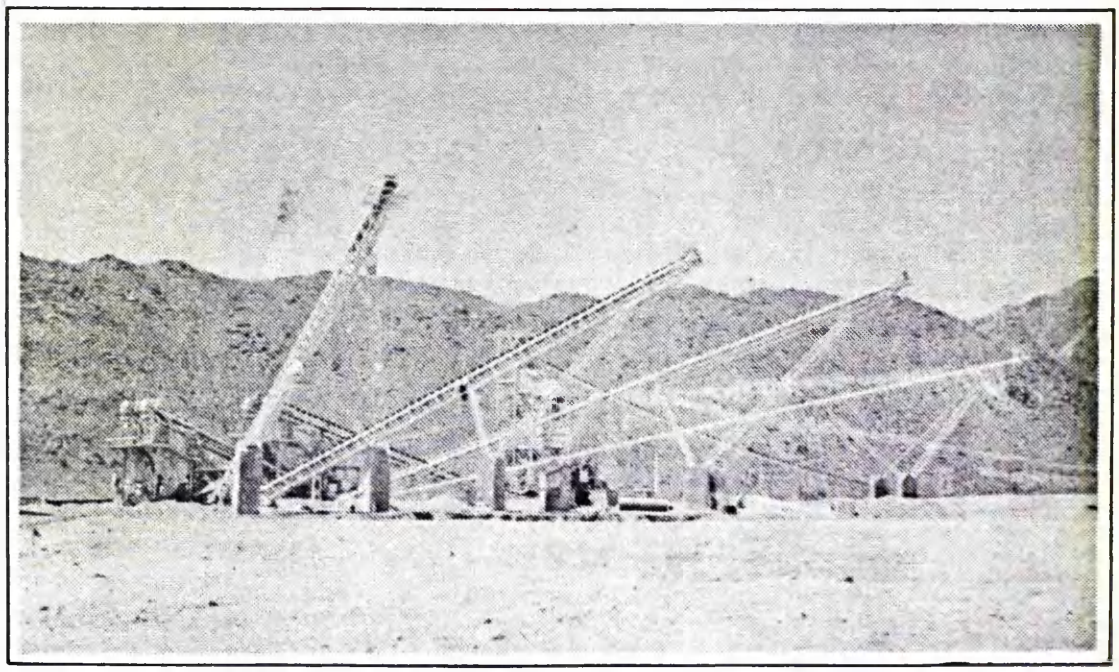




***Source: C.G. Gurdon.***

**Figure 3.15 FRAC Quarrying Equipment.**





*Source: C.G. Gurdon.*

Rockwool is produced by heating basalt stone to 1,400 degrees centigrade and then spinning it like candy-floss to create an insulating material like fibre glass. The new capital intensive ceramic tile factory uses a special hard clay-like shale which is found nearby. The company has its own quarries which produce these raw materials which are then delivered to the two factories.

The FRAC opened the largest aggregate crushing quarry and plant in the Middle East in 1985. The 3 mn tonnes capacity project reached full production in its second year of operation. The company is owned by the Fujairah government, (50%), Gulf Aggregate of Kuwait, (35%), and the Saudi Arabian based Bin Ladin Organisation, (15%). Like Ras Al Khaimah, which also has no oil, Fujairah is now placing great emphasis on the building material industry. Given the availability of abundant reserves of such materials and the large potential market in the Gulf, these projects seem both logical and viable, [97], **(See Figures 3.14 & 3.15 above).**

### 3.2.11f North Yemen

The non-hydrocarbon mining sector of North Yemen is still in its infancy but shows considerable potential. As exploration work in Saudi Arabia has revealed, the Arabian Shield which covers almost all of North Yemen is very mineral rich. Consequently there has been a

substantial increase in the level of aerial survey work in recent years and the government is confidant that metallic minerals including copper, lead, zinc and silver will be found in economically viable quantities.

At the moment the only large scale mineral exploitation is at Salif, on the coast to the north of Hodeida, where the Yemen Salt Company is extracting some of the 25 mn tonnes of rock salt. In addition rock and aggregate is quarried at various sites and cement blocks and tiles are also produced. The **Table 3.21** provides some of the recent production statistics for these items.

**Table 3.21 : Mineral Production in North Yemen 1978-81**

| Mineral | Unit | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|---|
| Rock salt | 000s t | 58 | 73 | 154 | 64 |
| Rock & Aggregate | 000s cu.m | 19 | 78 | 76 | 567 |
| Cement | 000s t | 66 | 68 | 81 | 85 |

**Source** : Economist Publications, **EIU Regional Review : The Middle East & North Africa 1986**, op cit, p.274

### 3.2.11g South Yemen

Like its northern neighbour, South Yemen's mineral production is very small and is confined to salt and building materials. So far there is no cement industry although a 350,000 tonnes capacity plant was being planned at Batis, about 100 kms north-east of Aden, before the 1986 civil war. This is despite the fact that traditional building materials are possibly more

suitable for the harsh environment, and that imported cement will still be cheaper.

The other building materials are important for the country's industrial sector. Volcanic slag is used in the manufacture of slabs for prefabricated buildings. Gypsum is used to produce chalk and plaster, while floor tiles and concrete blocks are also made. The construction sector is one of the country's few industries which is well endowed with sufficient raw materials, [98].

South Yemen's salt production is centred on the evaporation of sea water at Khawi Maksar where the Public Organisation for Salt operates large salines. In addition rock salt is produced from salt domes near the border with North Yemen. **Table 3.22** below provides the salt production figures for a seven year period in the 1970s.

**Table 3.22 : Salt Production in South Yemen 1971-77**

| Year | Production |
|---|---|
| 1971 | 66,168 tonnes |
| 1972 | 71,128 " |
| 1973 | 42,815 " |
| 1974 | 34,270 " |
| 1975 | 6,876 " |
| 1976 | 36,502 " |
| 1977 | 100,681 " |

**Source** : Ministry of Planning, **Statistical Yearbook 1980**, Aden, PDRY, p.116

## 3.3 Conclusions
**********

This chapter has dealt with non-hydrocarbon mineral production in the Arab Middle East. It has been seen that parts of the region, notably ancient Egypt, were the world's cradle of mining. Since then, however, mining activity was very sporadic until after the Second World War. There were long periods of inactivity when technical or economic factors made mining and quarrying impossible. Modern scientific methods have now enabled previously unobtainable deposits to be mined economically.

The country by country survey of mineral production showed that the nations of the Maghreb in general, and Morocco in particular, have by far the largest mining industry. By contrast many of the small Gulf states have no minerals except for a few building materials. Indeed, excluding these, phosphates are the only major mineral outside the Maghreb. With the exception of an Egyptian iron ore mine and few small gold, chrome and copper mines, there are no metallic mineral mines to the east of Tunisia.

The chapter showed that phosphates are by far the most important single mineral in the region. It accounts for about a quarter of world's phosphate production and half of its exports. By contrast, with the exception of

Algerian mercury, the region is totally insignificant in terms of world mineral production.

Despite the relative paucity of the deposits, the chapter showed that there has been a resurgence of exploration activity. The majority of the countries in the region are now trying to develop what reserves they have. This has been shown by the emergence of new phosphate producers in Egypt, Iraq and Syria as well as the rehabilitation of a number of gold mines in the Arabian Shield. In addition modern scientific methods including satellite imagery have enabled exploration activity to locate new and economically viable reserves. Consequently despite the currently low level of mineral production in the region, excluding the Maghreb, the chapter has shown that there is considerable potential for the future.

**Chapters Two** and **Three** have attempted to provide as comprehensive an analysis as possible of the non-hydrocarbon mineral deposits and their production. Having examined he background it is now possible to look at various related issues. Two of the most important are the mining industry's role as a a major employer and the import and export of minerals. A study of these issues is then followed by an examination of the mining sector in the national economies of the Arab Middle East

states. An analysis of the role of mining in the regional economic development of four diverse areas is then undertaken in the final section of the thesis. We therefore turn to an analysis of employment in the mining industry throughout the Arab Middle East.

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# CHAPTER FOUR
**********

# EMPLOYMENT IN THE MINING SECTOR
**********

## Introduction.
**********

This chapter analyses the vitally important topic of employment in the mining sector. It examines the contrast between the large number of men who are employed in the relatively large Maghrebi mining industries and the very small numbers engaged in the capital intensive mining projects in the Gulf. The problem of recruiting sufficient numbers of suitably trained personnel to work in an often harsh environment is also considered. It will be seen that this has led to the use of "third country nationals", or TCNs as they are usually known, in the richer countries. The role of the mining sector as an employer in various regions of particular countries is studied in further detail.

## 4.1 The Number of Mining Employees.
**********

It is very difficult to estimate the number employed in the Middle East mining sector. Some countries provide highly detailed statistics while others provide almost none. The problems are exacerbated by the fact that the statistics that are available normally refer to

government projects and exclude private quarries and brickworks. Similarly, the decision of where to draw the line between mining and quarrying and mineral processing is very blurred. Should cement industry or metal refinery workers be included in the employment total ? Whether or not to include "Third Country Nationals" in the employment total is an additional problem.

**Table 4.1**, which details the number of employees who work in the mining and quarrying sector in the Middle East, attempts to provide the most comprehensive information currently available. Where possible the individual companies or projects are included, together with the overall total. It should be noted that in some countries the total includes the quarrying of building and construction materials and the cement industry, while this is excluded from other available national figures. As an example the statistics for Oman and Tunisia only include the principal mining projects while those for Egypt and Libya include all aspects of non-hydrocarbon mining and quarrying. The figure for Iraq includes a breakdown of employment in the building material industry, which probably goes beyond the scope of this study. In addition the dates of the statistics vary from country to country. General estimates have been made for those countries which do not provide an overall figure Consequently the table should be treated

as a very approximate guide to the overall picture, rather than a comprehensive breakdown of employment on a project by project basis.

**Table 4.1 : EMPLOYEES IN THE MIDDLE EAST MINING SECTOR**

| COUNTRY | TOTAL EMPLOYEES |
|---|---|
| **Morocco [01]** | **61,571** |
| (Office Cherifien des Phosphate) | ( 31,179 ) |
| (Phosboucraa) | ( 2,456 ) |
| (Lead & Zinc Production) | ( 2,331 ) |
| (Copper Production) | ( 674 ) |
| (Iron Production) | ( 1,050 ) |
| (Manganese Production) | ( 450 ) |
| (Silver Production) | ( 706 ) |
| (Cobalt Production) | ( 566 ) |
| (Antimony Production) | ( 132 ) |
| (Fluorspar Production) | ( 250 ) |
| (Barytes Production) | ( 1,442 ) |
| (Salt Production) | ( 128 ) |
| (Ghassoul Production) | ( 190 ) |
| (Ceramic Clay Production) | ( 20 ) |
| **Algeria [02]** | **45,446** |
| Mining & Quarrying - Public Sector | 14,608 |
| ( Erem ) | ( 3,160 ) |
| ( Enof ) | ( 3,700 ) |
| ( Ouenza ) | ( 1,218 ) |
| ( D'Jebel Onk ) | ( 845 ) |
| Mining and Quarrying - Private Sector | 3,124 |
| Building Materials, Ceramics & Glass - Public | 22,029 |
| Building Materials, Ceramics & Glass - Private | 5,685 |
| **Tunisia [03]** | **24,000** |
| (Compagnie des Phosphates de Gafsa) | ( 14,016 ) |
| (Sotemin) | ( 2,756 ) |
| (Iron) | ( 1,038 ) |
| (Marine Salts) | ( 465 ) |
| (Research) | ( 578 ) |

**continued overleaf .....**

continuation of Table 4.1

| | |
|---|---|
| **Libya [04]** | **10,900** |
| **Egypt [05]** | **59,800** |
| **Sudan [06]** | **10,000** |
| (GMRD - Khartoum) | ( 275 ) |
| (GMRD - Port Sudan ) | ( 200 ) |
| (SMC - Ingessana ) | ( 250 ) |
| (SMC - Port Sudan ) | ( 50 ) |
| (BRGM - Port Sudan ) | ( 225 ) |
| (Minex - Gebeit ) | ( 208 ) |
| **Jordan [07]** | **8,068** |
| **Mining** | **5,288** |
| ( Jordan Phosphate Mining Company ) | ( 3,933 ) |
| (Ruseifa) | ( 650 ) |
| (El Hassa) | ( 1,650 ) |
| (Wadi El Abiad) | ( 450 ) |
| ( Arab Potash Co. ) | ( 1,355 ) |
| **Quarrying** | **1,203** |
| **Lebanon [08]** | **2,500** |
| **Syria [09]** | **13,000** |
| **Iraq [10]** | **24,924** |
| (Mishraq Sulphur Mine) | ( 538 ) |
| (Phosphates) | ( 192 ) |
| (Bricks) | ( 16,315 ) |
| (Cement) | ( 5,319 ) |
| (Glass & Products) | ( 1,663 ) |
| (Tiles & Mosaics) | ( 1,055 ) |
| (Stones) | ( 226 ) |
| **Saudi Arabia [11]** | **5,100** |
| **Kuwait [12]** | **942** |

continued overleaf
Table 4.1 continued .....

| | |
|---|---|
| Oman [13] | 2,500 |
| (Oman Mining Company | 843 ) |
| (Oman Cement Company | 360 ) |
| (Raysut Cement Company | 200 ) |
| Qatar [14] | 750 |
| (Qatar National Cement Company | 485 ) |
| U.A.E. [15] | 3,500 |
| (National Cement Company | 500 ) |
| (Union Cement Company | 465 ) |
| (Fujairah Cement Industries | 200 ) |
| (Ras Al Khaimah Co. for White Cement | 250 ) |
| (Fujairah Rock & Aggregate Company | 180 ) |
| (Emirates Ceramics Factory including marble | 260 ) |
| (Fujairah Rockwool Factory | 70 ) |
| North Yemen [16] | 576 |
| South Yemen [17] | 1,500 |

Sources : Included in footnotes.

## 4.2 Capital Intensive or Labour Intensive ?

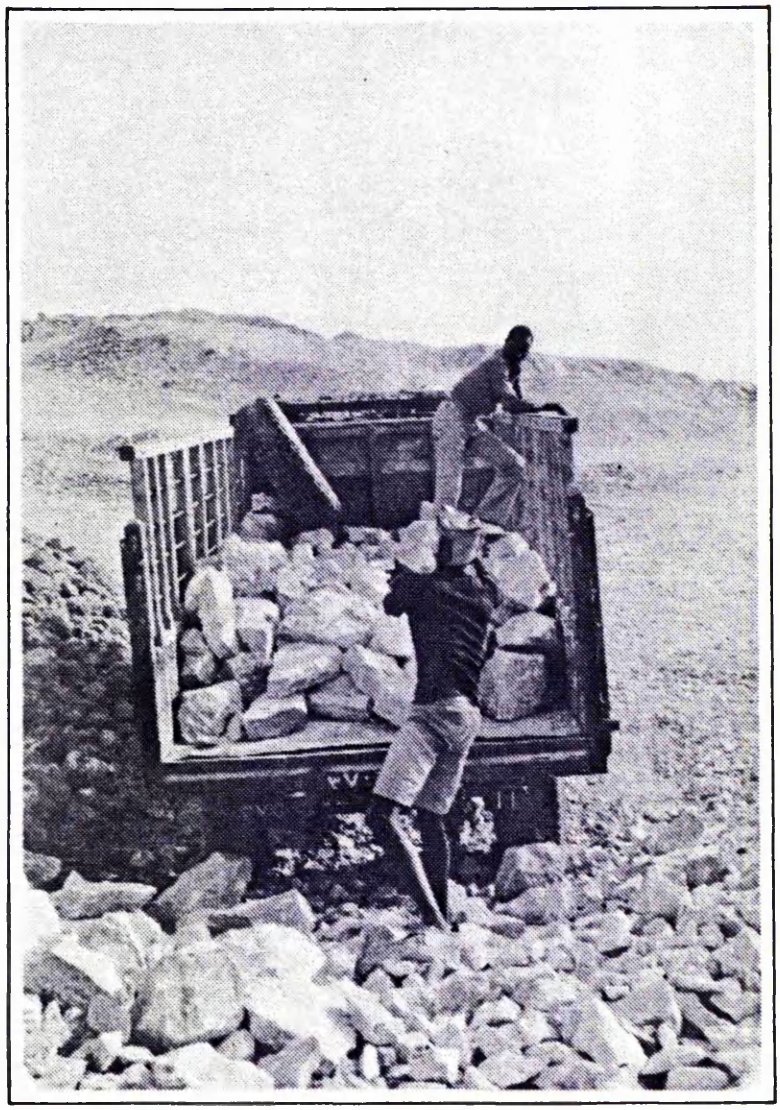
Mining operations in the Middle East vary considerably in terms of the use of capital equipment. They range from almost exclusively manual quarrying to some highly capital intensive underground mining projects. The balance between use of capital and labour is determined by several factors. These include the availability and price of both, the value of the product being extracted, the mining environment, the technical problems involved,

the level of investment and the relative wealth of the mine owners, be they private companies or governments.

An example of an operation which uses minimal capital equipment is the Bir Eit gypsum quarrying operation in Sudan's Red Sea province. Although dumper trucks were used to load the gypsum until 1976, the high cost and lack of fuel and spare parts necessitated the return to a manual operation. As it was discovered during the author's visit to Bir Eit, it takes two men an hour to load each seven tonne truck, **(see Figure 4.1)**. Naturally such low productivity is highly inefficient, particularly considering that the area's gypsum reserves total hundreds of million of tonnes, **[18]**.

If some of Sudan's mining operations suffer from an almost total lack of capital in Saudi Arabia there is almost a surfeit of capital. A perfect example is the prestigious Mahd adh Dhahab gold mining project. The rehabilitation of this small but very rich ancient mine project is the government's showcase mining scheme and consequently nothing is too good or expensive. Besides the latest equipment and excellent working conditions, a 150 mile tarmac road was built to link the mine to Jiddah. In addition a new runway was constructed next to the mine specifically for King Fahd's flying visit in April 1984.

**Figure 4.1**
**Gypsum production at Bir Eit, in Sudan's Red Sea Hills.**



***Source: C.G. Gurdon.***

In confidential interviews with the author, senior mining experts working in the country stated that if such a rich mine had been located in Canada or Australia it would have been worked out by a few miners working with second hand equipment and living in tin shacks. In Saudi Arabia ample money is, or rather until recently was, always available for such projects. Unfortunately this only led to delays in bringing the mine into operation. The development of the Gebeit gold mine in Sudan, which is similar to Mahd adh Dhahab and began at almost the same time, was much quicker and it came into production much earlier. This was partly because the project did not have almost limitless resources and economic considerations had to be taken into account by its private sector development company, [19].

It is obvious that the balance between capital and labour has to be right. A project which has insufficient capital equipment will almost certainly remain small scale and relatively inefficient, no matter how large and rich the mineral deposit. However, the over-emphasis on modern equipment and infrastructural development can delay and hinder a potentially very profitable small scale mining operation. There are many examples of both such types of projects, not only in Saudi Arabia and Sudan but throughout the Middle East.

## 4.3. The Problems of Recruitment
**********

The cost, availability and requirement of both capital and labour play an integral part in determining the use of both in mining operations. In most of the countries of the region, including those in the Maghreb which have large mining industries, there are no shortages of competitively priced labour. Indeed, as it will be seen in later chapters, mining and quarrying is an important employer in many areas of the Middle East.

In the oil rich countries there is a major problem in recruiting sufficient numbers of trained mining personnel. In Saudi Arabia, for example, the generally high standard of living means that few Saudi nationals are prepared to work underground. Consequently the vast majority of both the skilled and unskilled jobs in the mining sector are done by non-Arab, non-Western "Third Country Nationals", (TCNs) . The majority are from the Indian sub-continent or South-East Asia. Filipinos are often used because of their experience in the large domestic mining industry. Besides being highly skilled and hard workers the TCNs' wages are substantially lower than those received by Saudi nationals.

These factors result in an unusual staffing system in almost all the mining and quarrying projects in the

Gulf, whether it is gold mining in Saudi Arabia, copper mining and processing in Oman, or cement production in the UAE. Officially the senior management is composed of nationals from the host country. In reality, however, there is usually a Western expatriate team of consultants who act as "shadows" and provide the actual day to day project management. Then there are usually Western departmental chiefs who run the mining and processing operation which is undertaken by skilled TCNs. The majority of the service jobs in the camps are done by unskilled TCNs with no mining experience. There is then a small pool of men from the local community who act as drivers and night watchmen.

The locals are often unnecessary but are employed for two reasons. They increase the number of nationals working on the project and thereby make it appear more valuable to the local area. It also ensures that the mining project is welcomed by the local community. There are some operations which dispense with the illusion by simply paying local sheikhs and tribal elders a monthly retainer without expecting them to do any work. During fieldwork it was seen in Saudi Arabia that these can be more than US$1,000 a month and are treated as a form of insurance policy by the project's management, [20].

Besides these factors there is also an additional problem of recruiting local geologists and mining

engineers. Because there are still so few qualified nationals they are highly valued. Naturally the governments want to train and use their own nationals rather than expatriates for both prestige and financial reasons. Recognising this, most newly qualified graduates expect and receive a government desk job and are unwilling to undertake fieldwork. The result is that a graduate in his early twenties with negligible experience is able to earn a very high salary in Jiddah, Dubai or Muscat while his expatriate "shadow" usually does most of the actual work. Despite this, the graduate is often officially senior to the "shadow" and usually earns substantially more.

The result is that mining projects are often top heavy with over-paid and unproductive Gulf nationals. Consequently many of the government schemes are less economically viable than they might otherwise be. This situation is far less prevalent in some of the private mining projects which have to be geared towards profit. The problem was highlighted by an analysis of the country's mining industry by expatriate consultants, who recommended that the over-rapid promotion of Saudi graduates should be avoided, [21].

There are a number of problems associated with the recruitment and training of mining personnel in the

Middle East. Outside the Maghreb there is little or no tradition of underground mining and it is therefore a new experience for most workers. The majority of the mines are located in areas with a harsh climatic environment where there is little or no social infrastructure. Life in mining camps is therefore usually both harsh and boring, holding few non-financial attractions for its workforce. By its very nature underground mining is a sophisticated industry which requires a reasonably skilled workforce. Normally the lack of such personnel necessitates the recruitment of men from the urban areas.

In the rural areas the majority of the inhabitants are either nomadic pastoralists or small scale private farmers. Underground mining work, which requires both discipline and good time keeping, generally holds little attraction for such people. This is particularly true in the richer countries where there is almost a cradle-to-grave welfare system. Therefore, while locals are willing to be employed above-ground by a mining company as drivers or night watchmen, few are prepared to work on a dirty and arduous underground mining shift system.

Although they are not unique to the mining industry there are a number of other problems which are associated with employing locals in some Middle East countries. The strict Islamic nature of some societies

can create disruptions as workers have to stop to pray up to five times a day which can be both inconvenient and dangerous in a mining environment. Strict observance of the fasting month of Ramadan usually creates a relatively unproductive period of the year. Indeed, many industrial companies and projects are virtually forced to close for the month.

As already noted, many of the indigenous employees are from distant cities and are consequently separated from their families for long periods. In the event of a family crisis or celebration their responsibilities can lead to long periods of absence from work. These can naturally disrupt the smooth and efficient working of both a mining and mineral processing operation. This is particularly true in the case of a smelter which has to be kept hot and in use twenty-four hours a day.

As a result of these problems mining projects in many countries are forced to recruit TCNs. Not only are they a reliable workforce but they are also normally cheaper to employ than urban based locals. In addition they are almost captive employees since, because work permits are issued specifically for one company, they cannot usually transfer to alternative employment. They tend to work for at least eighteen months before returning home. Many will work for a single company in the Gulf for up to

five or ten years before finally returning home to a new house that they have built with the proceeds of their years of labour.

Personal interviews by the author in the Gulf countries showed that, while Western expatriates can earn between two and three times their normal wage by working in the Middle East, the ratio can be as high as ten for employees from the south and south-east Asia. Consequently, despite the often harsh environment, they tend to be a very hard working and disciplined workforce, [22].

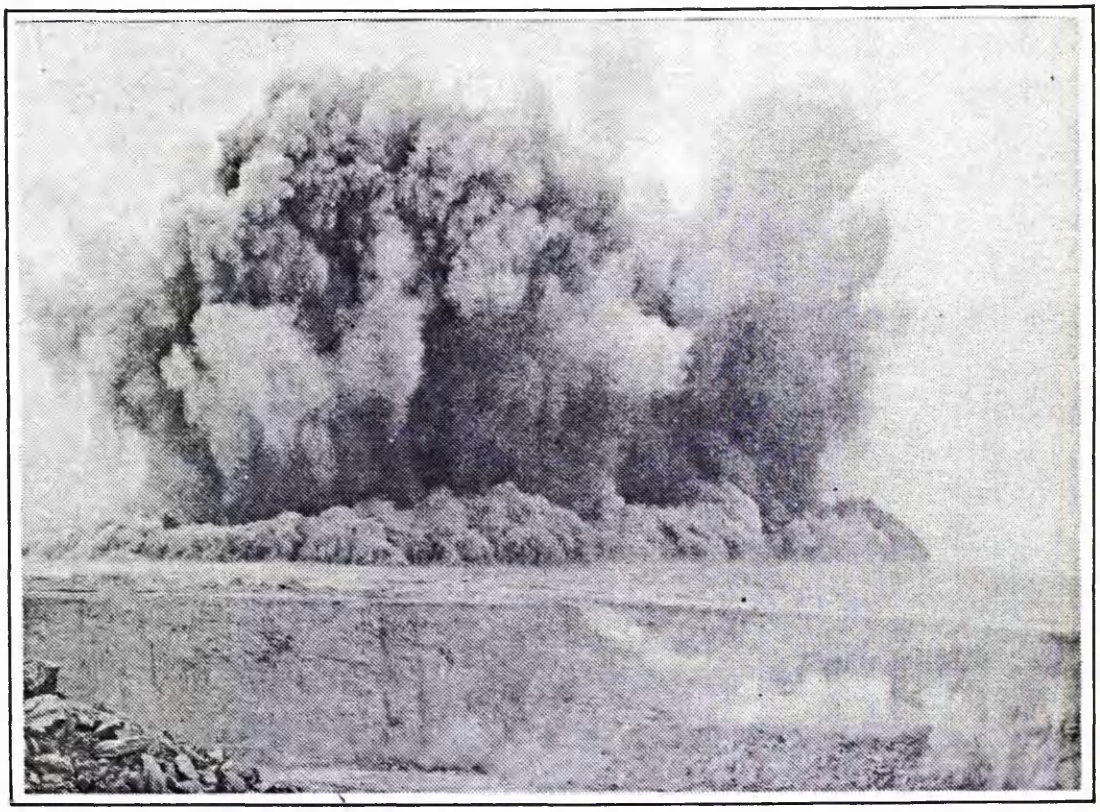
The problem of recruiting indigenous labour does not exist in the Maghrebi countries which have a long history of mining. Many mines have been operating for almost a century and jobs are often handed down from father to son. The mines are important employers despite the fact that they are often located in relatively fertile agricultural areas. Although the wages are generally good the salary differential with other economic sectors is not as great as it is in the Gulf countries.

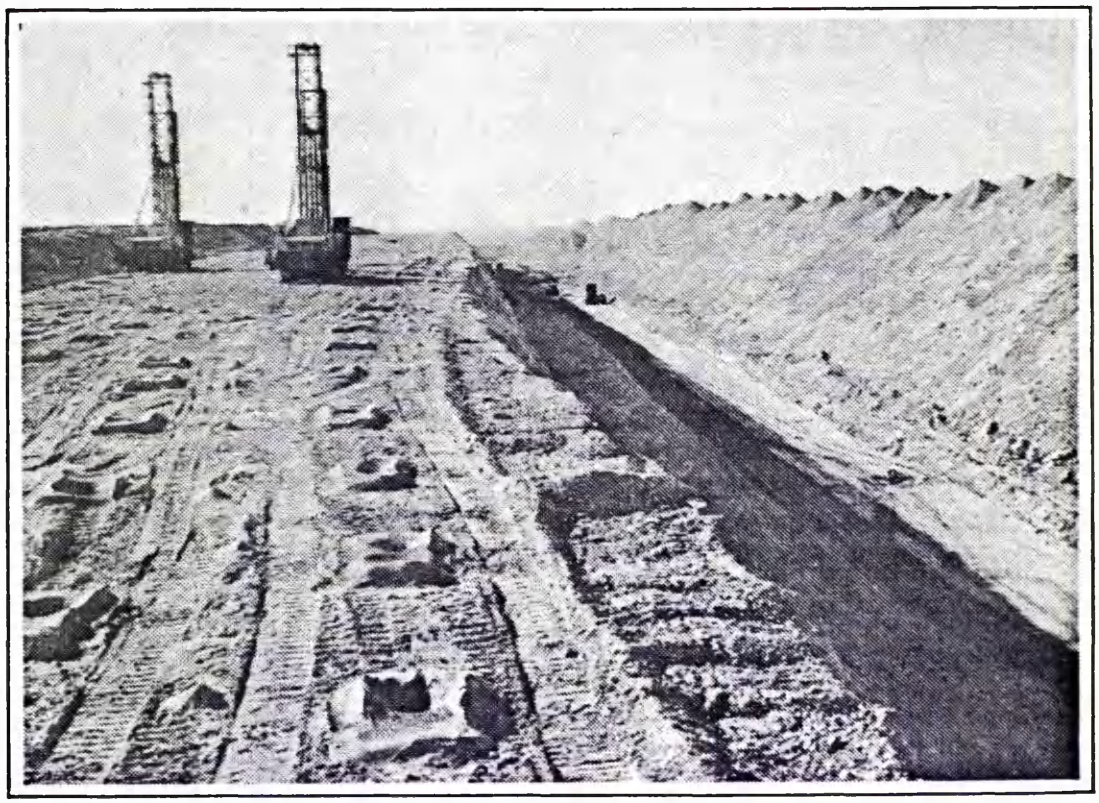
The mines have created both employment and infrastructural development in areas such as the Algerian-Tunisian border region. Statistics do show, however, that the majority of the senior mining

personnel are from the major cities rather than the local area. As was seen by the author in Tunisia and Algeria, a number of companies are now begining to put local boys through university and training programmes so that the mining areas produce a larger proportion of such men, [23].

In the other areas of the Arab Middle East there is almost no underground mining. The numerous phosphate and building material projects, as well as Egypt's iron ore mines, almost all use the same method of extraction. The overburden is removed and the material is then extracted by mechanical or manual methods, after which it is transported for processing and marketing, **(See Figure 4.2)**. There are no major shortages of labour and the necessary training is relatively limited. Consequently the vast majority of jobs are undertaken by local men while the senior personnel and technicians are usually brought in from the largest cities. Possibly the only major project which employs a different process is Jordan's Arab Potash Company which harvests potash from the bottom of carnallite pans in the Dead Sea. Even here the majority of the employees are local men. Indeed, after the phosphate mines, it is the largest single employer in central Jordan, [24].

**Figure 4.2 Surface Mining Methods.**





*Source: C.G. Gurdon.*

## 4.4 Expatriate Specialists
**********

Until an indigenous workforce can be both trained and encouraged to work in the mining industry, the use of mainly expatriate employees will have to continue. While the workforce is predominantly from south-east Asia and the Indian sub-continent, the senior personnel and technicians are from North America, eastern and western Europe.

The nationality of these specialists is largely dependent on the specific mineral industry and the political affiliation of the host country. Some like Algeria, Libya and Syria have assistance from Soviet and other East European technicians. Much of the geological survey work in both Egypt and Sudan was undertaken by Soviet specialists before they were replaced by Western Europeans in the early 1970s. In Saudi Arabia, which probably has the largest number of expatriate specialists, the majority of the geologists are American and French.

It was learned in a series of interviews by the author throughout the Middle East in 1985, that the expatriates have worked in other major mining areas. The gold mining projects in Saudi Arabia and Sudan are run by British engineers, most of whom have worked in South Africa or

the other gold producing countries. The majority of the specialists working for the Oman Mining Company previously worked in the Zambian copper industry. Many of the iron and steel industries in the region employ either East European or Japanese personnel. The new and highly sophisticated potash project in Jordan is working with Jacobs Engineering, the US company which built the plant, [25].

By contrast the larger and older Maghrebi mining industries employ very few foreigners. During the past century they have built up the experience and technical expertise to run their mining industries comparatively efficiently and successfully. There are a few East European technicians in the Tunisian lead and zinc mines and elsewhere, although these are the exceptions rather than the rule compared with the rest of the region.

While most underground mining operations have to employ western expatriates, the region's phosphate industries are largely self-sufficient. The older Maghrebi and Jordanian operations employ comparatively few expatriates. As an example the Moroccan phosphate industry, which is by far the largest mining operation in the Middle East, employed only 72 foreigners out of a total workforce of 26,466 in 1983, [26]. In the more complex downstream operations, such as those in the Tunisian fertilizer industry, technicians from the

foreign companies which constructed the processing plants usually assist in the training of the indigenous workforce. The new phosphate producers have also received technical assistance from the more experienced Moroccan and Jordanian personnel. The necessity to employ foreign geological and mining specialists is likely to continue in the foreseeable future.

### 4.5 Government & Company Training Projects

In order to reduce their dependence on expatriates both government parastatals and private companies have embarked on education and training programmes. In addition the five Arab Conferences for Mineral Resources since 1972 have all stressed the importance of Arab co-operation in professional manpower training. This has included not only the technicians but also the manual labourers in the mines and quarry.

The education and training schemes have varied from country to country within the Middle East and from project to project. The lack of finance and organisation has prohibited the formation of such programmes by some governments. Consequently both geological exploration and training work has taken the form of bilateral or multilateral aid from donor countries. The United Nations Development Programme has undertaken exploration

work in Jordan, Morocco, Sudan, Tunisia and South Yemen, [27]. Other countries which have assisted in Sudan's mineral exploration and development programme include the USSR, China, Japan, West Germany and France, [28]. The French government's Bureau de Recherches Géologiques et Minières, (BRGM), is also involved in extensive work in North Yemen and Saudi Arabia, where the former is an aid project and the latter a long term contract.

Of all the countries in the region, Saudi Arabia probably has the most ambitious and expensive mineral exploration and development programme. It also puts a great deal of emphasis on the training of Saudi nationals in general and geologists and mining engineers in particular. The country is almost starting from scratch because it was only in the past decade that the first mining engineering students graduated from a Saudi Arabian university.

In 1984 the Deputy Ministry for Mineral Resources (DMMR) sponsored 24 of its employees to study overseas for undergraduate and postgraduate degrees. A further 49 received overseas non-academic technical and administrative training. Meanwhile it sponsored the training of a further 87 students within the Kingdom, of which 79 learnt English, and three were university students, [29]. Such great emphasis is placed on the study of English because it is the language of all of

the DMMR's technical reports as well as that of its principal consultants.

In the Maghrebi countries, French is used in the training programmes of Algeria, Morocco and Tunisia. Unlike Saudi Arabia they already have a large and experienced mining sector so that the obstacles are not as great as in the Gulf. As an example of the Morocco's commitment to training the vitally important Office Cherifien des Phosphates (OCP) has 433 staff in its training department. Between 1973-83 OCP had 7,414 trainees and 33,322 employees attended refresher courses, [30]. It also created a new vocational training centre at Laayoune and a high level technical centre near the new fertilizer works at Jorf Lasfar. Its competitors in other phosphate producing countries have similar training programmes, albeit somewhat smaller.

Initially the new Arab Potash Company (APC) had a very ambitious and expensive training scheme. Besides the 31 experts from Jacobs Engineering, who were working in accordance with the management contract until mid-1986, APC also hired 190 skilled Pakistani and Indian industrial technicians. The company adopted a policy of appointing a Jordanian counterpart for each expert and many of the technicians in order to provide the Jordanians with a chance of gaining the necessary

technical experience to take over the expatriates' responsibilities when the management contract ended, [31]. Because of financial problems, however, the company had to review this policy and 96% of its 1,355 personnel are now Jordanian.

## 4.6 University Education

While the mining ministries and companies are doing what they can to train their personnel, the standard of their graduates is equally important. The majority of their annual intake of administrators, geologists, mining engineers, technicians and other skilled workers arrive from universities or polytechnics. Their formal qualifications will range from technical certificates to doctorates. A major problem is that the standards differ so much from institution to institution. Besides the general level of education, other factors which are important include foreign language proficiency, technical knowledge and fieldwork experience and capabilities. As an example of the difference in the qualities of graduates it is perhaps illustrative to compare geology students in Sudan and Saudi Arabia.

The University of Khartoum has a small but very reputable Geology Department. The majority of its staff were trained by Soviet geologists in the early 1970s and some have remained with the department. Until the

attempted Communist coup in 1971 the Soviet Union had provided the principal foreign assistance to the mining industry. Indeed, much of the recent success in locating new mineral deposits in the Red Sea Hills resulted from using maps prepared by Soviet and Sudanese geologists.

The geology graduates produced by the university tend to be very strong in fieldwork experience but weaker in scientific laboratory work. The lack of finance means having to use old and dilapidated equipment which the university cannot afford to replace. By contrast the students appear to be both willing and able to undertake long field trips in very arduous conditions. Indeed, the fieldwork trips which are usually supervised by department staff are the highlight of the year.

The result is that most graduates are competent, while those who have done post-graduate training in Sudan or overseas are excellent. Their command of English was demonstrated at the Fifth Arab Conference on Mineral Resources in Khartoum in 1985. To the annoyance of many of their fellow Arab delegates, the Sudanese geologists delivered their papers in English, declaring that it was easier than using Arabic technical words. The majority of the graduates who do not emigrate to work in the Gulf or elsewhere, usually work for the government's Geology & Mineral Resources Department (GMRD) and Sudanese

Mining Corporation (SMC). The foreign mining companies working in Sudan almost universally praise the standard of the GMRD and SMC geologists. In interviews conducted by the author in 1985, British expatriate staff from Minex who are working on the Gebeit gold project freely admitted that the Sudanese played a significant role in undertaking part of the geological work, [32].

In Saudi Arabia the situation is somewhat different. There are comparatively few Saudi geology and mining engineering graduates and they have a very privileged status once they leave university. According to a number of western expatriates who are working in the mining sector, the quality of the graduates is generally very poor. Although they have access to highly sophisticated and expensive equipment their basic geology is mediocre and their fieldwork experience negligible. The problem appears to be that they are very reluctant to leave the comfort of their air-conditioned vehicles and do proper fieldwork. The field-trips tend to be short and close to the major cities or roads.

Staff at one major western mining group which is working in the country told the author that they believe that Saudi graduates are only trained to the same level as first year university students in western universities. Those who join the company have to undertake an intensive training course. This involves general and

technical English language courses, followed by further geology training in both the west and Saudi Arabia. It is only after this that they are of any use to the company.

The problem is that most qualified geologists and mining engineers are almost immediately able to join a government ministry or mining project. Their field work is usually shadowed by expatriate specialists while they tend to stay behind their desks. It should be noted, however, that the situation in the private sector is somewhat different. A number of highly competent Saudi geologists and mining engineers are working at Al Masane and other private mining and quarrying projects, [33].

Besides Sudan and Saudi Arabia many of the other countries in the Middle East also have university geology and mining departments. Their size, experience and quality is largely dependent on the history of mining in the particular country. Not surprisingly the oil producers have tended to concentrate on petro-geology and petroleum engineering. In general their experience of non-hydrocarbon minerals is very limited although new departments are being created. In the Maghreb there is a long history of mineral scholarship and its phosphate experts in particular are highly competent, as are their Jordanian counterparts.

The other country which has a long history of training geologists is Egypt where the Egyptian Geological Survey was founded in 1896, [34]. Although petro-geology has become more important in recent years there are still many metallic mineral geologists who obtained their basic training in Egyptian universities. As in Sudan, there were a number of Soviet and East European geologists in Egypt, who played a major role in the geological survey work during the early 1970s. They were also involved in training young Egyptian geologists, both in the universities and once they started working with the Egyptian Geological Survey, [35].

## 4.7 Recruitment Problems
**********

As the Middle East's mineral deposits are developed there will be an increasing requirement for all levels of manpower in the mines and quarries. There are a number of obstacles to recruitment including the lack of mining experience, illiterate or unskilled workers, the harshness of the working environment, inadequate wages and alternative work opportunities.

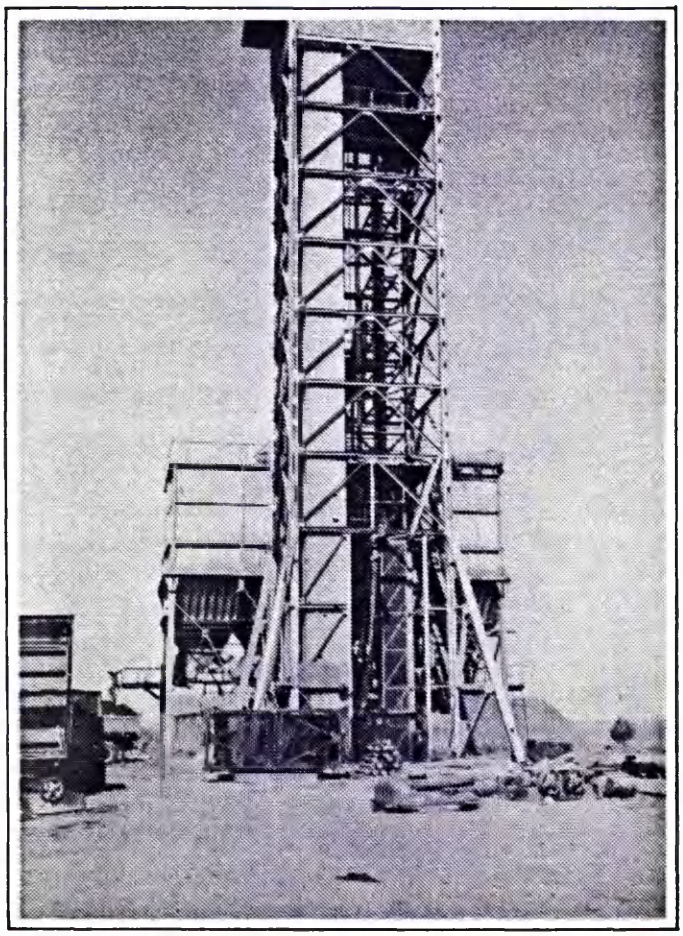
There are different levels of mining experience in each area and country in the Middle East. While mining has been the principal employer in parts of the Maghreb for decades in the Arabian peninsula there had, until the

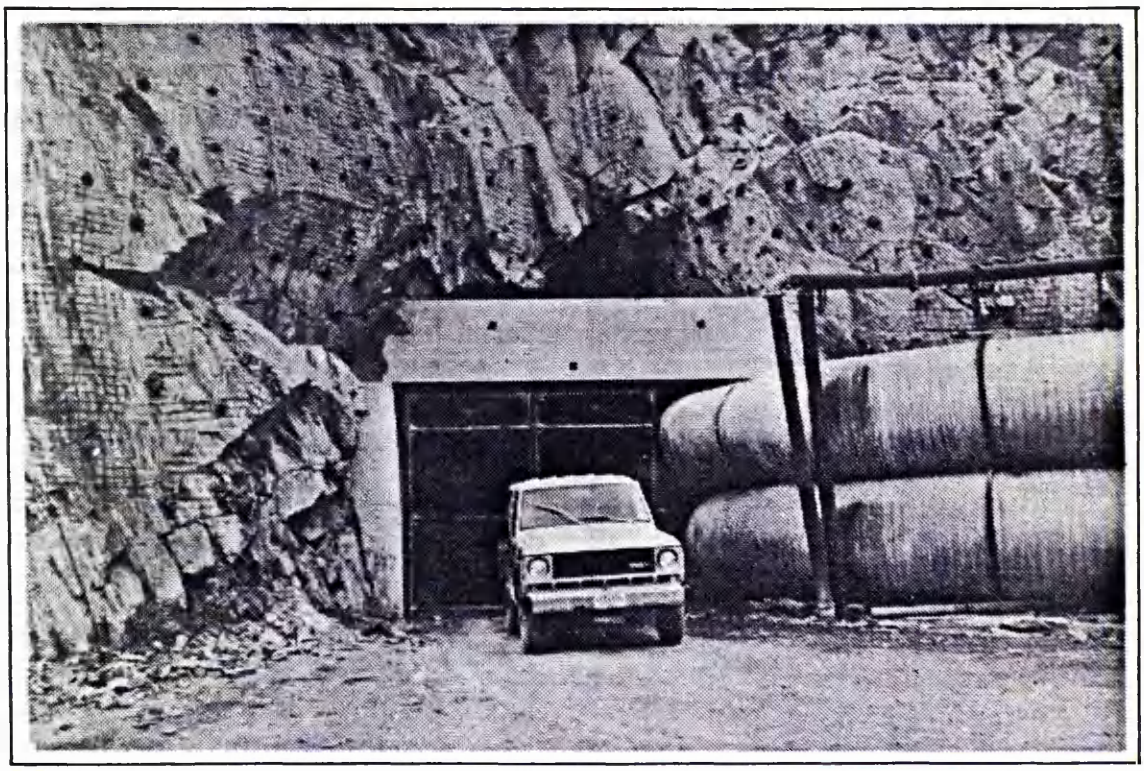
past few years, been no mining experience for ages. As a result it has been necessary to recruit expatriates until an indigenous workforce can be trained.

Besides the lack of experienced mining personnel there is also a problem with the general standards of the workforce in many countries. While it is possible to train a few mining engineers, geologists and administrators in almost all the countries of the region, it is often more difficult to train the general workforce. Because the majority of the mining projects are in remote areas there is usually not a pool of skilled workers who can work on them. Although it may be a generalisation, outside the traditional mining areas most of the potential employees in the rural areas are often illiterate, badly educated and without easily transferred skills. The alternatives for any mining project are therefore to train the locals, use urban workers or import TCNs. For many reasons, some of which have been discussed earlier in this chapter, employing TCNs may be the most sensible and economic solution in many countries.

Underground mining schemes are, by their very nature, both complex and often dangerous. Whether they use the old shaft system or the more modern portal and ramp, which allows trucks to drive from the surface to the mineral seams, **(See Figure 4.3)**, there are potential

**Figure 4.3 Shaft vs Portal.**
**Examples of shaft and portal entrances to mines.**





*Source: C.G. Gurdon.*

dangers. These include flooding, gas leaks, cave-ins, exhaust fumes, and the use of dynamite and heavy equipment. There was an accident at the Sohar copper mine in northern Oman soon after the author visited the project in 1985 when a number of miners were injured during a sub-caving operation. Even in Morocco, which is the region's leading mining country, there are numerous mining accidents with 3,852 in 1983 of which 22 were fatal, [36]. Consequently it is essential that the workforce adheres to adequate safety standards in order not to endanger themselves or the mining operation. The use of expensive and complex equipment also requires trained personnel who will not damage it. A skilled and preferably literate workforce is therefore essential.

While some projects are located in relatively pleasant and fertile areas, particularly in the Maghreb, this is not generally the case. Most of the mining projects in Saudi Arabia, Sudan, Egypt and elsewhere in the region are located in arid desert environments. This means that most projects have to be self-sufficient in power, water and all the other amenities. Unless the operators can provide all these facilities it is very difficult to attract skilled workers and technicians. Even in Algeria, where most of the projects are in the fertile north of the country, 70% cent of the specialists work in urban based administrative jobs with 40 going to

Société Nationale de Recherches et Exploitation Minières, (Sonarem), affiliate companies [37].

Often the only way to attract sufficient numbers of qualified workers is to pay comparatively high wages. In almost all the countries of the region, wages in the mining sector are substantially higher than other sectors of the economy in the region. This differential in wage rates vary from country to country.

In the Maghreb, where many of the projects are adjacent to fertile agricultural land, the differential is relatively small. Indeed, many of the miners own small farms where they and their families produce a major proportion of their food. In the more hostile environments, the wage differential is far greater. One of the problems, however, is that despite the current low oil prices the economics of mineral exploration are less favourable than oil exploration and development. Consequently it is easier to pay high wages in the oil sector than the non-hydrocarbon mineral sector. The problem is exacerbated by the fact that world mineral prices are still quite low, while the majority of the Middle East mineral deposits are very small.

Another problem is the attractions of alternative jobs which can broadly be divided into three types; general urban employment, alternative industrial jobs and

agricultural work. Despite the fact that the wages may not be higher in the latter sector there is often an apparently illogical attachment to the land. While the relatively high wages in the mining sector may be attractive, many people in the rural areas appear to prefer working on their traditional farm holdings. they are often unsuited to the work practices and discipline of the mining sector.

The Middle East has become increasingly urbanised since the end of the Second World War and there has been a comparable rise in urban employment opportunities. In addition, the living standards and amenities are usually far better in the towns and cities of the region. Even for the unemployed or those working in the informal sector, urban life is often easier than in the rural areas.

It can be equally difficult to attract workers from the rest of the industrial sector who could make the transition to the mining sector relatively easily. Industrial wages for skilled workers tend to be higher than most other sectors and therefore the attractions of high wages in the mining sector tend to be diminished. Also the attractions of urban life for industrial workers tend to hinder the movement to mining schemes. If that were not enough there is also the problem of

transferring from normal industrial employment in a factory or foundry to underground face work, where conditions are likely to be considerably harder.

There are obviously problems in recruiting labour for the mining projects in areas which have little or no mining history. The solution would appear to be the recruitment and training of local men who could replace the expatriates in the future. Provided wages and employment conditions make such work attractive enough and there is adequate training, there should be fewer problems in recruitment in the future. Once a mining project has started experience has shown that it is easier to recruit sufficient numbers of skilled personnel. In the meantime expatriates will continue to be widely used in the Middle East's mining industries.

### 4.8 Breakdown of employment types.
**********

Each mining project employs many different grades of personnel including unskilled, skilled, technical and administrative workers. This section examines the approximate breakdown between these different grades of employees in the Middle East. It takes examples from various projects in the region and then analyses the apparent trends. A number of questions need to be answered. Are the projects top heavy with urban based managers? On average how many technicians and

administrators are employed for each miner? What is the approximate ratio between skilled and unskilled workers? The question of wages is analysed in the next section.

**Table 4.2 : OCP EMPLOYMENT STATISTICS IN JANUARY 1984**

| | | |
|---|---|---|
| Labourers and clerical staff | 23,992 | ( 82 % ) |
| Technicians and office employees | 4,692 | ( 16 % ) |
| Executives, engineers and equivalent | 635 | ( 2 % ) |
| **Total number of employees** | **29,319** | **(100 % )** |

| | Labourers | Tech | Exec | Total | |
|---|---|---|---|---|---|
| Headquarters | 917 | 654 | 260 | 1,831 | ( 6.2%) |
| Mining areas | 16,278 | 2,695 | 235 | 19,208 | (65.5%) |
| Processing & Port | 6,797 | 1,343 | 140 | 8,280 | (28.2%) |
| Total | 23,992 | 4,692 | 635 | 29,319 | (100 %) |

**Type of Activity**

| | |
|---|---|
| Production | 21,720 |
| Housing & Social | 2,486 |
| Procurement, material | 2,252 |
| Administration | 655 |
| Medical Care | 602 |
| Training | 413 |
| Transportation | 336 |
| Finance | 220 |
| **Total** | **29,319** |

**Distribution by Function**

| | | |
|---|---|---|
| Mining | 15,980 | ( 55.7 % ) |
| Beneficiation | 6,160 | ( 21.5 % ) |
| Processing | 5,226 | ( 18.2 % ) |
| Sales & deliveries | 1,278 | ( 4.5 % ) |
| **Total** | **28,684** | **(100.0 % )** |

**Source :** A. Belkhadir & M.A.Chaoui, **Phosphates in Morocco**, op cit, Slide 13.

Table 4.2 above provides the breakdown of employees working for OCP, which is the largest mineral producer in the region, as of 1st January 1984. The total number of employees was 29,319 of which 20,471 worked for OCP and the remainder were distributed amongst its affiliated companies. The table shows that 82% of the total workforce were manual labourers and clerical staff. The overall company ratio of labourers to technicians to administrators was approximately 40:8:1 so that for every executive or engineer there were 8 skilled and 40 unskilled workers. Only 67.8% of the labourers, however, worked in the mining areas and many of these are probably doing non-essential jobs. It is worth noting that the final part of the table shows that almost half of the total workforce work in the important downstream activities.

Another example of the employment breakdown in phosphate projects is at El Hassa in central Jordan where in 1985 there were 1,820 employees. Of these 300 (16.5 %) were engaged in administrative work, 390 (21.4%) in the mechanical department, 385 (21.2%) in mining and 250 (13.7%) in the processing section, [38]. The remaining 495 were predominantly employed in the service and transport departments which include the supermarket, shops, laundry, schools and other facilities.

| Table 4.3 : SOTEMIN'S EMPLOYEE STATISTICS - 31/3/1985 | | |
|---|---|---|
| Cadres | - Tunisians | 51 |
| | - Foreigners | 18 |
| Technicians | | 242 |
| Labourers | - Underground | 1,093 |
| | - Plant & Processing | 270 |
| | - Others | 468 |
| Sub-Total | - Underground | 1,155 |
| | - Plant & Processing | 308 |
| | - Others | 679 |
| TOTAL | | 2,142 |

Source : Statistics provided by Sotemin at El Kef, 1985

**Table 4.3** above provides a breakdown of the employees working for the Société Tunisienne D'Expansion Minière, (Sotemin). It administers six lead and zinc mines in western and northern Tunisia from its headquarters at El Kef. Interviews with company officials in March 1985 by the author showed that Sotemin had 2,142 employees of which 163 or 7.6% worked in the offices at El Kef and Tunis, the workshop, and the export terminal. The remaining 1979 worked in the six mines of whom 1155 (58.4%) work underground and 308 (15.6%) in the processing plants. Of 2,142 employees there are 51 Tunisian and 18 foreign cadres, 242 technicians and 1,831 workers, [39].

Phosphate and underground mining, as well as construction material quarrying, are predominantly done

by semi-skilled and unskilled workers. By contrast, as **Table 4.4** shows, the Arab Potash Company's (APC) highly sophisticated plant on the Dead Sea has a high proportion of skilled technicians. In 1984 they made up 509 (43%) of its 1,183 employees, with the drivers who transport the potash to the export terminal at Aqaba being the second largest group. Most of the employees worked at the plant itself, while others worked in its company township, the port, and its former administrative headquarters in Amman. What is very noticeable is the number of university graduates who were employed by the company for training and orientation and would eventually take over from the skilled foreign technicians, **[40]**.

**Table 4.4 : ARAB POTASH COMPANY EMPLOYEES - 31/12/1984**

| GROUP | H.Q. | Plant | Town | Aqaba | TOTAL |
|---|---|---|---|---|---|
| Admin Officers | 39 | 58 | 18 | 3 | 118 |
| Engineers | 5 | 73 | 3 | 2 | 83 |
| Accountants | 10 | 3 | 1 | - | 14 |
| Skilled Technicians | 12 | 412 | 57 | 28 | 509 |
| Semi-skilled | 8 | 75 | 33 | 5 | 121 |
| Drivers | 10 | 143 | 10 | 1 | 164 |
| Sub Total | 84 | 764 | 122 | 39 | 1,009 |
| Daily workers | - | 136 | 30 | 8 | 174 |
| Graduates | 26 | 93 | 13 | 2 | 134 |
| **TOTAL** | **110** | **993** | **165** | **49** | **1,317** |

**Source :** Arab Potash Company, **Annual Report 1984**, op cit, p.18

By examining these three examples of mining projects it can be seen that the make-up of the workforce varies

from project to project. The proportion of skilled workers tends to be greater in underground projects than in surface quarrying such as the phosphate industry. The proportion of technicians who are required increases as a company embarks on downstream operations. This can be seen in the statistics for APC which has a highly sophisticated processing plant.

It should also be noted that there is considerable under-employment in many of the region's mining and quarrying operations. A proportion of the unskilled labourers work in the administrative headquarters as messengers, tea-boys, guards, night watchmen, gardeners and staff drivers. Although their wages are comparatively low it is, in many cases, an example of wasteful and unnecessary manning. In the three examples which have been studied in this chapter the ratio of workers to administrative staff were 40:1, 32:1 and 10:1 for the Moroccan, Tunisian and Jordanian projects, respectively. This perhaps illustrates the more complex and skilled nature of the work involved in the latter projects. Interestingly both the phosphate and underground mining projects have a labourer to technician ratio of 8:1.

## 4.9 Wages & Employment Conditions
**********

The Middle East mining sector's wages and employment conditions vary considerably from country to country and project to project. They range from poorly paid daily manual workers in the Sudanese gypsum quarries to the comparatively well paid underground miners in Saudi Arabia. Between these two extremes are the numerous mining projects in the region where the terms and conditions are generally higher than the average national industrial wage. There are major disparities between the wages and conditions in different countries and projects. One of the reasons is the use of expatriate workers in many of the mining projects in the oil-rich countries.

An example of a scheme which uses western and TCN expatriates is the privately owned Al Masane project near Saudi Arabia's border with North Yemen. **Table 4.5** below provides a breakdown of the monthly labour costs for the principal mining and processing jobs which the mine's 1982 feasibility study expected to be paid when the mine finally came into operation. It should be remembered that these salary levels are not exceptional for the Gulf countries. One expatriate mining specialist interviewed by the author believes that Al Masane is the most economically run mining project in the region and the salaries are not as excessive as other projects.

| Table 4.5 : AL MASANE MINE - MONTHLY LABOUR COSTS | |
|---|---|
| a). Geological technician; Chief of Purchasing | -- $1,000 |
| b). Drillers, Underground truck operators, Scoop operators, Accountants, Chief warehouseman, Safety employees | -- $ 900 |
| c). Crusher, grinder and floatation operators; Mechanics, Welders, Truck drivers, Blasters, Electricians, Diamond drillers, Surveyors, Drafters, Personnel agents | -- $ 850 |
| d). Pipefitters, Explosives handlers. | -- $ 750 |
| e). Maintenance equipment drivers, Assayers, Helpers, Carpenters, Scalers | -- $ 650 |
| f). Security guards, clerks, camp labourers | -- $ 600 |
| g). Maintenance labourers, Timekeeper | -- $ 500 |

Monthly costs shown in wage scale include :
10 % regular overtime, paid at 50% premium.
One month paid vacation per year.
Holidays (12) days worked, paid at 100 % premium.
A bonus of half a month's pay per year.
Average monthly wage = $ 760.00 or $9,120 /year

**Source** : Watts, Griffis & McQuat Ltd, **Feasibility Study - Al Masane Project**, Toronto, August 1982, p.152

It is worth noting that there are additional costs besides the actual salary. There is the payroll burden which includes return air fares for expatriates, medical costs, life and social insurance. It was estimated to an average US$2,465 per man or 27% of the yearly average wage. Besides the miners and process workers any project also employees additional administrative and transport staff, camp workers, security guards, clerks and general labourers. Therefore the table below is only guideline to salary levels rather than total labour costs, **[41]**.

While the mining sector wages in the oil rich countries are comparatively very good, they are by no means normal throughout the region. While the actual salaries vary from country to country, all the major phosphate and underground mining projects provide similar wages and benefits. In most projects the basic wage levels are higher than those in the surrounding area.

In a series of interviews by the author in Jordan in 1985 it was discovered that the wages in the phosphate industry are the highest salaries in the country. Indeed those at El Hassa in central Jordan are 50% higher than those at Ruseifa near the capital at Amman. At the latter the minimum monthly wage was JD80, (US$32.6), for unskilled labourers, after which there are fourteen salary grades. Most men in both sites usually worked until they are sixty and 15% of Ruseifa's workers had been with the company for more than 25 years. The Jordan Phosphate Mines Company (JPMC) provided free health insurance and also paid JD20-JD30, (US$8.15 - US$12.22) per man for full insurance for each family. In addition there was free transport and 65% of the cost of food for batchelors living on site. Like most mining projects in the region, the company provided free water, electricity, schools and many other facilities, **[42]**.

The Ouenza iron ore mine in eastern Algeria is one of the major employers in the area. Interviews conducted by the author showed that the salaries are above the national average and that workers receive a pension totalling 80% of their wages when they retire at 55. They pay 8-11 % of their salary for social security and medical cover. There is a month's paid holiday per year for all employees. The company owns 800 houses which it provides rent free and water but not electricity are also provided. There is also a 50% subsidy on a midday meal for the workers. Like most of the older mining projects in the region many of the workers joined the company when they left school. In many families in the town fathers and sons and brothers work together, **[43]**.

An example of very small scale mining operation which lacks even the most basic amenities for its workers is the gypsum works in the Sudanese Red Sea Hills. Interviews with the workers showed that they only received S£3 or less than US$1 a day for a very arduous eight-hour shift. They received a month's paid holiday but there is no pension or social security. They received free food but had to live in tents in a camp environment, **[44]**.

## 4.10 Conclusions
**********

As it will be seen in later chapters, mining and quarrying plays an important employment role in many areas of the Middle East. The balance between labour and capital changes towards the latter as the projects become more sophisticated. Underground mining is far more capital intensive than surface quarrying. The building material sector is therefore highly labour intensive and provides considerable employment opportunities for well populated countries such as Egypt, Sudan and the Maghrebi nations. By contrast the sparsely populated Gulf countries have tended to move towards capital intensive projects because of the lack of a skilled workforce and their very high wage rates.

Overall it can be seen that there are considerable employment opportunities in the mining and quarrying sectors of the economy. This will only be achieved, however, when the many demographic, training and structural problems can be overcome. Besides providing employment, the mining sector can also provide substantial benefits to the national economy of many countries in the region. One of these is the revenue earned from exporting non-hydrocarbon minerals. It is this subject that is analysed in detail in the next chapter.

Footnotes.
**********

01. Total and phosphate numbers come from Ministère de l'Energie et des Mines, **Activité du secteur minier 1983**, op cit, Annex V4. The OCP total comes from the Mining Journal, **Mining Annual Review 1988**, London, 1988, p.420. Statistics for other minerals are from - Ministère du Plan, Direction de la Statistique, **Annuaire Statistique du Maroc 1985**, Rabat, 1985, pp.226-234.

02. The total figure and the public and private sector divisions are derived from - Direction Générale des Statistiques, **Les Résultats de l'Enquête Emploi et Salaires de 1979**, May 1981, Algiers, pp.8-9. The individual company statistics were obtained from **Personal interviews by author in Algeria**, May 1985.

03. Direction des Mines et de la Géologie, **Aperçu sur l'activité du secteur des mines au cours de la période 1981-1984**, op cit, p.7. Total is from EIU, **Country Profile : Tunisia 1987/88**, Economist Publications, London, 1987, p.13

04. Central Bank of Libya, **28th Annual Report**, Tripoli, 1984, p.35.

05. National Bank of Egypt, **Economic bulletin**, Vol.39, No.3 & 4, Cairo, 1986, p.251

06. The total for Gebeit comes from Greenwich Resources plc, **Annual Report 1986**, London, p.4. The other individual company and project figures were taken from **Personal interviews by author in Sudan**, February 1985. The total is the author's estimate based on the hundreds of small-scale bricks-works and quarries in the country.

07. The total is derived from adding the 1,355 employees from the Arab Potash Company (**MEED**, 16 September 1988, p.23), which had not been built in 1981, to the mining and quarrying total given in - Department of Statistics, **Statistical Yearbook 1983**, Vol No.34, Amman, 1984, p.233. The figures for the individual companies and projects were gathered in interviews conducted by the author in Jordan in April 1985.

08. Because of the war in Lebanon no reliable statistics are available. This figure is a personal estimate by the author based on the importance of the cement and building material industry to the country's export statistics.

09. International Monetary Fund, **Syrian Arab Republic - Recent Economic Developments**, Washington, November 1978, Table 8, p.16.

10. Principal source : Economic Commission for Western Asia, **Industrial Development in Iraq : Prospects and Problems**, Beirut, September 1979, Vol 1, p.118.

11. Economist Intelligence Unit, **Saudi Arabia : Country Profile 1986/87**, London, 1986, p.11

12. A.Kurbursi, **The Economies of the Arabian Gulf : A Statistical Handbook**, Croom Helm, London, 1984, p.149. (1979 Statistic).

13. The figures for the individual companies are taken from - **Personal interviews by the author in Oman**, March 1985. The total figure is the author's personal estimate based on the building material sector in the country.

14. The total figure is the author's estimate while the QNCC figure was obtained in a personal interview by the author with the company in Doha in March 1985

15. The individual company statistics were obtained in **Personal interviews by the author in the UAE** in March 1985. The total figure is the author's estimate.

16. Economist Intelligence Unit, **EIU Regional Review : The Middle East & North Africa 1986**, London, 1986, p.273.

17. Personal estimate by the author

18. **Personal interviews by author in Sudan**, February 1985

19. **Personal interviews by author in Saudi Arabia**, March 1985

20. **Personal interviews by author in Saudi Arabia**, March 1985.

21. G.R.Davis, N.H.Fisher & V.E.McKelvey, **An assessment of the conduct of the third Five-Year Development Plan of the Deputy Ministry for Mineral Resources**, Technical Record DM-TR-02-1, Jiddah, 1982,p.32.

22. **Personal interviews by author in Gulf area**, 1985.

23. **Personal interviews by author in the Maghrebi**

countries, June 1985.

24. **Personal interviews by author in Jordan** January 1985

25. **Personal interviews by author throughout the Middle East**, January-July 1985.

26. Ministère de l'Energie et des Mines, **Activités du secteur minier 1983**, op cit, Annex V4.

27. J.S.Carmen, **Obstacles to mineral development : A pragmatic view**, Pergamon Policy Studies 18, Oxford, 1979, pp.41-63.

28. F.A.Ibrahim, **Sudan's mineral deposits**, Mining Magazine, January 1983, p.34.

29. Deputy Ministry for Mineral Resources, **Saudi Arabia Mineral Resources Annual Report 1403-04**, op cit, p.44

30. A.Belkhadir & M.A.Chaoui, **Phosphates in Morocco**, op cit, Slide 14 & 15.

31. Arab Potash Company, **Annual Report 1984**, op cit, p.17 & 18.

32. **Personal interviews by the author in Sudan**, February 85

33. **Personal interviews by the author in Saudi Arabia**, March 1985.

34. Egyptian Geological Survey & Mining Authority, **Mineral Map of Egypt**, op cit, p.3.

35. **Personal interviews by author in Egypt** January 1985.

36. Ministère de l'energie et des Mines, **Activité du secteur minier 1983**, p.20-21.

37. H.A.Temmar, **Stratégie de developpement indépendant - La cas de l'Algérie : un bilan**, Editions Publisud, Paris, 1983, p.205.

38. **Personal interview by author in Jordan**, May 1985.

39. **Information provided by Sotemin to the author**, Tunisia, May 1985.

40. Arab Potash Company, **Annual Report 1984**, op cit, p.18

41. Personal interview by author at Al Masane, March 1985, Saudi Arabia.

42. Personal interviews by author at El Hassa and Ruseifa, Jordan, January and May 1985.

43. Personal interview by author at Ouenza, Algeria, June 1985.

44. Personal interview by author at Bir Eit, February 1985.

# CHAPTER FIVE
**********

## ARAB NON-HYDROCARBON MINERAL TRADE.
**********

### Introduction.
**********

Chapter Five concentrates on the volume and value of mineral exports in which phosphates are overwhelmingly predominant. The chapter uses the latest available national, United Nations and U.S. Bureau of Mines sources for the basic trade statistics. It deals with some countries in greater detail. These include major phosphate producers such as Morocco, Jordan and Tunisia.

Besides dealing with the volume of mineral trade in the Arab Middle East, the chapter also examines some of the related issues. These include the Middle East's share of the world mineral trade, the principal direction of trade, world mineral prices and the sale of processed minerals. It concentrates on certain specific minerals and countries. The Middle East's importance in phosphate exports and building material imports is highlighted. In terms of the direction of trade it will be seen that, while most mineral imports come from the industrialised nations, an increasing proportion of the Middle East's mineral exports, particularly of phosphates, are now going to South and South East Asia.

The chapter shows that, with the exception of phosphates where it has had some leverage, the Middle East is a "price-taker" rather than "price-maker" for both mineral imports and exports. This is because production and consumption levels are relatively low and therefore it does not wield much power in world markets. At the same time it will be seen that it has even less control in terms of its nascent downstream mineral processing activities. Even where there has been a major expansion such as that in the production of fertilizers, the Middle East is still relatively insignificant in world trade. The chapter therefore examines whether greater co-operation between the Arab countries could increase their influence in world mineral trade. In contrast to the over-optimistic calls for greater unity this chapter attempts to analyse the subject in a realistic manner and reach rational conclusions.

## 5.1 Phosphates
**********

As **Table 5.1** below illustrates, the Arab phosphate producers play a very important role in the world phosphate trade. The six Arab phosphate rock exporters are in order of current importance; Morocco, Jordan, Syria, Tunisia, Algeria and Egypt. Iraq, the only other Arab producer, uses all of its phosphate rock in its domestic fertilizer industry and exported none during the Gulf War although exports will now be resumed.

Table 5.1
ARAB SHARE OF TOTAL PHOSPHATE PRODUCTION 1966-87 (000s)

| Year | World | | Arab | | Arab % of world | |
|---|---|---|---|---|---|---|
| | Prod | Exports | Prod | Exports | Prod | Exports |
| 1966 | 71,308 | 31,383 | 14,253 | 12,633 | 19.97% | 40.25% |
| 1967 | 74,958 | 32,609 | 15,138 | 13,019 | 20.19% | 39.92% |
| 1968 | 78,742 | 36,941 | 16,084 | 13,684 | 20.61% | 37.04% |
| 1969 | 76,034 | 36,541 | 15,426 | 13,791 | 20.29% | 37.74% |
| 1970 | 79,991 | 38,172 | 16,393 | 14,793 | 20.49% | 38.75% |
| 1971 | 82,097 | 40,362 | 16,774 | 15,643 | 20.43% | 38.76% |
| 1972 | 87,674 | 43,111 | 19,573 | 17,397 | 22.32% | 40.35% |
| 1973 | 96,526 | 49,140 | 22,558 | 20,069 | 23.36% | 40.84% |
| 1974 | 108,465 | 54,569 | 26,681 | 23,512 | 24.60% | 43.09% |
| 1975 | 108,911 | 43,356 | 20,087 | 16,612 | 18.44% | 38.32% |
| 1976 | 108,032 | 41,005 | 22,162 | 19,322 | 20.51% | 47.12% |
| 1977 | 117,828 | 47,933 | 24,429 | 21,052 | 20.73% | 43.92% |
| 1978 | 126,592 | 50,887 | 27,731 | 22,128 | 21.91% | 43.48% |
| 1979 | 132,036 | 53,398 | 29,801 | 22,812 | 22.57% | 42.72% |
| 1980 | 139,388 | 52,083 | 29,632 | 23,330 | 21.26% | 44.79% |
| 1981 | 139,015 | 45,715 | 31,492 | 23,057 | 22.65% | 50.44% |
| 1982 | 123,465 | 43,395 | 29,029 | 20,267 | 23.51% | 46.70% |
| 1983 | 136,685 | 46,890 | 34,839 | 21,442 | 25.49% | 45.73% |
| 1984 | 150,119 | 47,716 | 37,299 | 22,452 | 24.85% | 47.05% |
| 1985 | 145,304 | 46,190 | 35,686 | 22,192 | 24.56% | 48.05% |
| 1986 | 139,051 | 44,265 | 37,654 | 22,390 | 27.08% | 50.58% |
| 1987 | 146,612 | 44,929 | 39,113 | 22,253 | 26.68% | 49.53% |

**Basic Source :** British Sulphur Corporation Limited, **Raw Materials Report**, 8th & 17th October, 1985, London.
**Source 1985-87 :** Mining Journal, **Mining Annual Review**, Mining Journal Ltd, London, 1988, p.109-110

Between 1966 and 1987 the Arab share of world phosphate production varied from 18.44% - 27.08% while its share of world phosphate exports ranged from 37.04% - 50.58%, [01]. From 1966 to 1974 exports rose steadily from 12.633 mn tonnes to 23.512 mn tonnes. In January 1974 Morocco quadrupled its export prices which led to a major decline in demand and the search by importers for alternative sources of supply. Consequently Arab phosphate exports fell sharply to 16,622 mn tonnes in

1975. Exports have since risen again to reach an average of about 22 mn tonnes, with 23,330,000 tonnes being exported in the peak year of 1980, **[02]**.

Table 5.2
**ARAB PHOSPHATE EXPORTS 1966-1987 (in 000s tonnes)**

| Year | Morocco | Tunisia | Jordan | Egypt | Algeria | Syria | TOTAL |
|---|---|---|---|---|---|---|---|
| 1966 | 9,138 | 2,394 | 744 | 319 | 38 | | 12,633 |
| 1967 | 9,344 | 2,234 | 870 | 459 | 112 | | 13,019 |
| 1968 | 9,771 | 2,172 | 1,073 | 416 | 252 | | 13,684 |
| 1969 | 10,264 | 1,855 | 926 | 386 | 360 | | 13,791 |
| 1970 | 11,254 | 2,109 | 656 | 268 | 452 | | 14,739 |
| 1971 | 11,886 | 2,410 | 642 | 248 | 457 | | 15,643 |
| 1972 | 13,562 | 2,306 | 949 | 175 | 340 | 65 | 17,397 |
| 1973 | 16,104 | 2,225 | 1,084 | 142 | 285 | 229 | 20,069 |
| 1974 | 18,609 | 2,407 | 1,464 | 112 | 399 | 521 | 23,512 |
| 1975 | 13,105 | 1,725 | 1,093 | 105 | 283 | 301 | 16,612 |
| 1976 | 14,652 | 1,857 | 1,633 | 115 | 592 | 473 | 19,322 |
| 1977 | 15,791 | 1,898 | 1,777 | 197 | 658 | 691 | 20,873 |
| 1978 | 17,306 | 1,667 | 2,133 | 192 | 619 | 895 | 22,812 |
| 1979 | 17,868 | 1,517 | 2,695 | 187 | 860 | 1,261 | 24,388 |
| 1980 | 16,499 | 1,449 | 3,572 | 219 | 768 | 823 | 23,330 |
| 1981 | 15,635 | 1,046 | 3,479 | 155 | 791 | 951 | 22,057 |
| 1982 | 13,977 | 1,139 | 3,538 | 186 | 704 | 722 | 20,266 |
| 1983 | 14,463 | 1,208 | 3,688 | 299 | 583 | 1,011 | 21,252 |
| 1984 | 14,860 | 1,165 | 4,695 | 230 | 568 | 934 | 22,452 |
| 1985 | 14,790 | 1,128 | 4,610 | 149 | 821 | 694 | 22,192 |
| 1986 | 13,696 | 1,193 | 5,198 | 183 | 818 | 1,302 | 22,390 |
| 1987 | 13,061 | 1,245 | 5,543 | na | 800 | 1,604 | 22,253 |

Source : British Sulphur Corporation Limited, **Raw Material Report**, op cit.

### 5.1.1 Morocco

Morocco is the world's largest phosphate exporter and, as **Table 5.2** shows above, in 1987 it exported 13,061 mn tonnes or 58.69% of the Middle East total, **[03]**. As the other Arab countries have increased both their production and export levels the Moroccan share has

fallen from 72% in 1966 to its current level. Moroccan phosphate rock is sold on both the domestic and overseas market. Of the 20.955 mn tonnes of phosphates delivered in 1987, 13,061 mn tonnes or 62.33% was exported, **[04]**. It is exported from Casablanca, Safi, Laayoune and the new fertilizer complex at Jorf Lasfar. **Table 5.3** below provides the latest statistics for Morocco's domestic sales and exports. It also provides information about the destination of the exports and shows that Western Europe is by far the most important market.

**Table 5.3 - MOROCCAN PHOSPHATE EXPORTS 1986-87**

| (Figures in 000s t concentrates) | 1986 | 1987 |
|---|---|---|
| **Production** | **21,178** | **20,955** |
| Total sales | 21,101 | 20,999 |
| Domestic sales | 7,405 | 7,939 |
| **Total exports** | **13,696** | **13,061** |
| of which | | |
| Western Europe | 7,929 | 7,130 |
| Eastern Europe | 2,844 | 2,315 |
| Latin America | 958 | 1,125 |
| Asia | 1,839 | 1,871 |
| North America | 102 | 251 |
| Australasia | 25 | 368 |

**Source** : M.Mew, **Morocco** in Mining Annual Review, 1988, **op cit**, p.421

Besides phosphate rock, Morocco also exports substantial quantities of phosphate based chemicals and fertilizers. In 1987 sales of phosphoric acid rose by 18.4% to MD3,584 mn (US$429 mn) thereby replacing raw phosphate exports, which fell by 17.7% MD3,080 mn (US$368.5 mn), as Morocco's principal export, **[05]**. By early 1988 OCP

had completed its plan to bring new solid fertilizer production capacity onstream at Jorf Lasfar. There are plans to eventually treble the size of the plant which is already one of the largest fertilizer complexes in the world. It is therefore obvious that in the future an increasing proportion of Moroccan phosphate will be exported as fertilizer rather than basic rock.

### 5.1.2. Jordan.

Jordan has been able to find new markets for its high grade phosphate rock, and between 1966 and 1987 its phosphate exports have risen steadily from 744,000 tonnes to 5,543 mn tonnes. Jordanian phosphate is exported to markets throughout the world but principally to South and South-East Asia. Aqaba's modern port is capable of handling 60,000 tonnes bulk carriers and this is being increased to 100,000 tonnes. The port's two phosphate berths currently handle up to 5.25 mn tonnes of phosphate each year, [06].

With phosphate exports totalling 5.543 mn tonnes in 1987, Jordan is the world's third largest exporter after Morocco and the United States. It has a very important advantage in the Asian markets over its North African competitors because Aqaba on the Red Sea is so much closer. Consequently in 1987 Asian countries accounted

for 2.676 mn tonnes or 48.28% of total exports, followed by Eastern Europe (36.4%) and Western Europe (13.83%). While phosphates appear relatively unimportant in terms of gross national product, being only 4% of the total, they are the country's most important export taking over 30% of the total, [07].

### 5.1.3 Syria

In recent years Syria has overtaken Algeria, Egypt and now Tunisia in the level of phosphate exports. Until 1972, when domestic production began, Syria was importing small amounts of Jordanian phosphate. Since then its own production has increased, by 26% in 1986 and 24% in 1987 alone, to total almost two million tonnes. While domestic use has remained relatively stable at around 368,000 tonnes, the level of exports has risen sharply by 50% in 1986 and 23% in 1987 to reach 1.6 mn tonnes, [08]. The planed expansion of the port facilities at Tartous should enable the level of phosphate exports to eventually be increased to 2.4 mn tonnes. In line with its political links, Syria's major clients are East European countries such as Romania, Yugoslavia and Bulgaria. Because of the high chlorine content, which is between 0.15-0.25%, Syrian phosphate is less attractive than others in the foreign markets. Consequently it is difficult to market for cash and is therefore better suited to barter trade.

### 5.1.4 Tunisia.

The move towards increased downstream processing is most noticeable in the raw phosphate export statistics for Tunisia. As **Table 5.2** showed Tunisian exports declined in the 1970s from about 2.4 mn tonnes in 1971 to 1.245 mn tonnes in 1987. Because of its low grade, Tunisian phosphate is less attractive for importers and cannot obtain the same prices as the high grade phosphate producers. Tunisia has therefore invested heavily in downstream activities and this is reflected in the statistics.

While phosphate production rose from 3.2 mn tonnes to 6.388 mn tonnes between 1966 and 1987, the level of exports has fallen from 2.6 mn tonnes to 1.245 mn tonnes in the same period. The principal export markets are Western (45.46%) and Eastern (41.12%) Europe followed by Asia (7.7%), **[09]**. The value of phosphate exports has been rising - from TD13.5 mn to TD30.4 mn between 1966 and 1984. While phosphate concentrate exports fell by 52% during this period the export of predominantly phosphate based fertilisers grew 170,000 tonnes to 973,000 tonnes, **[10]**. This 572% increase in volume was out-matched by a 1,945% increase in terms of value, **[11]**. From this it can be seen that Tunisia's diversification into downstream activities have

generally been very successful.

### 5.1.5 Algeria

Like its North African neighbours, Algeria has been exporting substantial quantities of phosphate for decades. As **Table 5.2** indicated exports rose to a peak of 860,000 tonnes in 1979 although this had fallen to 568,000 tonnes by 1984 before rising to 800,000 in 1987, **[12]**. There had been a major fall in the level of exports after the French left Algeria after independence. This is shown by the fact that the 1957 export level was 573,000 tonnes while only 38,000 was exported in 1966, **[13]**. By the 1980s Algeria was exporting between 55%-65% of its total phosphate tonne capacity trains from the mine at Djebel Onk to the Mediterranean ports, **[14]**. The latest development plan envisaged a major expansion of the domestic fertilizer industry to be based in the Tebessa region near Djebel Onk. It is therefore likely that an increasing proportion of Algeria's production will be used for fertilizer production rather than exports.

### 5.1.6 Egypt

**Chapter Three** showed that Egyptian phosphate production fell by about 20% in the years following the 1967 Arab-Israeli War. During the next decade it remained at about 500,000-600,000 tonnes, before rising slowly to

1,110,000 tonnes by 1987, [15]. During the same period phosphate exports fell from a maximum of 459,289 tonnes in 1967 to a minimum of 104,663 tonnes in 1975, since when it has fluctuated from year to year, [16].

There are a number of reasons for these changes during the past twenty years. Egypt consumes more chemical fertilisers per hectare of agricultural land than any other country in the region, [17]. At least half of the fertilizer consumption comes from domestic production and this ratio is increasing all the time. Egypt's phosphate and nitrate fertilizer industries have managed to attain productive efficiency by capitalising on the low cost of phosphate rock, electricity and labour. The country has a major advantage over some of its competitor phosphate producers in the region because it has such a large domestic market for its phosphatic fertilizers. Beneficiation is, however, more difficult and costly because of the high pyrite content, [18].

By using its Red Sea ports, Egypt also has a transport cost advantage over its regional competitors for the important South and South East Asia markets. Despite this, with the exception of China and more recently Indonesia, it has no major markets in these regions. The primary reason is that Egypt's phosphates are, like Tunisia's, generally low grade and cannot therefore compete with Jordanian phosphate which is also exported

from the Red Sea. Eastern European countries such as Rumania, Yugoslavia and Czechoslovakia are amongst Egypt's oldest, if not most important, clients. This is because they often operate within long term counter-trade agreements, whereby phosphates are exchanged for plant and machinery imports. Given the rise in domestic use it is likely that the level of exports will continue to fall in the future.

## 5.2 Iron Ore

This study does not include Mauritania which is a major iron ore exporter because, although it is a member of the Arab League, it is not strictly in the Arab Middle East. The only other exporters are Algeria and Morocco because Egypt and Tunisia use all of their ore in their domestic iron and steel industries. The new plants in the Gulf countries are not included because although they have cheap fuel they have to import iron ore from major producers such as Australia and Brazil.

### 5.2.1. Algeria.

Until recently Algeria was a major iron ore exporter but the domestic iron and steel industry, which is centred on the El Hadjar complex near Annaba, has taken an increasing proportion of production. As **Table 5.4** below

indicates, while overall production has risen since 1957, the proportion which is exported has declined from 98% to almost nothing, [19]. There are a number of reasons for this decline. Until independence France took the vast majority of Algeria's iron ore production but the French market declined substantially in the early 1960s. The domestic iron and steel industry has taken an increasing proportion of Algeria's iron ore since the early 1970s. Also the decline in the world demand for

**Table 5.4 : ALGERIAN IRON ORE EXPORTS 1957-87**

| Year | Production | Exports | Export % |
|---|---|---|---|
| 1957 | 2,790,000 t | 2,745,000 t | 98 % |
| 1967 | 2,570,000 t | 2,400,000 t | 93 % |
| 1976 | 2,790,000 t | 1,734,000 t | 62 % |
| 1981 | 3,482,000 t | 1,507,000 t | 43 % |
| 1982 | 3,705,000 t | 1,445,000 t | 39 % |
| 1983 | 3,684,000 t | 1,301,000 t | 35 % |
| 1984 | 3,664,000 t | 974,452 t | 27 % |
| 1985 | 3,380,000 t | 7,000 t | 0 % |
| 1986 | 3,360,000 t | 0 t | 0 % |
| 1987 | 3,380,000 t | 0 t | 0 % |

**Sources :**

a). H.M.Temmar, **Stratégie de developpment indépendant : Le cas de l'Algérie : Un bilan.**, Editions Publisud, Paris, 1983 , p.205.

b). Arab Industry Review, **Algeria**, op cit p.264

c). Mining Annual Review 1988, **op cit**, pp.55-56

iron and steel products in the 1980s has affected all producers including Algeria. At the same time the growth of major low cost producers such as Australia and Brazil has hindered smaller and higher cost producers such as Algeria.

### 5.2.2 Morocco

Until recently Moroccan annual iron ore exports were very small varying between US$1.3 mn and US$4.9 mn, [20]. In terms of tonnage, exports have fluctuated between 233,983 tonnes in 1982, 150,597 in 1983, 116,000 in 1984, 148,000 in 1985, and about 140,000 tonnes in 1986 and 1987, [21]. Until recently almost all of Morocco's iron ore production was exported with the proportions ranging from 70%-100% between 1982 and 1985, [22]. This has changed now that the steel rolling mill at Nador has been commissioned. Although the current market conditions make small scale steel plants uneconomic, it is possible that Morocco will develop an iron and steel industry in the future. Despite this, the industry is high on the list of sectors that the government is planning to privatise.

## 5.3 Lead & Zinc

It was seen in previous chapters that lead and zinc deposits are often found and extracted together. It is only the Maghrebi countries which produce and export lead and zinc although a number of other countries in the region import and re-export both minerals. As an example, in 1983 Saudi Arabia imported US$6,761,000 worth of zinc and re-exported US$239,000 worth, [23].

This chapter is only concerned with those countries who produce as well as export both minerals.

### 5.3.1 Morocco

As Table 5.5 below illustrates, Morocco produces and exports both lead and zinc. In 1983 about 46% of the lead ore that was produced was exported, compared with 55.5% and 32.9% in 1984 and 1985, respectively. In 1983 principal clients for the ore were Spain (41%), France (30%), West Germany (12%), Sweden (6%), Belgium (3%) and Tunisia (2%). Morocco has continued to produce and export lead ore despite falling demand and prices in Western Europe. The principal reason was the presence of 611 tonnes of silver and other auriferous minerals in the ore which was valued at Dhs8 mn, (US$1.12 mn). The remainder of the ore was turned into lead metal at the Cadetef foundry at Oued el Heimer. Of this total 55,701 tonnes was exported to Italy (50%), Greece (21%), Holland (19%), France (3%) and Egypt (1.5%), [24].

Although it is not as important as lead, the table also shows that zinc is exported by Morocco. Between 1982 and 1985 the proportion of its zinc production which was exported ranged between 73%-100%. In 1983 the principal markets for the zinc were Switzerland (34%), France (34%), Belgium (21%) and Italy (11%), [25].

Table 5.5 : MOROCCAN LEAD & ZINC EXPORTS (000s tonnes)

| | | Tonnage | Value (Dhs) | Value (US$) |
|---|---|---|---|---|
| **Lead Ore** | | | | |
| Production | 1982 | 147,959 | 273.2 mn | 45.38 mn |
| | 1983 | 138,796 | 258.8 mn | 36.40 mn |
| | 1984 | 144,000 | na | na |
| | 1985 | 152,000 | na | na |
| Exports | 1982 | 55,749 | 106.6 mn | 17.71 mn |
| | 1983 | 63,918 | 150.5 mn | 21.16 mn |
| **Lead Metal** | | | | |
| Export | 1982 | 51,907 | 180.2 mn | 29.93 mn |
| | 1983 | 55,701 | 170.7 mn | 24.00 mn |
| | 1984 | 80,000 | 193.0 mn | na |
| | 1985 | 50,000 | 137.0 mn | na |
| **Zinc Ore** | | | | |
| Production | 1982 | 22,442 | 22.8 mn | 3.79 mn |
| | 1983 | 14,610 | 24.2 mn | 3.40 mn |
| | 1984 | 21,000 | na | na |
| | 1985 | 27,000 | na | na |
| Exports | 1982 | 16,360 | 21.3 mn | 3.54 mn |
| | 1983 | 13,887 | 21.8 mn | 3.07 mn |
| | 1984 | 21,000 | 51.0 mn | na |
| | 1985 | 26,000 | 64.0 mn | na |

Exchange Rates :$1 = 6.02 Dhs in 1982 & 7.11 Dhs in 1983

Source : Ministère de l'Energie et des Mines, Activité du Secteur Minier 1983, op cit, Appendixes I - IV and Morocco, in Arab Industry Review, op cit, p.213

### 5.3.2 Algeria

As in Morocco, lead and zinc are found together in three Algerian mines at El-Abed, Kherzet-Youscef and Ain-Barbar. The first is the most important producing an ore with a lead and zinc content of 3.85% and 1.46% respectively. Its modern floatation processing plant can treat 2,000 tonnes of ore each day to produce a 61%-65%

lead and 53%-55% zinc concentrate, [26].

As **Table 5.6** shows below, zinc production has been almost double that of lead during the past 30 years. Up until the mid-1970s Algeria was exporting the vast majority of its zinc. More recently it has all been processed at the electrolysis unit at Ghazaouet. In 1972 all of the zinc was exported but by 1975 about 85% was being used in the domestic market, [27]. Meanwhile all of the lead concentrate continued to be exported.

**Table 5.6 : ALGERIAN LEAD & ZINC EXPORTS (000s tonnes)**

| Year | Pb Prod | Pb Export | Zn Prod | Zn Export |
|---|---|---|---|---|
| 1957 | 15.0 | 15.0 | 50.0 | 49.0 |
| 1967 | 6.0 | 7.0 | 13.0 | 21.0 |
| 1970 | 10.0 | 6.0 | 33.0 | 28.0 |
| 1976 | 3.0 | 5.0 | 6.0 | - |
| 1981 | 4.9 | 5.6 | 20.0 | 1.0 |
| 1982 | 4.8 | 5.0 | 20.8 | - |
| 1983 | 5.0 | 5.9 | 20.9 | - |

**Note** : Pb = Lead, Zn = Zinc

**Sources** : 1957-76 **H.M.Temmar**, op cit, p.205-6.
1981-83 **Arab Industry Review**, op cit, p.264.

### 5.3.3 Tunisia

The only other Arab country which has exported lead and zinc is Tunisia. The Société Minière et Metallurgique de Tunisie, (SMMT), produces finished lead products from its smelter at Megrine which has recently been

rehabilitated. The remaining lead concentrate, together with part of the stockpile, has been exported. Therefore, as **Table 5.7** shows below, it has been possible for Tunisia to appear to export more lead than it produces in certain years. In the past, lead concentrate imports have made up the deficit when local production has not met the smelter's requirements, **[28]**.

The lead is turned into metal before being exported while Tunisia's zinc is exported as ore concentrate. The table below shows that, like the case of lead, zinc is often stockpiled before being exported in later years. As with the vast majority of all other mineral exports

**Table 5.7 : TUNISIAN LEAD & ZINC EXPORTS 1981-84**

| Year | Pb.Prod | Pb.Exports | Zn.Prod | Zn.Exports |
|---|---|---|---|---|
| 1980 | 13,900 t | 12,300 t | 16,800 t | 20,309 t |
| 1981 | 10,200 t | 11,300 t | 14,900 t | 12,936 t |
| 1982 | 8,600 t | 14,400 t | 15,200 t | 13,412 t |
| 1983 | 7,900 t | 3,700 t | 13,700 t | 14,268 t |
| 1984 | 6,500 t | 6,600 t | 12,100 t | 14,000 t |

**Note** : Pb = Lead, Zn = Zinc

**Source** : Institut National de la Statistique, **op cit**, Tables XII.2 & XV.3.X

from the Maghreb countries, Western Europe is the principal market for the zinc concentrate. The chief buyer often changes, however, with Italy recently replacing France as the principal client with Spain also being important, **[29]**.

## 5.4 Copper

Morocco and Oman are the only countries in the region which export copper. While the former exports it as an ore, Oman exports refined copper anodes and cathodes. Their combined production and export levels are so small that they play a minimal role in the world copper market. As such they are perfect examples of "price-takers" rather than "price-makers". If Chile or one of the other major producers were to release more copper onto the market, thereby depressing the already low world copper prices, both Moroccan and particularly Omani copper production and exports would be totally uneconomic. Both countries would then have to decide whether economic or social factors would determine their future operation.

### 5.4.1 Morocco

Copper is Morocco's third most important mineral in terms of value after phosphates and lead. **Table 5.8** below provides the statistics for Morocco's copper production and export. It shows that between 1981-84 almost all of Morocco's copper ore production was exported although there are plans to build a copper concentrate and sulphuric acid plant at Jorf Lasfar, [30]. The decline in world copper prices and the devaluation of the Moroccan Dirham is also illustrated

by the table. In 1981 Spain (31%), Finland (27%), and West Germany (26%) took the majority of Morocco's copper ore and concentrate, [31].

**Table 5.8 : MOROCCAN COPPER EXPORTS 1981-84**

| Year | Production | Exports | Value Dhs | Value US$ |
|---|---|---|---|---|
| 1981 | 23,100 t | 20,600 t ( 89%) | 50.6 mn | 9.79 mn |
| 1982 | 62,797 t | 59,048 t ( 94%) | 128.1 mn | 21.27 mn |
| 1983 | 69,503 t | 67,109 t ( 97%) | 183.0 mn | 25.73 mn |
| 1984 | 63,800 t | 67,900 t (106%) | 191.5 mn | 21.74 mn |

Exchange Rates : $1 = 5.17 Dhs in 81, 6.02 Dhs in 82, 7.11 Dhs in 83 and 8.81 Dhs in 84.

**Source** : Bank of Morocco, **Annual Report 1984**, Rabat

### 5.4.2 Oman

Oman's much more modest copper production at Sohar is all exported after it has been processed into 99.98 % pure copper cathodes. In 1984, which was its first full year of production, 15,060 tonnes of refined copper was exported valued at US$21 mn. The Oman Mining Company also produced and sold 5,900 tons of chromite, 1,600 kgs of silver and 52.5 kgs of gold valued at US$1.65 mn, [32]. **Table 5.9** outlines the production and export statistics for the period from 1984 to 1986.

**Table 5.9 : OMC Copper Exports 1984-1986**

| | 1984 | 1985 | 1986 |
|---|---|---|---|
| Production (tonnes) | 15,060 | 14,405 | 14,583 |
| Exports (tonnes) | 15,060 | 14,317 | 14,561 |
| Value of exports (US | 21.0mn | 18.4mn | 20.2mn |

**Source** : Oman Mining Company Annual Reports 1984-1986

Originally copper was to be exported from a specially constructed jetty near Sohar but instead it is taken by truck to Mina Qaboos near Muscat from where it is exported. The Amalgamated Metal Corporation of the UK has a contract to take 12,000 tonnes of Omani copper a year. The remainder is sold by a number of firms on the spot market. Although Oman's high quality copper carries a price premium on the London Metal Exchange, at the moment the poor market conditions have limited both production and export levels.

## 5.5 Other Metallic Minerals

Besides iron, lead, zinc and copper a number of other metallic minerals are exported in relatively small quantities from the Arab Middle East. While most of these are in the Maghrebi countries there are also two minor isolated projects in Sudan. Although aluminium is both produced in and exported from the region, it is not included in this survey because it uses imported raw materials and is therefore not part of the domestic non-hydrocarbon mining sector.

### 5.5.1 Morocco

The table below outlines Morocco's recent minor metallic mineral exports which exclude lead, copper, iron and

zinc. In terms of the value of exports in 1983 they are, in order of importance; silver, manganese ore, auriferous copper, cobalt ore and antinomy ore. Although only 79,688 kgs of silver was exported in 1983, it is one of the most important minerals in Morocco in terms of value. About 91% of the silver that was produced in 1983 was exported with the most important clients being France (61%), Switzerland (21%) and the UK (18%), [33].

**Table 5.10 : MOROCCO'S METALLIC MINERAL EXPORTS.**

| Mineral | 1982 | | | 1983 | | |
|---|---|---|---|---|---|---|
| | Tonnage | Dhs | US$ | Tonnage | Dhs | US$ |
| Silver | 54 | 81.0 | 13.47 | 80 | 204.5 | 28.76 |
| Manganese | 81,904 | 60.0 | 9.98 | 57,689 | 50.3 | 7.07 |
| Aurif. Cu. | 1,130 | 14.6 | 2.42 | 1,314 | 16.8 | 2.37 |
| Cobalt Ore | 5,570 | 72.9 | 12.10 | 2,161 | 7.2 | 1.00 |
| Antimony Ore | 1,740 | 4.7 | 0.79 | 1,110 | 3.0 | 0.43 |

Figures for value in millions of Dirhams & US Dollars

Source : Ministère de l'Energie et des Mines, **Activité du Secteur Minier 1983**, op cit, Appendix II.

The production and export of manganese is largely dependent on the general level of activity of the world's chemical industry. Both declined during the world recession in the early 1980s. In 1983 a total of 57,689 tonnes of manganese was exported from Morocco with a value of Dhs50.3 mn or US$7 mn. The most important client countries were France (31%), West Germany (20%), the Netherlands (13%), Italy (11%), Spain (8.5%), East Germany (8.3%), the United Kingdom (3.9%),

Czechoslovakia and the USA, [34].

Auriferous copper contains gold which can be separated from the ore. In 1983 all of the 1,130 tonnes which was exported went to Sweden, [35]. The statistics for cobalt ore provide an example to show the remarkable price fluctuations of some minerals. In 1982 cobalt exports were valued at Dhs13,079 a tonne (US$2,172) compared with Dhs3,322 a tonne (US$453) in 1983. After the closure of the mine at Bou-Azzer at the end of 1982 the majority of the disposable stocks were exported in 1983 and both production and exports have now ceased. The only other metallic mineral which is exported by Morocco is antimony ore which is relatively insignificant, being worth only about US$430,000 in 1983. In that year the most important clients were Belgium (62%), Yugoslavia (27%), Spain (6.5%) and France (4.1%), [36].

### 5.5.2 Algeria

Besides producing and exporting iron, lead and zinc Algeria also exports substantial quantities of mercury. The country is a major mercury producer with about 10% of the world's reserves and 17% of the world's total mercury production, [37]. The unit of both production and exports is the industry's standard 34.5 kgs bottles. Algeria's domestic demand for mercury is only about 500 bottles a year and therefore approximately 30,000

bottles of mercury are exported. Most of this goes to the battery, chemical and pharmaceutical industries in Western Europe. Algeria has now joined the Western world's two other major producers, Spain and Turkey, in an unofficial cartel in a successful attempt to push up the depressed market price by stockpiling their production. The free market price has been forced up from below US$210 a flask in September 1986 to US$300-US$310 in October 1988, [38].

### 5.5.3 Tunisia

Besides those already outlined in this chapter the only other metallic mineral that Tunisia exports is silver. It is produced in very small quantities during the treatment of lead ore but during the past few years it has fallen from 3,600 kgs in 1982 to 1,700 kgs in 1984. The level of exports is directly dependent on production levels and was 3,300 in 1983, [39]. In terms of value Tunisia's silver exports ranged from US$0.6 mn and US$3.5 mn between 1979-1983, [40].

### 5.5.4 Sudan

Besides Oman's copper exports, the only non-Maghrebi country to export metallic minerals is Sudan. Although the projects are very small by international standards

they are important for particular regions in the country. There are two metallic mining projects which both export all of their production. These are chromite ore from the Ingessana Hills and gold from the Red Sea Hills. There has also been intermittent mica and manganese production which was always export orientated.

Between 1961 and 1981 it is calculated that 308,840 tonnes of chromite ore were produced, of which 226,854 tonnes or 73% was exported, the remainder being stockpiled for later sale, [41]. During the past 25 years production and exports have fluctuated wildly between 5,000-35,000 tonnes. It is hoped that both can be substantially increased in the future. This will depend on increasing investment and reducing transport and labour costs in an otherwise very low cost and labour intensive mining operation.

The chromite is transported by truck from the Ingessana Hills to Damazine from where it is sent by rail to Port Sudan for export to Japan and Western Europe. The high grade Sudanese chromite attracts a premium price on the world markets where its principal competitors are Albania and Turkey. Therefore, while Sudan cannot compete with the major producers it should be able to ensure an adequate export market for its increasing production levels, [42].

Production of gold in commercial quantities has now restarted at the Gebeit mine in the Red Sea Hills. The mine and treatment plant are expected to produce and process about 50,000 tonnes of high grade ore each year. All of the gold which is recovered from the very high grade mine is exported via Port Sudan. Gold production and exports also began from two other mines in 1988 and this will accelerate in the next few years. Together with other mines in the region, which are expected to come on stream during the next decade, it is hoped that Sudan will be able to export increasing quantities of gold in the future. While this will not make Sudan a major producer or exporter, in a small way it should help the chronic balance of payments situation. Although many problems would have to be overcome, it is also possible that Sudan may be able to develop other small mining projects which can help earn valuable foreign currency.

## 5.6 Building Materials
**********

While phosphates and metallic minerals may be more obvious hard currency earners, building materials are very important trade items in the Arab Middle East. Although this chapter concentrates on mineral exports, it should also be remembered that the Middle East countries also import huge quantities of building

materials.

**Table 5.11 : 1983 BUILDING MATERIAL IMPORTS (US$ mn)**

| Country | 1 | 2 | 3 | 4 | 5 | TOTAL |
|---|---|---|---|---|---|---|
| Algeria | 196 | - | 29 | - | 4 | 229 |
| Bahrain | 26 | 7 | - | 3 | 1 | 37 |
| Egypt | 144 | 20 | 11 | 1 | 3 | 179 |
| Iraq | 147 | 17 | 8 | 7 | 7 | 186 |
| Jordan | 11 | 7 | - | - | 1 | 19 |
| Kuwait | 106 | 15 | - | 26 | 15 | 162 |
| Lebanon | - | 16 | 2 | - | 6 | 24 |
| Libya | 62 | 30 | 2 | 9 | 12 | 115 |
| Morocco | - | - | - | - | - | - |
| Oman | 86 | 11 | - | 3 | - | 100 |
| Qatar | 33 | 9 | - | 3 | - | 45 |
| Saudi Arabia | 491 | 125 | 17 | 182 | 52 | 867 |
| Sudan | 3 | - | - | - | - | 3 |
| Syria | 10 | 4 | 3 | 1 | 2 | 20 |
| Tunisia | 13 | 5 | 4 | - | 3 | 25 |
| UAE | 71 | 17 | - | 14 | 5 | 107 |
| North Yemen | 11 | - | - | 1 | - | 12 |
| South Yemen | - | - | - | - | - | - |
| **TOTALS** | **1,410** | **283** | **76** | **250** | **111** | **2,130** |

1 = Cement, 2 = Non-Refractory Bricks, 3 = Refractory bricks, 4 = Building Stone, 5 = Stone, Sand & Gravel. Figures rounded off to nearest $ 1 mn

**Source** : United Nations, Trade Statistics 1983, op cit

**Tables** 5.11 and 5.12 show that the Middle East is a major importer of cement which totalled almost US$1,500 mn in 1983. In that year the area took 49.1% of the world's total cement imports, of which Saudi Arabia represented a staggering 16.8%, **[43]**. By comparison cement exports were negligible, although some gypsum and limestone is exported for foreign cement industries. This should change now that the Gulf War has ended and both Iraq and Iran will need huge quantities of cement for their reconstruction projects.

Table 5.12 : 1983 BUILDING MATERIAL EXPORTS (US$ mn)

| Country | 1 | 2 | 3 | 4 | 5 | TOTAL |
|---|---|---|---|---|---|---|
| Algeria | - | - | - | - | - | - |
| Bahrain | - | - | - | - | - | - |
| Egypt | - | - | - | - | - | - |
| Iraq | - | - | - | - | - | - |
| Jordan | - | - | - | 7 | 2 | 9 |
| Kuwait | - | 1 | - | 1 | - | 2 |
| Lebanon | 9 | 2 | - | 1 | 1 | 13 |
| Libya | - | - | - | - | - | - |
| Morocco | - | - | - | - | 4 | 4 |
| Oman | - | - | - | - | 1 | 1 |
| Qatar | - | - | - | - | - | - |
| Saudi Arabia | 9 | - | - | - | - | 9 |
| Sudan | - | - | - | - | - | - |
| Syria | - | - | - | - | 3 | 3 |
| Tunisia | - | - | 4 | - | - | 4 |
| UAE | - | - | - | - | 10 | 10 |
| North Yemen | - | - | - | - | - | - |
| South Yemen | - | - | - | - | - | - |
| **TOTALS** | **18** | **3** | **4** | **9** | **21** | **55** |

1 = Cement, 2 = Non-Refractory Bricks, 3 = Refractory bricks, 4 = Building Stone, 5 = Stone, Sand & Gravel. Figures rounded off to nearest $1 mn

**Source** : United Nations, **Trade Statistics 1983**, op cit

The construction boom during the 1970s led to a substantial increase in the import of both standard and refractory bricks. Once again Saudi Arabia is the dominant importer taking 5.8% and 2.3%, respectively, of the world trade; the comparable figures for the region as a whole being 13.1% and 18.5% for the standard and refractory brick trade, **[44]**. Although Iraq has invested heavily in new brick plants and hoped to export substantial quantities this could not begin until the Gulf War ended.

The growth in Saudi Arabia's building material imports is best illustrated by the fact that its share of world building stone imports rose from 0.9 % in 1974 to a high of 22% in 1982, while the that of the Middle East rose from 3.2% to 25.2% in the same period. Although its dominance is less pronounced for stone, sand and gravel imports, Saudi Arabia still accounted for 44% of the region's imports, [45].

What the statistics reveal is the tremendous potential for building materials production and their intra-regional exports in the future. Taken in total, in 1983 the countries of the Arab Middle East imported over US$2,000 mn of these major building materials. When taken in conjunction with others such as asbestos, clays, gypsum, limestone and glass it is obvious that the building material sector is very important. Any country in the region which was able to develop a successful building material industry would have a ready market in the rest of the region.

## 5.7 Other Non-Metallic Minerals

Besides phosphates and building materials, there are also some other non-metallic minerals exports from the Arab Middle East. These include natural sulphur from

Iraq, potash from Jordan, fluorspar and barytes from the Maghrebi countries as well as certain other minor exports. This section examines some of these exports and provides a few statistics for the quantity and destination of the exports.

### 5.7.1 Morocco

Besides phosphates Morocco also exports small quantities of other non-metallic minerals. As Table 5.13 illustrates below, the most important is baryte which is used in drilling mud by the oil industry. The demand for it is therefore dependent on oil drilling activity which has been declining in recent years. This is particularly true in the case of Moroccan exports which mainly go to the USA which in 1983 took 186,227 tonnes or 51.8% of the total. The other principal clients were the UK (15.8%), the Netherlands (12.2%), Angola (5.9%), Antilles (4.1%), Mexico (3.5%) and Mexico (3.0%). Meanwhile 4,762 tonnes were sold on the local market to the state oil company ONAREP for Dhs2.6 mn or US$366,000, [46]. Although it remains Africa's largest baryte producers, output has dropped sharply from a record 561,000 tonnes in 1984 to around 180,000 tonnes in 1987 and exports have obviously also fallen.

Fluorspar is also both produced and exported by Morocco, with 54,025 tonnes or 89.6% of the 60,300 tonnes which

was produced being exported in 1983. The majority of these exports went to three countries; Canada (50.2%), the USA (34.2%), and Norway (15.6%), [47]. As Table 5.13 shows, Morocco also exports relatively small quantities of special clays which are used in the ceramic industries.

**Table 5.13 : MOROCCAN NON-METALLIC MINERAL EXPORTS**

| Mineral | 1982 | | | 1983 | | |
|---|---|---|---|---|---|---|
| | Tonnage | Dhs | US$ | Tonnage | Dhs | US$ |
| Baryte | 384,078 | 123mn | 20mn | 359,294 | 112mn | 16mn |
| Fluorspar | 60,512 | 59mn | 10mn | 54,025 | 68mn | 9mn |
| Spec.Clays | 16,744 | 0.8mn | .1mn | 20,837 | 1mn | .2mn |

**Source :** Ministère de l'Energie et des Mines, **Activité du secteur Minier 1983**, op cit, Appendix II

## 5.7.2 Tunisia

Besides phosphates and some building materials, Tunisia only exports two other non-metallic minerals - sea salt and fluorspar. Although baryte is produced it is used exclusively by the domestic metallurgic industry to produce drilling mud for the Tunisian oil industry. Fluorspar production is also used predominantly by the domestic chemical industry to produce aluminium fluoride with most going to the Industrie Chimique du Fluor, although there are also intermittent exports. By contrast substantial quantities of sea salt are produced and exported. Between 75%-85% of the salt, which is

produced in salines near Sousse and Sfax, is exported. The principal clients in 1983 were Italy (37%), the USA (11%), Bulgaria (10%) and Yugoslavia (9.5%), **[48]**.

**Table 5.14 : TUNISIAN NON-METALLIC MINERAL EXPORTS**

| Mineral | (in tonnes) | 1981 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|
| Sea Salt | Production | 467,938 | 421,200 | 375,000 | 400,000 |
| | Exports | 377,420 | 354,556 | 293,603 | 300,000 |
| Fluorspar | Production | 30,360 | 33,210 | 33,755 | 45,000 |
| | Exports | - | 1,394 | - | 5,000 |

**Source :** Direction des Mines et de la Géologie, **Aperçu sur l'activité du secteur des mines au cours de la période 1981-1984**, op cit, p.4

### 5.7.3 Jordan

Like its much larger phosphate industry, the export sales from Jordan's Arab Potash Company on the Dead Sea were concentrated in South and South-East Asia. In 1984, which was the second year of operation, production was 486,000 tonnes compared to 280,000 tonnes in 1983. Of this 449,602 tonnes or 92.5% was exported. As **Table 5.15** below shows, the principal clients were India (22%), Indonesia (13%), China (12%), Malaysia (11%), France (7%) and South Korea (7%), **[49]**. In 1984 Jordan's share of the world potash market, which was dominated by Canada and the Soviet Union which accounted for 60 % of the 29 mn tonne total, was only 1.1%, **[50]**. Production and exports increased to about 1.2 mn tonnes by 1987 and Jordan's share of the world market should continue to

increase in the coming years.

**Table 5.15 : ARAB POTASH COMPANY SALES 1983-1984**

| COUNTRY | 1983 (MT) | 1984 (MT) |
|---|---|---|
| India | - | 98,000 |
| Indonesia | 12,040 | 57,000 |
| China | 63,380 | 54,000 |
| Malaysia/Singapore | 28,979 | 48,850 |
| France | 78,510 | 32,760 |
| South Korea | 45,000 | 32,000 |
| Taiwan | 22,000 | 28,080 |
| Brazil | - | 25,000 |
| New Zealand | - | 19,315 |
| Japan | - | 15,000 |
| Iraq | 2,784 | 8,097 |
| Senegal | - | 8,000 |
| Turkey | - | 7,000 |
| Burma | - | 6,500 |
| Italy | - | 5,000 |
| Ivory Coast | - | 5,000 |
| **TOTAL** | **211,193** | **449,602** |

Source : Arab Potash Co. Ltd., **Annual Report 1984**, op cit p.15.

As with its phosphate exports, Jordan has a distinct geographical advantage over its rival exporters because the port of Aqaba is so much closer to its most important markets in the Indian sub-continent. It should also be able to build new export markets in the Middle East itself as the fertilizer industry in the region expands. Although some natural potash and other similar salts are produced in the Middle East, with the exception of the Israeli project located just on the other side of the Dead Sea's "truce channel", Jordan is the only major potash producer in the region.

### 5.7.4 Others

There are also a few other non-metallic minerals which are exported either in very small quantities or irregularly. These include sea salt from a number of countries, Iraqi natural sulphur and one or two others. South Yemen produces 50,000-75,000 tonnes of salt of which a major proportion is exported, with other exporters including Saudi Arabia, Kuwait, Jordan and Sudan. While some of these last countries are involved in re-exports to other Arab countries and produce very little salt, Egypt exports quite large quantities of salt to other regions. In 1981 production fell to 19,500 tonnes compared with 49,407 tonnes the previous year. Of this Bulgaria took 12,800 tonnes or two-thirds of the total, with Rwanda taking a further 2,000 tonnes, [51]. As already seen Tunisia is the only major salt exporter in the Arab Middle East.

Iraq has the potential to export substantial quantities of natural sulphur from its huge Mishraq deposit near Mosul. Until 1980 most of the sulphur had gone to the Umm Qasr chemical complex on the Gulf coast. The Gulf War made this and the export of sulphur from the Gulf impossible although some has been exported via the Jordanian port of Aqaba. Because of the damage to the Umm Qasr complex, which was in the war zone, it is

likely that until it is repaired all of the sulphur production will be exported rather than processed.

Although there are also exports of other non-metallic minerals, they are all on a small scale and are often scrap metals rather than minerals produced within the country. In addition many involve re-exports whereby an agent in one country imports a consignment of minerals or building materials and then re-exports it to a third country. This is particularly important in the case of Jordan which acted as a conduit for Iraq whose ports were closed because of the Gulf War. Some of the lower Gulf countries such as the UAE, Qatar and Oman are also used as a staging port for imports which are then ferried across the Gulf to Iran.

## 5.8 Principal Direction of Trade

While the Arab Middle East accounts for almost half of world's phosphate exports, in general the region's role as a mineral exporting region is comparatively small. With the exception of Algerian mercury, the region probably accounts for less than 5% of all mineral exports. Meanwhile building materials in general, and cement in particular, are by far the most important mineral imports to the Middle East.

The statistics in this chapter have shown that Western

Europe is the most important market for Middle East minerals. The Maghrebi countries of Morocco, Algeria and Tunisia have natural geographical advantages being so close to Western Europe in general, and the northern Mediterranean countries in particular. As an example Spain and France take about two million tonnes of Morocco's phosphate with Belgium taking a further 1.6 mn tonnes. This pattern is also repeated for other mineral exports from the Maghreb which predominantly go to Western Europe.

It should be noted that Algerian exports, as well as other countries such as Syria, Libya and South Yemen, are geared to socialist countries in Eastern Europe. In addition much of Egypt's mineral trade takes the form of long term government to government bilateral trade deals with socialist countries such as China, Yugoslavia and Bulgaria.

It is perhaps natural that those countries which lie further east have attempted to concentrate their mineral trade with the major markets in South and South-East Asia. This is particularly important in the case of Jordanian phosphates and potash which are used by the agricultural sector rather than industry. As Asian countries develop their own fertilizer industries the demand for Middle East phosphates and potash will

undoubtedly increase.

The smaller mineral exports such as Omani copper and Sudanese chromite and gold are usually sent to Western Europe. Like all other mineral exports they are dependent on world market conditions which have generally been depressed and stagnant throughout most of the 1980s. Because of the small scale of mineral production in many of these projects the exports are often handled by agents on the London and other metal exchanges.

During the 1970s construction boom building materials imports flooded into the Middle East in general and the Gulf states in particular. The region, which accounted for almost half of the total world cement imports, was supplied by major cement producers including Spain, Greece, Poland, Japan and South Korea. The dominant supplier for almost all the other building material imports is Italy.

## 5.9 World Mineral Prices
**********

Like all other mineral producers, the Middle East is affected by the current generally low level of mineral prices. During the early 1980s the industrial recession led to a fall in the demand for metallic minerals and therefore their prices. With the possible exception of

phosphates, the region has little or no ability to dictate the world price of any other mineral. Its limited share of world production make it a "price-taker" rather than "price-maker".

The six Middle East phosphate exporters account for almost half the world total. In the past there have been attempts to create an Arab producers' cartel which could influence prices, as Opec did with oil prices in the 1970s. Morocco quadrupled the price of its phosphate exports in January 1974 and this led to a substantial increase in production levels in the rest of the region. This in turn caused a significant fall in prices in 1975/76 and again in 1981/82. This decline was also caused by the economic recession in the industrialised countries, which led to a fall in the demand for phosphates for their fertilizer and chemical industries. Opec's problems of maintaining its oligopolist position show that the Middle East will probably nevewr be able to fix any world mineral prices.

## 5.10 Export of Downstream Mineral Products

Like the rest of the developing world the countries of the Arab Middle East are trying to create downstream industries to process their mineral deposits. The processed products are then used by the domestic

metallurgic and chemical industries with the remainder being exported. There are a number of reasons for this move towards downstream activities including the increase of the value of the product which is naturally more beneficial than exporting basic raw materials. In addition, it reduces the mineral's volume and therefore the transport costs. Naturally the production of processed minerals also reduces the dependence on the imports of such products.

All of the phosphate producers have been moving towards downstream activities and exports. In 1983 Morocco exported 857,680 tonnes of phosphoric acid, 641,100 tonnes of triple super phosphate (TSP) and 197,000 tonnes of mono-ammonia phosphate (MAP). The proportion of total production which was exported in 1983 were 69%, 96% and 89%, respectively, [52]. Turkey and Western Europe were the most important market for the phosphoric acid and MAP, while the TSP market was more evenly divided throughout the world. Phosphoric acid exports totalled MD3,584 mn (US$429 mn) in 1987 and now exceed raw phosphate exports which brought in MD3,080 mn (US$368.5 mn) in 1987.

Besides phosphates the region is also producing and exporting other processed minerals. These include small quantities of iron and steel from Algeria, Egypt and Tunisia, lead and zinc metal products from the Maghreb,

copper from Morocco and Oman, Moroccan silver as well as some others. Aluminium production and exports from the Middle East are quite large but, because they use imported raw materials, are not included in this survey.

Cement is the major downstream building material which is exported. The UAE cement industry has a production capacity of about nine million tonnes while its domestic demand is only 1.8 mn tonnes. It has therefore had to rely on cement exports to neighbouring countries such as Saudi Arabia, Bahrain, Oman and Qatar. This move towards the production and export of downstream processed minerals can be expected to continue and expand in the future because of the end of the Gulf War.

## 5.11 Intra-Arab Trade

The trade statistics demonstrate the potential for increased intra-Arab trade in minerals. So far this has largely been confined to the re-export of minerals from third countries. The current level of exports to other countries in the region is very small. There appears to be a bias against Arab products despite the fact that Middle East cement, for example, fully meets international standards and is better quality than cement which has been imported from South Korea or elsewhere which was produced months before being used.

Despite this, cement and other mineral products are imported from Europe and South-East Asia rather than from neighbouring states.

The industrial sector in the Middle East remains relatively underdeveloped and therefore the principal markets for the metallic mineral exports are in Western Europe rather than within the region. It is hoped that this situation may change as domestic metallurgic and chemical industries are established in the region. The growth of the fertilizer industry should also increase the Middle East demand for regionally produced phosphates and potash. Two of the problems in this respect are demographic and financial. While countries such as Egypt, Morocco, Algeria and Sudan have the largest populations in the region and are therefore potential markets for metals, chemicals and fertilisers they are also amongst the poorest countries in the region. By contrast, the oil-rich Gulf states which could afford to establish these new capital industries, have small populations and restricted domestic markets.

The greatest potential for intra-Arab trade is probably in building materials. Compared with underground metallic mining the extraction process is both cheap and less capital-intensive. Therefore poorer countries such as Egypt and Sudan could produce and export building materials to the huge Saudi Arabian market. In 1981

Saudi Arabia imported over 200,000 tonnes of gravel and 30,000 tonnes of gypsum from as far afield as Finland, despite the fact that both are available in neighbouring Egypt and Sudan.

This is only one example of such anomalies and it therefore appears that there is considerable scope for intra-Arab trade in building materials. This would depend on the richer countries making a determined effort to import their minerals from the rest of the region rather than always choosing the non-Arab option. Not only could this be highly beneficial for some of the poorer Arab countries but it could also be cheaper for the importing countries in the long run.

## 5.12 Conclusions
**********

There are a number of conclusions that can be drawn from the evidence which has been presented in this chapter. With the notable exception of phosphates, the region is unlikely to play a major role in world mineral exports because of the scale of mineral production and the small domestic markets. Consequently, the producers will remain "price-takers" rather than "price-makers". Even the region's apparent dominance in terms of world phosphate exports has not enabled it to establish a successful producers' cartel to push up prices. Given

the alternative sources of production and the political strains between the various producers, it is highly unlikely that such a cartel could ever be formed or successfully maintained. While phosphate exports are major hard currency earners for the producer countries, it is important to put the mining industry into perspective. Therefore in the next two chapters we examine its actual role in the national and regional economies of the Arab Middle East.

**Footnotes**
*********

01. British Sulphur Corporation Ltd, **Raw Material Report 8th & 17th October 1985**, op cit. and Mining Journal, **Mining Annual Review 1988**, op cit, pp.109-110

02. **ibid**

03. **ibid**

04. Mining Journal, **Mining Annual Review 1988**, op cit, p.421

05. **Middle East Economic Digest**, London, 24/6/1988, p.26

06. Jordan Phosphate Mining Company, **Annual Report 1984**, op cit, p.35

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08. Mining Journal, **Mining Annual Review 1988**, op cit, p.428

09. Mining Journal, **Mining Annual Review 1988**, op cit, p.9

10. Statistiques Financieres, **May 1985, No.71**, Tunis, pp.66-69

11. **ibid**

12. British Sulphur Corporation Ltd, **Raw Material Report - 8th & 17th October 1985**, op cit.

13. H.M.Temmar, **Strategie de developpement indépendant: Le cas de l'Algérie : Un bilan**, Editions Publisud, Paris 1983, p.206.

14. Ferphos, **D'Jebel Onk**, Tebessa, op cit, p.6.

15. British Sulphur Corporation Ltd, **Raw Material Report - 8th & 17th October 1985**, op cit. and Mining Journal, **Mining Annual Review 1988**, op cit, p.109

16. **ibid**

17. Arab Industry Review 1985, **Fertilisers : Self-sufficiency an attainable target**, op cit, p.118

18. U.S. Bureau of Mines, **Area Report : International Volume 3, 1983**, Washington, 1984, p.

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20. United Nations, **Trade Statistics Yearbook 1984**, Table 281, p.64.

21. Ministère de l'Energie et des Mines, **Activités du secteur minier 1983**, op cit, Appendix II & IV. and Mining Journal, **Mining Annual Review 1988**, op cit, p.55

22. **ibid**

23. United Nations, **Trade Statistics Yearbook 1984**, op cit, Table 683, p.148.

24. Ministère l'Energie et des Mines, **Activités du secteur minier 1983**, op cit, pp.82-83.

25. **ibid**, p.83

26. Entreprise Nationale des Produits Miniers Non-Ferreux et des Substances Utiles, **Brochure**, op cit.

27. H.M.Temmar, **Strategie de developpement indépendant: Le cas de l'Algérie : un bilan**, op cit, pp.205-6

28. Banque Centrale de Tunisie, **Rapport Annuel 1984**, Tunis, July 1985, pp.49-50.

29. **ibid**

30. Bank of Morocco, **Annual Report 1984**, Rabat, p.2-6

31. U.S. Bureau of Mines, **Area Report : International Volume 3, 1983**, op cit, p.639.

32. Middle East Economic Survey, **11th February 1986**, 28:18, Nicosia, p.18.

33. Ministère de l'energie et des Mines, **Activitié du Secteur Minier 1983**, op cit, p.85.

34. **Ibid**, p.86

35. **Ibid**, p.85

36. **Ibid**, p.38

37. M.R.Khawlie, **An overview of mineral resources in the Arab World**, 5th Industrial Minerals International Congress, Madrid, April 25-28 1982, p.1

38. Mining Journal, **Mining Annual Review 1988**, op cit, p.91 and **Mining Journal**, 16 September 1988, Vol.311, No.7986, p.239

39. Banque Centrale de Tunisie, **Rapport Annuel 1984**, op cit, p.51.

40. United Nations, **Trade Statistics Yearbook 1984**, op cit. p.143.

41. Dr.F.A.Ibrahim, **Sudan's Mineral Deposits**, Mining Magazine, January 1983, London, p.35

42. **Personal Interview by the Author** with Sudanese Mining Corporation, Khartoum, February 1985.

43. United Nations, **Trade Statistics Yearbook 1984**, op cit, p.505.

44. **ibid**, p.508-9

45. **ibid**, p.60 & 506

46. Ministère de l'Energie et des Mines, **Activités du secteur minier 1983**, p.85

47. **ibid**, p.88

48. Banque Centrale de Tunisie, **Rapport Annuel 1984**, op cit, p.51

49. Arab Potash Company, **Annual Report 1984**, op cit, p.15

50. **ibid**, p.10

51. U.S. Bureau of Mines, **Area Report : International Volume 3 : 1983**, op cit, p.294.

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# CHAPTER SIX
**********

# THE ROLE OF THE MINING SECTOR IN THE NATIONAL ECONOMY
**********

## Introduction
**********

In the introductory chapter we outlined a possible theoretical model for analysing the impact of the mining sector on regional and national economies. In this chapter we try to use the model to examine the indirect or **secondary impacts** before moving on to a regional analysis in **Chapter Seven**. An entirely comprehensive and comparative analysis is not possible because the necessary statistics are unavailable. Therefore the role of mining in the national economies is dealt with on a country by country basis.

The significance of the non-hydrocarbon mining sector in the region can be analysed by dividing the countries of the Arab Middle East into a number of groups. **Table 6.1** below illustrates these categories and the criteria used to establish them. It shows that the importance of the mining sector ranges from countries such as Morocco where it is highly significant to city states such as Kuwait where the sector's importance is negligible.

**Table 6.1 : A GUIDE TO THE ACTUAL SIGNIFICANCE (1) OF NON-HYDROCARBON MINERALS IN THE ARAB MIDDLE EAST**

| | 1st Commodity | 2nd Commodity | Conv.Meas %GDP | Conv.Meas %Exp | Non-oil I.V.A. |
|---|---|---|---|---|---|
| 2 | 3 | 4 | 5 | 6 | 7 |
| **High** | | | | | |
| Morocco | Phosphate | Others | 4.0 | 60 | 35 |
| Jordan | Phosphate | Others | 3.3 | 35 | 33 |
| Tunisia | Phosphate | Others | 2.5 | 31 | 24 |
| **Medium-High** | | | | | |
| Algeria | Iron Ore<br>Phosphate | Others | 1.5 | 23 | 20 |
| Egypt | Iron Ore<br>Phosphate | Build.Mat<br>Others | 1.0 | 1 | 20 |
| **Medium** | | | | | |
| Iraq | Building Materials | Phosphate<br>Sulphur | 0.5 | <1 | 20 |
| **Medium-Low** | | | | | |
| Lebanon | Cement | Build.Mat | 2.0 | 20 | 12 |
| U.A.E | Cement | Build.Mat | 0.2 | 10 | 10 |
| Oman | Cement | Copper | 1.2 | 7 | 20 |
| **Low** | | | | | |
| Syria | Phosphate | Build.Mat | 0.6 | 9 | 12 |
| S.Arabia | Cement | Build.Mat | 0.5 | <1 | 21 |
| Libya | Cement | Build.Mat | 0.6 | <5 | 7 |
| Qatar | Cement | | 0.3 | <1 | 24 |
| Sudan | Chrome | Build.Mat | 0.5 | <1 | 7 |
| Y.A.R. | Cement | Build.Mat | 1.5 | <1 | 17 |
| P.D.R.Y. | Build.Mat | Salt | 0.2 | <1 | 14 |
| **Negligible** | | | | | |
| Kuwait | Build.Mat | | 0.1 | <1 | 1 |
| Bahrain | Build.Mat | | 0.1 | <1 | 1 |

**Notes about Table**

The table is intended to provide a comparative analysis of some of the indicators of the importance of non-hydrocarbon minerals in the Arab Middle East.

**Table 6.1 continued overleaf .....**

**Table 6.1 continued .....**

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1.The countries have been divided into five groups which are based on the significance of the mining sector on each country's national economy. The criteria for assessing which group each country goes into include the mining sector's share of GDP and export revenues, and the scale of the mineral-related downstream industries. They range from those where mining and downstream industries are highly significant to "city states" which, although they may import minerals, have virtually no indigenous mineral industry.

2. The names of the countries are almost self-explanatory. U.A.E. is the United Arab Emirates; Y.A.R. is the Yemen Arab Republic which is more commonly known as North Yemen; and P.D.R.Y. is the Peoples' Democratic Republic of Yemen or South Yemen.

3. The **1st Commodity** refers to the most dominant mineral or minerals which are produced in each country based on the scale and importance of the industry. Building materials have been abbreviated to Build.Mat

4. The **2nd Commodity** refers to the mineral or minerals which are less important. In most cases there is no single secondary commodity which is more important than the others.

5. **Conven.Meas. % GDP** refers to the standard measure of the mining sector's share of total GDP as conventionally measured. It is used in this table to illustrate that there is a major difference between the standard measure of GDP and one which takes other factors into consideration.

6. **Non-oil % Exp** refers to the share of non-oil exports which is contributed by the export of raw and processed minerals including cement and building materials. In some countries exports are negligible or minerals and building materials are imported and the figure <1 % means less than one per cent. The statistics are taken from the most recent available sources which are used elsewhere in this study.

7. **Non-oil Indus.V.A.** refers to the proportion of the total value added of the non-oil industrial sector of each country. The figures are taken from the Arab Banking Corporation, **Industrialisation in the Arab World**, Occasional Papers Series - No.3, A.B.C., Bahrain, 1986. The figure includes the value added for the mining, building material and non-oil fertiliser industries.

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The subjects which are covered in this chapter include the sector's contribution to gross domestic product and industrial production. Its share of both total and industrial investment during particular periods in a number of countries is also examined. The role of the mining sector in a number of different types of country is analysed in greater detail. These include, Morocco and Jordan, which have important mining sectors but no hydrocarbons, Algeria, which has both, and Saudi Arabia which has a very small non-hydrocarbon mining sector compared to its huge oil industry.

## 6.1 High Significance Countries

There are three countries, Morocco, Jordan and Tunisia, in which non-hydrocarbon mining can be said to play a highly significant role in the national economy. The most obvious factor that unites the three is that they are the region's largest phosphate producers. In each country phosphate and phosphate products account for a major proportion of exports and foreign currency earnings, [01]. The industry also provides a major source of government revenue in the form of direct and indirect taxes, export levies and profit dividends. There are also important upstream and downstream linkages which have to be taken into consideration.

### 6.1.1 Morocco

The chapter begins with an analysis of Morocco because it is the most important mining country in the region. Phosphate, which accounts for over 80% of the value of mineral production, is important to the Moroccan economy, [02]. Although it initially only appears to account for about 2.0%-2.5% of gross domestic product this is a major under-estimation of its true significance. Even **Table 6.2** below, which shows how important the phosphate sector is in terms of both exports and state revenue, under-values its role, [03].

**Table 6.2 : PHOSPHATE'S SHARE OF MOROCCAN ECONOMY**

| | 1969 | 1974 | 1977 | 1984 |
|---|---|---|---|---|
| **Share of phos sector in :** | | | | |
| GDP | 2.2% | 3.5% | 2.4% | 2.8% |
| Rail freight traffic | - | 66.6% | 75.2% | - |
| Port freight traffic | - | 66.7% | 59.3% | - |
| **Share in total exports of:** | | | | |
| Phosphate rock | 22.4% | 55.0% | 36.5% | 24.2% |
| Phosphate products | 2.1% | 1.8% | 5.7% | 18.3% |
| **Share in state revenues :** | | | | |
| Mining taxes | 7.7% | 2.8% | 0.8% | - |
| Treasury receipts from OCP | 5.9% | 30.0% | 8.5% | - |

**Sources :**
1969-77 statistics :
World Bank, **Morocco : Economic and Social Development Report**, Washington, October 1981, p.17.
1984 statistics :
Bank of Morocco, **Annual Report 1984**, op cit, p.23 & Appendix A.35.

The phosphate industry's share of Morocco's total exports has risen from 22% in 1969 to 55% in 1974 following the quadrupling of phosphate prices by Morocco, **[04]**. It subsequently declined as phosphate prices have fallen while other exports have increased. Although the share of total exports decreased from 31%-24% between 1980-84, they increased in actual terms from MD3,011.8 mn to MD4,619.3 mn during the same period, [05].

In some ways the most important statistic is the spectacular rise in the export of phosphate products. It rose from 2.1% to over 15% of total export revenue between 1969 and 1987. Since the actual volume of exports has risen very substantially, these statistics actually underestimate the growth. Between 1980 and 1987 the export of phosphoric acid alone rose from MD793.1 mn (US$94.9 mn) to MD3,584 mn (US$429 mn), representing 8.2% and 15.42% of total exports, respectively, **[06]**. Phosphoric acid has now replaced phosphate as the largest single export commodity.

The importance of phosphates to state revenues and the transport sector is also illustrated by **Table 6.2**. Its contribution to government revenues has fluctuated considerably since 1969 when the phosphate sector accounted for almost 6% of the total. Following the

dramatic price rises, this increased to 30% in 1974 but has subsequently fallen as world phosphate prices have fallen, [07]. Meanwhile the sector has remained very important for Morocco's railways and ports, accounting for about two thirds of the total freight. Indeed, one of the problems for both is that the Office Cherifien des Phosphates (OCP), which is owned by the government, holds a very advantageous and almost monopolistic position when negotiating freight rates.

The contribution of the mining sector in general, and the phosphate sector in particular, is vital to the Moroccan government for a number of reasons. Besides providing a major proportion of its foreign currency receipts it is a principal source of tax and dividends to the treasury although these have fluctuated considerably. They rose from MD200 mn in 1973 to MD2,600 mn in 1975, before levelling out at about MD1,000 mn in the subsequent five years, [08]. Although more recent statistics are unobtainable, phosphates have undoubtedly remained one of the largest sources of tax revenue and customs duty for the government.

The fluctuations in its income from the sector have determined the government's ability to finance its economic development plans. The dramatic rise in phosphate prices between 1974-75 provided a short-lived bonanza for the government and there was an ambitious

revision of the 1973-1977 Development Plan. Its budget allocations for public and semi-public expenditures were revised very sharply upwards from MD10,000 mn to MD29,300 mn while those for the private sector remained stable. The revision assigned particular priority to government participation in highly capital-intensive industrial plants and to the Special Regional Development Fund in support of its aim to reduce regional disparities.

Problems arose when phosphate prices and therefore export revenues declined after 1975. Meanwhile Morocco's import costs in general, and oil products, food and capital goods in particular, continued to rise. Consequently since 1977 the government deficits increased and this naturally created serious economic problems. The 1974-75 windfall can therefore be seen as the result of a combination of fortunate circumstances and not the outcome of a deliberate policy.

Because of fluctuating world phosphate prices the government has deliberately attempted to increase the share of phosphate which is processed domestically. In this way it hopes to put its foreign exchange earnings and budgetary revenues on a more stable footing. A secondary motive is to increase the sector's value added as well as the number of downstream jobs. It is

important to note that, besides the actual production, the phosphate industry also includes beneficiation, transport, processing, marketing and shipping.

This is reflected in the fact that, besides the 15,980 employees who were engaged in actual phosphate mining in 1984, there were also 6,160 involved in beneficiation, 5,266 in processing and 1,278 in sales and deliveries, [09]. Of the company's 28,684 employees, which has subsequently risen to 31,179 by 1986, 8,140 worked in the coastal processing and shipping, while 1,571 worked at OCP headquarters at Casablanca, [10]. The phosphate sector also generates substantial additional employment in both upstream and downstream industries. As the latter expands in the coming years it can be expected that phosphate related employment will grow very sharply.

The OCP has a number of large subsidiary companies which handle these downstream operations thereby showing the scale and importance of the group. Maroc-Chimie operates two phosphoric acid plants which were constructed in 1965 and 1966 on the Atlantic coast at Safi. Maroc-Phosphore I and II, which are also located at Safi started operations in 1976 and 1981, respectively, [11]. The company which produces both sulphuric and phosphoric acid also operate Maroc-Phosphore III and IV which opened in 1986 at Jorf Lasfar near Casablanca where a

giant new port has been completed. Maroc-Phosphore V and VI, which will double production capacity and cost an estimated MD8,385 mn (US$1,003 mn), should be completed by 1991/92 thereby making it the world's largest solid fertilizer plant. It will consist of three units - a 1 mn t/y DAP plant, a 200,000 t/y ASP plant and a 400,000 t/y TSP plant. In 1983 Morocco accounted for 28% of world phosphoric acid exports and it is expected that its share will increase substantially once the project is completed, [12].

While the mother company, Maroc-Chimie and Maroc-Phosphore are the principal companies in the OCP group, there are other smaller subsidiaries. Fertima has the responsibility for supplying Morocco with fertilizers and harmonising production and distribution of fertilizer products. It was created in 1972 when two private companies merged but is now totally owned by OCP, with the supply programme being set by the Ministry of Agriculture and Agrarian Reform. The Fertima facilities include seven factories, eight storehouses, 235 agencies as well as the retailers, [13].

Marphocean was created by OCP in 1973 to meet the needs of transportation of both phosphate rock and products, with OCP owning 85%. The company owns and operates fifteen ships which carried over two million tonnes of

acid, chemicals, fertilizers and gas in 1984, **[14]**. Other companies in the OCP group include the Societe Marocaine d'Etudes Speciales et Industrielles (Smesi) which is involved in plant construction, and Centre d'Etudes et de Recherches des Phosphates Mineraux (Cerphos) which undertakes studies and research for the company, **[15]**.

It is obvious that the phosphate sector is extremely important to the Moroccan economy as a whole. The government receives substantial revenue from both phosphate exports and taxes. In addition OCP and all of its affiliate companies are also major industrial employers and clients for the transport system. The group, which had a turnover of US$600 mn in 1976, has been able to mobilise substantial international loans on behalf of the government. Its portfolio was valued at over MD1,000 mn and this represents about 55% of the investments in the mining sector, as well as investment in chemical (32%), transport (7%), and other sectors (6%), **[16]**.

The company's direct investments during the 1968-72 Plan represented about four per cent of the total amount invested in the Moroccan economy, and 5% during the 1973-77 Plan. Including the infrastructure related investments outlined in **Table 6.3**, OCP accounted for 15% of the total investment that was envisaged for the 1978-

80 Plan, [17].

| Table 6.3 : OCP INVESTMENTS 1968-80 (mn current MD) | | | |
|---|---|---|---|
| Investments | 1968-72 Plan | 1973-77 Plan | 1978-80 Plan |
| **Direct Investments** | | | |
| Mining Activities | 629 | 1,253 | 2,662 |
| Chemical Industries | - | 781 | 2,465 |
| Social Investments | - | 186 | 75 |
| **Total** | 629 | 2,220 | 5,202 |
| **Related Investments** | | | |
| Railway | - | 281 | 657 |
| Port Infrastructure | 23 | 136 | 385 |

**Source** : World Bank, **Morocco : Economic & Social Development Report**, Washington D.C., Oct 1981, p.154

The construction of downstream plants has been a major component in recent development plans and has received a large share of industrial development investment. As the new phosphate product plants at Jorf Lasfar are completed it can be expected that Morocco will become one of the world's largest producers of phosphate products. The danger is that this will precipitate the same type of price fall that occurred following the boom in phosphate rock exports after 1975. There is little doubt that the role of the phosphate sector in the Moroccan economy will become even more important.

By comparison, the rest of the Moroccan mining sector is less important although certainly not insignificant to the national economy. Non-phosphate mining is

administered by the Bureau de Recherches et Participation Minières (BRPM) which, in turn, is controlled by the Ministry of Energy and Mines' Direction des Mines. In 1984 BRPM had over 30 subsidiary companies with a portfolio of over MD350 mn, divided between mining (78%), ore processing (12%) and the petroleum and chemical industries (10%), [18].

The non-phosphate mining operations assist the Moroccan economy in a number of ways. They directly employ 13,221 people as well as indirectly employing and thereby supporting the families of thousands more, [19]. The sector is disproportionately important in some of the peripheral regions of the country where there is little or no alternative employment. There are significant non-phosphate mineral exports which are naturally beneficial to the national economy. Investment in the mining and processing operations amounted to MD300 mn in the 1968-72 Development Plan and MD1,300 mn during the 1973-77 Development Plan, [20]. This represented 48% and 59% of the phosphate sectors' level of investment. The failure to increase production and the continuing need for government financial support led to a sharp decline in the level of investment and a review of the economic viability of mining projects during the 1973-77 period.

Despite these problems the non-phosphate sector still

makes a sizable contribution to the national economy. In 1984 the sixteen BRPM subsidiary companies, excluding coal production, had a turnover totalling MD1,208 mn (US$137 mn) [21]. Their exports of 1,028,600 tonnes of minerals were valued at MD816.2 mn (US$93 mn), [22]. Therefore, although very small when compared with the phosphate sector, the other mineral projects do contribute to the Moroccan economy.

If all of this evidence is taken into consideration it is obvious that the original figure for the mining sector's contribution to Morocco's GDP is a considerable under-estimation. When all the upstream and downstream linkages are taken into consideration the true extent of the multiplier can be recognised. In other words for every MD1.0 mn worth of actual mineral sales an additional MD1.0 mn or more is generated in the rest of the economy. A more accurate estimate of the mining sector's direct and indirect contribution to national economy would show that, while the conventional measure of the mining sector's share of GDP is only about 5% of the total, the true figure is at least 10% and may have been as high as 20% during the mid-1970s.

### 6.1.2 Jordan

Besides Morocco the mining sector is probably most

significant to the Jordanian and Tunisian economies. Phosphates make up the over-whelming majority of the contribution to the Jordanian mining sector's output. The only other purely mining project which is in operation is the Arab Potash Company but, since it has only recently begun production, its role in the national economy is currently small albeit increasing rapidly. Although Jordan's large cement industry is not a purely mining operation it uses indigenous raw materials and is therefore briefly examined in this study. In addition there is a new fertilizer and chemical industry which is reliant on phosphate production for its raw material. Mining is undoubtedly very important to the Jordanian national economy in general, and to the principal production areas in particular.

The significance of the sector to the national economy is partially indicated by **Table 6.4** below. It covers the period from 1964 to 1975 and shows the effect of the dramatic phosphate price rise in 1974-75. Between 1964 and 1973 the receipts from the sale of phosphate rock fluctuated between JD2.42 mn and JD4.71 mn. In 1974 the price per tonne rose from JD4.32 to JD13.91 and then to JD19.051 in 1975, **[23]**. This led to a dramatic rise in the level of phosphate sales which rose from JD4.71 mn in 1973 to JD20.43 mn in 1974 and JD21.18 mn in 1975, **[24]**.

**Table 6.4 : PHOSPHATES IN THE JORDANIAN ECONOMY**

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| 1964 | 2.39 | 160.7 | 2% | 19% | 8.0% | na | 789 |
| 1965 | 2.42 | 180.5 | 1% | 15% | 9.0% | na | 1,100 |
| 1966 | 3.22 | 183.1 | 2% | 19% | 9.4% | 429.0 | 1,176 |
| 1967 | 3.72 | 170.9 | 2% | 25% | 8.8% | 215.1 | 1,436 |
| 1968 | 4.70 | 169.1 | 3% | 27% | 10.3% | 154.0 | 1,440 |
| 1969 | 3.92 | 198.1 | 2% | 20% | 10.0% | 41.6 | 1,227 |
| 1970 | 2.80 | 186.1 | 2% | 16% | 9.2% | 128.2 | 908 |
| 1971 | 2.69 | 199.4 | 1% | 16% | 8.5% | - | 996 |
| 1972 | 3.87 | 216.2 | 2% | 20% | 9.2% | 44.5 | 1,186 |
| 1973 | 4.71 | 241.3 | 2% | 21% | 9.4% | 81.4 | 1,496 |
| 1974 | 20.43 | 319.0 | 6% | 46% | 13.8% | 10,012.9 | 1,906 |
| 1975 | 21.18 | 365.0 | 6% | 47% | 12.3% | 12,820.6 | 2,514 |

**Notes :**
1 = Phosphate Rock Sales in JD mn
2 = Total GDP in JD mn (millions of Jordanian Dinars)
3 = Phosphate Sales as % of total GDP
4 = Phos Sales as % of mining & manufacturing sales
5 = Mining & Manufacturing sales as % of total GDP
6 = Government income from phosphates = JPMC Shares + Income and service taxes + Mining fee = in JD mn
7 = Number of employees in JPMC

**Sources**
Central Bank of Jordan, **Annual Reports**, Amman, 1964-76
Jordan Phosphate Mining Company, **Annual Reports**, 1964-76

This increase in revenues was also reflected by the rise in the phosphate industry's direct share of GDP, which jumped from 2% to 6% between 1973 and 1974/75, **[25]**. In 1979 mining and quarrying as a whole directly contributed JD27.5 mn or 5.08% of GDP, following the fall in phosphate prices, **[26]**. The effect of the price rise and subsequent fall is also reflected in phosphate's share of industrial production. Between 1964 and 1973 it fluctuated between 15%-27%% but jumped to 46% and 47% in 1974 and 1975, respectively, **[27]**. It should be noted that the statistics also reveal the

affect of the brief Jordanian civil war against the PLO, which began in "Black September" 1970, on GDP, phosphate sales and employment.

The table provides figures for the level of revenues that the Jordanian government receives from the phosphate sector. This is made up of three components; its shares in the Jordan Phosphate Mining Company, (JPMC), income and service taxes, and mining fees. The latter was introduced as a type of windfall tax following the phosphate price rises in 1974, when it was JD6.0 a tonne rising to JD11.0 a tonne in 1975, [28]. This mining tax accounts for the dramatic rise in the government's revenue after 1974. **Table 6.5** below provides statistics for JPMC's direct financial contribution to the treasury in 1983.

It is the role of the phosphate sector in Jordan's foreign trade and as a foreign currency earner that is most important to the national economy. Between 1958-67 phosphate exports represented an average of 34.5% of total domestic exports, rising to 38.4% between 1968-79. They ranged between 27.8% in 1963, when world prices were very low, to 60.2% in 1974 following the price explosion. The actual value in real terms rose slowly from JD1.35 mn in 1960 to JD5.5 mn in 1973, before taking off to JD23.77 mn the following year reaching JD27.55 mn in 1979, [29].

**Table 6.5**
**JPMC's Contribution to the Jordanian Treasury in 1983**

| | |
|---|---|
| Profits of shares owned by the government | 1,740,623 |
| Profits of shares owned in retirement funds | 423,529 |
| Tax on Company Profits | 3,572,111 |
| Income Tax from JPMC employees | 105,522 |
| JPMC contribution to social security | 709,416 |
| Staff contribution to social security | 404,708 |
| Sub-Total | 7,655,909 |
| Railway fees from mines to Aqaba | 5,429,239 |
| Fees to Ports Authority | 2,225,678 |
| **TOTAL** | **14,720,826** |

**Source** : Jordan Phosphate Mining Company, **Annual Report 1984**, (in Arabic), Amman, 1984, p.52

One of the difficulties facing the Jordanian government after the phosphate price explosion was the equally rapid price fall which threw the development plans into confusion. The 1976-80 Five Year Plan anticipated continuing high levels of phosphate export revenues as the price per ton rose from US$12.9 in 1973 to a maximum of US$60.96 in 1975, [30]. The discrepancy between planned and actual revenues is obvious from the following figures which indicate the ratio in millions of Jordanian Dinars at constant prices. The ratios of planned to actual revenues were 44:18 in 1976 and then 61:14.8 (1977), 73:15.1 (1978) and 81:15.9 in 1979, [31]. Therefore, while phosphate export revenues were expected to rise from JD44 mn to JD81 mn, they actually fell from JD18 mn to JD15.9 mn. Exports subsequently rose to JD69.6 mn (US$181.4 mn) in 1984 when phosphate

rock, which was the most valuable single export item, accounting for 24% of total exports, [32]. Although phosphate exports, which totalled US$350 mn in 1988 and an anticipated US$400 mn in 1989, have since fluctuated they have remained a vitallyy important source of foreign exchange.

Both the 1976-80 and 1981-85 Five Year Plans sought to reduce the country's dependence on the service sector, remittances and Arab aid. While the private sector was still expected to play a vital role in the economy, much of the state's contribution went into developing Jordan's few natural resources in general and phosphate, potash, cement and petrochemicals in particular. The 1981-85 Five Year Plan allocated JD758.8 mn or 23% of total investment to "mining and manufacturing", making it the largest single recipient sector. Of this total the mining, quarrying and cement industries received JD501.80 mn or 66% and 15.20% of manufacturing sector and total investment, respectively [33].

As **Table 6.6** below illustrates mining and quarrying plays an integral role in Jordan's industrial sector. The data for non-metallic mineral products refer to building materials including the very important cement industry. It shows that together with actual mining and quarrying, which is dominated by phosphates, building

materials accounted for about 35% of industrial gross output and 32% of industrial salaries. Since the statistics do not include the downstream industries they tend to under-estimate the importance of the mining sector.

**Table 6.6 : Mining's Role in the Industrial Sector**

| 1982 JD mn | Mining & Quarrying | | Non-Metallic Mineral Products | | Total Industry | |
|---|---|---|---|---|---|---|
| 1 | 45.462 | (18.8%) | 38.959 | (16.1%) | 242.0 | (100%) |
| 2 | 0.102 | | 6.086 | | -5.9 | |
| 3 | 10.887 | (24.6%) | 6.108 | (13.8%) | 44.3 | (100%) |
| 4 | 15.010 | (19.7%) | 9.058 | (11.9%) | 76.2 | (100%) |
| 5 | 81.750 | (10.4%) | 90.670 | (11.5%) | 785.4 | (100%) |
| 6 | 36.290 | ( 6.7%) | 51.700 | ( 9.5%) | 543.3 | (100%) |
| 7 | 19.463 | (15.3%) | 17.711 | (13.9%) | 127.5 | (100%) |

1 = Domestic Product
2 = Net Indirect Taxes
3 = Depreciation of Fixed Capital
4 = Employees Compensation
5 = Gross Output
6 = Intermediate Consumption
7 = Operating Surplus

**Source** : Department of Statistics, **Statistical Yearbook** 1983, No.34, Amman, 1984

Like other major producers Jordan has also moved into downstream phosphate-based fertilizer and chemical industries. The Jordan Fertilizer Industry Company, (JFIC), was established in 1975 to produce fertilizers, sulphuric and phosphoric acid, and aluminium fluoride. Its capital was raised from JD20 mn to JD40 mn in 1978 when its principal shareholders were the government (26%), JPMC (5%), the multilateral Arab Mining Company (10%), the World Bank's International Finance

Corporation (5%) and the Arab Petroleum Investments Corporation (Apicorp) of Saudi Arabia (5%), [34]. The investment for the Aqaba based project totalled US$440 mn and it began production in 1983. Unfortunately the world price of diammonium phosphate fell to 43% below that which had been used in the project's original feasibility study, [35]. The sustained losses of the JFIC dented the original optimism for this capital intensive prestige project.

In August 1986 JFIC was taken over by the profitable JPMC for a lump sum payment of JD60 mn. It has already made significant improvements and is running a much more efficient operation. Production costs have been reduced from US$250 to US$200 a tonne, although the world market price is still only around US$175 a tonne. The plant has never been able to produce more than about 65% of its design capacity and JPMC is now involved in arbitration with the plant's French manufacturer, [36]. Despite this, it is hoped that JFIC will eventually make an important contribution to the national economy.

Besides the production of phosphate rock and products, cement is the most important mineral-related industry for the Jordanian economy. Since the mid-1950s production has gradually increased from 86,000 tons in 1954 to 2,026,300 tons in 1984, [37]. In 1982 the Jordan

Cement Companies Factory added a sixth kiln to its plant at Fuheis outside Amman, thereby increasing its capacity to 2.2 mn tonnes. In late 1983 the 2 mn t/y US$224 mn South Cement Company plant at Rashadiyeh, 200 kms south of Amman, came on stream. Like the fertilizer plant domestic demand has failed to match expectations, falling from 1.9 mn tons in 1983 to 1.7 mn tons in 1984. Fortunately the new plant has managed to secure a 1 mn t/y contract with Egypt which will take half of its production, [38]. Despite this it is obvious that the Jordanian cement industry's production capacity at 4.2 mn t/y far exceeds the domestic and regional demand envisaged in the original feasibility studies conducted during the mid-1970s construction boom in the Arab Middle East. Despite this the cement industry accounts for about 25% of total industrial value added and 10% of industrial employees, [39].

The third major mineral related project, which could until recently have been termed a development planners' "white elephant", is the Arab Potash Company (APC) plant on the Dead Sea which is highly capital intensive and uses state of the art technology. Despite initial doubts and company losses production has risen from 280,000 tons in 1983 to its design capacity of 1.2 mn tonnes in 1987 and possibly 1.3 mn and 1.35 mn tonnes in 1988 and 1989, respectively, [40].

A number of conclusions can be drawn from these three downstream mineral processing operations. They were all planned during the wave of optimism in the mid-1970s when high levels of phosphate revenues as well as Arab aid and investment coincided with the Middle East construction boom. All three were predominantly expensive government funded capital intensive projects which sought to utilise and process Jordan's natural resources. In terms of their role in the national economy it could initially be argued that they were expensive mistakes and were the wrong solution to the country's development problems. When examined as growth poles for the development of central and southern Jordan, the conclusions might be different.

It is obvious that the conventional measure of the contribution of the mining sector to Jordan's GDP, at approximately 3.3%, is a major under-estimation. It ignores the vitally important cement industry and the downstream mineral processing plants. Furthermore, minerals in general, and phosphate in particular, play a vital role in Jordan's road and rail transport, shipping and trade. The sector is a major foreign currency earner and source of government revenue from both the companies and their employees. It is therefore obvious that there is a significant multiplier factor and its actual contribution to Jordan's GDP is probably about 10%. As

we will see in **Chapter Seven**, the mining industry is even more important in the regional economy of central Jordan.

### 6.1.3 Tunisia

The other country in which the mining sector plays a very significant part in the national economy is Tunisia although its role has changed during the past twenty years. In the past it was phosphate rock production and exports which contributed most significantly to the economy. Because of the low quality of Tunisian phosphates compared to its principal regional competitors there has been a consistent move towards downstream products. This has had two principal effects; exports have switched from raw phosphate rock to fertilizers and chemicals, and the value added of the mining sector has increased substantially. Obviously without the phosphate rock production the downstream industries could not have been established. The importance of the mining sector in the Tunisian economy must be viewed in this light.

**Table 6.7** below provides some of the principal statistics which illustrates the role of the mining sector in the Tunisian economy. It initially seems to show that its direct share of GDP has remained small in

recent years and has averaged only 1.64% of GDP during the early 1980s. In absolute terms its contribution has grown since 1980 from TD47.2 mn to TD74.5 mn (US$95.9 mn) in 1984, [41]. Two factors should, however, be taken into consideration. The sector's contribution to GDP should be adjusted to include the very important downstream chemical, fertilizer and cement industries, and all of the upstream and downstream linkages that they create. Secondly, although not as important as in the major oil producing countries, revenues from the non-renewable oil and petrochemical industries account for 15%-20% of GDP. Consequently the mining sector's direct and indirect contribution to GDP is far larger than it first appears.

The export statistics in **Table 6.7** show the growing importance of organic fertilizers, which are predominantly produced from phosphates. The export of raw phosphate rose by about 50% from TD20-TD30 mn between 1978 and 1984. During the same period the export of organic fertilizers grew from TD26.3 mn to TD120.8 mn, a rise of 460%. Consequently, raw phosphate and fertilisers accounted for almost a quarter of Tunisia's non-oil exports, [42]. It should also be noted that investment in building materials and the chemical and fertiliser industries are both about three times as great as that in the direct mining sector. The value added of both industries cannot be discounted because

since 1984 the value added of the chemical and fertiliser industry has undoubtedly overtaken that of the direct mining.

**Table 6.7 : THE MINING SECTOR IN THE TUNISIAN ECONOMY**

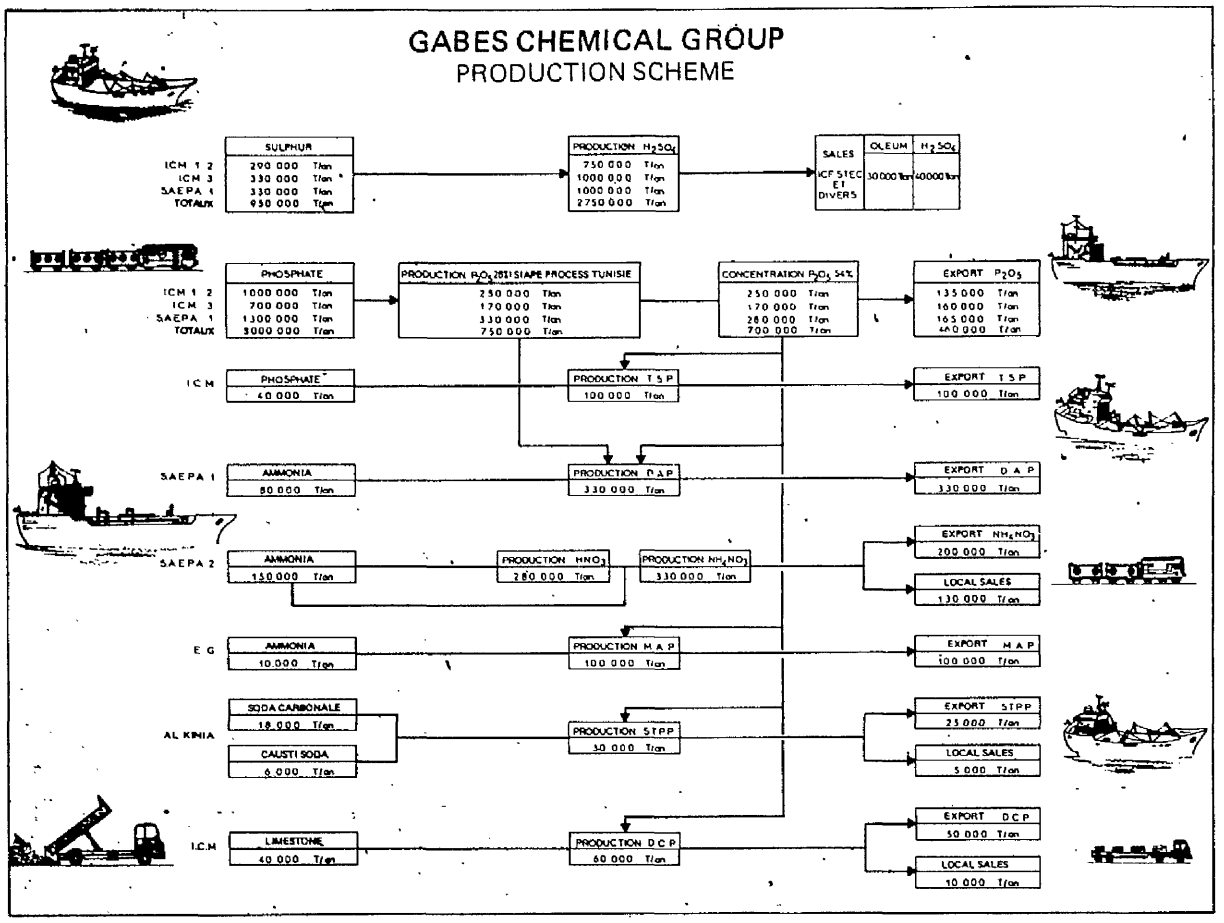
| | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|---|---|
| 1. | na | na | 47.2 | 64.9 | 54.8 | 65.0 | 74.5 |
| 2. | na | na | 1.8 | 2.1 | 1.5 | 1.4 | 1.4 |
| 3. | 20.8 | 19.9 | 23.6 | 24.3 | 27.7 | 27.9 | 30.4 |
| 4. | 26.3 | 36.9 | 66.6 | 96.3 | 105.1 | 116.5 | 120.8 |
| 5. | 3.2 | 5.2 | 5.0 | 3.9 | 4.5 | 1.1 | 2.1 |
| 6. | 48.4 | 31.6 | 22.4 | 23.4 | 35.6 | 15.5 | na |
| 7. | 50.5 | 34.9 | 25.2 | 25.6 | 37.4 | 19.5 | 27.0 |
| 8. | na | na | na | na | 76.9 | 99.0 | 98.0 |
| 9. | na | na | na | na | 52.6 | 84.1 | 84.0 |
| 10. | na | na | na | na | 52.8 | 63.0 | 66.0 |
| 11. | na | na | na | na | 72.4 | 106.4 | 126.8 |
| 12. | na | na | na | na | 39.5 | 37.8 | 56.0 |

**Notes :**
1 = Direct share of GDP in TD mn at current prices.
2 = Mining sector's direct share of GDP as a %
3 = Value of phosphate rock exports in TD mn
4 = Value of organic fertilizer exports in TD mn
5 = Value of lead exports in TD mn
6 = Investment in phosphate sub-sector in TD mn
7 = Investment in direct mining sector in TD mn
8 = Investment in building material industry
9 = Investment in chemical industry
10 = Value added of direct mining sector
11 = Value added of building material sector
12 = Value added of chemical & fertiliser industries

**Sources :**
EIU, **The Middle East & North Africa 1984 & 1985**, London, 1984 and 1985, p. 180 & 235.
Institut National de la Statistique, **Statistique Financiere**, Tunis, Fevrier 1985, p.68-69.
Institut National de la Statistique, **Annuaire Statistique de la Tunisie 1984**, Vol 28, Tunis.

The vitally important chemical and fertilizer industries are largely dependent on phosphates for their raw materials. The Gabes Chemical Group, (GCG), includes

## Figure 6.1 Gabes Chemical Group Production Scheme.




*Source: Gabes Chemical Group.*

four subsidiaries created by the Tunisian government between 1960 and 1976, **(see Figure 6.1)**. Its role is to process and increase the value of Tunisian phosphate rock while also forming a "growth pole" in the south for the country. Gabes was chosen as the site of the plants and an industrial port, power station and natural gas terminal were also built in the area.

The GCG uses 3 mn tons of phosphate, as well as sulphur, ammonia, limestone, soda carbonate and caustic soda. Its four companies produce 8,400 t/d of sulphuric acid, 2.270 t/d of 28% and 2,570 t/d of 54% phosphoric acid, and about 3,050 t/d of various types of fertilizers which the GCG markets with the phosphoric acid being transported in five of its own tankers. The number of group employees rose from 155 at the end of 1971 to 2,500 at the end of 1982. Of these 78% were less than thirty years old while 84% had a secondary or university education, **[43]**.

Besides the GCG there are also a number of other phosphate chemical plants and companies in Tunisia. The Société Industrielle d'Acide Phosphorique et Engrais (Siape) began processing phosphate in 1952 at its plants at Sfax. It currently has a production capacity of about 550,000 t/y of sulphuric and phosphoric acid and employs 1,400 workers. The Siape II plant at La Skirrah to the

south of Sfax came on-stream in early 1988. The US$130 mn plant created 500 direct and 1,000 indirect jobs to produce a further 3,500 t/d of sulphuric acid and 1,100 t/d of phosphoric acid. The Siape plant also has a US$10.5 mn fertilizer bagging plant at Mezzouna which employs 250 men.

The group also includes the Industries Chimiques de Gafsa (ICG) which is based at M'Dhilla in the heart of the phosphate region. Its 660 staff produce phosphoric and sulphuric acid as well as phosphoric fertilizers at the US$68.75 mn plant. Of the 1.0 mn tonnes of TSP fertilizer, about 85% is exported, with the remainder going to the domestic market, **[44]**.

The building material sector, which is dominated by cement, is the other indirect mining industry. Although it is not a major export earner, as **Table 6.7** showed, in some ways it is more important than the mining sector. It must be remembered that it is largely dependent on quarried minerals for its raw materials. In addition when building materials are included in the statistics, the mining sector accounts for over half of Tunisia's road, rail and shipping freight traffic. Indeed building materials account for 22% of all of Tunisia's rail traffic, **[45]**.

It is obvious that the total mining sector and all its

downstream processing industries are vital to the Tunisian economy. The overall contribution to GDP is therefore significantly greater than the conventionally measured figure of around 2.5%. With the sector's large multiplier effect the true figure is probably at least double that and could be as high as 9% of GDP.

## 6.2 Medium-High Significance

The **secondary impact** of the mining sector is greatest in the national economies of the three largest phosphate producers. We now turn to two countries, Algeria and Egypt, where its significance can be said to be medium to high. In both there are important iron and steel, phosphate and fertiliser, and cement and building material industries. The major difference between the large phosphate producers and these countries is that while Algeria and Egypt have large domestic markets they are less dependent on the minerals for foreign exchange earnings and government revenue. Algeria enjoys the benefits of a large hydrocarbon industry while Egypt also has other important foreign exchange earnings from remittances, Suez Canal traffic, tourism and cotton. The fact that the minerals are primarily used for the large domestic market should not obscure their importance to the industrial and construction sectors of the Algerian and Egyptian economies.

### 6.2.1 Algeria

By comparison with its eastern neighbour, the Algerian mining industry appears to play a much smaller role in the national economy. This is shown by statistics covering the period since 1967 which can be divided into the various development plans - the 1967-69 Pre-Plan, the first Four Year Plan 1970-73, the revised second Four Year Plan 1974-78, the first Five Year Plan 1980-84 and the current Five Year Plan 1985-89.

**Table 6.8 : THE MINING SECTOR IN THE ALGERIAN ECONOMY.**

| Indicator | 1967/69 | 1970/73 | 1974/77 |
|---|---|---|---|
| **1.Proportion of GDP** | | | |
| Mining & Quarrying | 0.34% | 0.45% | 0.42% |
| Construction Materials | 0.49% | 0.62% | 0.82% |
| **2.Av. Annual Growth Rates** | | | |
| Total GDP | 9.65% | 6.23% | 6.92% |
| Mining & Quarrying | 25.92% | 7.95% | 3.27% |
| Construction Materials | 21.63% | 5.00% | 23.50% |
| **3.Industrial Investment** | | | |
| Mining & Quarrying - AD | 0.17 mn | 0.70 mn | 1.10 mn |
| Construct. Materials - AD | 0.05 mn | 0.90 mn | 4.10 mn |
| Total Indust.Invest - AD | 4.70 mn | 12.40 mn | 47.86 mn |
| Mining & Quarrying = | 3.62% | 5.64% | 2.30% |
| Construction Materials = | 1.06% | 7.26% | 8.57% |

**Sources :**
H.Kharbachi, **Structural Change & Employment in Algeria**, Unpublished Ph.D., Rensselaer Polytechnic Institute, Troy, New York, May 1984, p.15-17

H.M.Temmar, **Strategie de developpement indépendant; le cas de l'Algérie : Un bilan**, Editions publisud, Paris 1983, Table X.1.

Until the most recent plan, between 50%-75% of total investment had gone to the industrial and hydrocarbon sectors, which included both the mining operations and the giant downstream projects such as the El Hadjar iron and steel complex near Annaba. The current 1985-89 Plan stresses the development of both agriculture and water supply which was seen as a break with the previous emphasis on the heavy industrial sector.

The 1985-1989 Plan also sought to stimulate industrial development on the High Plateau and in southern Algeria in order to reduce the continuing concentration of population on the coastal strip. Amongst the projects in the Plan were both a cement plant and a fertiliser plant at Tebessa with the latter using phosphate from Djebel Onk as its principal feedstock so that mineral processing will play a major role in this policy.

It would initially appear from **Table 6.8** that the non-hydrocarbon mineral sector has played a very small direct role in the Algerian economy since 1967. When oil and oil related industries, which account for over a third of GDP and half of government revenue, are taken out of the equation its importance is far greater. Despite its apparently small contribution, which is primarily due to the importance of the hydrocarbon industry, the growth rates have been very high in certain periods. During the Pre-Plan, mining and

quarrying was the fastest growing sector in the economy, while construction materials were fourth. Later during the 1974-77 Plan the construction material sector enjoyed the fastest growth rates, [46].

Table 6.8 also shows that the share of industrial investment which was allocated to both mining and quarrying, and construction materials, increased substantially in actual terms in successive plans by 647% and 8,200%. Although direct investment in the mining and quarrying sector has remained small - having never exceeded 10% of total industrial investment - when downstream industries including the iron and steel industry are taken into consideration the share is much larger, [47].

Between 1985 and 2,000 the national demand for iron ore is expected to rise from 3 mn to 17 mn tonnes while demand for phosphate will rise from 0.3 to 1.7 mn tonnes, [48]. Consequently it can be expected that investment in these and other mining sectors will increase very substantially in the coming years. Indeed after considerable debate it was finally decided in 1986 to begin the construction of a new 1.1 mn t/y steelworks at Bellera which is 60 kms south-east of the coastal town of Jijel. The new plant which, together with the associated infrastructural development, will cost up to

US$2,000 mn will use iron ore from Ouenza and other domestic sources. This represents over 10% of the industrial investment in the 1985-89 Five Year Plan and about 3.3% of its total planned investment, [49]. When its multiplier effect is included it strengthens still further the importance of Algeria's mineral resources to its national economy.

**Table 6.9 : ALGERIAN INDUSTRIAL EMPLOYMENT 1979**

| | Public | Private | Total | %Indus |
|---|---|---|---|---|
| Mining & Quarrying | 14,608 | 3,124 | 17,732 | 4.53 % |
| Building Materials | 22,029 | 5,685 | 27,714 | 7.10 % |
| I.S.M.E | 50,914 | 5,685 | 61,599 | 15.72 % |
| Chem.Fert.& Plastics | 17,439 | 8,540 | 25,979 | 6.63 % |
| Hydrocarbons | 28,459 | - | 28,459 | 7.26 % |
| Total Industry | 295,850 | 95,895 | 391,745 | 100.00 % |

**Note** : I.S.M.E. = Iron & Steel, Mechanical & Electrical Engineering

**Source** : Direction Général des Statistiques, **Les résultats de l'enquête emploi et salaries de 1979**, Mai 1981, Algiers, pp.8-9

Before Algeria won its independence from France, the mining and quarrying sector was the first to be nationalised in May 1960. It is still dominated by the public sector which accounts for about 80% of the total value added. As **Table 6.9** above illustrates in 1979 the small private firms had a total of 3,124 employees compared to 14,608 in the public sector. In the same year the building material sector, which is dominated by the cement industry, employed 22,029 and 5,685 workers

in the public and private sector, respectively. The large and important downstream iron and steel and fertiliser industries, which are entirely dependent on the mining sector, employ a large proportion of the additional 65,000 workers in other sectors of the economy. This will increase substantially when the new iron and steel complex begins production, [50].

Besides employment, mining and its related downstream industries also provide a significant proportion of total value added. Although mining and quarrying only directly accounts for about 1% of the value added of the total industrial sector, a large proportion comes from its related downstream industries.

**Table 6.10 : VALUE ADDED BY INDUSTRIAL SECTOR (AD mn)**

| (constant 1974 prices) | 1967 | 1970 | 1974 | 1977 | 1978 |
|---|---|---|---|---|---|
| Mining & Quarrying | 150 | 270 | 370 | 350 | 400 |
| Hydrocarbons | 13,095 | 16,420 | 18,420 | 20,800 | 22,760 |
| All Industries | 16,005 | 21,155 | 24,600 | 28,680 | 31,440 |
| Non Oil Total | 2,910 | 4,735 | 6,180 | 7,880 | 8,680 |
| Mining as % of total | 0.9 | 1.3 | 1.5 | 1.2 | 1.3 |
| Mining as % of non-hydrocarbon total | 5.1 | 5.7 | 6.0 | 4.4 | 4.6 |
| Hydrocarbons as % | 81.8 | 77.6 | 75.9 | 72.5 | 72.4 |

H.M.Temmar, **Stratégie de developpement indépendant. Le cas de l'Algérie : un bilan**, op cit, Table X.9, p.175

**Table 6.10** above provides an outline of the mining sector's direct contribution to industry's value added.

It shows that although its contribution is small, it did grow consistently in actual terms, and reached 6% of the non-oil industrial total, [51]. It should be noted that the table does not take account of the iron and steel, fertilisers or cement industries. Between them they would take a substantial share of industrial value added. While the total figures have changed since 1978 the general picture has not, so that it provides an illustration of the role of the mining sector in the Algerian economy.

A number of conclusions can be drawn about the role of the non-hydrocarbon mining sector in the Algerian national economy. The country does not have a mining sector which dominates the economy as it does in Morocco or Jordan. When the oil and petrochemical sectors are removed from the equation its significance is greatly increased. Above all mining and quarrying provides the raw materials for the iron and steel, fertiliser and cement industries which dominate Algerian industry. Without them Algeria would not have been able to diversify its economy as successfully as it has done during the past twenty years. Consequently when the multiplier factor is taken into consideration the actual mineral sector contribution to GDP is probably about 5%.

### 6.2.2 Egypt

Besides Algeria the other country where mining has a medium to high **secondary impact** on its national economy is Egypt. Conventionally measured statistics tend to under-estimate the importance of the sector and ignore the very strong upstream and downstream linkages that the mining sector produces. While industry and mining as a whole represented 13.8% of GDP in 1982-83, it appears that the direct share derived from mining and quarrying alone appears to be less than 1%, [52]. Similarly, although the number of workers directly employed in the sector rose from 29,000 to 39,500 between 1977 and 1981/82, the proportion of the total workforce remained the same at 0.3%, [53].

**Table 6.11 : MINING & QUARRYING IN EGYPTIAN ECONOMY**

| | | 1980/81 | 1981/82 |
|---|---|---|---|
| Production | (E£ 000's) | 55,556 | 65,440 |
| Sales | (E£ 000's) | 50,198 | 59,352 |
| Exports | (E£ 000's) | 4,271 | 4,750 |
| Average number of employees | | 23,061 | 24,109 |
| Wages | (E£ 000's) | 25,531 | 37,962 |

**Source** : Ministry of Information, **Industrial and Mineral Resources in Egypt**, Cairo, 1984, p.7.
**Note** : E£ = Egyptian Pounds

**Table 6.11** above provides some of the statistics for Egypt's direct mining and quarrying industries in 1980/81 and 1981/82. There are four sectors in the mining and quarrying industry - phosphates, salts, ore

and materials, and geological surveys which are all included in the table. During the 1982-86 Five Year Plan there were substantial investments in these sectors. **Tables 6.12, 6.13** and **6.14** provide the investment statistics during this period for the phosphate, ores and salt sectors, respectively.

Each provides the total investment for the particular project, the proportion which had been invested by mid-1982, and the part which was to be invested between 1982 and 1986. Taken together they show that the investment during the 1982-86 Five Year Plan was expected to total E#196.9 mn, including the Magra coal project. This represented only 2.8% of total government investment in industry and mining and 0.7% of overall government investment during the plan, **[54]**.

These tables would appear to be yet another indication that the non-hydrocarbon mining sector itself only plays a minor part in the Egyptian national economy. However it does make a significant contribution to other sectors of the economy. It provides the raw materials for the important iron and steel industry, phosphatic fertilizers and chemicals, and the building material industry including cement. The 1.5 mn t/y capacity Helwan iron and steel works, which is the largest single industrial plant in the country, uses Egyptian iron ore

Table 6.12
INVESTMENTS IN PHOSPHATE SECTOR 1982-86 (E# mn)

| Project | Total Inv. | Inv.by 30/6/82 | Planned.Inv 1982-86 |
|---|---|---|---|
| El Hamrawain | 56.7 | 35.4 | 21.2 |
| Abu Shegla | 37.0 | 3.0 | 0.9 |
| El Mahmadia East | 29.0 | 6.0 | 23.2 |
| El Mahmadia West | 26.0 | 4.6 | 31.4 |
| TOTAL | 148.7 | 49.0 | 76.7 |

Source : Ministry of Information, Industry and Mineral Resources in Egypt, Cairo 1984, p.16.

Table 6.13
INVESTMENT IN ORES SECTOR 1982-86 (Egyptian Pounds mn)

| Project | Total Inv. | Inv.by 30/6/82 | Planned.Inv 1982-86 |
|---|---|---|---|
| El Fairo Manganese | 40.0 | 1.0 | 2.3 |
| Ras Malab Gypsum | 25.0 | 1.4 | 11.0 |
| Foundry Sand | 4.5 | 1.6 | 2.8 |
| Bentonite | 5.0 | 0.2 | 4.7 |
| Magara Coal | 100.0 | 0.6 | 19.0 |
| TOTAL INVESTMENT | 174.5 | 4.8 | 39.8 |

Source : Ministry of Information, Industry and Mineral Resources in Egypt, Cairo, 1984, P.17

Table 6.14
INVESTMENTS IN SALT SECTOR 1982-86 (Egyptian Pounds mn)

| Project | Total Inv. | Inv to 30/6/8 | Planned Inv. 1982-86 |
|---|---|---|---|
| Ext.of El Max Salien | 22.840 | 12.433 | 10.400 |
| Recon. Port Said Salien | 25.500 | 9.032 | 16.400 |
| Karown Lake | 71.000 | 11.008 | 6.900 |
| Marsamatroh | 50.000 | 0.054 | 8.500 |
| Sabeka Salien | 28.768 | 0.200 | 20.700 |
| Borgelarab Salien | 29.715 | - | 17.400 |
| TOTAL INVESTMENTS | 227.823 | 23.827 | 80.400 |

Source : Ministry of Information, Industry and Mineral Resources in Egypt, Cairo 1984, p.17

from the Bahariya Oasis deposit, [55]. Similarly the fertilizer industry which is based at the Abu Zabal complex to the north of Cairo and produced almost one million tons of phosphatic fertilizers and chemicals in 1981/82, is supplied by the domestic phosphate industry, [56]. Both local gypsum and limestone is used in the Egyptian cement industry which, despite having an annual capacity of 13 mn tonnes compared with a demand for about 16 mn tonnes, only produced about 7.0 mn tonnes in 1987, [57]. In addition the vitally important building material industry uses predominantly domestic raw materials.

Mining and quarrying provides many indirect benefits to the Egyptian national economy. The iron and steel, fertilizer, cement and building material industries provide a significant proportion of the industrial sector as a whole. They employ thousands of workers, make both export earnings and import substitution savings, contribute a large proportion of total value added, as well as providing other benefits for the Egyptian economy.

The conventional measurement of GDP suggests that the direct contribution of the mining sector is only about 1%. From the evidence presented in this section it is obvious that a significant proportion of industry's 13.8% share involves the processing of minerals. There

appears to be large multiplier factor which suggests that the mining sector's true contribution to GDP is more like 4%-5%.

## 6.3 Medium Significance

### 6.3.1 Iraq

We now move to a country where the non-hydrocarbon mining sector is still significant but less so than in the previous countries which we have examined. The Iraqi non-oil mining sector is divided into three parts; natural sulphur, phosphates, and building materials which include cement production. In terms of their direct share of gross national product they appear to be largely insignificant.

**Table 6.15 : MINING IN IRAQI ECONOMY 1953-75 (% GNP *)**

| Sector | 1953 | 1960 | 1965 | 1970 | 1973 | 1975 |
|---|---|---|---|---|---|---|
| Mining incl oil | 24.5 | 23.8 | 20.7 | 20.0 | 32.4 | 29.4 |
| Mining excl oil | 0.4 | 0.3 | 0.8 | 1.0 | 1.0 | 0.4 |
| GNP | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

**Note:** Figures = constant 1969 prices, GNP = factor cost

**Source** : Economic Commission for Western Asia, **Industrial Development in Iraq : Prospects & Problems**, Volume 1, Structure & Performance, Beirut, 1979, p.18

**Table 6.15** above indicates that between 1953 and 1975 its share of GNP at factor cost varied between 0.3%-

1.0%, [58]. Despite this low proportion the value of mineral production did increase substantially since GDP rose from ID664.7 mn in 1960 to ID1,774.4 mn in 1975. Therefore mineral output grew from ID2,658,000 to ID7,097,600 during the same period, [59].

When oil revenues are taken out of the measurement of GDP, as Stauffer and others have argued they should be, the situation is very different. In 1980 oil accounted for 67% of GDP and approximately 85% of government revenue, [60]. Because government spending is such an important element in GDP it can be calculated that the overall non-oil mining sector comprises at least 5% of GDP although this probably under-estimates its importance.

In the late 1970s the Iraqi government put great emphasis on the construction sector. Even before the dramatic acceleration of activity in the 1976-80 Development Plan, the sector had already been expanding. Taking 1962 as the base year, an index of cement and construction production rose from 100 to 137.5 and 310.3 in 1970 and 1977, respectively, [61]. Between 1974 and 1980 the annual rate of growth of the construction sector was, at 31.3%, the second fastest in the economy, [62]. After mining and quarrying, which includes oil, construction was the second largest contributor to GDP

with between 8%-9%, [63].

It is obvious that cement and building materials are vital for the development of the Iraqi economy. The government's emphasis on the sector since 1976 has resulted in a dramatic increase in the level of production. The State Organisation for Construction Industries, (SOCI), has been responsible for the expansion of both cement and the other building materials.

Cement production rose from 2.7 mn tons in 1975 to an estimated 22 mn tons by the end of 1986, rising by 8 mn tons in 1984 alone. In the early 1980s eight new cement plants were started throughout the country, but production in the war zone areas has not been possible, [64]. Having already been able to save substantial sums by reducing cement imports, it is hoped that cement exports can be restarted now that the war has ended. The massive reconstruction programme which is now necessary has made cement and the building material sector, which expanded equally rapidly during the late 1970s, absolutely invaluable to the national economy.

Before the Gulf War began, the Iraqi government planned to use the development of the building material sector as a means of diversifying the economy and expanding the non-oil sector. Given the necessity to import vast

quantities of cement and other building materials to supply the highly ambitious new projects, it was a logical and wise operation. The building materials sector will be even more vital to the Iraqi economy now that the Gulf War is over. It will help Iraq in the rehabilitation of its shattered and war damaged economy, although imported plant and machinery will be even more important. Therefore, while its role is relatively small at the moment, the building materials industry will continue to play an increasingly important role in the Iraqi economy in the future.

The rest of the non-oil mining sector is currently less important, although it has considerable scope in the future. The Al Qaim chemical complex which uses phosphate from Akashat and sulphur from Mishraq in the production of ammonium phosphate and TSP fertiliser is expected to play an increasingly significant role in the non-oil economy. In addition, a secondary recovery plant, which will treat 600 t/d of sulphur residual to yield 152,000 t/y of sulphur and 60,000 t/y of sulphuric acid, will soon come on stream, [65]. Now that the war is ending it can be expected that the sulphur production and export will soon attain its pre-war levels.

Before the Gulf War began the non-oil mining sector was begining to play an increasingly important role in the

Iraqi economy. While its direct share of GDP has remained apparently small, it is an important industrial employer, produces an increasing amount of value added, and reduces import requirements. Even in 1981 the cement and building sector was estimated to contribute 18.3% of industrial value added. Consequently the non-oil mining sector's true share of GDP is probably closer to 5%, even when oil is included in the equation, and will continue to increase in the future.

## 6.4 Medium-Low Significance

It is difficult to subdivide the remaining countries because the divisions become less pronounced. In this next group of countries the **secondary impact** of the mineral sector is less than that in Iraq but could not be termed insignificant. Lebanon is in this category because, although it had an important cement industry, the continuing civil war has affected both production and exports. Despite the overwhelming dominance of oil in the United Arab Emirates, (UAE), the importance of the cement industry in the non-oil sector puts it in this category. The same is true of the Sultanate of Oman which, besides the two new cement plants, also has the copper mine and refinery. It should also be noted that the statistics become far more difficult to calculate as the mineral sector diminishes in significance.

### 6.4.1 Lebanon

The Lebanese economy, including the mining and quarrying sector, suffered acutely from the effects of civil war after 1975. Between then and 1981 it is estimated that the industrial labour force dropped by nearly 50%, the productive capacity declined by 25%, and over 70% of the plants were idle for more than 500 days during the six year period, [66]. The war has also made it very difficult to gather economic statistics in general, let alone any single industry. It is possible, however, to gauge the importance of the building material sector from export figures.

**Table 6.16 : BUILDING MATERIALS IN LEBANESE ECONOMY.**

| | 1980 | (%Tot) | 1981 | (%Tot) |
|---|---|---|---|---|
| **Exports in L£ mn & share of total industrial exports** | | | | |
| Building materials | 163 | (8.96) | 312 | (13.6) |
| Other non-metallic minerals | 136 | (7.47) | 263 | (11.5) |
| Black cement | 282 | (15.5) | 241 | (10.5) |
| **Exports as Share of Total GDP** | **1980** | | **1981** | |
| Building Materials | 1.164 % | | 1.857 % | |
| Other non-metallic minerals | 0.971 % | | 1.565 % | |
| Black cement | 2.014 % | | 1.434 % | |

**Source** : Economist Intelligence Unit, **EIU Annual Regional Review : The Middle East & North Africa 1985**, op cit, p.140-141. (L£ mn = Millions of Lebanese Pounds)

As **Table 6.16** illustrates building materials, including cement, accounted for 31.93 and 35.6% of total

industrial exports in 1980 and 1981, respectively. During the same two years the value of such exports accounted for 4.15% and 4.86% of GNP. While this appears to show that the sector is perhaps more important than in other countries in the region, a number of factors should be taken into consideration. In terms of the share of total exports, as opposed to industrial exports, the proportion is reduced to 16.1% and 22.6% in 1980 and 1981 respectively, [67]. Although more recent statistics are not available, between 1982 and 1985 the level of cement exports fell from LP227.26 mn to LP28.61 mn, or 11.8% - 1.28% of industrial exports, [68].

The stagnation of the construction industry in the Arab Middle East has been one of the reasons for the decline in exports, along with the political crisis in Lebanon itself. The decline in the cement and building material sector must be seen in light of the fact that the other sectors of the economy have also been destroyed or run down during the past decade. Furthermore, when the domestic conflict finally ends, the rehabilitation of the country will be highly dependent upon the building material sector. As with the case of Iraq it can be expected that it will be become increasingly important once the reconstruction programme can begin.

### 6.4.2 United Arab Emirates

Hydrocarbons dominate the economy of the United Arab Emirates, (UAE), but there is also a large and significant building material sector. There are eight cement plants in the country with a combined grinding capacity of 8.9 mn t/y. There are also large aggregate plants in the northern emirates of Fujairah and Ras Al Khaimah and small rockwool and ceramics factories in Fujairah. The building material sector is therefore one of the most important non-oil industries.

This is particularly true of the northern Emirates of Fujairah and Ras Al Khaimah which do not have large oil and gas reserves or production and have almost no other industry. Indeed, if the two northern Emirates were seen in isolation and were separated from oil rich Abu Dhabi and Dubai, the importance of the cement and building material would be even more significant. In 1982 Abu Dhabi accounted for Dhs82,200 mn or 70.4% of the UAE's total GDP while Dubai accounted approximately for a further 20%, [69]. Therefore of the remaining five emirates, Ras Al Khaimah and Fujairah probably account for little more than 5% of the UAE's total GDP. When their cement and building material industry, as well as all the associated linkages, are considered in light of this their importance to the northern emirates is obvious.

When oil is taken out of the equation their importance is not insubstantial for the UAE economy as a whole. In 1980 it accounted for 19.8% of the total manufacturing output. This proportion had declined to 9.9% by 1984 as the chemical and plastic industries have grown in importance. Despite this, it still accounted for 16.9% of the total number of employees in the manufacturing sector, [70]. Therefore, while still dwarfed by oil revenues, the UAE's non-oil mineral sector is important.

### 6.4.3 Oman

With the exception of the copper mining project near Sohar the Omani non-oil mineral sector is confined to building materials in general and cement in particular. The industries only really began production in the early 1980s and it is therefore too soon to measure its impact on the national economy. Initially it would appear that the copper project is earning minor export revenues but that these are dwarfed by the oil sector. This is possibly an over simplification and does not take other important factors into consideration.

Oil and gas directly account for about 56% of GDP, 99% of total exports and 80%-90% of government revenue, [71]. It is therefore axiomatic that the oil sector is

vitally important to the economy and that if it is removed from the equation the non-oil sector assumes a far greater significance. Before the two cement plants began production Oman was importing 1,280,000 tonnes of cement a year with about 600,000 tonnes, valued at US$52 mn, coming from the UAE, [72]. The 20% tariff which the government initially put on imported cement, and which has subsequently been increased to 50%, should ensure that the locally produced cement is used and this will have substantial import savings. Indeed, the current Third Five Year Plan anticipates that considerable non-oil export revenue will come from the cement plants and the copper mining project. As oil revenues have fallen in recent years the import savings and export revenues of non-oil industries have become more valuable.

Besides trade, the other area of importance is the share of investment that has gone to mineral related projects. The Sohar copper mining project entailed an investment of US$208 mn of which US$100 mn was for local infrastructure. The Oman Cement Company plant on the Rusail Industrial Estate cost US$144.7 mn with further funds being invested in the Raysut cement plant, the quarries which supply them with their raw materials, as well as cement block and tile factories.

While the importance of the mineral related sector should not be exaggerated neither should it be

diminished. Because it started its development process later than the others, Oman is probably the only country in the Gulf which still has major infrastructure projects to complete. These will require substantial quantities of building materials which Oman should now be able to produce rather than import. Similarly if it was to refine copper ore from both its own mines and from the Indian sub-continent, which normally has to be sent to Japan, the Sohar project could still become a major export earner. Consequently, the mineral related industries can be expected to become vital components in Oman's non-oil economy in the future.

## 6.5 Low Significance

We now turn from those countries which have small mineral sectors, but which are still important in terms of the non-oil economy, to those which have some but of little significance. These include poorer countries, such as Sudan and the Yemens, and oil producers like Saudi Arabia, Libya and Qatar. In these countries the mining and mining-related industries are generally small and relatively insignificant, even in terms of the non-oil sector. We begin, however, with Syria which is rather a special case.

### 6.5.1 Syria

There are a number of reasons why Syria is unlike the other countries whose small mineral related sectors have comparatively limited **secondary impacts**. Syria has a diverse economy in which the major industries include oil and petrochemicals, cotton and textiles, tobacco, food processing as well as general engineering. There is also significant production of phosphates and building materials including a large cement industry. Because of the large and diverse nature of the economy they tend to play a relatively limited role in the Syrian economy.

In 1980 the extraction industry accounted for 6,860 million Syrian Pounds (S£) or 12.5% of GDP. Of this total mining and quarrying, excluding the downstream industries, directly contributed only S£337 mn or 0.06% of total Syrian GDP, [73]. In 1985 phosphates accounted for a further S£76 mn or 1.2% of total exports while oil and oil products made up S£4,759 mn or 74%, [74].

Some of the phosphate production is used in the domestic fertilizer industry, while building materials also produce further value added. There are two triple-super-phosphate fertilizer plants at Homs and Deir El-Zoor with design capacities of 450,000 and 250,000 tonnes respectively, [75]. The former also produces 150,000 tonnes of phosphoric acid and uses 800,000

tonnes of phosphate rock which takes a substantial proportion of Syria's total phosphate rock production, [76]. Meanwhile, Syria is gradually turning from being a cement importer to an exporter. In the foreseeable future Syria's mature and diverse economy will ensure that the non-hydrocarbon mining sector remains relatively unimportant.

We now turn to three oil producers which also have a small non-oil mining sector but which, unlike Syria, do not have a diverse economy.

### 6.5.2 Saudi Arabia

Saudi Arabia is a rich oil exporter with a small population and a capital intensive nascent industrial sector. Unlike Syria, which also relies on other sources of revenues, the oil industry totally dominates the Saudi Arabian economy. This is reflected in **Table 6.17** below, which also shows the small direct contribution to GDP which was made by the non-oil mineral sector during the 1960s.

Even before the 1973-74 oil price explosion non-hydrocarbon mining played a very small role in the Saudi Arabian economy. Between 1962 and 1971 the sector's value added grew from SR15.5 mn to SR52.6 mn,

representing a 14.6% annual growth rate, [77]. With the exception of the oil industry itself, this was the fastest growth of any sector during the period. Despite this apparently impressive growth rate it was from a very low base and did not alter its direct share of GDP.

**Table 6.17 : MINING IN SAUDI ARABIA 1962-71 (SR mn *)**

| Year | Mining.1 | Mining.2 | Total.1 | Total.2 | %Tot.1 | %Tot.2 |
|---|---|---|---|---|---|---|
| 1962 | 4,593.3 | 15.5 | 8,603.7 | 4,025.9 | 0.18% | 0.38% |
| 1963 | 4,673.6 | 18.4 | 9,205.2 | 4,550.1 | 0.20% | 0.40% |
| 1964 | 5,792.2 | 25.1 | 10,257.5 | 5,090.4 | 0.24% | 0.49% |
| 1965 | 6,171.4 | 31.7 | 11,775.6 | 5,635.9 | 0.27% | 0.56% |
| 1966 | 6,823.8 | 35.4 | 13,078.6 | 6,290.2 | 0.27% | 0.56% |
| 1967 | 7,683.3 | 39.8 | 14,458.1 | 6,814.6 | 0.27% | 0.58% |
| 1968 | 8,189.4 | 41.9 | 15,660.7 | 7,513.2 | 0.27% | 0.56% |
| 1969 | 9,487.9 | 42.1 | 17,371.1 | 7,925.3 | 0.24% | 0.53% |
| 1970 | 12,835.3 | 44.5 | 21,276.3 | 8,486.5 | 0.21% | 0.52% |
| 1971 | 16,771.6 | 52.6 | 26,189.7 | 9,470.7 | 0.20% | 0.55% |

**Notes** : * = SR mn at current prices
Mining 1 = Value added including oil
Mining 2 = Value added excluding oil
Total 1 = Total GDP including oil
Total 2 = Total GDP excluding oil
%Total.1 = Non-oil mining's share of total GDP incl.oil
%Total.2 = Non-oil mining's share of total GDP excl.oil
SR = Saudi Riyal (In Oct 1988 US$1 = SR3.75)

**Source** : M.I.F.Khatrawi, **A diversification strategy for Saudi Arabia**, Ph.D. Economics, Georgetown University, Washington, USA, September 1975, p.73

As **Table 6.17** above shows, the non-oil mining sector's share of GDP fluctuated during the period but did not exceed 0.6% even when oil was excluded from the GDP total, [78]. When actual oil revenues are removed from the equation the conventional measurements of GNP still ignores their effect on government expenditure. This is particularly true in the case of Saudi Arabia where oil

accounts for at least three-quarters of government revenue which, in turn, finances at least a further 15% of the country's GDP. As Stauffer has shown, when the effects of oil are removed from the equation, the non-oil economy assumes a much greater significance. Therefore the non-oil mining sector's share of Saudi Arabia's GDP is undoubtedly greater than the figures in Table 6.17 suggest.

**Table 6.18 : SAUDI ARABIA'S GDP 1978/79-1982/83 (SR mn*)**

| Year | Non-oil mining | Oil mining | Total GDP | Mining % |
|---|---|---|---|---|
| 1978/79 | 1,120 mn | 131,098 mn | 249,539 mn | 0.448 % |
| 1979/80 | 1,361 mn | 237,218 mn | 385,807 mn | 0.353 % |
| 1980/81 | 1,696 mn | 340,997 mn | 520,589 mn | 0.326 % |
| 1981/82 | 1,969 mn | 323,328 mn | 524,719 mn | 0.375 % |
| 1982/83 | 1,785 mn | 192,874 mn | 414,448 mn | 0.431 % |

**Notes** : * = SR at current prices. 1982/83 = Estimate

**Source** : Economist Intelligence Unit, **EIU Regional Review : The Middle East & North Africa 1985**, London, 1985, p.205.

As **Table 6.18** above illustrates, between 1978/79 and 1982/83 the value added from the non-oil mining sector rose by 59.4% from SR1,120 mn to SR1,785 mn, **[79]**. The second oil price explosion dramatically increased both oil revenues and GDP although they then declined after 1981. Consequently, when measured in the conventional way, the non-oil mining sector's share of GDP remained almost the same at about 0.44% despite the growth in money terms of its total value added, **[80]**.

Saudi Arabia's non-oil mining is dominated by the building material sector and during the 1970s construction boom licences were granted to 629 establishments with a total authorised capital of SR21,947 mn up to 1982, [81]. The vast majority of these are companies which import materials from overseas rather than actually producing them. Despite this there are substantial numbers of, predominantly private, quarries which produce aggregate and other building materials. In 1983 there were 114 within 50 kms of Riyadh, 100 encircling Jiddah, 69 near Dhahran and many others around other towns and cities in the country, [82]. Naturally these and the rest of the building materials sector make a significant, although unquantifiable, contribution to the construction sector.

The importance of the Saudi Arabian cement industry should not be overlooked in this study. As in most developing countries it was one of the first industries to be established, begining production in 1959. Since then, the number of cement plants has increased to eight with a total capacity of 13.8 mn tonnes. Since the early 1970s the country has had a very high annual per capita consumption and production rapidly increased. It peaked at 23.2 mn tonnes in 1984 it has since fallen to about 11.2 mn tonnes in 1987. Despite the surplus the country still imports cement and the eight producers are both

discussing establishing a joint export company and demanding an increase in tariffs to protect the domestic industry, **[83]**. In 1983/84 the sector represented 20.8% of total industrial value added, excluding petroleum refining, which illustrates its importance, **[84]**.

Although the non-oil mining sector has grown rapidly in money terms during the past twenty years, it remains very small in relation to the rest of the oil dominated economy. While development of building materials has been quite rapid other mineral production is still limited and it employs very few men, most of whom are non-Saudi expatriates. Its exports are negligible while the import of building materials in particular has increased significantly during the past fifteen years. It is likely to be many years before the domestic mining sector makes a significant contribution to the Saudi Arabian economy although there is considerable potential for expanding its contribution.

### 6.5.3 Libya

Like the other Middle East oil exporting countries the **secondary impact** of Libya's non-hydrocarbon mining and quarrying sector on its national economy is still very limited as **Table 6.19**, which covers the 1973-77 period, shows. The value of mining output rose from LD12.0 mn to

**Table 6.19 MINING IN THE LIBYAN ECONOMY 1973-77 LD mn**

| | 73 | 74 | 75 | 76 | 77 |
|---|---|---|---|---|---|
| Mining value at factor cost | 12.0 | 14.4 | 18.5 | 23.0 | 27.5 |
| Mining as % of total GDP | 0.5 | 0.4 | 0.5 | 0.5 | 0.5 |
| Mining GFCF (1) | 1.9 | 2.3 | 2.3 | 3.0 | 4.0 |
| Mining as % of total GFCF | 0.30 | 0.23 | 0.21 | 0.24 | 0.27 |
| Industrial & Real } (2) | 180 | 369 | 48 | 43 | 3 |
| Estate Bank loans } (3) | 180 | 270 | - | - | 700 |

**Notes** :(1) = GFCF = Gross Fixed Capital Formation
(2) = Loans to Construction industry in LD 000s
(3) = Loans to Mining industry in LD 000s

**Source** : International Monetary Fund, **SPLAJ : Recent Economic Developments**, Washington, 25/07/1978

LD27.5 mn in this period, but remained at about 0.5% of total gross domestic product. Similarly while the sector's gross fixed capital formation rose from LD1.9 mn to LD4.0 mn, its proportion of the total has fluctuated between 0.21%-0.30%, **[85]**. The table also shows the great fluctuation in the total loans which the Industrial & Real Estate Bank provided to the mining and construction material sectors. They were largely insignificant in terms of their direct contribution to Libyan national economy during this period.

In more recent years the mining sector has increased both its output and share of GDP. As **Table 6.20** shows by 1981 its output had reached LD55.0 mn which represented 0.61% of GDP. It also illustrates the dominance of the oil and natural gas sector which

**Table 6.20 : MINING IN LIBYAN ECONOMY 1981-83 (LD mn)**

| (* = Estimate) | 1981 | 1982 * | 1983 * |
|---|---|---|---|
| Value of Oil & Nat Gas | 4,774.6 | 5,105.5 | 4,529.5 |
| % of GDP | 52.974% | 53.335% | 50.050% |
| Value of Mining & Quarrying | 55.0 | 56.4 | 52.0 |
| % of GDP | 0.61% | 0.59% | 0.57% |
| Value of Total GDP | 9,013.1 | 9,569.7 | 9,050.0 |
| % of GDP | 100.0 | 100.0 | 100.0 |
| No. of oil workers 000s | | 14.0 | 13.8 |
| % of Total workforce | | 1.3 | 1.2 |
| No. of Mining & Quarrying workers | | 10.4 | 10.9 |
| % of Total Workforce | | 1.0 | 0.9 |
| Total no. of labour-force | | 1,083.7 | 1,179.5 |
| % of Total workforce | | 100.0 | 100.0 |

**Source** : Central Bank of Libya, **28th Annual Report : Financial Year 1983**, Tripoli, 1984, p. 31 & 35.

accounted for 50%-54% of GDP between 1981 and 1983, [86]. Despite this disparity between the two sectors in terms of the value of their output and share of GDP, they had approximately the same number of workers. Mining and quarrying employed 10,900 in mid-1983 compared to 13,800 in the oil industry, representing 0.9% and 1.2% of the total respectively, [87]. In 1983 the value of output per worker was LD4,770 and LD328,225 in the mining and oil industries respectively. This disparity illustrates the relative importance of the two sectors to the Libyan economy.

### 6.5.4 Qatar

The third oil producer which comes into this category is Qatar. Its mining sector can be distinguished from the other small Gulf states because, although it is not as large as the cement and building material sector in the UAE, it does, unlike Bahrain and Kuwait, use indigenous raw materials.

The Qatar National Cement Company's 100,000 tonne annual capacity plant at Umm Bab began production in 1969 and was expanded to 300,000 tonnes/year in 1977. In addition the Al-Shoala Cement Company at Umm Said operates a 287,000 tonnes a year mill which uses imported clinker to produce cement. In 1983 the non-metallic mineral industries, which in effect means the cement sector, accounted for 14.3% of Qatar's total industrial value added, [88]. Indeed with the exception of the petrochemical sector it is almost the only industry which uses indigenous raw materials.

### 6.5.5 Sudan

Sudan and the two Yemens can also be put into this group of countries. All three are predominantly agricultural economies with only small industrial sectors and, although they have reserves, there is currently very limited oil production. In each it is the building

material and cement industries which are the most important part of the sector. While the two Yemens both produce salt from coastal salines, Sudan does have its small chrome and new gold mining projects.

The Sudanese mineral sector's direct contribution is still very small. Until 1966 its value could be counted in thousands of dollars rather than millions. Between then and 1981 its share of GDP ranged between 0.1%-0.5%, with its output rising from US$8.78 mn to US$19.38 mn, [89]. Although it has never reached its true potential and currently only represents a few million dollars the chromite mines in the Ingessana Hills produce vital foreign exchange. The small scale gold mining projects in the Red Sea Hills have not yet been fully developed and therefore their contribution to the national economy is still very small. If the current optimism over the region's mining potential is well founded it could become a very significant source of export revenue. Given Sudan's scarcity of foreign exchange and general economic circumstances any such opportunities will be important.

The only other major mineral related projects are the cement plants which rely on local raw materials. Like the rest of Sudanese industry the two cement plants at Atbara and Rabak have never operated at their full

capacity. In 1985 their combined production was only 162,000 tonnes or 30% of their 550,000 tonnes overall annual capacity, [90]. Consequently Sudan is having to use valuable foreign exchange or arrange counter-trade deals to import cement and meet domestic demand. In 1980 the cement plants accounted for 5% of total industrial value added, [91].

There are no formal statistics about their number, size, output, employment, value added or financial importance of the numerous small traditional brick works. Obviously they are still small and make little contribution to the national economy. As it will be seen in **Chapter Seven**, however, mining could play an important role in the regional economic development of particular regions such as the Red Sea Hills.

### 6.5.6 North Yemen (YAR)

Across the Red Sea in North Yemen the direct mining and quarrying sector, which is centred on building materials and rock salt, accounts for less than 2% of GDP. Between 1969-79 its contribution to GDP at current market prices grew from YR 11 mn to YR133 mn while its operating surplus grew from YR7.5 mn to YR96.0 mn during the same period, [92]. The sector's gross output in constant 1975/76 prices rose from YR32 mn to YR103 mn between

1969-79 but remained at around 1% of the total, [93]. According to a World Bank study there were 65 building material establishments in North Yemen in 1975, [94]. They had a total labour force of 646 which represented 22.7% of the manufacturing industry total, and a turnover of YR38.9 mn or 60.7% of the industry total. The fact that the single cement plant accounted for 11.6% and 35.4% of the industrial workforce and turnover, respectively, is an indication of how little industry North Yemen had in 1975, [95].

**Table 6.21 : MINING SECTOR IN Y.A.R. ECONOMY (YR mn *)**

| | Mining | Total | % Total |
|---|---|---|---|
| 1980 GDP | YR 149 mn | YR 12,630 mn | 1.18 % |
| 1981 GDP | YR 156 mn | YR 12,949 mn | 1.20 % |
| 1982 GDP (1) | YR 156 mn | YR 12,939 mn | 1.20 % |
| 1983 GDP (1) | YR 275 mn | YR 18,172 mn | 1.51 % |
| 1982-86 GPFC (2) | YR 905 mn | YR 28,100 mn | 3.22 % |

1 = Second Five Year Plan 1982-86 Target Growth Rates
2 = 1982-86 Gross Planned Fixed Capital formation
* = Yemeni Riyals at 1981 current prices $1 = 4.5

**Source** : Economist Intelligence Unit, **EIU Annual Regional Review : Middle East & North Africa 1985**, London, p.263.

As **Table 6.21** above illustrates, mining and quarrying itself, as opposed to the manufacture of building materials, accounted for less than 2% of GDP in the 1980s. In the 1982-86 Second Five Year Plan it was expected to receive YR905 mn or 3.22% of gross planned fixed capital, [96]. Of this the ferrous metal sector

was scheduled to receive YR485 mn or 54% of the total, of which the Hamoura copper extraction project was to get YR357 mn, [97]. During the plan two new cement plants were completed at Amran and Baijil, thereby increasing the country's capacity by 700,000 t/y and making a noticeable contribution to the national economy, [98].

### 6.5.7 South Yemen (PDRY)

In comparison with its northern neighbour, South Yemen (PDRY) has a smaller and even less important mining sector. As **Table 6.22** shows below, between 1969-77 the value of salt production, which is the most important mineral, did not exceed 3% of industrial output or 8% of the total industrial workforce, [99]. As a comparison, the table also shows that there have also been substantial cement imports during this period. The direct mining sector contributed little to the economy, averaging only 0.2% of GDP between 1973-76, [100]. During the 1981-85 Five Year Plan the proposed investment in the sector was YD31.4 mn, which accounted for 5.6% of total investment or 22.4% of total industrial investment, [101]. The oil refining and petrochemical sector, which uses imported rather than domestic crude oil, dominates the non-agricultural sector of the economy. As it expands it is likely that the non-hydrocarbon mineral sector will continue to play

a relatively small role in the South Yemeni economy in the future.

**Table 6.22 : MINING IN THE PDRY ECONOMY (YD 000s )**

| | 1969 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 103 | 148 | 160 | 81 | 134 | 142 | 25 | 220 | 613 |
| 2. | 1.8 | 2.9 | 2.6 | 1.2 | 1.4 | 1.0 | 0.2 | 0.9 | 1.9 |
| 3. | 221 | 240 | 259 | 264 | 250 | 244 | 148 | 120 | 279 |
| 4. | 6.8 | 7.2 | 6.7 | 6.0 | 4.3 | 3.9 | 2.5 | 1.4 | 2.8 |
| 5. | 355 | 144 | 331 | 259 | 407 | 1,422 | 916 | 974 | 844 |
| 6. | | | | | 305 | 356 | 193 | 325 | |
| 7. | | | | | 0.27 | 0.25 | 0.12 | 0.17 | |

1 = Value of output of salt industry in 000s YD
2 = Salt as % of value of total industrial output
3 = Number of employees in salt industry
4 = Salt as % of the numbers of industrial workers
5 = Value of cement imports in 000s YD
6 = Mining in GDP in YD 000s at current factor cost
7 = Mining as % of total GDP at current factor cost
* = US$1 = YD0.345 in 1983

Source : World Bank, **PDRY Current Economic Position & Prospects**, Report No.2151a YDR, Washington, Dec 1978.

## 6.6 Negligible Significance

We finally turn to two countries which are really city states and whose non-oil mining sector is of negligible significance to their economies. In both Bahrain and Kuwait it is confined to building materials most of which use imported raw materials and therefore fall outside the scope of this study.

### 6.6.1 Kuwait

The Kuwait Cement Company, which opened in 1972, can now produce 1.45 mn tonnes of cement but it uses imported clinker. There are also about ten building material companies of which the National Industries Company, producing sand-lime bricks and cement products and employing 2,600 men, is the largest, [102]. In 1983 non-metallic minerals, including the cement plant, accounted for KD39.80 mn or 10% of industrial production or 18% if oil refining is excluded, [103]. Despite this the sector still remains largely insignificant in terms of Kuwait's national economy.

### 6.6.2 Bahrain

Bahrain's building material sector is even smaller. It imports all of its cement requirements with most coming from the 2 mn t/y Saudi-Bahraini Cement Company which is located at Ain Dar in Saudi Arabia. Other Bahraini trading companies import building materials but the actual domestic production industry is very small.

## 6.7 Conclusions

This chapter has sought to provide a country-by-country account of the role of the non-hydrocarbon mineral sector in the national economies of the Middle East. The

primary conclusion is that the sector is much more important than it at first appears. It is most significant in the economies of the three major phosphate producers - Morocco, Jordan and Tunisia - where it is increased by the combination of export revenues, large-scale investment and major downstream industries. The fact that phosphate, like iron ore and cement but unlike most of the other minerals including oil, is a bulk commodity means that it is a very important element in the freight industry.

The significance of the building materials in general, and cement in particular, was demonstrated in this chapter and it is undoubtedly one of the largest non-oil industries in the Middle East. Because of the relatively simple technology and the availability of cheap raw materials almost every country in the region has at least one cement plant. Furthermore, unlike many other minerals, there is always considerable domestic demand for building materials and cement.

Besides the major phosphate producers, the mining sector also made a significant contribution elsewhere. Iron ore, phosphates and building materials, together with their respective downstream industries, are important to the large and diverse Algerian and Egyptian economies. The remaining countries can broadly be divided into the

oil producers and the non-oil producers. While mining may seem insignificant in the former group it assumes a much larger role when oil and natural gas, their non-renewable source of revenue, are removed from the equation. Although most of the non-oil countries are agricultural economies, building materials and cement are amongst the largest industrial sectors.

**Footnotes**
*********

01. Although Syria now exports more phosphate than Tunisia, the latter is a much larger producer

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03. World Bank, **Morocco : Economic & Social Development Report**, Washington, October 1981, p.17

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10. **Ibid**, Slide 13

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# CHAPTER SEVEN
**********

# MINING IN REGIONAL ECONOMIC DEVELOPMENT
**********

## Introduction

Having analysed the role of mining in the national economies of the region, we now turn to an examination of its impact on regional economic development. This can be done by studying four specific regions which illustrate different stages of the possible relationship between a mining industry and its environment. The four regions that have been chosen are the Algerian-Tunisian frontier region, central Jordan, northern Oman and the Red Sea Hills in Sudan.

The first is an area in which a wide variety of minerals has been mined for almost a century. Although mining is the largest industry, the region is a reasonably fertile and predominantly agriculture area. It is therefore possible to study the long term role of a mature mining industry in a mixed economy.

By contrast, outside the Jordan Valley, central Jordan has little agricultural potential. The phosphate and potash industries are the largest employers in the region and are vital elements in the regional economy.

Their role in developing this empty two-thirds of the country and in reducing the northward rural-urban migration is also important.

The copper mining in northern Oman is an example of an expensive capital intensive project which is designed to act as a catalyst for regional economic development. Being completed so recently the symbiotic relationship between the project and the Sohar area has not yet had a chance to develop. The infrastructure which the project has brought to the region can, however, be seen to be very beneficial.

Despite the fact that the area has considerably more potential than northern Oman, the Sudanese government does not have the necessary finance to develop the mineral deposits in the Red Sea Hills. The mining operations are therefore very small and under-capitalised. This analysis illustrates the different problems that have to be overcome by both rich and poor countries in order to develop their mineral resources.

The analysis of these four regions shows that the extraction and processing of non-hydrocarbon minerals can play an important role in regional economic development. Despite this it must be recognised that no two projects are the same and that no universal conclusions can be drawn.

## 7.1 Algerian-Tunisian Frontier
**********

The area with the longest history of modern mining in the Arab Middle East is the Algerian-Tunisian frontier area. As we saw in **Chapter Three** the arrival of the French colonial administrations heralded a revival of mining in the area. The Ouenza iron ore mine in Algeria was reactivated in 1896, when a French private company was given a mining licence. The neighbouring phosphate mines at Kouif and M'Zarta were run from the turn of the century by the Compagnie de Phosphate de Constantine, (CPC), **[01]**. Although it was not developed until 1961, the large Djebel Onk phosphate deposit was discovered in 1915 by CPC's owner Maurice Gingembre. Across the border in Tunisia the phosphate deposits were found in the Gafsa basin in 1885 by Philippe Thomas. Fourteen metallic mineral deposits were also developed in Tunisia between 1881 and 1901, **[02]**.

In both countries, the mining sector has undoubtedly contributed to the economic development of the frontier region for almost a century. In this section the role of two government parastatals, Algeria's Ferphos and the Société Tunisienne d'Expansion Minière, (Sotemin) is examined. While Ferphos administers the Ouenza iron and the Djebel Onk phosphate projects in eastern Algeria, Sotemin runs six mines in western Tunisia.

Ouenza produces well over 80% of Algeria's production of iron ore, [03], and the only other mines which are in production are at Boukhadra and Khanguet which are in the same region. All three were nationalised in 1966 and were administered by the giant Sonarem until it was split up in 1984. Ferphos, which takes its name from the French for iron, (fer), and the first part of phosphate, was established to run Algeria's iron and phosphate industries from its head-quarters at Tebessa. The town, which is almost equidistant between Ouenza and Djebel Onk, is the regional capital of the Wilaya de Tebessa and the largest administrative centre east of Constantine.

The creation of Ferphos was part of the government's plan, announced in October 1980, to shake up the public sector by splitting 61 public companies into 400 smaller and hopefully more efficient units, [04]. An important secondary motive was to slow down the rural-urban migration which has exacerbated the severe overcrowding of the coastal towns in general and of Algiers in particular. The plan also seeks to move some existing companies as well as new industries to the High Plateau and the Saharan Atlas mountains, which run in a belt across the country to the south of the coastal strip.

Lying about 1,250 metres above sea level, the Wilaya de

Tebessa has a continental climate which is very hot in summer and very cold with heavy snowstorms in winter. It is a predominantly agricultural area producing cereal crops, such as barley and wheat, and rearing livestock. With the exception of the mining sector there is currently little industry. Besides being a regional capital with the consequent government infrastructure, Tebessa also acts as a service centre for the surrounding area. In January 1980 the Wilaya de Tebessa had a population of 375,442 and was divided into five dairas or sub-districts, which are sub-divided into eighteen communes, [05].

The latest available census which provides a population breakdown was undertaken in February 1977. The Wilaya de Tebessa had a total population of 327,896, divided between 164,514 males and 163,383 females, while the urban population of 109,785 represented 33.48% of the total. About 75% of the heads of household either owned their own home or were members of a co-operative, 11% were tenants and 14% received free housing. The breakdown of the labour force showed that almost half (44%) were permanent salaried employees while the remainder were either self employed (29.7%), seasonal workers (11.4%), members of co-operatives (9.8%), or family helpers (4.4%), [06].

As Table 7.1 illustrates below the Wilaya de Tebessa is

principally an agricultural region with almost half of the labour force being employed on the land. The majority of those employed in the services and public works probably work for the government because the non-agricultural private sector is still small. Industry, which includes mining and quarrying, employed 13.8% of the total labour force but 26.7% of the urban labour force. The principal mining and quarrying projects employ the majority of the industrial labour force and there is very little non-mining industry in the Wilaya de Tebessa, [07].

**Table 7.1 LABOUR FORCE OF THE WILAYA DE TEBESSA 1977**

| | Total | Agricult. | Indus. | Services | B.T.P.* |
|---|---|---|---|---|---|
| Rural | 26,345 | 17,519 | 1,791 | 4,400 | 2,634 |
| | 100.0% | 66.5% | 6.8% | 16.7% | 10.0% |
| Urban | 14,310 | 959 | 3,820 | 6,440 | 3,091 |
| | 100.0% | 6.7% | 26.7% | 45.0% | 21.6% |
| TOTAL | 40,663 | 18,461 | 5,611 | 10,857 | 5,733 |
| | 100.0% | 45.4% | 13.8% | 26.7% | 14.1% |

Notes : * B.T.P. = Batiment et traveaux publicique = building and public works
The figures for each sector are calculated from the percentages provided by the original table and are rounded to the nearest whole number.

Source : Ministère de la Planification et de l'Aménagement du Territoire, 2eme Recensement general de la population et de l'habitat du 12 Fevrier 1977, Serie B Vol.9, Mars 1979, Algiers, pp.30-32.

### 7.1.1 Ouenza Iron Ore Mine

El Ouenza is located about 100 kms north of Tebessa and 20 kms from the Tunisian frontier. It also lies on the railway line which links Tebessa with the coastal city of Annaba, which is the major site of the country's iron and steel industry. The town lies below the Ouenza mountain of high quality siderite iron ore which is gradually being worked out. As it was discovered during a visit to the town by the author, the total population of Ouenza is 30,000 - 40,000, of whom 1,218 work for Ferphos, [08]. This represents between 9.1% and 12.2% of total population of the Wilaya de Tebessa and 3% of the total workforce. More importantly it accounts for 21.7 % of the total industrial labour force and 32% of the total number of urban industrial workers, [09]. Not surprisingly the company is the town's largest employer and over 10,000 men, women and children are probably dependent on the mine. Its employees and their families are also the principal customers for the remaining artisans and shop-keepers.

As **Table 7.2** below illustrates, in 1985 the 1,218 employees were divided between 902 manual workers, 271 "petit cadres" or foremen, 36 "cadres" or managers, and nine foreign technical advisors. Of the total, 398 worked at the mine itself, 112 in administration, 32 at

the foundry, 33 in the social and co-operative department, and the remainder in the security, mechanics and transport departments, [10].

| Table 7.2 : EMPLOYEES AT OUENZA IRON ORE MINE, MAY 1985 | |
|---|---|
| "Group 1" - (Manual workers) | 902 |
| "Petit Cadres" - (Foremen and shift bosses) | 271 |
| "Cadres" - (Administrators & Engineers) | 36 |
| Foreign Technical Advisors | 9 |
| **TOTAL** | **1,218** |
| Mine | 398 |
| Administration offices | 112 |
| Foundry | 32 |
| Social and Co-operative Departments | 33 |
| Security, Mechanical & Transport Depts | 643 |
| **TOTAL** | **1,218** |

**Source** : Personal interviews by author at Ouenza, May 85

Interviews by the author in 1985 revealed that the majority of employees come from the town's schools and work at the mine until they retire. There is a very small turnover of staff although some of the senior staff who come from elsewhere in the country leave after 5-10 years. There are two shifts, from 06.00-13.30 and 15.30-22.30 and each man work 48 hours a week with miners working a five day week followed by a six day week. Salaries, which are dictated by a national sliding scale, included a special AD350 (US$70) monthly supplement and every employee also receives a one month annual paid holiday. At 55 the workers retire and get a pension valued at 80% of their final salary. Although

there are very few, in the event of an accident the employee's family receive the pension. Between 8%-11% of the employee's salary is deducted at source as a contribution towards their pension, social security and medical expenses. Tax rates are based on a national scale and depend on a person's salary and their marital and family status. Although there are workers' representatives there have apparently never been any strikes since the mine was nationalised in 1966, **[11]**.

The company owns 800 houses in the town which it provides rent free to its employees who pay for electricity but not for their water. While the younger workers live with their families, almost all of whom work for the company, every employee is housed by the company. Each worker is entitled to a 50% subsidised meal at the end of the shift. Transport is provided by the company from the town to the mine, but not from the surrounding area for employees who live outside the town. There is a company doctor because by law one is required for every establishment with over 800 employees.

A water pipeline from Tebessa to the mine was recently installed which now enables the workers to shower at the mine rather than at home. The pipeline is owned and run by the government rather than the company which is also the government's principal electricity consumer in the

area. Diesel oil for the mine's twenty seven 20-50 tonne trucks is supplied from the coastal city of Annaba.

The Ouenza mine produces approximately 2.5 mn tonnes of iron ore each year. Four quarries are worked out in steps by drilling and setting off explosives, after which trucks transport the ore to a crusher. It is then fed along a mile long conveyer belt to the railway line. Eight 1,500 tonne capacity trains a day transport the iron ore to the El Hadjar steelworks near Annaba which takes over 90% of the mine's production, [12]. When it is completed the new Bellara iron and steel complex will also rely on iron ore from the Ouenza mine.

It is obvious that Ouenza is a classic example of a company town. The mine is by far the largest employer in the town with more than a quarter of the population being directly dependent upon the mine. Together with its employees the mine is the largest customer for most of Ouenza's other goods and services. The majority of the town's infrastructure was introduced as a direct result of the mining operation. Without it, there is little doubt that the town would die because there are few alternative sources of employment.

Iron ore production also has an important influence on the national economy. The massive El-Hadjar steelworks

at Annaba was specifically built to use Ouenza's iron ore and domestic limestone in order to reduce Algeria's dependence on imported steel, [13]. Ouenza not only assists the iron and steel industry but also the multitude of downstream industries. Amongst other things this creates employment, reduces imports and increases the amount of value added produced by the Algerian economy. In 1984 industry, excluding the hydrocarbon sector, accounted for 13.2% of GDP, a large proportion of which is partially dependent on the domestic iron and steel industry, [14]. These factors help explain the vital role played by iron ore mining in Algeria's regional and national economic development.

### 7.1.2 Djebel Onk Phosphate Mine

The French colonial army built a road from Tebessa to El Oued which passed through the village of Bir El Ater about 94 kms south of Tebessa. Until the Djebel Onk phosphate deposit, which had been discovered in 1906, was developed in 1960 the village was little more than a collection of huts. The reason for the 54 year delay between the discovery and development of the deposit was that until 1960, when technical processes had improved, it was economically unviable. The Societe Djebel Onk (SDO) began the initial development work in January 1961 and the processing plant finally came on stream in March 1966, [15].

Today the town of Bir El Ater has a population of about 5,000 families totalling 30,000-40,000 people. In October 1984 Ferphos had 845 employees at Djebel Onk of whom 647 worked in the phosphate quarry and processing plant, 170 in the transport and equipment maintenance departments, and 30 as "cadres" or administrators and engineers, [16]. Of this total 600-700 come from the immediate area although most of the cadres are from the major cities. The company's employees represent 15% of the region's total industrial workforce and 22% of the urban industrial labour force, [17].

During a visit to the town, the author discovered that about 150 of the predominantly senior personnel live in the company's township while the remainder live in Bir El Ater itself. The attractive and well planned township includes bachelor dormitories, two-floor family apartments and a number of detached houses as well as a canteen, club, dispensary with a company doctor, and sports facilities. The company's administrative building is located in the township which is about ten kilometres from the actual mine. The township is full of fir trees and flowers and is noticeably greener than the remainder of the desert town, [18].

Except for a few building material contractors there are

no other major companies in Bir El Atem which is largely devoted to servicing Ferphos and its employees. There are a few private sector shops, taxis, garages and workshops and other people work in the schools, hospital and on public works. The town, which is the district capital for an area of 5,000 sq kms, provides free education and health care in its eight primary and secondary schools and the public hospital. When the children leave school many work for Ferphos while others migrate to other jobs in Tebessa or elsewhere. Company salaries are, however, supplemented to make them attractive enough to induce workers to stay in the area. Like all other government jobs, employees are entitled to one month's paid holiday regardless of their rank, [19].

Although the road existed before mining began, almost all the rest of the infrastructure came with the mine. The railway line to Tebessa was constructed by Sonarem in 1965 to link up with the existing Tebessa-Annaba line. Three trains carry 4,500 tonnes of phosphate a day 341 kms from the Djebel Onk to the coast at Annaba. Although the French army brought electricity to the region before independence the supply has since been augmented. A 90 KV line supplies the area with power which is then distributed through 5.5 KV transformers to the quarry and the various workshops. Before the company arrived in Bir El Atem there were a few wells but the

nearest major water supply was 90 kms away at Cherra. A pipeline was built by the company to supply both the plant and the town but a second parallel pipeline has now been completed to bring an additional 300 $m^3$/hr for each. A "nodding donkey" which is owned and run by Sonatrach, the government's hydrocarbon parastatal, supplies 100-120 $m^3$ a day of fuel to the plant via a 12 kms pipeline, [20].

After being processed, the phosphate is transported by SNTF, the state railway company, to Annaba along the same line as the Ouenza iron ore. Because of depressed world market conditions, an increasing proportion of Algeria's phosphate production is being used in the domestic fertilizer industry. Currently there is one 550,000 tonnes/year capacity phosphate fertilizer plant at Annaba, which was built by Krebs of France in 1972, which also uses imported sulphur and potash, and ammonia from Arzew, [21]. Like the use of Ouenza's iron ore at the El Hadjar iron and steel works this can be seen as an important indirect **secondary impact** of the mining sector on the national economy.

The Second Five Year Plan 1985-89 envisaged a second phosphoric fertilizer plant at Tebessa which would take an increasing proportion of Djebel Onk's production. Although the fall in hydrocarbon revenues postponed such

plans it does fit into the government's general policy of decentralising industry and creating employment on the High Plateau. Consequently Djebel Onk's phosphate production could act as a focus for further economic development in the Tebessa region.

The arrival of the phosphate quarry and processing plant has obviously transformed the Djebel Onk area. A small village, inhabited by semi-nomadic herdsmen, was transformed into a town of 30,000-40,000 people with education, health and commercial facilities. The phosphate industry has provided good employment opportunities for the surrounding area and has been responsible for introducing the majority of the area's infrastructure. In short it has acted as a sort of "growth pole" and has contributed to regional economic development of the Wilaya de Tebessa.

### 7.1.3 Société Tunisiene D'Expansion Minière (Sotemin)

Across the border in Tunisia there are a number of underground mines, which are operated by the government owned Société Tunisiene D'Expansion Minière (Sotemin) from its regional headquarters at Le Kef. The company operates six mines of which four are located within 50 kms of the Algerian-Tunisian frontier. In addition there is also an iron mine at Jerissa in the area. Although

the mines are not as important as the phosphate industry in the Gafsa region this section examines the predominantly agricultural area near the frontier which has a such long mining history.

Like the Wilaya de Tebessa in Algeria, the area around Le Kef, which is the district capital of the Le Kef governorate, is on the Tunisian "tell" or plateau and is 2,400 feet above sea level. The town is 42 kms from the frontier and about 170 kms west-south-west of Tunis, [22]. In 1984 the Le Kef governorate had a population total of 249,000 or 3.56% of Tunisia's 7 mn people. They were divided between 38.7% in the towns, 25.9% in built-up villages and 35.4% living in scattered villages and individual farm-houses, [23].

Le Kef governorate is largely peripheral to modern-day Tunisia. The country's major urban areas and industrial plants are located on the shores of the Mediterranean and the Gulf of Gabes which is also the most important tourist area. The important oil industry, which also supplies the petrochemical sector, is centred in the extreme south and in the new offshore fields while phosphate production is mainly in the Gafsa basin. Agriculture, which is dependent on erratic winter rains, is generally regarded as the economy's weak link. Although it accounts for about 25% of employment, it only contributes 14% of GDP, [24].

The area near the Algerian border is a predominantly agricultural region. The majority of the farms are small family owned plots which produce cereal crops, fruit, vegetables, nuts and keep livestock. The administration of the governorate is based in Le Kef which, like Tebessa, is also the principal service centre for the area. Mining and related industries are almost the only other source of employment in the region.

Sotemin is part of the Direction des Mines et de la Geologie which, in turn, is controlled by the Ministère de L'Economie Nationale. Although the company has small offices in Tunis, its operational and administrative headquarters and main workshop are in Le Kef. The six mines are divided into two groups; the Secteur Nord which comprises Fedj Hassen, Jalta Gzala and Sidi Bou-Aounone (SBA); and the Secteur Sud of Fedj El Adoum, L'Akhout and Bou Jabeur. Of these Fedj Hassen, Fedj El Adoum and Bou Jabeur are being developed and modernised. Although it is administered from Le Kef, the Jalta Gzala mine is located near Bizerte on north coast rather than the Algerian frontier. The two remaining mines at L'Akhout and SBA are very old and are being closed down.

In 1985 Sotemin had 2,142 employees of whom 163 or 7.6% were at the offices at Le Kef and Tunis, the workshop

and the export terminal. The remaining 1979 worked in the six mines and their various processing plants, [25]. Sotemin's 2,142 employees represented less than one% of the region's total population of 249,400. The figure increases only marginally to 1.4% when the 710 employees at the nearby Jerissa iron ore mine and the 680 at the OUM El Khelil's Cement Company are included, [26]. Assuming that the Le Kef governorate's actual labour force was probably only about 30,000-40,000, this would have represented 9%-11% of the total work-force and a considerably larger proportion of the non-agricultural labour force.

A study of the mine at Fedj El Adoum, which the author visited in 1985, provides a useful insight into the role of mining in the area. While Bou Jabeur is a relatively new mine, Fedj El Adoum has been operating since 1891 although production has not been continuous and was interrupted by war and economic circumstances. The mine produces about 60,000 tonnes of lead and zinc ore a year, although this fluctuates because of the geological problems caused by the area's complex tectonic structure. In 1985 the operation employed about 332 men of whom 194 worked underground with the remainder working on the surface. The normal differential flotation process is used to produce concentrate although the plant was installed in about 1945 and is

very dilapidated. The 60% lead concentrate is taken to Tunis by truck where it is sold to the foundries, while the 50% zinc concentrate is all exported, [27].

The production methods have not really changed during the last fifty years. The mine's tunnels are small and the working conditions are very bad. The ore is removed in skips which are pushed manually along tracks out of the mine. The processing plant is very primitive and there are frequent problems. The Seventh National Development Plan envisaged a tripling of the annual production to 180,000 tons by the end of the decade. This was to be achieved through a TD17 mn, (US$14.56 mn) investment programme in new plant and machinery, although few new workers have been employed, [28].

The workers come from a ten kilometre radius around the mine, which is located close to the top of a mountain near the town of Krib. About 30% come from Krib itself while the remainder live on small family farms near the mine. The L'Akhout mine is located equidistant on the other side of the Le Kef to Tunis road which passes through Krib. Both are very important because they provide the only alternative source of employment in a generally poor agricultural area and wages are high by rural Tunisian standards. The Fedj El Adoum mine operates a 24 hour three shift system from 07.30-15.30,

15.30-23.30 and 23.30-07.30, while the office only works during the first shift, [29].

Besides being a principal source of employment the mine also provided the majority of the area's infrastructure. Sotemin's predecessors constructed the road from Krib to the mine and they brought electricity to the area and provided a local school for 200-300 children. The mine owns the only telephone in the area which is used by others in an emergency while the company doctor treats both the employees and their families. The only major problem is the supply of drinking water but this is being solved by the construction of a new water pipeline, [30]. Fedj El Adoum is not unique and the other Sotemin mines are equally important in their immediate areas.

While Fedj El Adoum has reserves of 4.1 mn tons of 10.93% lead and zinc ore, the Bou Jabeur mine has 7.1 mn tons of ore with a content of 4.89% lead-zinc, 16.22% baryte and 8.71% fluorspar. Although it only has 267 workers, compared with the 332 at Fedj El Adoum, it is the most important non-ferrous metal mine in the country. It is located within 200 metres of the Algerian frontier and is actually closer to Tebessa than it is to Le Kef. Annual production levels of ore are about 27,500 tons of baryte, 4,400 tons of lead-zinc and 8,800 tons of fluorspar. A TD7.7 mn (US$6.59 mn)

investment programme is expected to increase the annual production to 100,000 tons of ore by the end of the decade, [31].

Besides Sotemin's mines the Le Kef governorate also has an old iron ore mine at Jerissa which is administered by the Société du Djebel Jerissa. Operations began at the turn of the century and the mine now produces about 350,000 of ore - 300,000 tons of siderite and 50,000 tons of haematite. In 1985 it was calculated that the mine only had about five more years of haematite production and twenty years of siderite production. The centre of Tunisia's iron ore production has therefore shifted to the larger reserves at Tamera Douaria. About 710 workers are employed at the Jerissa mine from where the iron ore is taken by rail north to Bizerte via Tunis to the Manzil Bourguiba steel works - about 563,000 tonnes of iron ore being transported by rail in 1984 for receipts totalling TD1.9528 mn, [32]. This represented almost 18% and 16%, respectively, of the total volume and value of Tunisia's rail freight traffic, [33].

The OUM El Khalil's Cement Company plant, which is located close to Jerissa and produces about 500,000 tons of Ordinary Portland Cement a year, uses local limestone and gypsum and employs about 680 workers. Besides the domestic market an increasing proportion of the cement

is exported to Algeria and Libya. The plant was completed in 1975 as part of the policy to move industry to the less developed regions of the country, [34]. The volume and value of cement rail freight which is transported from the region is even greater than that for iron ore. Indeed, because there is no railway to carry phosphate from the Gafsa area to Gabes for export or processing, cement is the largest single item in Tunisia's rail freight, [35].

It is apparent that, like the Wilaya de Tebessa, the Le Kef governorate is an agricultural region which is relatively under-developed. Both are located on the high plateau and are largely peripheral to the major economic activity which is primarily located on the coast. The combination of potential employment opportunities and the status attached to urban life, acts as a magnet for people in such an area. There has been substantial migration from the "tell", which includes the Le Kef region, to Tunis and the other coastal cities, [36]. Between 1980 and 1984 there were 788 official emigrants from Le Kef governorate although this is undoubtedly a very conservative figure, [37].

The mining sector is one of the few alternatives to farming in the region. It has acted as a small brake on this rural-urban migration and has provided employment

to over 3,500 men in the region. Its wages are comparatively high and the conditions of employment are generally good. In addition the mines have been responsible for the introduction or improvement of the infrastructure in the region.

The forward linkages are not as strong in these small mining operations as they are in the phosphate industry. which is both much larger and provides the raw material for the very important fertilizer industry. Both Sotemin and Jerissa mines do, however, serve the country's iron and steel and foundry sector and thereby help provide additional downstream employment.

A number of important conclusions can be drawn about the history of mining on the Algerian-Tunisian frontier during the past 90 years. It is obvious that the industry has made a significant contribution to the regional economic development of the Tebessa and Le Kef regions which, while it should not be exaggerated, neither should it be minimised. Mining has brought three principal advantages. It has acted as one of the few non-agricultural sources of employment in regions which suffer from severe under-employment. The industry has also introduced or improved the standard of basic infrastructure, including roads, water, power, education and health services. In addition it has also provided

the raw materials for downstream industries although, until now, these have mainly been located in the large coastal urban areas.

The Algerian and Tunisian governments are both worried about the very rapid rate of rural-urban migration and the lack of employment opportunities in the rural areas. The former has already sought to rectify this by advocating decentralization and the relocation of some industries on the High Plateau. Mineral production and processing could act as a focus for the development of the border region and the plan for a fertilizer plant at Tebessa is an example of what could be done. The development of the mining sector could serve a number of functions by providing further employment, thereby reducing rural-urban migration, while also acting as a catalyst for the regional economic development of these peripheral areas.

## 7.2 Central Jordan
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We now turn to the role of non-hydrocarbon mining in the regional economic development of central Jordan. The country's largest phosphate mine and the Dead Sea potash project are both located in Karak Governorate. Besides being the largest single employers in the region the two are almost the only industrial projects in the governorate. This section examines the demographic and

economic dominance of northern Jordan and suggests that non-hydrocarbon mining could play an important role in the development of central and southern Jordan. The phosphate mines at El Hassa and Wadi El Abiad, and the Dead Sea potash project are studied. It will also be seen that mineral exports and processing are playing an important part in the development of the port and industries around Aqaba.

### 7.2.1 Jordan's Regional Imbalance

Since the Israeli capture of the West Bank in 1967 Jordan has been divided into five governorates - Irbid, Amman, Karak, Ma'an and Balqa While the first four lie in broad east-west belts across the country, Balqa Governorate lies between the capital and the River Jordan. The country's population distribution is very uneven with over 90% living in the three northern governorates, which account for less than half of the land area, and 55% of the East Bank population living in the Amman Governorate alone, [38]. By comparison the Karak and Ma'an governorate are very under-populated with only about 1.76% and 2.2% of the East Bank's total and urban population, respectively, in 1977 [39]. Since then the urban prominence of the northern governorates has probably increased despite the significant development of Aqaba during the 1980s. In 1983 Karak

governorate had a population of 147,500 or 5.91% of the national total while Ma'an had 87,300 or 3.5%, [40].

This demographic concentration is paralleled by an unbalanced regional development, particularly in the industrial and service sector. In 1978 the Amman Governorate had 85% and 71% of the East Bank's large and small industrial establishments, respectively, [41]. Similarly the majority of the modern services and infrastructure, such as electricity, health and educational services, are located in and around Amman.

In 1983 about 97.87% and 93.65% of the populations of Karak and Ma'an, respectively, lived on agricultural holdings, [42]. The towns of Aqaba, Karak and Ma'an are the only urban centres in central and southern Jordan. In 1981 the Karak governorate had 32 industrial firms employing 3,480 workers or only 1.53% and 2.45%, respectively, of the national total of firms employing more than five workers. The Ma'an governorate had 48 industrial establishments employing 8,100 workers accounting for 2.3% and 5.71% of the national total, respectively. Of these, the town of Aqaba had 33 firms and 5,560 employees, [43].

The Karak and Ma'an governorates are not only under-populated and under-developed but also have a very harsh environment. They are bi-sected by the Hedjaz railway

and the Desert Highway which follows it. To the east is a sand and rock desert which runs to the Saudi Arabian frontier and is very sparsely populated. The area to the west of the road and railway, which extends to the Jordan Valley, is an arid upland region with only limited cultivation. It should also be noted that, while the Jordan Valley is the country's principal agricultural region, its southern end which extends into Karak governorate is its least fertile part.

It is apparent that there are really two separate regions on the East Bank of Jordan. The north is relatively fertile and has the vast majority of the population, infrastructure, industry and service sectors. By contrast central and southern Jordan is a very harsh and arid environment which is under-populated and has lagged behind in the economic development of the country.

There has been substantial rural-urban migration during the past few decades which has been exacerbated as a result of these economic disparities. In order to help stem the northward migration the government concentrated its industrial and agricultural investment allocation in both the south and in the Jordan Valley during the 1970s. In addition it has tried to create jobs and services in the towns outside the Amman Governorate in

order to make them more attractive and thereby reduce migration to Amman. One of the ways in which this has been done is by developing the mining and mineral processing industries in central and southern Jordan.

### 7.2.2 Jordan Phosphate Mines Company (JPMC)

The El Hassa phosphate mine is the largest and most important in the country. Together with Wadi El Abiad, which is 22 kms further north, they now produce over 90% of Jordan's total phosphate output. Production began at El Hassa and Wadi El Abiad in 1962 and 1979, respectively. The two operations are closely linked and the majority of the Wadi El Abiad employees live in the El Hassa township.

During a visit to both mines by the author in 1985 it was found that El Hassa has 1,650 employees with a further 450 at Wadi El Abiad. Of these about half come from towns and villages in the region while the remainder live in the El Hassa company township. With the exception of 60 Egyptian expatriate workers, all the workers are Jordanian nationals, **[44]**. The Jordan Phosphate Mines Company, (JPMC), is the largest employer in the region. In 1981 the Karak governorate had 32 industrial establishments employing a total of 3,450 personnel so that JPMC's 2,100 workers represented about

61% of the total number of industrial workers in the whole governorate, [45].

The workers come from towns and villages within a 50 kms radius. The town of Karak, where 600 employees come from, is almost 100 kms by road but only 50 kms "as the crow flies". In 1977 Karak had a total population of 12,710 which has perhaps now risen to 15,000 [46]. Therefore in 1985 the JPMC workforce represents about 4% of the town's total population and perhaps a third of its workforce which, in turn, probably supports up to 5,000 people. While the married workers return home every day the bachelors only return to Karak at weekends.

About 30% of the skilled employees, including the management and technicians, come from outside the governorate. The majority of the senior staff at El Hassa and Wadi El Abiad are aged between 30-40 and are former graduates from Amman. The high wages and good working conditions ensure that there is a very small turnover of staff and many employees work at the mine for over twenty years until they retire at 60, [47].

In 1985 the wages at El Hassa were amongst the highest in the country and the basic salary was 50% more than that at the Ruseifa mine outside Amman. The minimum monthly wage for unskilled workers was 120 Jordanian

Dinars (US$294), compared with JD80 (US$196) at Ruseifa. There were then 14 incremental salary grades which depend on seniority. The production workers operate a 24 hour three-shift system, while the management work one shift from 07.00-15.00. Holidays vary from 18-30 days a year depending on status. The company pays JD20-JD30 a month in health and social security contributions for the employees and their families and also provides free health care and transport. The bachelors who live at the mine receive subsidised food with 65% being paid by the company, [48].

A very rough estimate can be made of the total salary bill which JPMC pumps into the local economy. The company's 1984 Annual Report states that it had 3,540 employees in January 1984 of which 2,100 or about 60% work at El Hassa and Wadi El Abiad in the Karak governorate. The company's total wage bill in 1983 was JD9,342,852 so that the region would have received about JD5.6 mn (US$13.72 mn). The wage levels at El Hassa and Wadi El Abiad are 50% higher than those at Ruseifa and Amman. Therefore, by weighting the total salary bill accordingly, the actual figure is probably closer to JD6.4 mn (US$15.7 mn), [49].

There are three groups of employees - the majority who live on site, those in the El Hassa township, and the

remainder who live in the towns and villages within a 50 kms radius. El Hassa, which has approximately 2,000 men, women and children, is almost a company town and its growth has been a direct result of the mine. Besides the 200 JPMC employees and their families who live in the town, the other residents own or work in shops, garages, workshops or keep livestock. The town includes a mosque, supermarket, bakery, laundry, hairdressers, a clinic (manned by three doctors and a dentist), club, restaurant, nursery and a 350 place elementary school. Besides the living quarters for the bachelors, the mine site has a supermarket, club and restaurant for the workers, [50].

Although it is officially independent of the company, El Hassa township receives considerable assistance from JPMC. The company built the school and roads in the town, introduced electricity and water, and supplies free transport and workmen when they are required. It also assists the clinic and the school when necessary. Without the phosphate mine, the township would neither have been built or expanded in the way that it has. Although the old El Hassa village still lies to the south of the township it is comparatively under-developed, [51].

The El Hassa and Wadi El Abiad mines receive their power supplies from the national grid although they also have

stand-by generators. Between them they use about 7.5 mn kilowatt/hours of electricity a month for which JPMC reportedly pays a "fair price". It also has its own water wells which have a total hourly capacity of 1,500 $m^3$. To process each tonne of dry phosphate requires 1.5 $m^3$ of water so that a total of about 500,000 $m^3$ of water is required each month, [52].

From the evidence obtained in a series of interviews conducted by the author in 1985 it was obvious that the El Hassa area has been developed during the past twenty years as a direct result of the mines. Until phosphate production began there was almost nothing in this empty desert except the Desert Highway road. The mines at El Hassa and Wadi El Abiad are now the largest single employers in the whole of Karak Governorate. They have also generated some additional employment in the services sector which caters for the JPMC employees. The mines themselves receive almost all their supplies from Amman so that the links with the local area are not as strong as they might otherwise be. Besides being a major employer, the mines have also been a catalyst for economic development with much of the region's infrastructure, including electricity, water and telephone services, arriving with the mines, [53].

The phosphate industry has also helped the regional

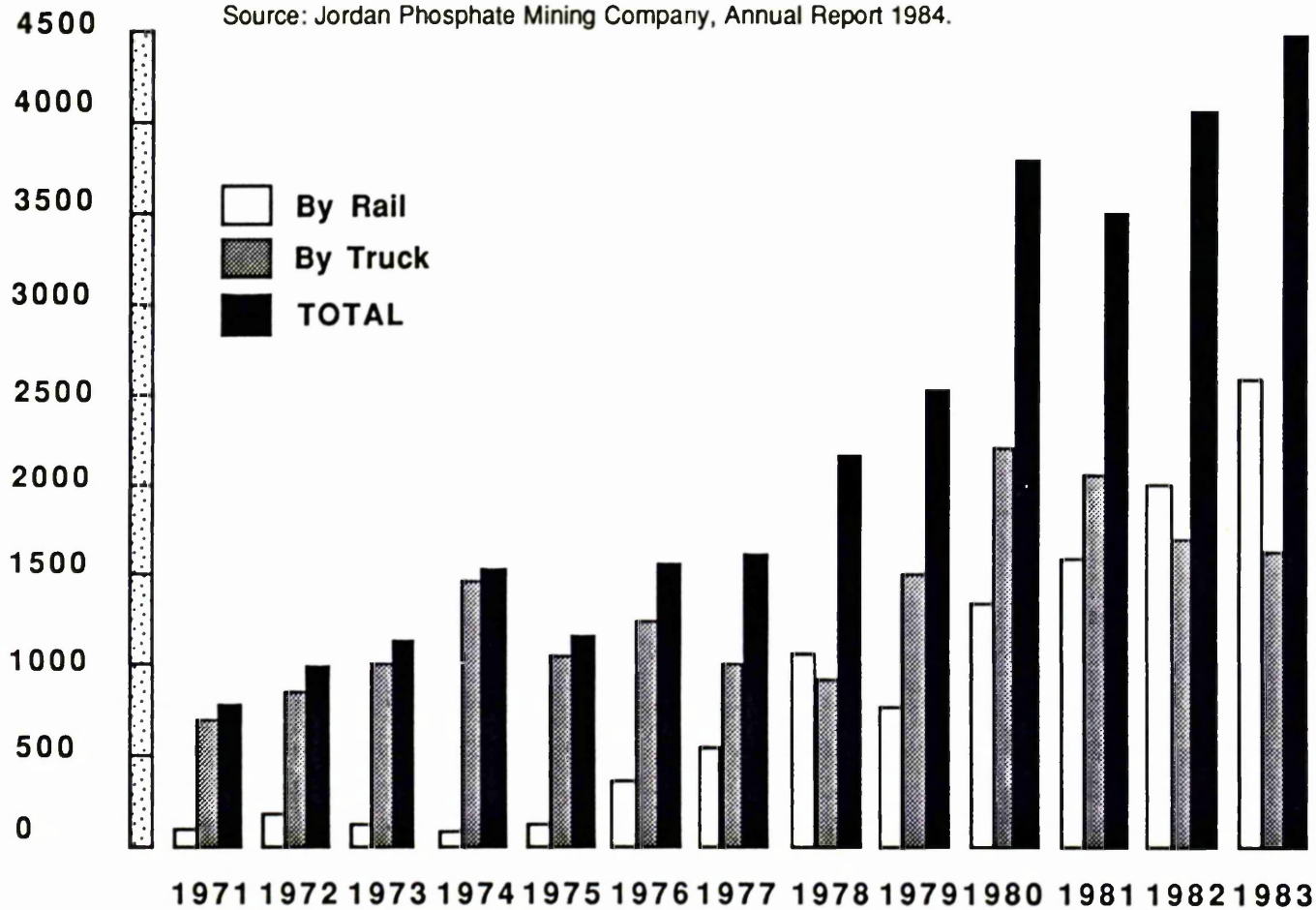
development of the Aqaba area. Besides the export of raw phosphate, the Aqaba-based Jordan Fertiliser Industries Company (JFIC) uses phosphate as its basic raw material. All phosphates exports from JPMC's mines are now taken to Aqaba port by road or rail. In 1971 the Jordanian Government negotiated a deal with West Germany to finance the rehabilitation of the railways in order to expand its annual phosphate capacity to 5 mn tons, **[54]**.

Phosphate from the Ruseifa mine outside Amman is still transported exclusively by private trucks because they are far more competitive than the railway system. Because their main profits are made in transporting goods from Aqaba to Amman or on to Iraq, they charge less per ton of phosphate rock than the railway charges from El Hassa to Aqaba despite the fact that El Hassa is 150 kms closer to Aqaba, **[55]**. In 1988 all trucks arriving at Aqaba were required to carry phosphate loads because the daily capacity of the railways have been halved to about 5,000 tonnes during the renovation of the railways.

Deliveries to Aqaba from El Hassa and Wadi El Abiad are usually by railway but also by private trucks, **(see Figure 7.1)**. The railway deliveries from El Hassa began in 1976 and from Wadi El Abiad in 1981. The phosphate side of the port has been expanded so that Berth A, which was commissioned in 1960, can handle 750,000

Figure 7.1
Dry Phosphate Transport by Railway and Trucks.
x Thousand Tons.

Source: Jordan Phosphate Mining Company, Annual Report 1984.



tons/year and Berth B, commissioned in 1969 and expanded in 1978, can handle up to 4.5 mn tons/year. There are six phosphate storage areas at the port with a total capacity of 340,000 tons. Ships of up to 60,000 dwt and a maximum of 41 foot draught and 50 metres width can use the port, [56]. The development of the port and the reopening of the Suez Canal were two of the principal reasons for the very rapid expansion of Jordan's phosphate exports. It was, however, Iraq's need for an alternative entrepot following the closure of its own Gulf ports during the Gulf War which increased Aqaba's traffic. In total the port is expected to handle around 21 mn tonnes of goods in 1988 and it is expected to expand its exports of Iraqi goods in general and sulphur and phosphates in particular.

Although it has had a number of problems, the Jordan Fertilizer Industries Company, (JFIC), is helping to develop the Aqaba region. The plant which began production in 1983 will eventually produce 750,000 tonnes of diammonium phosphate (DAP) and 105,000 tonnes of phosphoric acid using domestic phosphates and potash together with imported sulphur and ammonia. JFIC's losses, which were primarily caused by falling world fertilizer prices, led to JPMC's take-over of the company's administration and operations. Despite its problems, industry analysts believe that the plant's

medium to long term prospects are good. About 600 workers are employed by JFIC making it the largest single employer in the Aqaba area, [57]. Like the El Hassa and Wadi Abiad mines, this predominantly phosphate-based fertiliser industry is also making a significant contribution to the regional economic development of the Aqaba area.

### 7.2.3 Arab Potash Company (APC)

Besides JPMC's mines the most important project in Karak Governorate is the Arab Potash Company's (APC) plant. Although it experienced initial problems which are now being ironed out it has already made a major contribution to the economic development of the area. It is located at the southern-most end of the Dead Sea and at 1,300 metres below sea level is the lowest point on earth. The project is almost equidistant between Amman and Aqaba, being about 180 kms from both.

The nearest town, and the one where most of the workers live, is Karak which is located on the rim of a plateau which stands 3,400 feet above sea level, or 4,700 feet above the APC's plant. The Karak area has some dry-land farming but little irrigated agriculture because of the acute salinity of the Dead Sea and the very steep gradients. Karak is the administrative capital and service centre for the surrounding region.

During the author's 1985 visit to the project it was found that APC employed 1,160 people of whom 170 were skilled workers from the Indian sub-continent and 21 were Americans working for Jacobs Engineering which designed and supervised the plant. About 60% of the 969 Jordanians who work for the company come from the closest towns of Karak, Safi and Mazra'ah. Although employment is based on qualifications and suitability, the remaining skilled workers, engineers and administrators mainly came from the larger cities such as Amman, Irbid and Zarqa. APC is the second largest employer in Karak Governorate after JPMC's phosphate mines, [58].

When the APC project is added to the 1981 statistics for the region's other industrial establishments the total workforce increases to 4,640. Therefore APC employs a quarter of the total while, together with JPMC, the mining sector employs 3,260 or over 70% of the governorate's industrial workforce, [59].

Initially APC deliberately employed more men than it required in order to establish a skilled industrial workforce for the country in general and the region in particular. According to APC about 800 workers instead of the 1160 employees would be sufficient to run the

project. The surplus workers have gradually been made redundant in order to reduce the plant's already high operating costs, [60].

The potash refinery operates continually on a three shift system while the administrative and technical staff work a single 07.00-15.30 shift. The wages are probably the best in the country. For example, in 1985 a Grade 4 government employee in Amman received JD220 a month while the same worker would receive JD600 a month at APC. After a three month probation period the married workers from outside the region receive furnished accommodation. All employees contribute to a social security and savings scheme whereby they receive a comprehensive medical service for only one or two Dinars a month. Those employees who live at APC's township receive free accommodation, electricity and water and subsidized food. These terms and conditions have ensured a very low resignation rate, despite the relatively harsh physical environment, [61].

According to APC's 1984 Annual Report, its payment of salaries, wages and other benefits totalled JD3,008,265 (US$7.83 mn). Of this total JD391,939 was for the Amman head office, which has since been moved to the Dead Sea plant, and JD107,564 for the Aqaba office. Therefore JD2,508,762 (US$6.523 mn) was spent on salaries and benefits at the main plant in Karak governorate, [62].

About 200 unskilled and mainly illiterate workers come from the surrounding area. Each new worker is sent to the APC training centre where they are taught about using mechanical equipment and the safety rules and procedures. The monthly wage for the unskilled workers was JD77 making them amongst the highest paid unskilled workers in the country. Many have large families of between 8-10 children and they are therefore unable to save much of their wages. The Jordan Valley Authority provides low rent housing for a number of the men so that their lives are relatively secure despite the low rate of saving, [63].

Skilled workers told the author that they receive about JD180 a month after deductions and that this includes a JD40 living allowance and a JD50 site allowance, medical insurance and social security. If they have to live on site, such as the APC firemen, then they also receive free housing in the company township.

The APC is one of Jordan's most prestigious projects and the township which has been constructed near the site is very lavish by comparison with most industrial housing. There are 351 housing units where 170 families live in three types of accommodation. Bachelor studio apartments have a bed-sitting room, kitchen and bathroom, while

married quarters have two or three bedrooms, a living room, kitchen, bathroom and garage. The top management are housed in semi-detached villas and include an additional dining room. Visiting VIPs are housed in a very lavish guest-house which was designed to be literally "fit for a king" in case King Hussein himself were to visit the project, [64].

Besides the housing units the township also includes a number of other features. There is a 26 bed hospital including a maternity unit where 30 babies had been delivered in the two years up to April 1985. The hospital, which is staffed by three doctors, four nurses, a midwife and an X-ray technician, is able to handle emergency cases for the APC employees as well as locals. There is a small clinic and an ambulance at the refinery itself, as well as a helicopter pad for ferrying patients to Amman in the event of a major accident. The company also has its own fleet of three fire-trucks, a smoke detector system and emergency automatic water sprinklers. APC has a good working relationship with the army which could help if there was a major fire or explosion, [65].

The bachelors can go to school after work and then play badminton, tennis, volleyball or basketball in the company gym. The senior staff can use their social club which includes a bar, restaurant, swimming pool and

sports facilities. The company operates its own internal video service which shows films in Arabic and English between 20.00 and 24.00. The township also has a bank, post office, supermarket and two schools. One is a kindergarten with two teachers from local villages and forty infants. The Arabic school which was has about 50 children and three teachers was built by APC but is staffed by the Ministry of Education. There was also a small American school for the children of the Jacobs Engineering staff although this closed when the company's contract finished in 1985. Children over thirteen are taken to a school in Karak by an APC bus which also collects the married workers who live in the town. There is also a bus to Karak every Thursday for the wives of the township based staff for a weekly shopping trip, [66].

About 60% of the Jordanian employees are from Karak. The bachelors live in the APC township during the week but return to Karak at the weekend. The married personnel live in Karak and are ferried to and from the plant every day. Besides employment and the township the APC project also improved the regional infrastructure. The 178 kms road from Karak to Aqaba via the plant which follows the Israeli border was tarmaced not only for defence purposes but also to facilitate the export of potash from Aqaba. Until it was completed the only

tarmac road from Karak to Aqaba was via the Desert Highway which involved a substantial detour. Although Karak and the plateau were served by electricity and water, the APC project introduced these to the valley floor at the southern end of the Dead Sea. Communication links with the outside world use a microwave system to Amman which was more cost efficient than installing telephone lines. The APC appears to have an excellent working relationship with the local area and is considered to be a major asset for the region, [67].

It could and has been argued that, like the JFIC plant in Aqaba, the Arab Potash Company is really an expensive "white elephant" project, [68]. In 1984 APC lost JD14.105 mn (US$5.418 mn) compared to JD19.215 mn (US$6.973 mn) in 1983, [69]. When asked by the author to justify these losses, APC argued that the financial position could not be judged properly until it reaches its full capacity by 1987. At the same time it pointed out that the location of the project necessitated the high capital expenditure on infrastructure and that 85% of total costs are fixed compared with 15% variable costs, [70].

The company was proved right when it recorded its first profit in 1988 after having reached its 1.2 mn tonnes design capacity in 1987. Despite the recent rise in world potash prices from US$60/tonne in 1986 to

US$80/tonne 1988 it is still far short of the US$140/tonne in the company's original feasibility study.

While the economic viability and balance sheet must be taken into consideration when evaluating any project, other factors are also important. We have seen that Jordan's demographic and economic heartland is in the north of the country in general and around Amman in particular. The large Karak and Ma'an governorates in central and southern Jordan were largely ignored by the development plans until the 1970s. The 1981-86 Five Year Plan enshrined the following as three of its principal goals :

1. to develop the production of phosphates and potash and to utilise related chemical products;
2. to integrate the fertiliser related industries with one another and to provide the necessary infrastructure for the marketing and financing of this area;
3. and to achieve the better geographical distribution of new industrial sites which will be provided with basic infrastructural facilities, [71].

These three goals are obviously part of a general plan to locate new industries in the under-developed areas in general and the south in particular. While the

government cannot force industries to relocate, tax exemptions and incentives are being offered to encourage the establishment of new industries in these areas. If the government is not prepared to put such plans into action by locating public sector industries in the south, it cannot expect the private sector to do so. Therefore the APC and JFIC projects should not only be seen in terms of profit and loss but also as agents for the future development of these regions.

The Karak Governorate is now the centre of Jordan's non-hydrocarbon mineral production industry. Between them the JPMC and APC employed 3,260 men in 1985 who probably supported between 15,000 and 25,000 men, women and children. In addition, a number of shops and service industries are indirectly supported by the two companies and their employees. In 1983 the Karak Governorate had a total population of about 147,500 people, [72], and it can therefore be calculated that between 10%-17% of the total population are supported in one way or another by the mining sector.

Besides employment the mining projects have also played an important role in the development of Karak Governorate's infrastructure. Both JPMC and APC built sizeable townships in areas where almost nothing previously existed. They brought in electricity and water supplies, health and education services and

improved transport and communications links.

The development of Aqaba has also been facilitated by mineral exports. The export terminal and the JFIC plant employ over 850 personnel in Aqaba who, since Aqaba's total population is probably around 35,000, represent about 2.5% of the town's total population and about 15% of its industrial labour force, [73]. Like Karak governorate the Aqaba area has also benefited from the mining sector and its multiplier effect.

It was announced in early 1987 that the development of the large phosphate reserves at Es Shidiyah, which is located 120 kms north-east of Aqaba, will go ahead. With estimated reserves of 1,186 mn tonnes, or 3.6 times greater than the total reserves of the three existing mines, it is eventually expected to become Jordan's principal mine, [74]. Being so close to Aqaba it will have natural geographical and therefore cost advantages for phosphate exports. Besides the mine itself a town will be constructed to accommodate up to 25,000 people. The multiplier effect will be very significant and it will eventually become one of the focal points of the regional economic development of the Ma'an governorate as El Hassa, Wadi El Abiad and the APC project have for Karak governorate.

The only conclusion that can be drawn from the evidence presented in this section is that the non-hydrocarbon mineral production and processing industries are playing a vital role in the regional economic development of the Karak and Ma'an governorates. It can be expected that this role will increase in future years and that it will continue to act as a catalyst for other industrial and service sector companies.

## 7.3 The Sohar Region of Northern Oman

This section analyses the role of the Oman Mining Company's (OMC) copper mining project on the regional economic development of the Sohar region of northern Oman. It examines the effect of the project itself and its intended role as a catalyst for the region's industrial development. The question of whether a highly capital intensive project employing predominantly expatriate labour benefits the indigenous population is considered. The section also examines what, if any, alternative projects could act as an agent for regional development.

Unlike the other countries examined in this chapter, the Sultanate of Oman is overwhelmingly dependent on its hydrocarbon exports. In 1983 oil and gas accounted for 56% of Oman's GDP, 89% of government revenue and 99.4% of exports, [75]. By contrast, although 80% of the

population is involved in agriculture and fishing, the sector is totally insignificant in terms of value and accounted for only 1.6% of GDP, [76].

The non-oil industrial sector is even smaller and only contributed 1.4% of GDP in 1983, [77]. However, using Stauffer's model which we have already analysed it can be estimated that Oman's oil-independent GDP is only about 25% of the conventional measurement. Consequently the non-oil industrial sector is much more important when the use of non-renewable oil reserves is removed from the equation and only the productive sectors of the economy are considered. It should be remembered that like oil and gas non-hydrocarbon minerals are also non-renewable.

Probably the two largest non-oil industries are the copper mining project near Sohar and the cement plants at Rusail near Muscat and Raysut near Salalah. The remaining factories are involved in food processing and light industrial consumer goods. Non-hydrocarbon minerals therefore make an essential contribution to Oman's non-oil economy. The real question that must be addressed is whether these industries benefit the regions in which they are located or are they enclave industries which have little effect on the indigenous population.

The town of Sohar lies on the Gulf of Oman coast about 150 miles north-west of Muscat. It is the capital of the region and was once the capital of the whole country. It is dominated by a rather dilapidated white fort and the old souk has been erased to make way for new development, [78]. The coastal strip is a comparatively fertile and small private-sector farming and petty trading are the principal occupations. There is also an efficient 20 hectares high-technology vegetable farm run by Oman Sun Farms near Sohar which competes with the local producers, [79].

The Sohar region is one of two areas which have received special attention in the national development plans - the other being the previously unstable south near the border with South Yemen. The reasons include the Sultan's need for support from the important northern tribes around the old capital. Many northern Omanis have been migrating either to the UAE, where they join the armed forces, or to the capital area around Muscat. Also the unresolved dispute with Abu Dhabi and Saudi Arabia over the Buraimi oasis left six of its nine villages in Abu Dhabi and three in Oman, [80]. Under such circumstances the Omani government is keen to show the people in the Buraimi area that life in Oman is as good as that on the Abu Dhabi side of the border. Consequently it has tried to develop the region's

infrastructure and improve the Omanis' standard of living.

There are at least two important indications of the importance of the region to the government. Not only has Sultan Qaboos spent an increasing amount of time in the area but also the committee overseeing its development reports directly to the Diwan or Royal Court, [81]. This is similar to the way in which a Royal Commission rather than a ministry is responsible for Saudi Arabia's new industrial cities at Jubail and Yanbu.

One of the focal points of the region's economic development is the Oman Mining Company's (OMC) copper mining and refining project. Although it is very small by international standards, in many ways it is the country's flagship for the Sultanate's efforts to diversify exports and the economy away from oil. It is hoped that it could act as a catalyst for the establishment of downstream copper industries which could use the refined metal. This would be part of an industrial estate which is planned for Sohar, which would also provide experience of industrial work and practices, [82].

The economic viability of the OMC project is debatable and there are a number of problems with the project. The

most important of these is the very small scale of the mine, which produces less than 20,000 tons a year, and the low world price of copper. Therefore while the mine just about breaks even at an operating level it makes a loss after depreciation. Secondly the grade of copper which is being mined is not as high as expected and this has meant that the smelter and refinery are not able to work at full capacity. At the same time, unless further ore reserves are located, the mine's active life will be a maximum of about ten years. Although it is believed that there is more copper within a 30 km radius of the plant it is probably not enough to be economic. OMC may therefore possibly use its plant for toll smelting of imported copper concentrate. Although there is excessive smelting capacity OMC has the advantages of being close to India, which currently exports concentrates to Japan for processing, [83].

However it has to be asked what benefits this apparently uneconomic project can bring to the Sohar region. These can broadly be divided into four elements - the provision of employment, the introduction of infrastructure, the provision of a important new market for local traders and the agent for the industrialisation of northern Oman. These and other issues were examined during a visit to the project by the author in 1985.

At that time OMC employed 843 men of which there were

323 Omanis, 48 western expatriates and 472 "regional expatriates" or "Third Country Nationals" (TCNs) who were predominantly Filipinos and Indians. The majority of the Omanis were drivers and guards, although they also included a number of technicians and all of the Grade Three management. The company has an active policy of training Omanis to replace expatriates and it also runs a small training school. An engineering training school is planned for the future although the emphasis will still be on-the-job experience. The company believes that it must begin to reduce the expatriate labour force by training Omanis as technicians and machine operators. It is hoped that recent graduates from the government's vocational training colleges can be tempted to work for OMC rather than being attracted to the government jobs in Muscat. Although OMC recognises that it is usually more expensive to hire an Omani rather than an Indian or Filipino at certain levels, it believes that the project must help to develop the human as well as the natural resources of the region, [84]. While this may be a very laudable policy, there are a number of problems in recruiting Omanis in such a capital intensive and regimented project.

Sohar has an approximate population of 10,000 while the mine, which is about 30 kms from the town, employs 323

Omanis who are from the surrounding region. Assuming that the majority have families and a number of children, it is likely that OMC probably supports a minimum of 1000-1500 Omani men, women and children. Although most of them live in the company town at Magan, many are from Sohar and the surrounding villages. In addition OMC is a major customer for many local farmers, fishermen and traders. It is obvious that, while it would be a very expensive job creation programme if it brought no other advantages, the OMC project has the potential to be a major employer in northern Oman.

Perhaps the most tangible advantages that the copper mining project has brought to the area is the development of the region's infrastructure. The project's total capital cost was US$213 mn of which the Saudi Fund for Development (SFD) provided US$100 mn and the Omani government the remainder. The majority of the Saudi finance was used to develop the infrastructure, including a township, power station, roads, pipelines and an export jetty, [85].

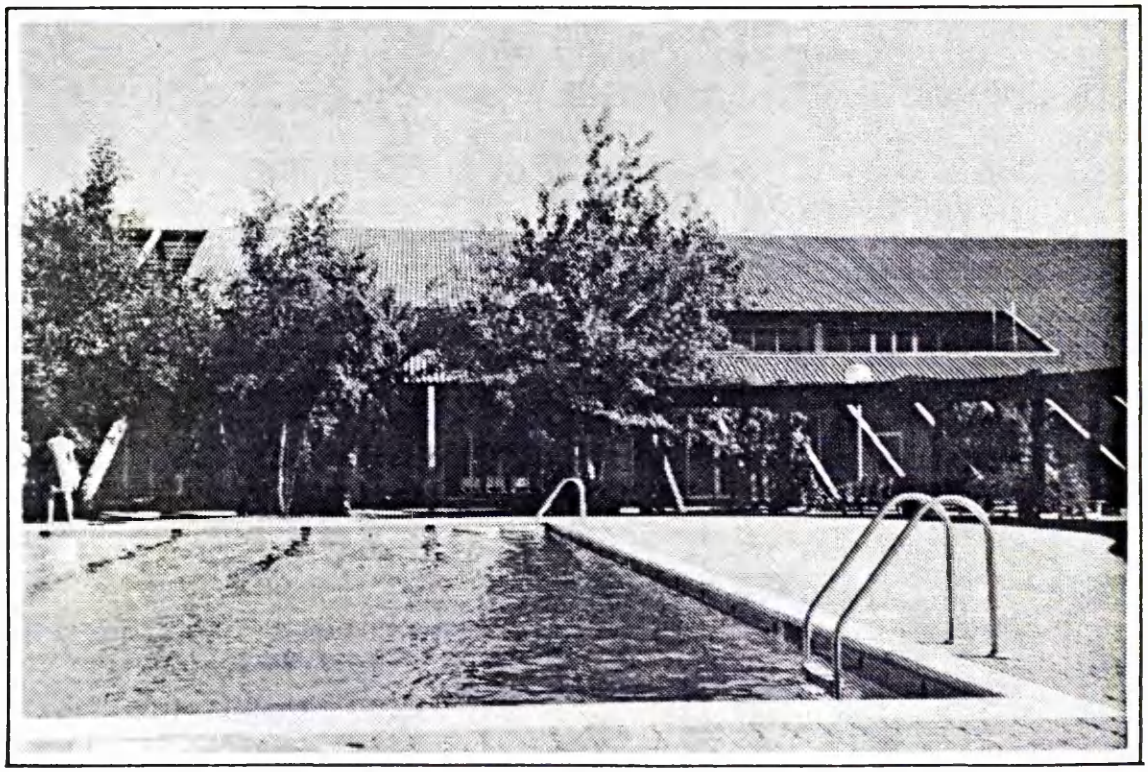
The township of Magan, which the author visited is located about 20 kms from the plant and 30 kms from Sohar. It was specifically built for OMC at a cost of about US$30 mn, [86]. It has various grades of accommodation ranging from six dormitories for the TCNs to very large and well furnished villas for the senior

personnel. In addition there are shops, a supermarket, bank, library, clinic and a small school with 29 pupils. The senior staff club includes a restaurant, swimming pool, cinema and many sports facilities, **[87]**. Although many Omanis live at Magan, the majority of the current inhabitants are regional and western expatriates.

One of the major advantages of the very attractive and well equipped township is that, unlike most mining camps which are in isolated and hostile environments, the Omanis and the western expatriates are able to live with their families. It is very noticeable that there are many women and children living in Magan, which seems to create a very relaxed working environment for the project. As the OMC management points out when the expensive town is criticised, Magan will remain an important town for the local population long after the current ore reserves are worked out in the 1990s, **[88]**, **(see Figure 7.2)**.

The electric power for both the mining project and the Magan township is generated at the plant by three 18 MW heavy- duty industrial gas turbines. One of the three is owned by the Ministry of Electricity & Water (MEW) and is used to supply surrounding towns and villages but the whole power plant is run by OMC. The existing power station already supplies electricity to Saham and Shinas, 70 kms south and 50 kms north of Magan,

**Figure 7.2**
**Housing and Senior Staff Club at OMC Township, Magan, Oman.**



*Source: C.G. Gurdon.*

respectively. The MEW takes over the transmission from Magan where it is stepped down from 66 KV to 33 KV to continue to the villages.

Two new 30 MW turbines have recently been commissioned and they will be used to supply the Omani villages in the important Buraimi oasis via 132 KV power lines. Eventually the total power generated by the plant is expected to reach 200 MW, making it a substantial regional power station. It is also planned to link it to Muscat and thereby create a national grid. Rather than having to employ a contractor to run and maintain the expanded power station, the MEW has come to an agreement with OMC whereby the company will continue to run the plant while also helping to train Omani technicians to do so. In this way the company is helping to develop the infrastructure of the northern region and is of direct benefit to the local community, [89].

The fuel for the electricity generation is provided by a 227 kms sixteen inch diameter natural gas pipeline from Muscat which will be able to supply the power station with all the gas that it needs. The gas is supplied to the plant by the Ministry of Petroleum and Minerals, which is also the 100% owner of OMC. The pipeline would probably not have been constructed if the gas had not been required for the copper mine and processing plant.

Although there are no current plans to provide domestic gas to the Sohar area any new industrial projects would presumably use the power from the expanded power station. Therefore while the gas pipeline is expensive in terms of the project's capital costs it is of long term benefit to Sohar region, [90].

Besides the township, power station and gas pipeline, a number of other improvements were made to the infrastructure. The road between Sohar and the Buraimi oasis, which passes near Magan, the mine and the plant, was upgraded for the project. An US$8.5 mn jetty was built on the coast so that the processed copper cathodes could be exported directly from northern Oman. In fact it is now transported by road to Mina Qaboos near Muscat from where it is exported. Although it may be used in the future almost the only ship to currently use the jetty is Sultan Qaboos's private yacht, [91].

The plant uses seawater which is piped 34 kms from the export jetty. The concentrator uses 4,000 $m^3$ of seawater a day. The domestic water for the township is piped from Wadi Gizzi a few kilometres from the plant. Although it hardly ever rains in the area, Wadi Gizzi has a very large catchment area and collects much of the water from mountains 30-40 kms away. The company recognises the problems of fresh water supply and is trying to cut back on the use of fresh water, except at Magan. Originally

the fresh water was quite acidic because of the reaction of the water and the sulphide in the rock but the excessive acid was pumped out in 1981. The supply of fresh water will remain a concern but apparently not a problem in the immediate future, [92].

It is obvious that, although the original capital costs of the project were very high, the OMC project has been responsible for the development of the infrastructure in the Sohar region. At the same time it also provides a ready market for local traders. Fresh fruit and vegetables, fish and some meat is bought in Sohar by the company for the bachelor canteens. The western expatriate wives all shop in the town and the local garages and taxi services are also used. The company itself uses some local contractors for minor building works although most work is done by OMC employees. Magan is a company town but it has a close relationship with Sohar through the Wali or mayor of Sohar and senior local police officers.

The project is also assisting the development of the Sohar region is its role as the nucleus of the planned industrial city. The committee which is planning the development reports directly to the "Diwan" or Royal Court, There are ambitious plans for an industrial estate near Sohar which would include a new city centre

and hospital as well as improved road, and even rail, links with Muscat. There have also been feasibility studies for downstream wire and tube plants which would use OMC's copper cathodes, [93]. These projects are, however, long term developments and the lower oil revenues have delayed their inauguration.

It can be argued with some justification that, while the OCM project may not be ideal, it is a better use of resources than that to which so much of the Gulf countries' oil wealth was put to during the 1970s. Although oil will remain the overwhelmingly dominant sector of the Omani economy, it is important that both agriculture and non-oil industries are encouraged while the oil revenues are still available. The alternative is the continuation of the "rentier" economy which has, in many ways, been so detrimental to the Gulf Co-operation Council, (GCC), countries.

## 7.4 The Red Sea Hills of Sudan
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Unlike Oman and the other Gulf countries, Sudan does not have the benefits of oil revenues. It is the poorest and least developed country in the Arab Middle East. The country has a multitude of economic and social problems, as well as trying to cope with the effects of the drought, famine, floods, the civil war and the influx of

over one million refugees. Under such conditions any projects which can assist in the economic development of a particular region are naturally very welcome.

This section examines the role of non-hydrocarbon mining in the regional economic development of the Red Sea Hills. Analysing the role of mining at different stages of economic development, we now turn to be what can described as "frontier mining" operations in Sudan's Red Sea Hills. This is an environmentally harsh but mineral-rich area of a poor and under-developed country. Mining operations in the area are small scale and very under-capitalised.

Gold mining has a very long history in the Red Sea Hills but until recently there had been no mining since independence. Besides gold there are a number of other mining operations including gypsum and various building materials. From studies carried out by both Sudanese and foreign geologists, it is obvious that the area also contains a number of other minerals including silver, tungsten and copper. It seems that mining and quarrying could be expanded in the region and could play an increasingly important role in the region.

The Red Sea Hills are the Sudanese section of the mineral rich Arabian Shield which extends north and south in Egypt and Ethiopia, respectively, and in Saudi

Arabia across the Red Sea. The hills rise up from the relatively narrow strip along Sudan's 480 kms of coastline, [94]. The hills, some of which are over 2500 metres high, lie in a north-south belt which is over 200 kms wide in some areas. The environment is very harsh with a very hot and arid climate. Until the Port Sudan to Khartoum highway was finished, road links through the hills were extremely difficult. The railway lines from both Atbara and Kassala to Port Sudan, which the British were forced to build through seasonal dry river beds, are still frequently subject to washouts as a result of flash floods.

With the exception of Port Sudan, Suakin and possibly Sinkat there are no towns in Red Sea province with populations of over 10,000 people. The vast majority of the inhabitants are nomadic herdsmen or owners of small private farm plots. While Port Sudan is a predominantly Arab city, the population in the rest of the province is mainly Beja. This non-Arab but Muslim tribe, which has its own language, accounted for 646,000 or 6.3% of Sudan's total population in the 1955/56 census which was the only one which took account of tribal origin, [95]. While the total number of Beja has obviously increased since independence the proportion in the national population is probably approximately the same.

In recent years the rate of rural-urban migration to Port Sudan has increased sharply. During the 1984/85 drought and subsequent famine the Beja and their herds were devastated, and hundreds of thousands came down from the mountains to Port Sudan and to the feeding camps. At the same time the concentration of infrastructure in Port Sudan and its economic importance has turned it into an island of relative prosperity in a sea of absolute poverty. Consequently, any project which assists in the development of the areas outside Port Sudan will naturally be very important. The harsh climate and environment makes major agricultural development almost impossible and it is possible that mining and quarrying could provide the nucleus for small scale regional economic development.

The Gebeit gold mine is being redeveloped by Minex Developments (Sudan) Ltd. The company's original 80,000 sq kms concession runs from the Red Sea to the River Nile, except for the area between longitude 34-36 degrees, although it is unclear how far south the concession area extends. Besides Gebeit the company has also identified a number of other gold deposits which it is planning to develop in the future, [96].

The development of the Gebeit gold mine, which is located 250 kms north-west of Port Sudan, began in 1979. The company employs 28 expatriates and 180 of the 300-

400 men who live in the Gebeit area. Many were natural miners and gold panners who have now been trained in modern mining techniques. After they have been continuously employed for six months, workers must by law be permanently employed. In 1985 the Gebeitis were paid £S4.0 a day which, although less than US$1, was a reasonable daily wage in rural Sudan. Drivers received £S3-£S6 for a eight hour day plus overtime, so that they received an average of about £S150 (US$33) a month. Teams, which explore the Red Sea Hills during the three months of winter, include about five Bejas from Gebeit who are paid about £S3 a day plus food. They are taught how to prospect for certain minerals and they become geologists as well as diggers. By using a guide who is bilingual in Arabic and Beja, the company geologist is able to achieve far more work than if the Gebeitis were exclusively manual labourers, [97].

Besides providing some employment the mine has also assisted Gebeit in other ways. The government has built a village school at Gebeit and has staffed it with three teachers including a Beja. It is now attended by many of the children in the area who had been herding livestock in the past. The company provides medicines for the local inhabitants who can also travel to Port Sudan in company vehicles when there is space. Instead of there being an average of one truck to Port Sudan

every month there were already at least two company cars a week by 1985. Minex is able to contact both the police and emergency services in Port Sudan if there is a crisis and there is usually at least one air flight a week from Khartoum, [98].

The company acts as a nucleus and help centre for the people within a 50 mile radius of Gebeit. Most of them live in the village during the dry season and herd livestock in search of new pasture during the rainy season. Although most of the food for the company employees is bought in Port Sudan, Minex does buy chickens and goats and some vegetables from the Gebeitis, thereby increasing their incomes. By 1985 there were three permanent shops and merchants were already begining to import goods, including charcoal, from Port Sudan for the community, [99].

Gebeit has more than doubled its population since the rehabilitation of the mine began. Gebeitis who had migrated to Port Sudan in search of employment have begun to return. Teachers, who had previously shunned Gebeit because of its harsh environment, are now prepared to move to the village with their families. Gebeit has a good water supply with ten major wells, each one being 10-12 metres deep. Minex pumped water out of the old mine and is now drilling further water wells. The company power supply, which is diesel generated, is

also used by the police, [100].

While the role of the rehabilitation of the gold mine at Gebeit should not be exaggerated neither should it be dismissed. Although the mine is currently very small when compared with Ouenza in Algeria, El Hassa in Jordan or even the OMC copper project in Oman, it is important for the immediate area. The Red Sea Hills are very underdeveloped and there is little or no economic activity outside the Port Sudan region. If Gebeit and other small gold mines can slow rural-urban migration and act as a catalyst for the regeneration of village life then they have performed an important function, while also producing profits for the company and the government in their joint venture agreement.

Besides Minex the other foreign company which has been operating for some time in the Red Sea Hills is the French government's Bureau de Recherches de Geologiques et Minieres, (BRGM). It has been in Sudan for about six years and has been working in the Red Sea Hills between longitude 34-36 degrees. Because, unlike Minex, it is not an under-capitalised private company, BRGM has been able to undertake an extensive and comprehensive exploration work. Its most interesting find has been in the Ariab area in the south-west of its concession area. A very large gossan has been discovered with large

deposits of high grade polymetallic ore, [101].

BRGM officials, who were interviewed by the author in 1985 in Khartoum and Port Sudan, are planning to develop three or four gold mines within a 50 kms radius. Despite only producing 250 kgs - 500 kgs of gold a year, they would be economically viable because, unlike almost all other minerals, small scale gold mines are profitable. The equipment to develop the mines could be moved from site to site so that the development costs would be split between the mines. Each would employ 50-60 personnel and be self sufficient in water and vegetables while other supplies will be imported from Port Sudan. BRGM is confident enough about the project to be considering the construction of a 150 kms water pipeline from the River Nile to the Ariab area. Although it is only in the planning stage it appears that at least three gold mines will be developed in the region within the next decade. This would be a great fillip to the interior of the Red Sea Hills and would undoubtedly make a significant contribution to the regional economic development of the area, [102].

During the period that BRGM has been involved in Sudan, its regional base has been at Port Sudan. In 1985 it had a total staff of 350 of whom 15 were French expatriates, but this number will increase to 25 once the mines are operating. The exploration work was done with the

Ministry of Energy and Mining's Geological & Mineral Resources Department, (GMRD). Of the 350 BRGM employees, 127 were seconded from GMRD and received a salary top-up from BRGM, [103].

Now that the first mine is being developed it is being financed by a Sudanese, French and Saudi Arabian joint venture company. The division of shares gives the Sudanese government 60%, the Total oil company 30%, and BRGM 10%. The purchase of the Sudanese government's share, held by the Sudanese Mining Corporation, (SMC), was financed by Saudi Arabia which has the option to take up shares in the future, [104].

The success of the Gebeit gold mine rehabilitation project has fuelled considerable interest in gold mining in the Red Sea Hills. Total, the French oil company which has a 30% stake in the joint venture, was known to be keen to quicken the pace of development. Similarly the government's desire for additional hard currency revenues has led to its encouragement of mining development. The company believes that while it could have brought one mine to production by now, its steady and comprehensive approach will produce more beneficial long-term results. Besides Minex and BRGM a number of private-sector companies have been sufficiently encouraged to invest in gold exploration and mining

projects, [105]. This will help the economic development of the Red Sea Hills' hinterland.

The government's Geology and Mineral Research Department, (GMRD), has its Red Sea Hills regional headquarters in Port Sudan. There it has 200 employees including the director, four senior geologists, ten geologists and eight technicians. Some of the senior staff and new geology graduates come from Khartoum. Port Sudan is the most important regional office for training geologists because it is by far the most active of the four, the others being at Atbara, Kurmuk and Nyala, [106].

The GMRD works with Minex, BRGM and all the other mineral exploration companies. Once a deposit is to be developed the government's role is transferred to the Sudanese Mining Corporation, (SMC). In the Red Sea Hills the SMC is involved in a gypsum quarrying operation at Bir Eit near the coast about 70 kms north of Port Sudan. Although the gypsum reserves could be as much as 400 mn tons the quarrying operations are very small scale and primitive. Like Gebeit, however, this small quarrying operation could help in the future regional development of the area.

In 1985 the project only employed about 30 men although this was expected to increase as production is stepped

up in the future. Of the 30 only eight came from the immediate area while many of the others are originally from the Nuba Mountains of Southern Kordofan. The principal reason that more local men do not work at the quarry is that most are involved in sheep smuggling which is far more lucrative. Up to 600,000 head of livestock are smuggled from Sudan to neighbouring countries including Saudi Arabia. In 1985 a sheep that sold for £S40 in Sudan could be sold for £S300-£S400 in Saudi Arabia so it was obviously a very profitable business. Bir Eit is one of the principal smuggling ports because it is located almost exactly opposite Jiddah. For some reason Bir Eit sends ewes while smugglers in Port Sudan send rams. The boats which cross the Red Sea with sheep return with consumer goods to be sold on the black market in Port Sudan, **[107]**.

Because of this profitable smuggling the locals had little incentive to do back-breaking work in the gypsum quarry, despite the fact that it was the only source of legitimate employment in the area. The 1984/85 drought and subsequent famine radically altered the situation. The majority of the local livestock died and the smuggling business all but vanished. Consequently some of the locals began working in the gypsum quarry in order to earn enough money to support their families. The problem is that they are almost all Bejas who are

small and wiry and are not as well suited to quarry work as the big and muscular Nuba workers, [108].

In 1985 the author was told that gypsum was taken by truck to Port Sudan where about 15,000 tons of the 25,000 tons total was sent by rail to the Maspio Cement Company in Atbara. A further 3,000 tons goes to the cement plant at Rabak near Kosti, the Port Sudan chalk factory takes 2,500 tons and other small local customers buy 1,000-2,000 tons. Production should eventually increase to about 50,000 tons when SMC can obtain machinery spare parts and sufficient fuel supplies, [109].

There were long-term plans for a Saudi-funded and Swedish-run project to export up to 100,000 tons of gypsum to Saudi Arabia. This would use a conveyer belt to take the gypsum the eight kilometres to the coast and on to ships standing off the shore. If the plan were adopted, it would ensure that the operation was adequately financed and that, although it would not become totally capital intensive, its machinery would be in working order. The project would provide employment for larger numbers of locals and the area's infrastructure would be improved. While this would naturally be of great benefit to Sudan, it would also provide very competitively priced gypsum for the large and important building sector in Jiddah. Unfortunately

Saudi Arabia seems keener on developing its own more inaccessible gypsum deposits. Consequently while an almost infinite quantity of cheap gypsum is available just across the Red Sea, a major expensive and capital intensive gypsum industry is being developed in Saudi Arabia, [110].

While gold mining may be very glamorous, it is building materials which currently make up the bulk of the mineral production in the Red Sea Hills region. There is a small marble quarry and polishing plant at Sinkat to the south-west of Port Sudan. So far it is small and has very limited effect on the local area. The majority of the building material quarries ring Port Sudan which, being the only major city in the province, uses most of the material. All of them are privately owned and employ 25-50 men who usually live in the city. Studies by the author showed that salaries range from £S150-£S300 a month depending on experience and status. Most of the quarries provide aggregate for the road building and other construction projects. Although their role is not obvious all of these small building material quarries are assisting in the economic development of the Port Sudan area, [111].

The mining and quarrying sector in the Red Sea Hills is still very small. Its impact on the region has so far

been relatively insignificant. However, it is also obvious that it has considerably future potential. If Sudan had a fraction of the finance that is available in Oman and other Gulf countries, which have much small mineral deposits, then many of these projects would have had a greater impact on the region. Despite this the development of mining and quarrying projects, particularly in the interior of the Red Sea Hills, should provide a considerable economic boost to an area which has little or no alternative focus for economic development.

## 7.5 Conclusions
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This chapter has examined the role of non-hydrocarbon mining and quarrying in the regional economic development in four specific regions in the Arab Middle East. The Algerian-Tunisian border region has a long history of modern mining on both sides of the frontier. Both are peripheral agricultural regions which have largely been ignored or forgotten in the development planning. In recent years, however, the governments are keen to reduce rural-urban migration and establish industries in such peripheral regions. Consequently the mining sector is seen as acting as an agent for future regional economic development.

It is obvious that the regional economic development of

the Algerian-Tunisian border area has benefited from the mining projects. While agriculture will continue to be the principal employer in the area, mining has played an important role for almost a century. Furthermore, as the decentralisation policy takes shape, it is likely that these previously peripheral regions will become more important and that mining will continue to play an important role in their economic development. In addition the minerals are transported to other regions where they are used as the raw material in the steel, fertilizer and foundry industries. This naturally has a multiplier effect and helps in the development of industries in other regions.

The second area that was analysed in this chapter was the Karak Governorate of central Jordan. Here it was seen that, unlike the Algerian-Tunisian frontier which is an agricultural region, there was almost nothing in the area before phosphate was discovered at El Hassa and without JPMC's activities the area would be almost uninhabited. It is obvious that phosphate mining has been responsible for the development of the El Hassa area during the past twenty years.

It can and has been argued that the highly capital intensive and sophisticated project is a "white elephant" and a huge waste of money. In some ways it was

a symbol of the optimism of the mid-1970s when Arab oil wealth would help to finance the industrialisation of the Arab world. The APC plant and the Jordan Fertilizer Industries Company (JFIC) plant at Aqaba, which processes phosphates from El Hassa and elsewhere, are both losing money because of their very high capital costs and the current low world fertilizer prices.

Despite this it was seen that the APC plant and township are important to the Karak area. The company is the second largest employer after JPMC and thereby supports a significant minority of the area's population. In addition it has introduced and improved the infrastructure near the southern end of the Dead Sea. Although it could be argued that the company town is a lavish and unnecessary expense, it created a modern and well equipped town where previously there was none.

Perhaps above all the APC and JPMC projects brought two immediate advantages to the area. They introduced modern industrial working practices to a previously exclusively agricultural area through extensive training and on-the-job experience. By providing excellent wages and conditions they are also helping to stem the flow of migrants to Amman. In this way they have helped to reduce the regional inequalities which are so prevalent in Jordan. By providing raw materials for export and processing in Aqaba, they have also contributed to the

development of southern Jordan which had also been neglected.

Having examined the capital intensive APC project in Jordan, the Oman Mining Company's (OMC) copper mining and processing plant near Sohar was examined. It was seen that this is an example of an oil-rich country deciding to develop an industry which, under normal circumstances, would not be economically viable. This was done in order to develop one of the few non-oil natural resources that Oman possesses and thereby act as a catalyst for the industrial development of the Sohar region.

Despite very limited copper reserves the Omani government decided to go ahead with the development of the mine. Almost nothing was too good for the prestige project and the mine, plant and township are all very modern, capital intensive and excellently equipped. If the mine is of marginal economic benefit the question is what role does it play in the regional economic development of the Sohar region ?

It was seen that the Saudi Fund for Development provided US$100 mn towards the project which was spent on developing the region's infrastructure. While OMC provides local traders with some business, it is not a

major employer in the region. This highlights a problem throughout the oil rich Gulf states because, unlike the Maghreb and other countries such as Jordan, there is no history of mining in Oman. Local people have neither the experience nor the inclination to do difficult and hard mining work which requires both industrial discipline and training. While they can continue to employ western and TCN expatriates do the work then very few of the industrial projects in the region will provide real employment in the Gulf countries. The oil price fall and the general recession in the Gulf must also place the plan for an industrial estate at Sohar in doubt. Despite this, since there are almost no alternative non-oil industries, the expensive and state-of-the-art OMC copper mining project has undoubtedly benefited the Sohar region of northern Oman.

By comparison with northern Oman, the Red Sea Hills of Sudan have the opposite problem. It is an area with considerable mining potential but which does not have adequate finance to fully exploit such advantages. Despite this, while Saudi Arabia spared no expense to develop the Mahd adh Dhahab mine, the Gebeit mine in pauper Sudan was first into production, despite having begun the development work at almost the same time.

Unlike the projects in Oman, Saudi Arabia and even Jordan, the development of the gold mines in the Red Sea

Hills was seen to be typical frontier type of mining. Working in a very hostile environment and with limited financial and capital resources, a number of gold mines are being developed. Although their impact on the immediate area will be relatively small, the chapter showed that they did provide some benefits. The only conclusion that can be reached is that if a fraction of the money invested in northern Oman went to the Red Sea Hills a small but viable mining industry could be established. This would naturally be a major component in the regional economic development of this area which has almost no alternative source of income.

From this chapter's analysis of four different regions it was shown that non-hydrocarbon mining does play an important role in their regional economic development. While it may not be as large or profitable as the oil industry it can act as a catalyst for the development of what were previously very peripheral regions. It was seen that mining projects bring numerous beneficial direct **primary impacts** to its immediate environment. Besides providing non-agricultural employment, thereby supporting large numbers of people in relatively sparsely populated regions, the industry has also introduced or improved the infrastructure in certain areas.

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# CHAPTER EIGHT : CONCLUSIONS & FUTURE PROSPECTS
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This thesis has had two principal aims - to provide as much information as possible about the mining sector in the Arab Middle East and to analyse the role of mining in both its national and regional economies. This very short concluding chapter is intended to briefly draw the strands of the thesis together and to point the way to future areas of possible research on the subject of non-hydrocarbon mining in the Arab Middle East.

## 8.1 The salient conclusions of the thesis
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Although numerous conclusions could be drawn from the information provided in this thesis, there are four salient points which should highlighted. These are - the scale and scope of the mining sector in the region, the very strong forward and backward linkages that it generates, the consequent under-estimation of its true share of gross national product, and its potentially important role in regional economic development.

To most people the mining industry is normally associated with the huge underground mines, such as those in South Africa where gold and other precious metals are extracted from the depths of the earth, or with the massive surface strip mining operations which

disfigure the landscape. As this thesis has sought to demonstrate, the reality is that the mining sector is very diverse and ranges all the way from these large-scale projects down to a few men hacking away at the earth with picks and shovels. While some of the largest operations, such as the Ouenza iron ore mine in Algeria and the El Hassa phosphate mine in Jordan, represent massive investment and employ thousands of men others, such as the Bir Eit gypsum works and the alluvial gold mining camps in Sudan, are tiny.

Besides the variations in size the Middle East mining sector is also very diverse in scope. It includes a very wide range of ferrous and non-ferrous metals, as well as those minerals which are used in the fertiliser, chemical, ceramic, and construction industries. Indeed, the latter are probably the most important of all because building materials are used in all the other sectors of the economy. This thesis has sought both to quantify and illustrate the wide ranging nature of the mining sector so that its scope can be fully appreciated.

Secondly, highlighted by the thesis are the very strong forward and backward linkages associated with the mining sector. The strong forward linkages mean that the development of a mining project usually leads to the

formation of new downstream industries, or the expansion of existing ones, which use its output as a raw material. Even in the Middle East, where much of the mineral production is exported in its unprocessed state, there has been an increasing trend towards the formation of downstream industries. Similarly it has been seen that the mining sector's own demand for inputs, such as plant and machinery, electricity and housing, all create strong backward or upstream linkages which also effect and usually benefit the rest of the economy.

As a result of these factors it has been demonstrated that the mining sector's share of gross domestic product has been significantly under-estimated and that, when properly measured, its contribution is far larger. Although there was insufficient data to calculate its actual share of GDP in any specific country, the thesis did provide an equation which would enable such a calculation to be made.

It has also provided conclusive evidence of the role that the mining sector can and has played in the economic development of specific regions. Indeed, before going on to outline areas of future research, it should be emphasised that, largely because of the lure of oil wealth, the regional and national governments of the Arab Middle East have tended to ignore or under-estimate both the importance of non-hydrocarbon mining and the

role that it could play in economic development. Although it is obviously preferable, it is not necessary to have vast mineral reserves in order to benefit the economy. Even the development of a small-scale building material quarries both assists the local construction industry and reduces the need for imports. As this thesis has demonstrated, the mining sector has proved particularly beneficial in developing the remote peripheral regions which are usually ignored by economic development plans.

The principal hypothesis of this thesis is that non-hydrocarbon mining makes a significant contribution to the economic development of specific regions in the Arab Middle East. Mining has been shown to be particular important in the economic development of areas such as the Algerian-Tunisian border, central Jordan and parts of Morocco. Although it is less significant in the oil producing countries there is no doubt that the role of the mining sector could be expanded. These conclusions could be demonstrated by applying the equation outlined in the introductory chapter, to all the countries of the Arab Middle East with the possible exception of the virtual city-states such as Bahrain and Kuwait.

## 8.2 The Future of Mining in the Arab Middle East

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Until all the governments of the region recognise its

full potential the non-hydrocarbon mining sector will remain comparatively under-developed in the Middle East. While phosphate and, to a lesser extent, iron ore production will continue to be major industries in a handful of countries, most governments will continue to focus on the exploration and development of hydrocarbons reserves to the virtual exclusive of anything else.

As this thesis has shown, mining does more than simply provide export revenues or import substitution savings. It creates employment and develops infrastructure, not only in the mining sector itself but also in both upstream and downstream industries. In addition to the numerous other benefits outlined in this thesis, it also helps to reduce the disparities between the core and peripheral regions of many countries.

Unlike oil, which after being brought to the surface can simply be piped to the economic heartland of the country which is usually on the coast, mining requires a permanent and fully-mined operation at the mining site. Often being the first non-agricultural industry in a peripheral region, mining can, and usually does, act as a catalyst for its economic development. Given the Middle East's seemingly inevitable growth of rural-urban migration and regional disparities, governments should consider how they can develop the mineral reserves,

particularly in peripheral regions.

Greater co-operation between the countries of the Arab Middle East is essential in order to avoid duplication and to develop the region's mining industry in the most efficient way. For example, it would have made more sense to have concentrated the UAE cement industry in Ras Al Khaimah and possibly Fujairah, which has limitless raw materials but no oil, rather than building plants in Abu Dhabi, Dubai, Sharjah, Ajman and even Umm Al Qaiwain. Similarly, Saudi Arabia should be importing its gypsum from the vast deposits just across the Red Sea in Sudan rather than having to establish a domestic industry which would be more expensive and would require imported labour. Why plan to develop iron and phosphate industries in the Kingdom when phosphate can be imported from Jordan, Syria, Egypt and Iraq and iron ore could come from Egypt and possibly Algeria. While regional politics may make such co-operation impossible, duplication should be avoided and each country should specialise in those minerals in which it has natural advantages. The richer Arab countries should also supplement their financial aid by expanding mineral imports from other Arab countries rather than relying on non-Arab suppliers.

Given the fact that on a world scale, with the exception

of phosphates, the Arab Middle East is not a major producer of any minerals, governments should concentrate on those which can be developed economically and require limited capital investment. Gold is the most obvious example because even small mines producing a few hundred kilogrammes can be very profitable and the Arabian Shield has a long and proven history of gold mining. If a fraction of the investment put into Oman's copper or Jordan's potash refineries were invested in rehabilitating the ancient gold mines in Sudan, Egypt, Saudi Arabia and the two Yemens, there is no doubt that profitable operations could soon be established. Other relatively high value, low volume, minerals which could be developed in the region include silver, mercury, chromite, cobalt, antinomy, manganese, tungsten and molybdenum.

The other principal area of interest should be on building materials. While the region's domestic demand for most minerals is relatively limited, mainly because of the small population and the lack of an integrated and sophisticated industrial base, there is a huge demand for building materials. Besides this, the fact that quarrying is a much simpler and less capital-intensive industry than underground mining is an obvious advantage. Industries supplying building materials to both the domestic and regional markets should therefore be developed, particularly in those poorer non-oil

producing states which have few alternative sources of export revenue.

In order to achieve these aims the governments of the region must take them seriously. Universities should expand their syllabuses so that the level of indigenous expertise in all aspects of geology, mining and mineral processing is improved. The government department which supervises and develops non-hydrocarbon mining should no longer simply be the poor relation of the oil ministry. Instead, mining should be seen as a separate and vitally important element of regional economic development, particularly in the peripheral regions where there are few if any alternative sources of income.

## 8.3 Future areas of research

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It has been stressed that this examination of the mining sector in the Arab Middle East is an introduction to a topic which has largely been ignored or brushed aside by most analysts who have tended to concentrate on the role of the oil industry in economic development. Obviously such a broad-based international study cannot and has not been able to examine specific regions in great detail. It is therefore hoped that, having attempted to provide an introduction to the subject, researchers will be able to use this thesis as a starting point for more

detailed studies of specific regions or mining industries.

The most intriguing area of future research would be to gather the necessary data to apply to the equation, which was outlined in the introductory chapter, and thereby determine the actual proportion of gross domestic product which is generated by the mining sector in a specific region or country. This would require the quantification of the "mineral rent", government revenues, the value of domestic sales and the mining sector's overall multiplier effect. The last would be particularly complicated because it incorporates the multiplier effect of the mining sector's contribution to a country or region's industrial, transport, construction, utility and commercial sectors. Despite this, such a calculation would be possible if the necessary data can be obtained.

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