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Basic Definitions

Mine: an excavation made in the earth to extract minerals.

Mining: the activity, occupation, and industry concerned with the extraction of minerals.

Mining Engineering: the art and science applied to the process of mining and the operation of mines.

Mineral: a naturally occurring substance, usually inorganic, having a definite chemical composition and distinctive physical characteristics.

Rock: an assemblage of minerals

Ore: A natural aggregation of one or more solid minerals that can be mined, processed and sold at a profit.

Waste or gangue: mineral that lacks utility and value when mined (gangue is more intimately associated with ore than is waste)

Mineral deposit: geologic occurrence of minerals in relatively concentrated form.

Ore deposit: economic occurrence of minerals that can be extracted at a profit.

Metallic ores: include ores of the ferrous metals (iron, manganese, molybdenum, and tungsten); base metals (copper, lead, zinc, and tin); precious metals (gold, silver, and platinum); and radioactive metals (uranium, thorium, and radium).

Nonmetallic ores: consist of industrial minerals such as phosphate, potash, stone, sand, gravel, sulfur, salt, and industrial diamonds.

Mineral fuels: include coal, uranium, and several less common, marginal sources (lignite, oil shale, tar sand, and coal bed methane).

Surface Mine: An excavation that is entirely open or operated from the surface.

Underground Mine: An excavation that consists of openings for human and machine entry driven below the surface.

Mining History

- First miners: Paleolithic man – 450,000 B.C.
- Oldest known underground mines: Hematite at Swaziland, Africa - 40,000 B.C.
- Clay smelting pots: Czechoslovakia – 30,000 B.C.
- Egyptian mines attained depths as deep as 800 feet.
- Fire setting was used to break rock. Egypt – 5,000 B.C.
- Egypt starts using iron: Egypt – 3,000 B.C.
- First smelting of copper with coal: China – 3,000 B.C.
- Greeks start using steel: Greece – 1000 B.C.
- Romans bring organization to mining: Roman Empire – 100 A.D.
- First technical mining document and first engineering document: De Re Metallica– Germany –1556 A.D.
- First explosives used in European mines: Hungary – 1627 A.D.
- First School of Mines: Joachimstal, Czechoslovakia – 1716 A.D.
- Dynamite invented: Alfred Nobel – 1867 A.D.

Mining's Contribution to Civilization

Everything We Have and Everything We Use Comes From Our Natural Resources. If it can't be grown it must be mined.

Every year, 46,000 pounds of new minerals must be provided for every person[~] in the United States to maintain our standard of living



10,841 lbs.
Stone



8,220 lbs.
Sand & Gravel



742 lbs.
Cement



404 lbs.
Salt



350 lbs.
Phosphate



326 lbs.
Clays



853 lbs.
Other Nonmetals
(estimated)



603 lbs.
Iron Ore



93 lbs.
Aluminum



23 lbs.
Copper



13 lbs.
Lead



12 lbs.
Zinc



6 lbs.
Manganese

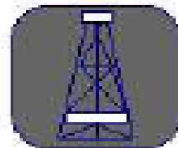


10 lbs.
Other Metals
(estimated)



.0264 T oz.
Gold

Plus



7,520 lbs.
Petroleum



7,751 lbs.
Coal



8,164 lbs.
Natural Gas



1/4 lb.
Uranium

Contribution to Economy

- The total value of domestically produced raw mineral materials in 2000 was about \$44 billion.
- Industries that consume processed mineral materials contributed \$4,790 billion in sales to the gross output of all industries.
- Total gross output (sales) of all industries in the United States in 2000 was about \$17,000 billion, and the gross domestic product was about \$9,980 billion

US Mining Employment, 2000

Coal	122,083
Metal	45,282
Nonmetal	27,641
Stone	79,577
Sand and Gravel	42,746
Contractors	39,986
Total	357,315

Number of Mining Operations

Coal	2,490
Metal	323
Nonmetal	801
Stone	3,820
Sand and Gravel	6,442
Total	13,876

Common Minerals and Their Uses

Aluminum

Most abundant metal element in Earth's crust. Bauxite ore is the main source of aluminum. Used in packaging, transportation and building.

Asbestos

Asbestos minerals are used in fireproof fabrics, cloth, paper, paint filler, gaskets, roofing composition, reinforcing agent in rubber and plastics, brake linings, tiles, electrical and heat insulation, cement and chemical filters.

Beryllium

Used in the nuclear industry and in light, very strong alloys used in the aircraft industry. Beryllium salts are used in fluorescent lamps, in X-ray tubes and as a deoxidizer in bronze metallurgy. Beryl is the gem stones.

Cobalt

Used in superalloys for jet engines, chemicals (paint dryers, catalysts, magnetic coatings),

Copper

Used in electric cables and wires, switches, plumbing, heating; roofing and building construction; chemical and pharmaceutical machinery; alloys. Leading producers are Chile, United States, CIS, Canada, Zambia and Zaire.

Feldspar

A rock-forming mineral; industrially important in glass and ceramic industries; soaps; bond for abrasive wheels; cements.

Fluorite (fluorspar)

Used in production of hydrofluoric acid, which is used in the pottery, ceramics, optical, electroplating and plastics industries; in the metallurgical treatment of bauxite; as a flux in open hearth steel furnaces and in metal smelting; in carbon electrodes; emery wheels; electric arc welders; toothpaste; and paint pigment.

Gold

Used in dentistry and medicine; in jewelry and arts; in medallions and coins; in ingots as a store of value; for scientific and electronic instruments; as an electrolyte in the electroplating industry. Leading producers are South Africa, United States, Australia, Brazil, Canada, China.

Gypsum

Processed and used as prefabricated wallboard or an industrial or building plaster; used in cement manufacture; agriculture and other uses.

Halite (sodium chloride--salt)

Used in human and animal diet, food seasoning and food preservations; used to prepare sodium hydroxide, soda ash, caustic soda, hydrochloric acid, chlorine, metallic sodium.

Iron Ore

Used to manufacture steels of various types.

Lead

Used in lead batteries, used in electrical and electronic applications; TV tubes and glass, X-ray and gamma radiation shielding; soundproofing material in construction industry; United States is largest producer (mainly from Missouri).

Manganese

Essential to iron and steel production. Major producers: South Africa.

Mica

Micas commonly occur as flakes, Sheet muscovite (white) mica is used in electronic insulators; ground mica in paints, as joint cement, as a dusting agent, in well-drilling muds; and in plastics, roofing.

Phosphate rock

Used to produce phosphoric acid for ammoniated phosphate fertilizers, feed additives for livestock, elemental phosphorus, and a variety of phosphate chemicals for industrial and home consumers.

Potash

A carbonate of potassium; used as a fertilizer, in medicine, in the chemical industry and to produce decorative color effects on brass, bronze and nickel.

Pyrite

Used in the manufacture of sulfur, sulfuric acid and sulfur dioxide; pellets of pressed pyrite dust are used to recover iron, gold, copper, cobalt, nickel; used to make inexpensive jewelry.

Quartz (silica)

As a crystal, quartz is used as a semiprecious gem stone. used in manufacturing glass, paints, abrasives, and precision instruments.

Silica

Used in manufacture of computer chips, glass and refractory materials; ceramics; abrasives; water filtration.

Silver

Used in photography, chemistry, jewelry; in electronics because of its very high conductivity; as currency, usually as an alloy; in lining vats and other equipment for chemical reaction vessels, water distillation, etc.; Mined in 56 countries, silver's largest reserves are in the United States Canada, Mexico, Peru.

Sodium Carbonate (soda ash or trona)

Used in glass container manufacture; in fiberglass and specialty glass; also used in production of flat glass; in liquid detergents; in medicine; as a food additive; photography; cleaning and boiler compounds; pH control of water. Most U.S. production from Wyoming.

Sulfur

Used in the manufacture of sulfuric acid, fertilizers, chemicals, explosives, petroleum refining.

Titanium

A metal used mostly in jet engines, airframes and space and missile applications. Produced in western and central U.S., the UK, China, Japan.

Tungsten

Used in metalworking; construction and electrical machinery and equipment; in transportation equipment; as filament in light bulbs; as a carbide in drilling equipment; in heat and radiation shielding; textile dyes, paints and for coloring glass.

Uranium

using uranium in nuclear generation. It is also used for nuclear medicine, atomic dating, powering nuclear submarines.

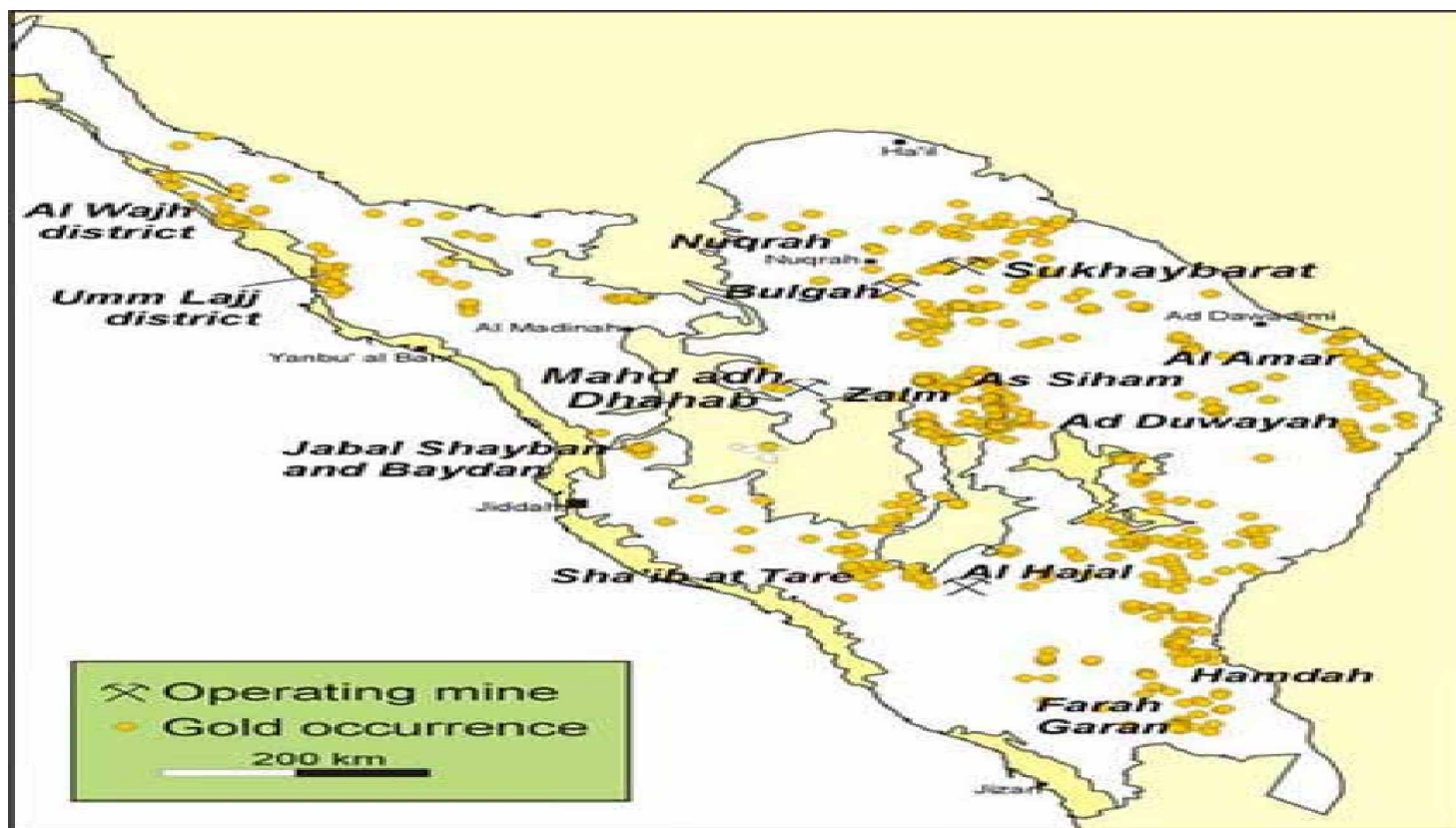
Zinc

Used as protective coating on steel, as die casting, as chemical compounds in rubber and paints; used as sheet zinc and for galvanizing iron; electroplating; metal spraying; automotive parts; electrical fuses; anodes; dry cell batteries.

Mineral Resources in Saudi Arabia

Gold

Gold mining in Saudi Arabia dates back 5,000 years and search for the metal, throughout history, resulted in the discovery of hundreds of occurrences. At the present time, most occurrences are represented by sites of ancient mining. The advance of cyanide heap leaching techniques in the 1980s to the stage of profitable extraction of gold from rocks containing as little as 0.75 g/t Au opened up new prospective areas in Saudi Arabia and spurred a strong phase of exploration that continues to the present. Many occurrences have been sampled and a significant number drilled, and 4 locations at the present time are operating mines.



Gold occurrences in the Arabian Shield

Gold deposit types: size and grades

VMS-stratiform in volcanosedimentary rocks

Jabal Sayid — 23.6 Mt @ 1.5 g/t Au + Cu
Al Masane — 7.03 Mt @ 1.25 g/t Au + Cu, Zn, Ag
Kutam — 3.8 Mt @ 0.2 g/t Au + Cu, Zn, Ag
Nuqrah N and S — 0.466 Mt @ 8.6 g/t Au + Zn, Ag
Farah Garan — 0.225 Mt @ 2.8 g/t Au + Zn, Cu, Ag
Al Hajar - 3.5 Mt @ 3.28 g/t Au + 38 g/t Ag
Sha'ib at Tare — 0.3 Mt @ 6.3 g/t Au
Baydan — 0.5 Mt @ 1-5 g/t Au

Hydrothermal alteration zone

Hamdah — 0.06 Mt @ 18.8 g/t Au

Epithermal veins

Al Amar — 1.55 Mt @ 12.31 g/t Au + Zn, Cu, Ag and 3.0 Mt @ 5.1 g/t Au
Umm ash Shalahib — 0.9 Mt @ 3 g/t Au
Mahd adh Dhahab — 1.142 Mt @ 31.8 g/t Au + Zn, Cu, Ag

Mesothermal veins — Veins in plutons and country rock

Jabal Shayban — e.g., 2-9 g/t over 6 m.
Lugatah — >1 g/t Au in veins 1-5 cm thick
Ash Shakhtaliyah — 0.74 Mt @ 5.2 g/t Au
Jabal Guyan — Average grade of sampling 6.19 g/t

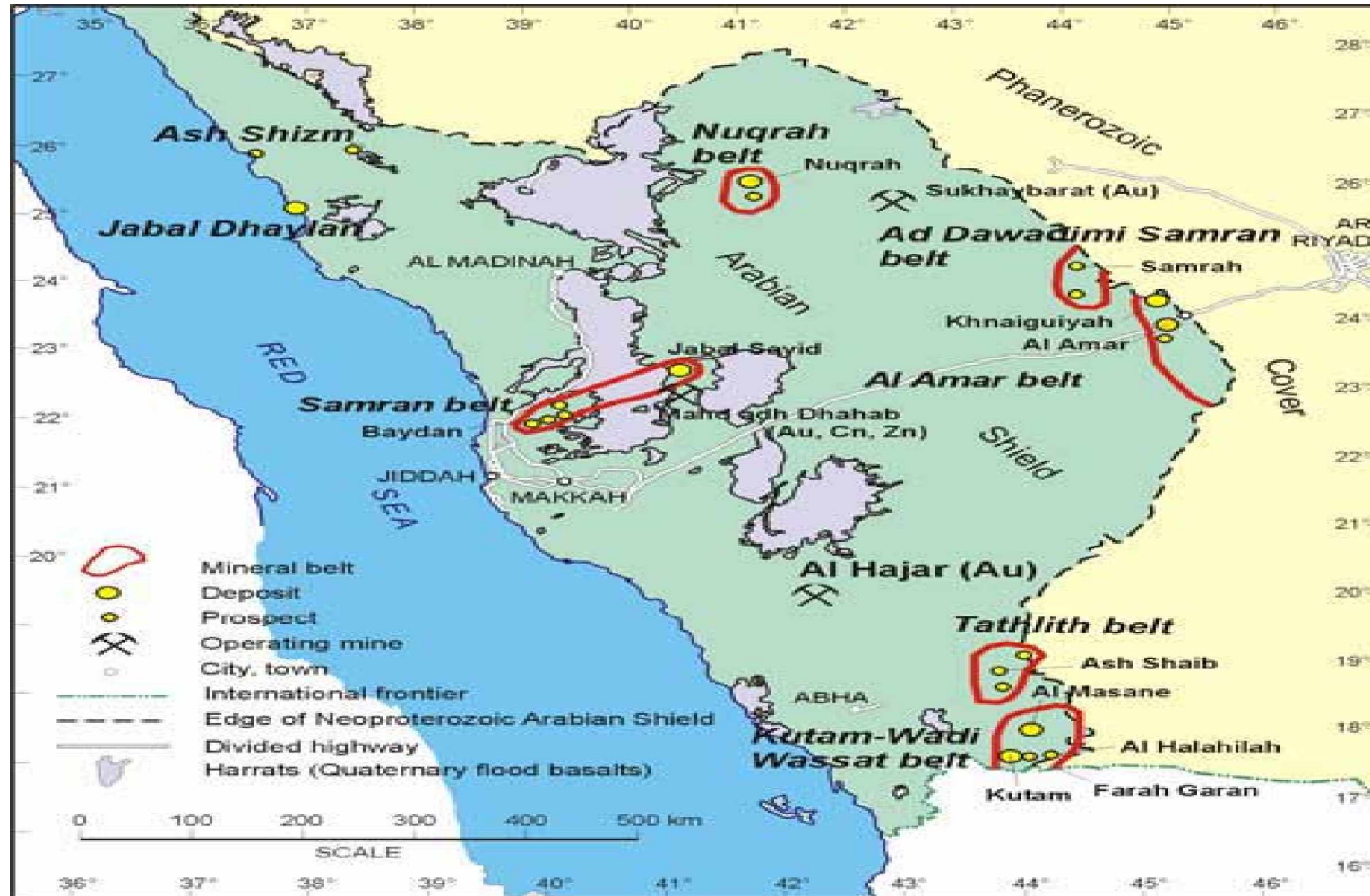
Mesothermal veins — Veins in plutons and country rock

Sukhaybarat — Production reserve 8.4 Mt @ 2.5 g/t Au
Ad Duwayah — 14 Mt @ 0.5 g/t Au
An Najadi — 0.25 MT @ 1.8 g/t Au
Ashumta — 0.23 Mt @ 1.6 g/t Au
Umm Matirah — 0.3 Mt @ 7.3 g/t Au
Zalm — 6 Mt @ 2 g/t Au
Umm al Qurayyat — 0.155 Mt @ 3.8 g/t Au
Bulghah — 36.4 Mt @ 1.05 g/t Au

Producing mines in red

Zinc

Zinc occurrences in Saudi Arabia are widespread, although none are large and zinc is only produced from one deposit as a byproduct of gold mining. However, the local market has significant demand for zinc metal (estimated to be 27,706 tonnes in 2003) and zinc exploration is one of the priorities of the SGS.



Map of selected zinc occurrences and mineral belts
Copper

Copper is an important major metal that has been worked in the Middle East for the past 6,000 years, and the mine at Timna, between Aqaba and the Dead Sea, is one of the oldest sites of metal smelting in the world.



Malachite, Wadi Yiba: the type of conspicuous coatings of secondary copper minerals that would have attracted ancient miners to promising sites for prospecting

Phosphate

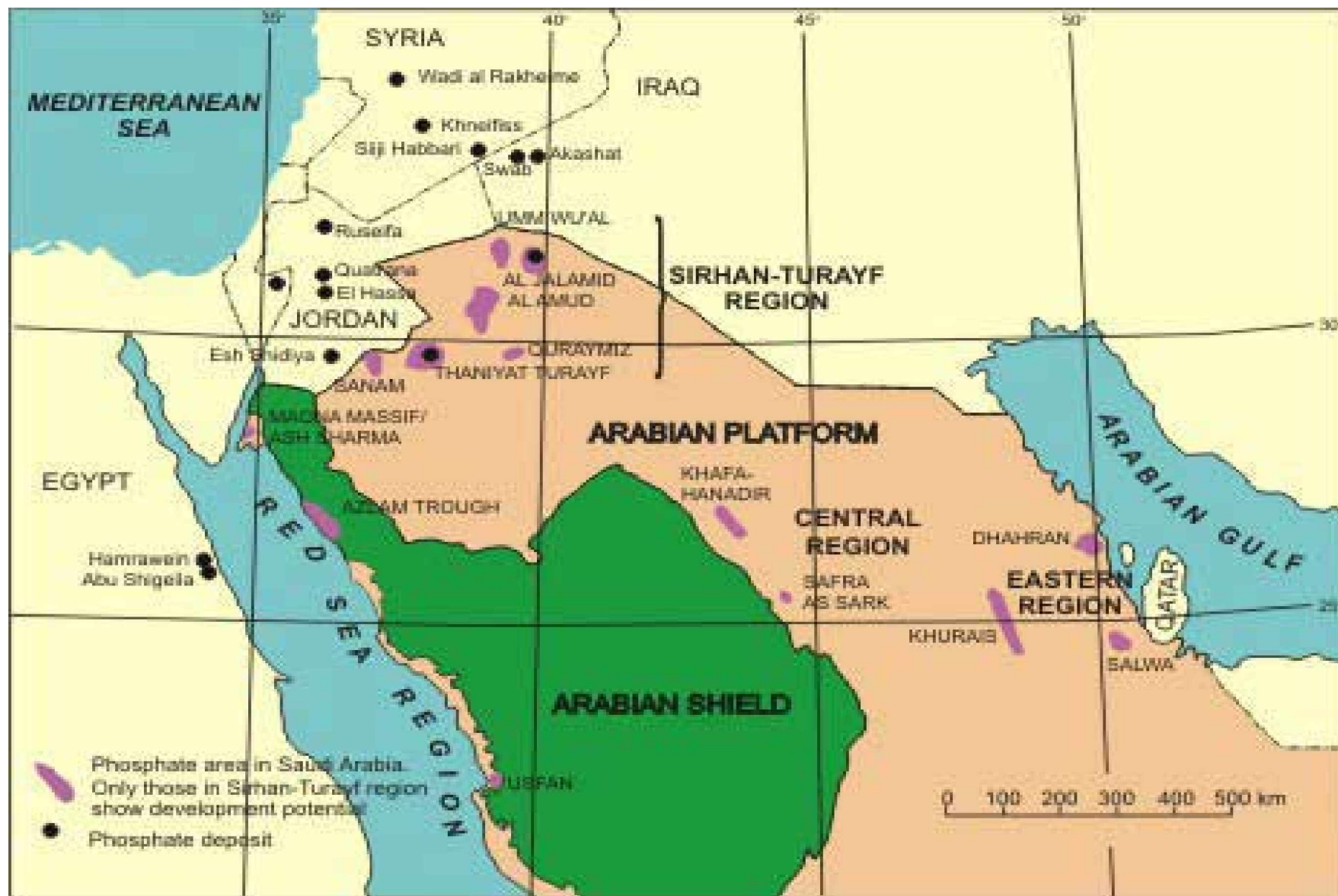
Phosphate is the main ingredient in fertilizers and as such is an essential material for the economy and health of the world. Although Saudi Arabia has no production at the present, it has a vast phosphate resource in the Sirhan-Turayf region in the northern part of the Kingdom and is potentially a major supplier to the world market.

- The best explored and largest deposit is at Al Jalamid, which has measured reserves of 213 Mt averaging 21% P_2O_5 and a stripping ratio of 2.3:1. Indicated resources amount to a further 187 Mt, 19.7% P_2O_5 , stripping ratios 5:1 or less
- The Umm Wu'al North area has a demonstrated and inferred total resource of 537 Mt averaging 19.35% P_2O_5 with a stripping ratio less than 5:1
- The Al Amud area has a demonstrated resource of 24 Mt averaging 21.03% P_2O_5
- The Sanam prospect has a calculated resource of 23 Mt averaging 16.91% P_2O_5 , both with stripping ratios of less than 5:1

PROPERTIES AND PRINCIPAL USES

Phosphorus is an element vital for plant growth but is commonly deficient in soils; hence good agricultural practice requires the addition of phosphorous, generally in the form of superphosphate or diammonium phosphate (DAP), and a large industry has grown up to manufacture these fertilizers. The raw material is phosphate rock, which contains an appreciable phosphorous content generally in minerals of the apatite (calcium fluorophosphate) group. Less commonly such phosphate rock, after grinding, may be used directly on acid soils.

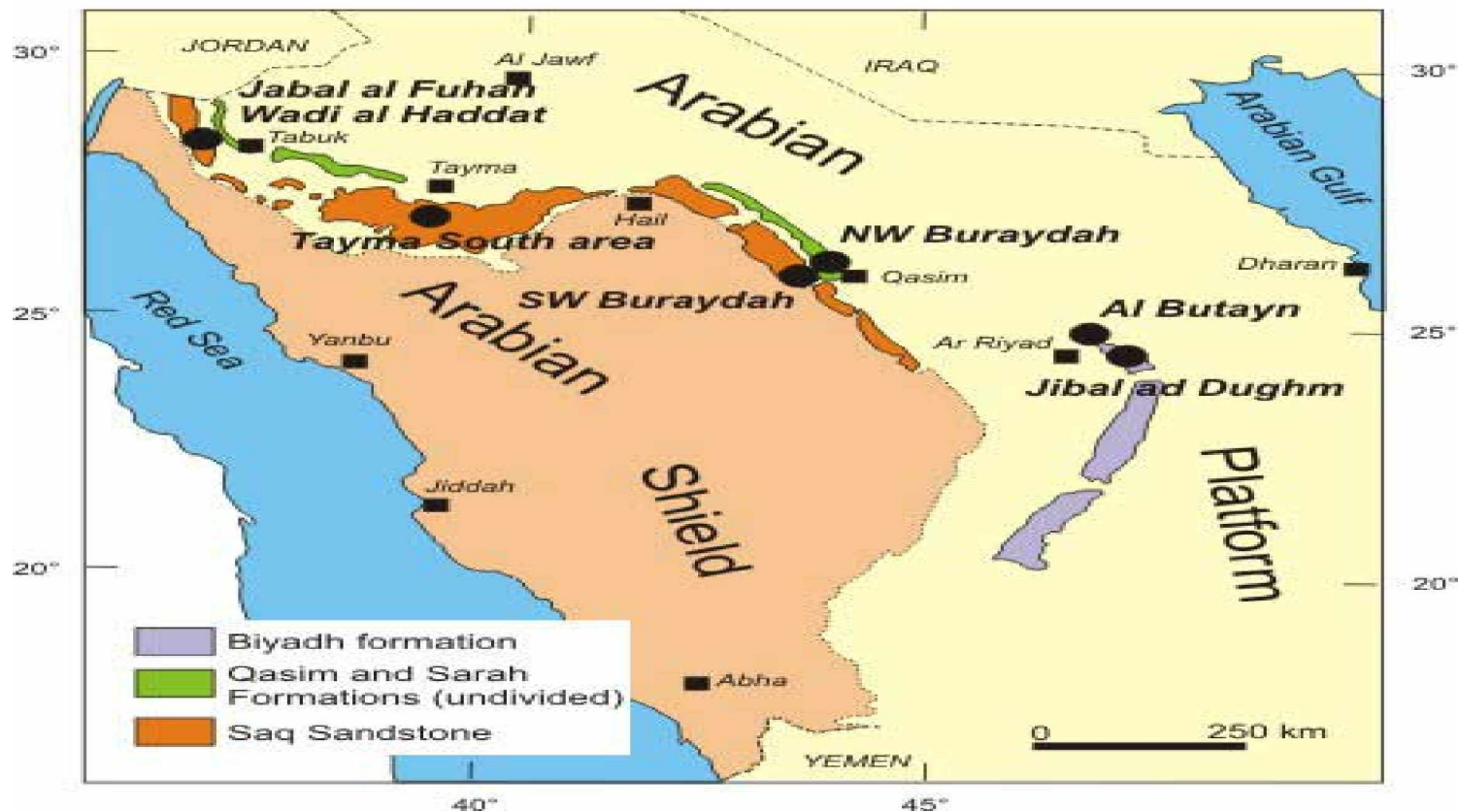
About three quarters of phosphate rock production is employed for the production of fertilizers, and the use of fertilizers is now so widespread that the presence of phosphorus compounds in the run-off from farmlands is causing environmental concern. Other uses of phosphorus compounds derived from phosphate rock include the manufacture of detergents, supplements to animal feedstuffs, pharmaceutical preparations, and insecticides. In its elemental form, phosphorus burns spontaneously on contact with air at 44°C; this unsocial property is utilized in incendiary bombs.



High-Grade Silica Sand and Sandstone

High-grade silica sand (>97.5% SiO₂) is an essential raw material in many industries and is used in Saudi Arabia in the manufacture of container glass, glass fiber, chemical products, and silicon metal; as filler for rubber, plastics, and ceramics; and in the construction business.

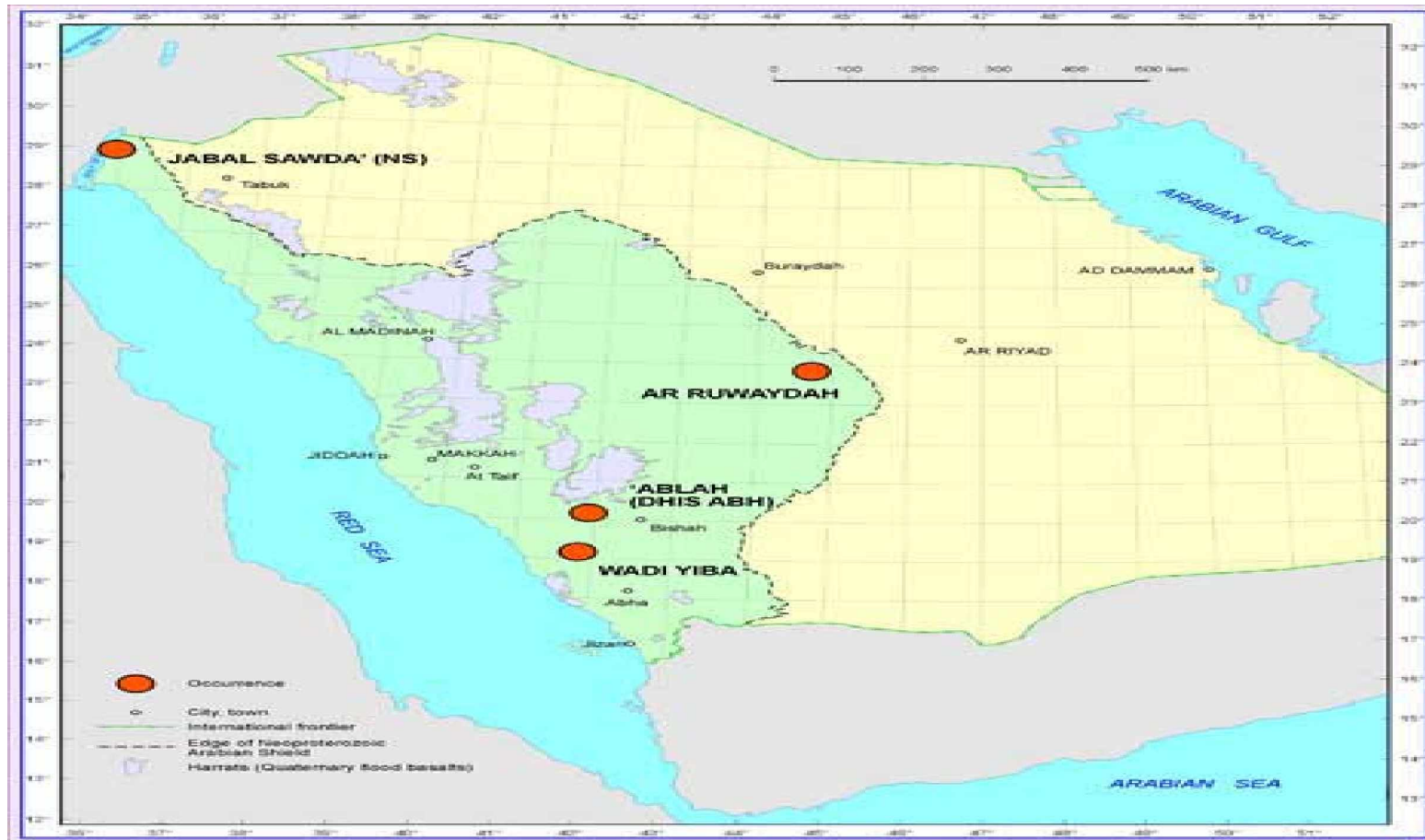
Worldwide, the commodity occurs both in rock and granular forms as sandstone and unconsolidated sand. Saudi Arabia has a surplus of eolian and alluvial sand, but silica in the form of sand is normally contaminated by iron oxide and other impurities and, in Saudi Arabia, does not meet the basic chemical specifications for industrial applications. Fortunately, however the country contains large volumes of quartz-rich sandstone, which after crushing and processing provide silica sand of high quality and great abundance.



Quartz-rich sandstone formations and high-grade silica deposits in central and northern Saudi Arabia

Feldspar and nepheline syenite in Saudi Arabia

The most suitable rocks in Saudi Arabia for feldspar/feldspathoid concentrations are feldspar-rich, nepheline-bearing plutons of the Arabian shield, and pegmatites, especially pegmatites associated with posttectonic granite that has an alkalic or aluminous trend and forms batholiths with rounded or lobate contours.



Feldspar and nepheline syenite occurrences in Saudi Arabia

Kaolin in Saudi Arabia

Kaolin is one of the most important of the industrial minerals and finds widespread applications as a filler and coater in the paper industry and, to a lesser extent, as a filler and extender in the production of rubber, plastic, and paint. It is of paramount importance as a raw material for ceramics of all kinds, and is also used in the manufacture of structural clay products. Various kaolinitic clays are highly refractory. Kaolinitic clays are widespread in the clastic Phanerozoic rocks of Saudi Arabia. Potential economic deposits of kaolin are located in the Ar Riyad-Al Kharj area, particularly at Khushaym Radi, and in the vicinity of Buraydah.

Kaolinitic clays are almost entirely restricted to areas of Ordovician to middle Cretaceous clastic formations north and east of the Arabian Shield. No kaolinitic deposits are known on the Shield with the exception of a few isolated examples of weathered granite. Tertiary clays of the Red Sea coastal plain are mainly smectitic.

Kaolinitic deposits in the vicinity of Ar Riyad are located at Khushaym Radi and Darb Sid. The deposits belong to the Lower Cretaceous Biyadh Sandstone and, particularly, the Upper Cretaceous Wasia Formation. Lenses of white kaolin occur in the middle part of the Biyadh Sandstone and layers and lenses of kaolinitic clay and pure kaolin interbedded with sandstone occur in the Wasia. The kaolinitic clay facies of the Wasia Formation are exposed intermittently for several hundred kilometers from the Al Jawf area in the north of the Kingdom to the Al Kharj area east of Ar Riyad.



Basalt and Scoria (Poozolan)

Industrial uses of basalt and scoria in Saudi Arabia

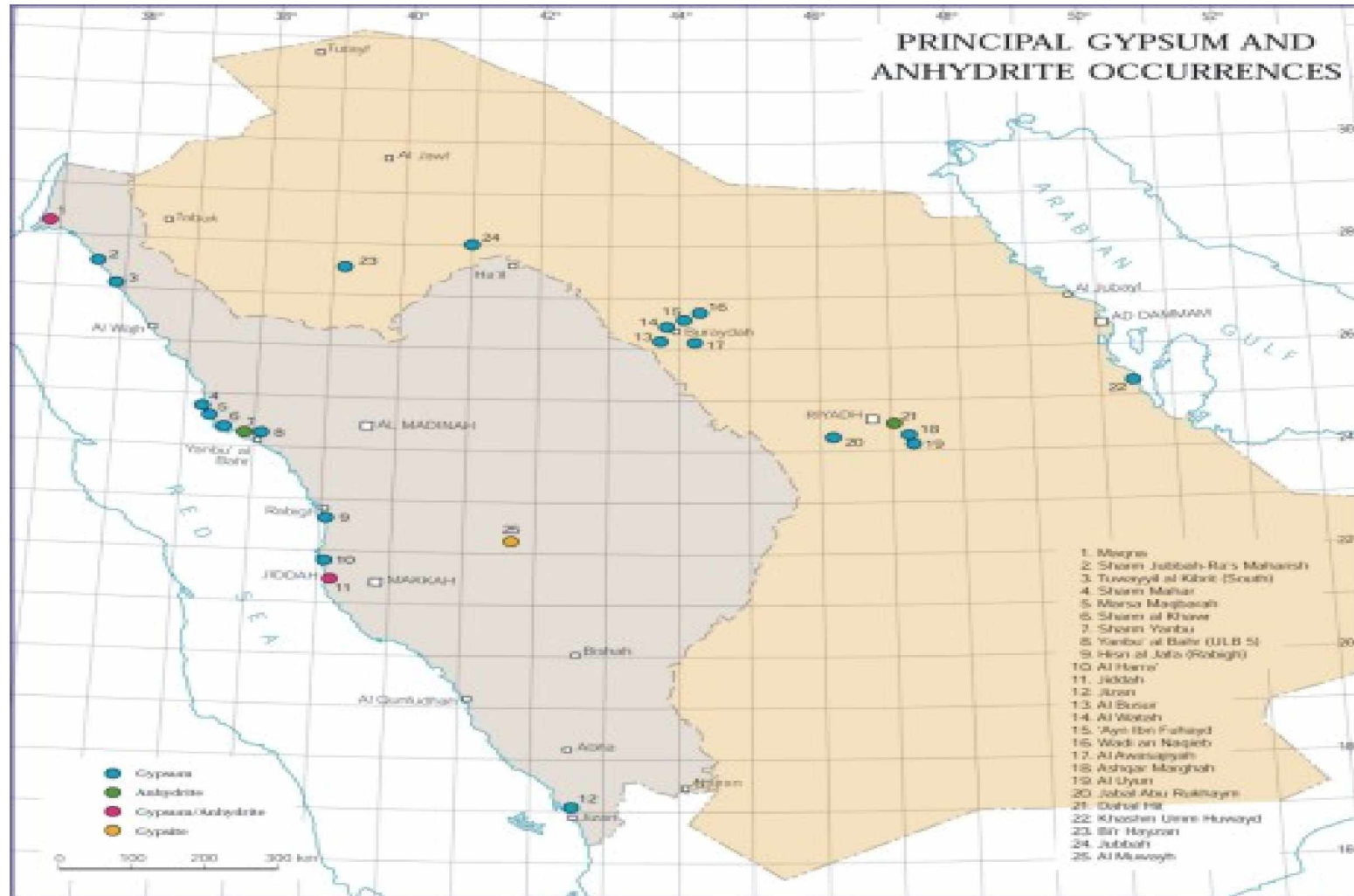
Volcanic activity that accompanied the opening of the Red Sea from the Miocene (25 Ma) to the present, resulted in the formation of vast fields of subaerial basaltic flows in the western part of Saudi Arabia, referred to by the Arabic term 'Harrat'. These harrats cover an area over about 90,000 km², and extending over parts of the Proterozoic Arabian shield and adjacent Phanerozoic rocks of the Arabian Platform and Red Sea basin. The principal harrats are Harrat Rahat, Harrat Uwayrid, Harrat al Hutaymah, Harrat Kishb, Harrat Khaybar, and Harrat al Birk. The lava flows are commonly composed of picritic to ankaramitic basalt and may contain peridotite nodules.

Several hundred eruptive centers are distributed on the basaltic fields, and are characterized by pyroclastic cones, shield volcanoes, and phreatomagmatic craters. The pyroclastic cones consist of black or red, lightweight, loose to agglomerated scoria, and minor amounts of olivine nodules.

Currently in Saudi Arabia, basalt is used in manufacturing rock wool and road aggregate. However, it has the potential for use in the manufacture of cast basalt tiles, pipes and other corrosion resistant ceramic applications. Scoria is also used for pozzolan cement production. Preliminary results on the horticultural applications of scoria are encouraging. Scoria is an excellent medium, which holds water in its pores and allows air circulation to the root zone of the plants.

Gypsum And Anhydrite In Saudi Arabia

Gypsum in Saudi Arabia occurs in Cenozoic rocks of the Red Sea Rift Basin, in Mesozoic strata of the Arabian Platform near Buraydah and the Ar Riyadh area, and in Cenozoic formations on the Arabian Gulf coast. Sandy and clayey gypsiferous deposits too impure for exploitation are present in sabkhahs throughout the Kingdom.

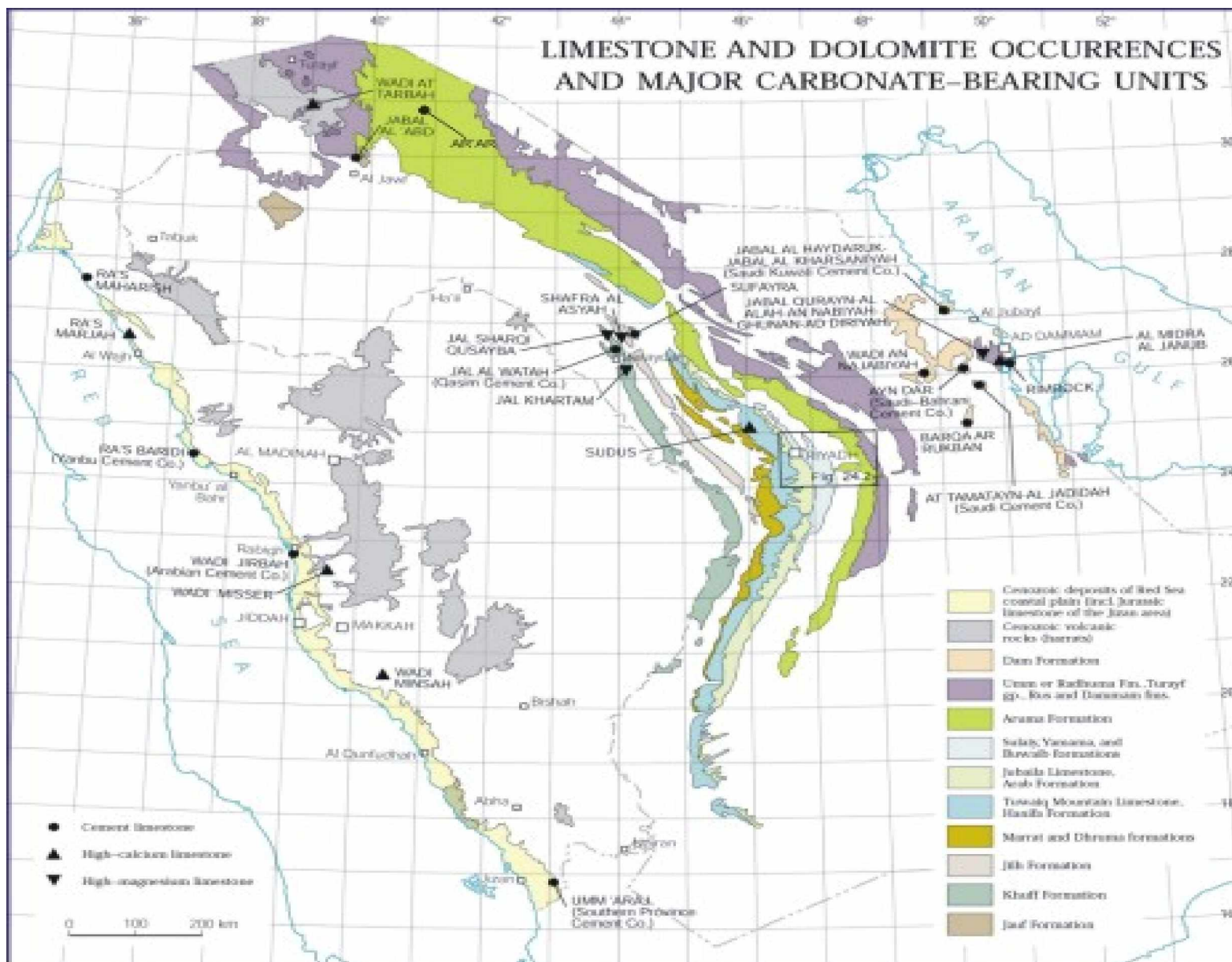


Limestone and Dolomite Rocks in Saudi Arabia

Saudi Arabia is richly endowed with limestone and dolomite. Deposits are currently worked for crushed stone and as raw material for cement. Limestone and dolomite resources are chiefly in Phanerozoic rocks that flank the northern and eastern sides of the Neoproterozoic Arabian Shield; they are particularly abundant in the central region of the Kingdom. Quaternary raised coral-reef limestone of the Red Sea coastal plain is the principal source of cement-grade limestone in the west of Saudi Arabia. Jurassic limestone is worked for cement in the Jizan area, in southwesternmost Saudi Arabia.

Carbonate rocks are abundant in Saudi Arabia, particularly in the curved belt of gently dipping Phanerozoic strata on the northern and eastern flanks of Arabian Shield. Limestone is present particularly in Upper Jurassic and Lower Cretaceous strata. Dolomite is well represented in Upper Cretaceous and Paleocene-Eocene formations and to a lesser extent in Upper Jurassic units.

Carbonate rocks, commonly dolomitic limestone, are also present in the narrow strip of Tertiary (and minor Jurassic) strata in the Red Sea basin that fringe the western edge of the Arabian Shield, and as Quaternary raised coral reefs. Within the Arabian Shield, variably metamorphosed limestones form relatively small beds of crystalline limestone and marble.



Cement-grade limestone

1.-Red Sea coastal area

The most favorable, and currently exploited, cement-grade carbonates are Quaternary coral limestone present as raised reefs discontinuously exposed from the Farasan Islands in the south to Haql in the north, and Jurassic limestone located in the Jizan Area. Known occurrences include:

- Ra's Baridi
- Wadi Jirbah
- Ra's Maharish
- Umm 'Araj

2.-Riyadh area

The Ar Riyadh area has enormous reserves of cement-grade limestone in the Lower Cretaceous Sulaiy Formation and the Permian Tuwaiq Mountain Limestone. The Sulaiy Formation is worked by the Yamama Cement Company SE of Riyadh where the formation has a maximum thickness of about 170 m and an outcrop width east of as much as 30 km. The Tuwaiq Mountain Limestone is not yet worked but contains massive, fine-grained, and generally soft cement-grade limestone in its upper two thirds.

3.-Qasim (Buraydah area)

Limestone for cement in the Buraydah area is contained in the Permian Khuff Formation and the Jurassic Marrat Formation. The Khuff Formation has low magnesia calcarenite 20-25 m thick and is used in the Qasim Cement Company's plant at Jal al Watah, 18 km north of Buraydah. Fine-grained limestone of the Marrat Formation is also low in magnesia and is a potential raw-material source for the manufacture of high sulfate-resistant cement.

4.-Eastern Province

Carbonate rocks in the Eastern Province are commonly magnesia rich or excessively siliceous, but favorable areas for cement manufacture are known in at least four areas:

- Al Hufuf area
- Wadi an Najabiyah
- Ad Dammam
- Jabal al Haydaruk

5.-Northern Region

Cement-grade limestone is not common in the northern part of the Kingdom but deposits are known at:

- Jabal al 'Abd, near Al Jawf
- Wadi at Tarbah, an inlier of limestone in the Al Harrah lava field

Ornamental stone in Saudi Arabia

Ornamental stone is used widely within the Kingdom of Saudi Arabia and several varieties of granite are exported.

Commercially exploitable deposits of plutonic igneous rocks, mostly granite but also quartz monzonite, anorthosite, and gabbro, occur in the Arabian Shield, mainly in the southern, western and eastern parts.

Deposits of marble also occur in the Shield, notably in the western and east-central areas. Jurassic oolitic limestone (“Riyadh stone”) is worked extensively to the west of Riyadh. Deposits of Cenozoic coral-reef limestone are present along the Red Sea coast; they were exploited in the past for building stone but have a more restricted use today.

Evidence of an early use of natural stone for masonry can be seen in the defensive structures and ancient dams of the western and southern parts of the country. Notable examples are the watchtowers and fortified grain stores of the Asir mountains where roughly dressed dark-gray and greenish schists have been used with white quartz to create a distinctive local architecture. Near Khaybar, about 130 km north of Al Madinah, a large ancient dam (now breached) was constructed from blocks of columnar basalt. Coral-reef limestone, an excellent natural insulating material, was used extensively to build the large old houses of Jiddah, Yanbu‘ al Bahr, Umm Lajj, and Al Wajh.

Types of Ornamental stone

Almost any kind of rock can be used as ornamental stone provided it possesses aesthetic and decorative appeal, can be polished, and is sufficiently resistant to weathering. In practice, the main Saudi Arabian rocks used as ornamental stone are igneous rocks, marble, and limestone.

Igneous rock

In commercial terms, the name “granite” is applied to a wide range of igneous rocks extending from true granites (in a petrologic sense), through diorite, monzonite, and syenite, to gabbro and anorthosite. The granites have a visible crystalline texture but, whereas the true granites are composed essentially of feldspar and quartz plus mica or hornblende, the gabbro end of the range is darker in color and contains little or no quartz. Granites have properties that make them suitable for such applications as:

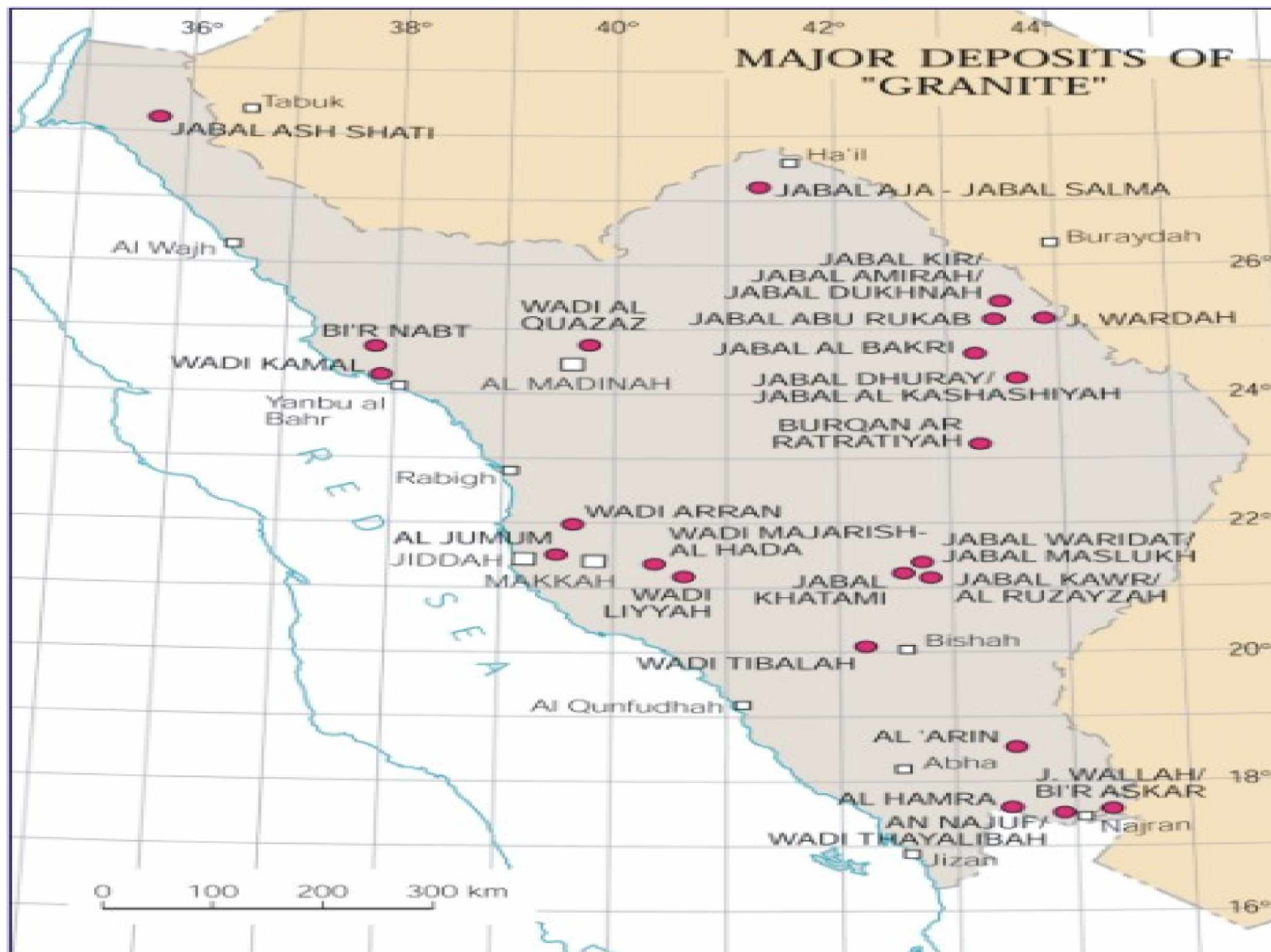
- Curtain wall or facing stone for exteriors and interiors, floors and stairs.
- Monument construction
- The manufacture of curbstones and paving stones

The quality of granites are best shown by polishing, but all finishes, such as honed or flame-cut finishes, (which give a paler color) are suitable. Split surfaces can be given to steps, curbstones, and paving slabs. The finished products have a high resistance to weathering, particularly in the dry, hot, or humid climate of the Kingdom, and also resistance to acid pollution and frost action.

Saudi Arabia has abundant resources of igneous rock suitable for the production of high-quality ornamental stone. About 40 occurrences have been identified (all commercially called “granite”) that are suitable for exploitation by the ornamental stone industry. The most favorable areas are the Najran, Ranyah, southern Ar Rass, Ad Dawadimi, Jiddah-At Ta’if, and Yanbu‘ al Bahr-Al Madinah districts. Many sites have been investigated and some are being quarried commercially or on a pilot scale.

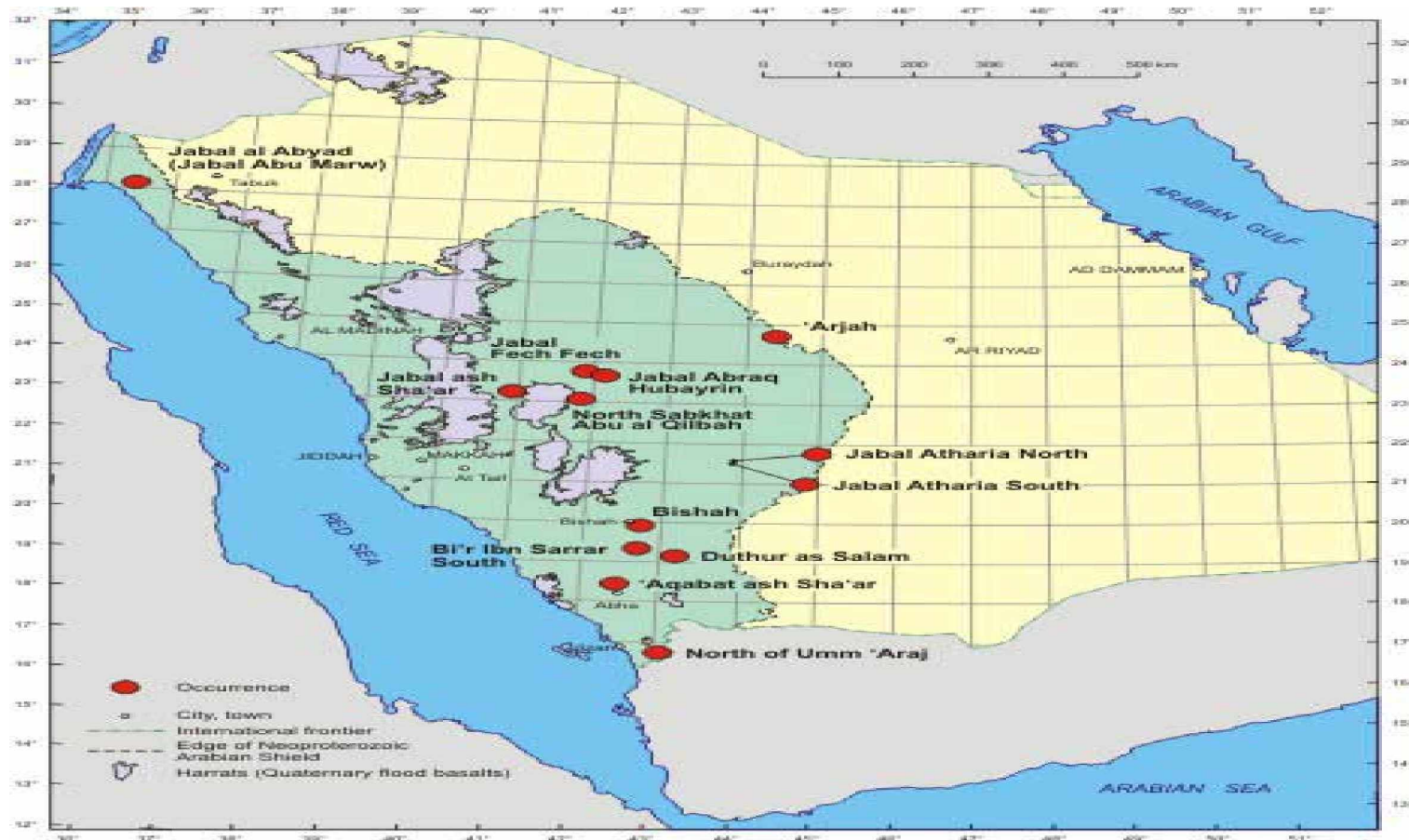
All the igneous rocks used as ornamental stone in the Kingdom are from the Proterozoic Arabian Shield. The true granites are commonly gray or pink, but range from red, through red-brown and brown, to black. In addition, red and brown quartz monzonites, black and blackish-brown anorthosites, and black gabbros occur. In general, the exploited igneous rocks are holocrystalline and medium to coarse grained but some, used for special effect, are fine grained.

Domestic use of ornamental stone is growing in Saudi Arabia and there is an international demand for certain types of Saudi granite. In an attempt to search for new areas and possibly new types of rocks for quarrying, a general reconnaissance was carried out in the northwestern part of the Arabian Shield, roughly from Duba in the north, to Umm Lajj in the south. The zone under investigation (about 85,000 km²) covers seven quadrangles (Umm Lajj, Wadi Al ‘Ays, Al Wajh, Sahl al Matran, Al Muwaylih, Shaghab, southern part of Al Bad) at 1:250,000 scale. The presence of port facilities in both Duba and Yanbu is a favorable factor for possible exports of commercial blocks or manufactured products.



Quartz In Saudi Arabia

Quartz veins and pegmatite occur through out the Arabian shield where they are related in part to granitic intrusive. Most of the quartz veins are mineralized but some occurrences are barren. These veins are suitable for industrial applications especially in the for the production of silicon, ferrosilicon, piezo- electric quartz, and electronics. For these application the quartz raw material must contain ($> 99\%$ SiO_2 , $< 0.1\%$ Al_2O_3 , $< 0.1\%$ Fe_2O_3).



Stages of Mine Cycle

- Prospecting
Looking for mineral deposits
- Exploration
Defining a mineral deposit
Detailed Sampling & Assaying
Establishing a mineral inventory
Ore Reserve Evaluation
- Development
All work performed to prepare a mineral deposit to be a producing mine.
- Production:
The actual mining process.
- Reclamation
Performance of all environmental restoration at a mine after completion of mining activities.

The various stages in the life cycle of a mine often overlap.

