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Geology and Nonfuel Mineral Deposits of Africa and the Middle East

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Abstract

A nation's endowment of nonfuel mineral resources, relative to the world's endowment, is a fundamental consideration in decisions related to a nation's economic and environmental well being and security. Knowledge of the worldwide abundance, distribution, and general geologic setting of mineral commodities provides a framework within which a nation can make decisions about economic development of its own resources, and the economic and environmental consequences of those decisions, in a global perspective. The information in this report is part of a U.S. Geological Survey (USGS) endeavor to evaluate the global endowment of both identified and undiscovered nonfuel mineral resources. The results will delineate areas of the world that are geologically permissive for the occurrence of undiscovered selected nonfuel mineral resources together with estimates of the quantity and quality of the resources. The results will be published as a series of regional reports; this one provides basic data on the identified resources and geologic setting, together with a brief appraisal of the potential for undiscovered mineral resources in Africa and the Middle East. Additional information, such as production statistics, economic factors that affect the mineral industries of the region, and historical information, is available in U. S. Geological Survey publications such as the Minerals Yearbook and the annual Mineral Commodity Summaries (available at http://minerals.usgs.gov/minerals).

The region covered in this report is a major producer of mineral commodities such as antimony (4.0 percent of world production in 2003), asbestos (5.8 percent), barite (12.9 percent), bauxite (11.1 percent), bentonite (5.9 percent), boron (34.5 percent), bromine (39.6 percent), cobalt (49.7 percent), copper (2.4 percent), chromium (46.4 percent), diamond (industrial 46.8 percent and gem 50 percent), fluorite (11.5 percent), gold (17.3 percent), gypsum (13.3 percent),

helium (15.6 percent), iron ore (5.3 percent), kyanite (53.7 percent), magnesite (17.3 percent), manganese (32.9 percent), mercury (25 percent), nickel (4.8 percent), perlite (9.4 percent), phosphate (38.3 percent), platinum-group metals (platinum, 72.2 percent; palladium, 37.9 percent), potash (11.9 percent), pumice (15.0 percent), strontium (20.5 percent), sulfur (10.2 percent), tantalum (12 percent), titanium (22.1 percent), vanadium (25.0 percent), vermiculite (50.0 percent), and zirconium (31.5 percent). In addition, the countries in the region are among the world's major producers, or have significant known reserves of beryllium, cesium, feldspar, graphite, hafnium, lead, lithium, molybdenum, niobium (columbium), nitrate, industrial quartz crystal, scandium, silicon, soda ash, sodium sulfate, thorium, tin, and yttrium. The United States does not produce enough of some mineral commodities to supply all of its current domestic demand, and it relies on imports to satisfy these needs. In 2003, the United States imported 100 percent of its arsenic, asbestos, bauxite and alumina, fluorspar, graphite, indium, manganese, niobium (columbium), industrial quartz crystal, rubidium, strontium, and vanadium from sources that include countries in this region. Although Africa and the Middle East are rich in mineral resources (both identified and undiscovered), continuing civil and international warfare, human rights abuses, the spread of terrorism, the AIDS epidemic, and the instability of the political and business sectors in many nations of the region are increasingly affecting the progress of new exploration and development activities.

Africa is endowed with a number of the world's giant ore deposits or districts including gold (and uranium) resources in the Witwatersrand Basin, South Africa; Kalahari manganese fields, South Africa; chromium, platinum, and vanadium resources of the Bushveld Igneous Complex, South Africa, and chromium and platinum resources of the Great Dyke, Zimbabwe; ilmenite, rutile, zircon-bearing heavy mineral sands of South Africa (Namaqualand, Natal-Zululand), Mozambique, Sierra Leone and Cameroon; copper and cobalt resources of the Central

African Copperbelt (Zambia and Democratic Republic of the Congo (Congo-(Kinshasa) [formerly Zaire]); diamond deposits of Kimberly, South Africa, and west Namaqualand area of South Africa, Namibia, Botswana, Angola, Congo-(Kinshasa), Sierra Leone, and Tanzania; Ashanti gold fields of Ghana; Mount Nimba iron ore deposits of Guinea-Liberia as well as those of South Africa; bauxite deposits of Cameroon, Guinea, and Guinea-Bissau; and uranium resources of Niger. Of these major deposits, gold deposits of the Witwatersrand Basin; manganese resources of the Kalahari; chromium, platinum and vanadium resources of the Bushveld Igneous Complex; copper and cobalt deposits of the Central African Copperbelt; and diamond deposits of Africa are of particular importance because of their size, grade, and production.

Similarly, the Middle East has a wide variety of productive metallogenic settings and hosts a number of the world's great mineral districts. The amalgamated terranes of the Arabian shield contain deposits of copper, zinc (some with significant gold) and iron related to volcanic rocks. These deposits are found primarily within the western block of the Arabian shield and include the Jabal Sayid (copper), Al Masane (zinc, copper, gold), Al Hajar (gold, copper) and Wadi Sawawin (iron) deposits in Saudi Arabia. Gold deposits related to volcanic rocks are also present and include the world-class Mahd adh Dhahab and Al Amar deposits of Saudi Arabia. The process of craton formation during the collision of the western and eastern blocks of the Arabian shield produced gold deposits related to granitic intrusions and gold deposits related to ultramafic rocks/major shear zones (orogenic Au in suture zones). Gold deposits related to ultramafic rocks/major shear zones are concentrated along the north–northwest-trending collisional suture zone separating the west and east blocks of the Arabian shield. Examples of significant gold deposits related to granitic rocks include the Sukhaybarat and Ad Duwayhi deposits in Saudi Arabia. A period of magmatic activity followed the craton formation process

and generated numerous granitic intrusions throughout the Arabian shield. During this time many deposits of molybdenum, tin, tungsten, niobium, tantalum, yttrium, and rare earth elements (REE) related to granitic intrusions were formed. The most significant of these is the world-class Ghurayyah deposit (niobium, tantalum) in northwest Saudi Arabia.

Rocks of the Arabian platform host the vast petroleum and natural gas resources of the Middle East. Phosphate is the most economically important nonfuel mineral resource in Arabian platform rocks. Phosphate-bearing sedimentary rock sequences are present in Mesozoic-Cenozoic basins of the northern part of the Arabian peninsula and extend from Saudi Arabia into Jordan, Israel, Syria, and Iraq. This region represents the eastern end of the Tethyan phosphate province that extends across North Africa and into the Middle East. Important phosphate deposits related to sedimentary rocks include the Esh Shidiya deposit in Jordan, the Sawab and Akashat deposits in western Iraq, and the Al Jalamid, Al Amud, and Umm Wu'al deposits in northern Saudi Arabia. Rocks of the Arabian platform also host deposits of copper, lead, zinc, silver, and aluminum. Copper deposits related to sedimentary rocks are found at Timna, Israel and in Paleozoic sedimentary rocks of southwest Jordan and northwest Saudi Arabia. Accumulations of lead and zinc minerals have been observed in Mesozoic sedimentary rocks within a deep petroleum well in northeast Saudi Arabia and a lead-zinc-silver deposit related to sedimentary rocks is hosted in Mesozoic rocks at Jabali, Yemen. The Az Zabirah deposit in northeast Saudi Arabia is a significant aluminum deposit related to sedimentary rocks. The Arabian platform also contains significant industrial mineral resources, in addition to phosphate. These include silica sandstone, limestone, and bedded salt deposits in northern and eastern Saudi Arabia, and salt dome deposits in the southern Persian Gulf and southern Iran.

The Tethysides geologic province is also well endowed in a variety of nonfuel mineral resources. Particularly the Pontide magmatic arc along the Black Sea coast of Turkey and the

central magmatic arc of Iran contain numerous copper-gold deposits related to granitic intrusions, zinc-copper deposits related to volcanic rocks, gold deposits related to volcanic and sedimentary rocks, and iron deposits related to granitic intrusions. Significant examples include the Sar Cheshmeh deposit in Iran (copper-gold), the Cayelli deposit in Turkey (zinc-copper), and the Bafq district (iron) in Iran. Significant lead-zinc deposits related to sedimentary rocks also occur in the Tethysides and include the Mehdiabad and Angouran deposits in Iran. Deposits of chromium related to ultramafic rocks and copper related to (mafic) volcanic rocks are present in suture zones of the Tethysides. The most significant deposits of this type are found in Cyprus, Turkey, and Oman, and include the Skouriotissa and Mathiati deposits of Cyprus (copper, sulfur), the Guleman, Kopdag and Koycediz districts of Turkey (chromium), and the Aarja deposit in Oman (copper). Extensional basins in western Turkey host significant gold deposits related to volcanic rocks and borate deposits (source of boron) related to sedimentary rocks. Gold deposits, yet to be developed, include the Ovacik, Kisladag, Efemcukuru, and Cukurdere deposits. The borate deposits of western Turkey represent 60 percent of the world's reserves of borate. Significant deposits are concentrated in the Kirka, Emet, Bigadic, and Kestelek districts of northwest Turkey.

The Red Sea Basin hosts a variety of nonmetallic and metallic mineral resources. These include salt, potash (a source of potassium), zinc, lead, and the potential for gold. Salt and potash deposits are found throughout the length of the Red Sea coastal regions. The most significant deposit is found at the Farasan Islands off the southwest coast of Saudi Arabia. Deposits of lead and zinc related to sedimentary rocks are found within the northern Red Sea coastal plain regions of Saudi Arabia and Egypt. The most significant deposits are the Jabal Dhaylan, in Saudi Arabia, and the Umm Gheig, in Egypt. Deposits of zinc, lead, gold and silver are currently being deposited locally from hot metal-rich brines in "deeps" in the axial trough of

the Red Sea. Gold prospects related to volcanic rocks are present in western Yemen. This, in conjunction with the presence of active hot springs along the southern Red Sea margin, make the region prospective for undiscovered gold deposits related to volcanic rocks.

A recurrent theme of this report is that mineral deposits are associated with large-scale geologic processes that reoccur in time and place. Mineral deposits do not occur randomly; their distribution is intimately related to the geologic history of each continent. The more we know about the geologic fabric of each continent and the processes that control the regional and local distribution of mineral deposits, the better we can answer where new deposits will be found and what they will contain.

Introduction

This report is part of a series of regional reports that present summary information about the world's endowment of nonfuel mineral resources. These reports are designed to inform the nonearth scientist about the major mineral commodities present, their locations, and their general geologic setting. The reports are organized by the five regions shown in figure 1. Additional information, such as production statistics, economic factors that affect the mineral industries of the region, and historical information, is available in U. S. Geological Survey (USGS) publications such as the annual Minerals Yearbook and the Mineral Commodity Summaries (available at http://minerals.usgs.gov/minerals) and through the detailed references provided at the end of this report. A brief overview of the potential for undiscovered mineral resources is included in this report.

The data in this report will be incorporated into the ongoing USGS international quantitative mineral resource assessment of the nonfuel mineral resources of the world. This project is designed to assess the global endowment of both identified and undiscovered nonfuel mineral resources at a scale of 1:1,000,000 (Briskey and others, 2001, 2002). The results will delineate areas of the world that are geologically permissive for the occurrence of undiscovered selected nonfuel mineral resources, together with estimates of the quantity and quality of those resources. The global assessment will provide information that will assist in efforts to maintain a sustainable world supply of essential mineral resources while minimizing the global environmental and other societal impacts of mining.

The region covered by this report ranges in latitude from the equator to 42º north and to 38º south, and in longitude from 18º west to 63º east. It varies in elevation from the lowest point

in the world, the Dead Sea at –411 m below sea level, to 5,895 m at Mount Kilimanjaro in northern Tanzania, the highest peak in Africa (fig. 2).

Information in this report covers the 70 countries of Africa and the Middle East (fig. 3; table 1). The region covered in this report is a major producer of mineral commodities including antimony (4.0 percent of world production in 2003), asbestos (5.8 percent), barite (12.9 percent), bauxite (11.1 percent), bentonite (5.9 percent), boron (34.5 percent), bromine (39.6 percent), cobalt (49.7 percent), copper (2.4 percent), chromium (46.4 percent), diamond (industrial 46.8 percent and gem 50.0 percent), fluorite (11.5 percent), gold (17.3 percent), gypsum (13.3 percent), helium (15.6 percent), iron ore (5.3 percent), kyanite (54.9 percent), magnesite (17.3 percent), manganese (32.9 percent), mercury (25 percent), nickel (4.8 percent), perlite (9.4 percent), phosphate (38.3 percent), platinum-group metals (platinum, 72.2 percent; palladium, 37.9 percent), potash (11.9 percent), pumice (15.0 percent), strontium (20.5 percent), sulfur (10.2 percent), tantalum (12.0 percent), titanium (22.1 percent), vanadium (25.0 percent), vermiculite (50.0 percent), and zirconium (31.5 percent). In addition, the countries in the region are among the world's major producers, or have significant known reserves of beryllium, cesium, feldspar, graphite, hafnium, lead, lithium, molybdenum, niobium (columbium), nitrate, industrial quartz crystal, scandium, silicon, soda ash, sodium sulfate, thorium, tin, and yttrium (table 1). Many of the countries are small developing nations that have a limited amount of known mineral resources; however, some of these countries contain major deposits of gold, aluminum, and diamonds.

The United States does not produce enough of many mineral commodities to supply all of its current domestic demand, and it relies on imports to satisfy these needs. In 2003, the United States imported 100 percent of its arsenic, asbestos, bauxite and alumina, fluorspar, graphite, indium, manganese, industrial quartz crystal, rubidium, and strontium from sources that include

countries in Africa and the Middle East. Although the region, and particularly Africa, is rich in mineral resources (both identified and undiscovered), a general lack of adequate infrastructure and concerns about continuing civil and international warfare, human rights abuses, the spread of terrorism, the AIDS epidemic, and the instability of the political and business sectors in many countries of the region are increasingly affecting the progress of new exploration and development activities.

The mineral commodities that are present in any region are very much dependent upon the regions geologic history. Different kinds of mineral deposits form in different geologic environments or settings; some mineral deposits form during the crystallization of magma (molten rock) as it cools at some depth in the crust as an igneous intrusion, some are precipitated on the bottom of the ocean, and some are concentrated by tropical weathering at the surface. The large region of Africa and the Middle East has great geologic diversity that reflects a long and complex geologic history. Mountains were formed and eroded away, continents collided and pushed up new mountains, and even the belt of tropical weathering associated with the equator has shifted with the movement of the continents over time.

Regional Geologic Framework

The geologic evolution of Africa and the Middle East is recorded in a complex array of rocks that range in age from some of the oldest found on Earth to the present. The ages of the older rocks of Precambrian age are grouped into the Archean Eon—before 2,500 million years ago, or the Proterozoic Eon—between 2,500 and 540 million years ago. The ages of younger rocks are grouped into the Paleozoic Era—between 540 and 250 million years ago; the Mesozoic Era—between 250 and 65 million years ago; and the Cenozoic Era—between 65 million years

ago and the present. The geologic evolution of Africa and the Middle East, extending from the Archean to the present, covers much of the history of Earth, which is about 4.5 billion years old.

Rocks record the conditions of their formation and subsequent evolution. For example, the accumulation of sediments in ancient oceans results in sequences of shale, limestone, and sandstone. These sedimentary rocks are changed during deep burial, under conditions of high heat and pressure, into various types of metamorphic rocks such as shale into slate or limestone into marble. Metamorphism is often associated with mountain building and with the melting and intrusion (emplacement) of magma in the crust and volcanism at the surface. These processes lead to a new cycle of erosion and deposition of sediments in the ocean or in basins on land.

Just as specific types of rocks are formed by different geologic processes, so are specific types of mineral deposits formed in association with different rocks and processes. With knowledge of the distribution in time and space of the rock types in a region, their associated mineral deposits, and other geologic information, mineral resource specialists can estimate the likely locations and the quantity and quality of undiscovered mineral resources in a region.

The elevation of the land surface, or topography, is a direct result of geologic processes. Figure 2 is a digital elevation map that shows what the Earth would look like if all the water was drained out of the oceans and areas were colored according to their elevation in the region of Africa and the Middle East. Green shows relatively low-lying areas of the continents (Congo Basin, for example); brown indicates higher elevations of mountains (for instance, the Atlas and Zagros Mountains) and plateaus. Dark blue shows the distribution of the ocean floor with light blue indicating the location of undersea mountains. As illustrated in figure 2, the study area contains extremely varied topography.

The Earth is divided into three main layers: the crust, mantle and core (fig. 4; Kious and Tilling, 1996). The crust, or outermost layer (like the shell of the egg), is rigid and thin compared

with the other two layers. It ranges in thickness from 0 to 100 km. Below the crust is the mantle (like the white of the egg), a dense, hot layer of semisolid rock approximately 2,900 km thick. At the center of the Earth is the core (like the yoke of the egg) that is composed of both solid and liquid iron-nickel alloy. Other major layers in the earth are the lithosphere (the crust and upper-most solid mantle) and the asthenosphere (a zone in the upper mantle that consists of several hundred kilometers of deformable rock).

Another expression of the geologic evolution of the Earth is the major geologic units that comprise the crust and lithosphere. The crust and lithosphere are broken into a dozen or more large and small tectonic plates that are moving relative to one another as they ride on top of hotter, more mobile mantle material (figs. 5 and 6). (The term tectonic relates to the cause or result of structural deformation of the Earth's crust.) A tectonic plate is a massive, irregularly shaped slab of solid rock, generally composed of both continental and oceanic regions. Plates can vary greatly in size, from a few hundred kilometers to several thousands of kilometers across. Plate thickness also varies greatly, ranging from less than 15 km for young oceanic plates to about 200 km or more for ancient parts of continental plates (for instance, the cratons of the African continent; fig. 7a). The plates move relative to each other, sometimes spreading apart (divergent plate boundary), sometimes colliding with each other (convergent plate boundary), and sometimes scraping past each other (figs. 5 and 6).

Different types of mineral deposits are formed as the result of various tectonic processes. Figure 5 illustrates some of the major tectonic processes that result in the formation of major types of mineral deposits. Many of these deposit types are commonly associated with plate margins, especially in areas of convergence, divergence or where the movement of plates results in the formation and transport of magmas and hot fluids. For example, at divergent plate boundaries such as an oceanic spreading center, circulation of water down through the crust

results in hot solutions (hydrothermal fluids) that leach metals from the rocks and carry them upward toward the sea floor along faults. When these metal-rich fluids mix with cold sea water, copper-, zinc-, and lead-rich sulfide minerals are precipitated as mounds on the sea floor forming volcanic massive sulfide deposits (VMS). At convergent plate boundaries (orogens) with a subduction zone, melting at depth produces magmas that result in chains of volcanoes forming island arcs in the oceans (the Mariana Islands, for example) and continental margin arcs on land (for instance, the Cascade Mountains of Washington State). Intrusions associated with volcanoes in these arcs can form large copper- and gold-rich deposits called porphyry copper deposits. A variety of other mineral deposits also can form in these arcs as a result of circulating hot fluids including gold-rich quartz veins, large silver and gold deposits at shallow levels in volcanoes (epithermal and hot-spring deposits), and polymetallic (multi-metal) replacement deposits. Areas where continental crust is stretched (extended) have linear fault-bounded depressions (rifts) that are sites for volcanism and sediment accumulation. Circulating hot fluids in rifts can form a variety of deposit types including sediment-hosted lead- and zinc-rich sulfide deposits (MVT and sedex deposits), sediment-hosted copper deposits, and evaporates rich in salt, potassium, boron, and other elements.

For the summaries below of geologic and tectonic history of the study area, the reader should refer to figure 3 for regional geographic names.

Major Geologic Provinces and Structures of Africa and the Middle East

Africa and the Middle East are part of several large tectonic plates (fig. 6), the history of whose movements about the Earth's surface is recorded in their rocks, major faults and other geologic structures. All of Africa and much of the Middle East are part of one large plate, the African plate, which has been moving slowly northeastwards from spreading centers located in the Atlantic Ocean, approximately midway between Africa and South America, and the Indian

Ocean, where the African plate is separated from the Eurasian plate (figs. 2, 5 and 6). These spreading centers are where the plates are moving away from each other and new magma is extruded, forming a ridge of undersea mountains that sometimes reach the surface to form volcanic islands, such as Cape Verde in the Atlantic Ocean. In Iran, the Zagros Mountains (figs. 3, 6, and 7a-b) record the history of past collisions between continents. Similarly, the Atlas Mountains of Morocco and the Cape Fold Belt of South Africa record collisions of the African continent with other continental plates (figs. 2 and 7a). Because of the geometry of the plate motions, the Arabian Plate is colliding with the East European plate thereby causing earthquakes throughout the Tethysides of Turkey and Iran (fig. 7b). The East African rift system of eastern Africa and the opening of the Red Sea are prominent geographic features of the region that are the result of relatively recent spreading between the African plate and the Arabian plate (figs. 2 and 6).

For general background information and perspectives on the geologic evolution of Africa and the Middle East, the reader is referred to the following compendiums that provide excellent overviews of the geologic evolution and mineral resources of Africa and the Middle East: Aghanabati (1986), Burollet (2004), Lachelt (2004), U.S. Geological Survey (2004a, b), Yoshida and others (2003), Tawadros (2001), Wilson and Anhaeusser (1998), Schluter (1997), Burke (1996), Wendorff and Tack (1995), Hester and others (1991), Petters (1991), Said (1990), Bowen and Jux (1987), United Nations Development Program (1987), Anhaeusser and Maske (1986), Kesse (1985), Wright and others (1985), Cahen and others (1984), Kogbe (1976), de Kun (1965), Schulter (2006), Tankard and others (1982), and Pelletier (1964).

Africa

Continents grow through the transfer of magmas from the mantle to the crust. This process occurs at convergent plate boundaries and near hotspots. Hotspots are areas in the middle

of a lithospheric plate where magma rises from the mantle and erupts at the Earth's surface. Continents are also formed by accretion, through the collision and welding together of existing land masses. Africa, with a surface area of approximately 30 million km^2, records a long and complex history of crustal growth and continental collisions spanning more than 3.6 billion years.

Like other major continents, Africa is made up mostly of very old rocks of Precambrian age (older than 540 million years) that form a vast stable crystalline basement to younger rocks. These areas of Precambrian crust are cored by ancient cratons, which are parts of the Earth's crust that formed and became stable during the earliest geologic periods (>1,600 million years ago) and have been little deformed for prolonged periods of time. The cratons are comprised of volcanic and sedimentary rocks preserved in what are called greenstone belts (because of their green color resulting from abundant green metamorphic minerals) and large areas of sodium-rich granitic rocks (called tonalites) and a variety of highly metamorphosed and deformed rocks. The major cratons of Africa are the Kalahari, Tanzanian, Kasai (also called the Congo or Zaire), and West African cratons, which contain some of the oldest geologic sequences preserved on Earth and host major mineral deposits unique in size and/or concentration. Smaller cratonic nuclei include the Bangweulu craton of Paleoproterozoic age (2,500 to 1,600 million years ago) in central Africa, and the East Saharan craton in northeastern Africa of Archean (>2,500 million years ago) and Paleoproterozoic age (fig. 7a).

The cratons are surrounded by belts of deformed rocks, called orogens, which become progressively younger outwards from the cratons (fig. 7a). The orogens are largely the result of complex collisions between the various cratons and collisions with other continents through time. The orogens labeled in figure 7a largely resulted from widespread Neoproterozoic to early Paleozoic (950 to 450 million years ago) collisional events that culminated in formation of the

supercontinent called Gondwana, which was composed principally of South America, Africa, Arabia, Madagascar, India, Antarctica and Australia (Cahen and others, 1984; Petters, 1991). Gondwana eventually became incorporated into the supercontinent of Pangaea between 450 and 350 million years ago, the youngest of the supercontinents, which included most of the existing continents. During Africa's residence as part of Pangaea, large basins formed across the continent that where filled with thick sedimentary sequences including thick coal deposits in southern Africa. About 330 million years ago, a convergent (subduction) zone developed along the southern margin of Pangaea deforming sedimentary rocks along the southern margin of Africa to form the Cape Fold Belt (fig. 7a). Pangaea began to break up about 160 million years ago and is still dispersing today. Breakup of the Gondwana portion began with the separation of Madagascar, India, Antarctica and Australia (called East Gondwana) from eastern Africa by about 160 million years ago. Between about 130 and 100 million years ago, South America separated from western Africa along what is now the Mid-Atlantic Ridge (fig. 2). The separation (rifting) of these continents from Africa was accompanied by large outpourings of basalt (magmas rich in iron and magnesium derived from the mantle). The breakup continues today with rifting along the Red Sea, Gulf of Aden and the East African rift system (figs. 2 and 6). The northward movement of Africa since the breakup of Pangaea also has resulted in the collisional Atlas Mountains in Morocco (Atlas orogen, fig. 7a) as well as the Alps in Europe and mountain chains extending east through the Middle East (fig. 2; see discussion below).

Throughout the African continent, most major mineral deposits, with the exception of diamonds, were formed in association with rock units and geologic events older than about 540 million years (during the Precambrian). The rocks containing primary diamond deposits are generally younger than 540 million years in age but are restricted to crustal areas older than 1.6 billion years old (fig. 10m).

Middle East

The regional geologic framework of the Middle East region is best described in terms of the following major geologic provinces: (1) the Arabian shield, (2) the Arabian platform, (3) the Tethysides, and (4) the Red Sea Basin (figs. 2 and 7b). The Arabian shield consists of Neoproterozoic age crust, formed in convergent (subduction) plate settings, which amalgamated along collision (suture) zones. The Arabian shield was exposed and separated from the Nubian shield of northeast Africa during Cenozoic crustal arching, rifting, and spreading of the Red Sea Basin. The Arabian platform consists of a thick sequence of Paleozoic, Mesozoic and Cenozoic sedimentary rock surrounding the Arabian shield. The flat featureless desert regions of Syria, Israel, Jordan, Iraq, Saudi Arabia, the Persian Gulf States, Yemen, and Oman are underlain by relatively flat-lying sedimentary rocks of the Arabian Platform (figs. 2 and 3). The expansive dune fields of the Ar Rub' al Khali (the Empty Quarter) of southeastern Saudi Arabia covers a large part of the Arabian platform (fig. 2). Arabian Platform rocks in southwestern Iran have been extensively folded and faulted along the Zagros Mountains (fig. 3). The Tethysides is a Mesozoic-Cenozoic orogenic belt of mountainous terrain that extends from central Europe (the Alps) through Turkey, the Caucasus, Iran, Afghanistan, Pakistan, the Himalayas, and southeast China to Vietnam (fig. 7b). In the Middle East region, the Tethysides corresponds to the belt of mountainous terrain that encompasses all of Turkey, Cyprus, and Iran, and extends into the northeast region of Iraq and the Oman Mountains in northern Oman (figs. 2 and 7b). Rocks of the Tethysides consist of folded and faulted Proterozoic, Paleozoic, Mesozoic, and Cenozoic volcanic and sedimentary rock sequences, intrusive rock complexes, and sutures zones that formed during closing of the Tethys ocean and the collision of the Afro-Arabian and Eurasian plates, which is ongoing today (Şengör and Natal'in, 1996a). As a result of ongoing collision, the Tethysides is a region of active seismicity.

The Red Sea Basin is a Cenozoic rift or extensional basin that separates the Arabian Peninsula from Africa, the central part of which is now filled with waters of the Red Sea (fig. 8). The northwest-oriented axis of the basin is an active spreading center. The Red Sea axis is the site of abundant low-level seismicity related to spreading, though much of the spreading motion is manifested by movement and occasional large-magnitude earthquakes along the Dead Sea rift, which extends northwards from the north end of the Red Sea through the border region of Israel and Jordan (figs. 2 and 6).

Principal Commodities and Mineral Deposits

Deposits of metals and industrial minerals have formed throughout the history of Earth and form a highly diverse assemblage of commodities and mineral deposit types in Africa and the Middle East (table 2; fig. 9a). Older rocks commonly are deformed and recrystallized and are associated with a different assemblage of mineral deposits than are younger rocks. The old Archean and Proterozoic rocks that compose the cratons are associated with large iron, manganese, copper, cobalt, chromium, platinum-group metal, diamond, and gold deposits. Significant quantities of lead and zinc are present in the much younger, and less eroded mountains of Morocco, the Cape Fold Belt of South Africa and the Tethysides of the Middle East. Gold deposits are found in rocks of many types and ages. However, some deposits, called placer deposits, are concentrated by running water and thus are generally associated with young stream and river channels or sometimes with older “fossil” channels (paleoplacers). Mineral deposits vary by geologic environment as well as age. For example, mineral deposits related to mountain building are located in the Atlas Mountains of Morocco and in the Zagros Mountains of Iran, whereas deposits related to sedimentary basins and evaporation such as halite, phosphate,

and potash occur throughout northern Africa, the Red Sea region, and the Middle East (the Dead Sea).

Table 2 is a compilation of the major commodities and the deposits from which they are produced throughout Africa and the Middle East. The table documents major commodities from more than 1,000 mineral deposits in the region thereby underscoring the importance and diversity of these mineral deposits and their geologic environments as sources of commodities for our modern society. The major sources of data for table 2 are the USGS mineral databases MRDS-MAS/MILS (McFaul and others, 2002) cross-referenced against the International Metallogenic Map of Africa (Council for Geoscience and Commission for the Geological Map of the World, 2003), the ACP Mining Data Bank website (ACP Mining Data Bank, undated), and against publicly available national databases where available (for example, the mineral occurrences database and GIS map of the Democratic Republic of Congo (Chartry and Franceschi, 2004)). Records were retained if geographic coordinates were intact, if known reserves or total resources were listed, and/or if the development category of the deposit was listed as abandoned, past producer, producer, temporary shutdown, or intermittent producer.

Mineral deposits of a particular commodity commonly form in similar ways throughout time and space, so particular geologic features can be used to find mineral deposits and then to classify them into various types. Table 3 briefly describes how the deposits identified in table 2 are classified by type, how the deposits formed, and gives examples of these deposits. In figures 9a-f, the principal mineral deposits are shown by location, principal commodity, and type of deposit. Figures 10 a-q show simplified geologic settings for each of the major mineral deposit models and selected major deposits or districts of the region. Comparison of these features with the geology and tectonics (figs. 5, 6, 7a and b, and 8) shows a strong correlation between geology, commodity, deposit type, and tectonic processes.

Metals

Metals can be concentrated to form a mineral deposit in Earth's crust by a variety of mechanisms. If the metals are concentrated enough to make their extraction economical, the concentration is called an ore deposit. Thus, a mineral deposit is a more general term. Mineral deposits form as the result of a combination of factors, including the availability of metals in a source area, a means to transport the metals, and a mechanism to concentrate and deposit them. Similar geological characteristics of the source areas, and in the transportation and concentration processes, result in similar features among the deposits. These features permit mineral deposits to be grouped, described, measured, modeled, and discovered. The mineral deposit models allow predictions to be made of the abundance and location of undiscovered deposits. These models can be defined as the systematic arrangement of the essential characteristics of a group of similar mineral deposits. The models present the features that a group of mineral deposits have in common and that are essential to form a concentration of metals. A collection of mineral deposit models published by Cox and Singer (1986) is used to organize deposits by type in this report. Selected descriptive models are used to illustrate the diagnostic features that deposits have in common. The following paragraphs briefly outline the use, nature of occurrence, and location of significant deposits considered in this report. The data for the tables are modified slightly from the 2003 data presented in Mineral Commodity Summaries 2004 (USGS, 2004a). The term "reserve base" is defined as that part of an identified resource that meets specified minimum physical and chemical criteria related to current mining and production practices, including those for grade, quality, thickness, and depth. Reserves are that part of the reserve base that can be economically produced (USGS, 2004a).

Aluminum

Aluminum is a very light but strong metal. Because aluminum is ductile, it can be drawn into wires or pressed into sheets or foil. Its light weight and resistance to corrosion make it ideal for use in aircraft, automobiles, beverage containers, and buildings. Aluminum makes up 8 percent of the Earth's crust; only silicon and oxygen are more plentiful. Although aluminum is a common element in many rocks, it is economical to mine and process only in rocks called bauxite. Bauxite, an impure mixture of highly aluminous minerals, is the principal raw material used to make aluminum. Known global resources of bauxite are estimated to be 55 to 75 billion tonnes, located primarily in South America (33 percent), Africa (27 percent), Asia (17 percent), Oceania (13 percent), and elsewhere (10 percent) (USGS, 2004a). The United States imported almost all of the bauxite it consumed in 2003; however, the country has nearly inexhaustible sub-economic resources of non-bauxite aluminum.

Table 4. Bauxite—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Guinea	11.1	2	32.2	26.1

Bauxite is a surficial deposit (table 3) that forms by weathering of aluminum-bearing rocks in an area that has a tropical climate with alternating wet and dry seasons and a terrain with high relief and good drainage, all of which promote chemical leaching and the resulting concentration of aluminum. The aluminum is concentrated when silicate minerals (rock-forming minerals that contain silica) and clays are decomposed, and silica and other components are removed, leaving a soil relatively enriched in aluminum. A similar process is shown for iron (fig. 10a). Figure 9e shows that almost all of the aluminum deposits in Africa are in close

proximity to the current equator. The Boke mine and Société de Bauxites de Kindia's mine are two important producers of bauxite in Guinea (USGS, 2004a).

Antimony

Antimony is a brittle, silvery-gray semimetal used principally for flame retardants. It also is used in ammunition and automotive batteries and as a decolorizing agent in glassmaking. There was no United States mine production of antimony in 2003; domestic antimony production was derived entirely from the recycling of lead-acid batteries (USGS, 2004a).

Table 5. Antimony—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
South Africa	4.0	2	1.9	6.4

The primary ore mineral in antimony deposits is stibnite (antimony and sulfur). It is usually present with quartz, gold, and silver in hydrothermal vein-type mineral deposits. The antimony resources of South Africa are primarily contained in the antimony-gold deposits of Archean age that occur along the so-called Antimony Line in the Murchison Greenstone Belt, Northern Province (Ward, 1998).

Chromium

About 80 percent of the chromium consumed worldwide is used in stainless and specialty steels to increase resistance to oxidation and corrosion. There is no substitute for chromium in these steel products. World resources of chromite (chromium, iron and oxygen; the ore mineral of chromium) are sufficient to meet world demand for centuries to come. Currently, chromite is produced from a limited number of sources in Kazakhstan, South Africa, Zimbabwe, India,

Turkey, Philippines, and Albania. A significant portion of world chromium resources (~95 percent) is concentrated in southern Africa in the Bushveld Complex of South Africa and the Great Dyke of Zimbabwe (Schurmann and others, 1998). Production figures for 2003 for Turkey and Zimbabwe were not available (USGS, 2004a)

Table 6. Chromium—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
South Africa	46.4	1	12.3	11.1

Chromium and other metal deposits including those rich in nickel, platinum-group metals, or vanadium are generally found in layered mafic-ultramafic (rocks enriched in magnesium and iron) igneous rock complexes. The largest chromite deposits are in layered mafic-ultramafic complexes like the Bushveld Complex (fig. 10h) and Great Dyke (fig. 6) in the Kalahari craton in southern Africa (fig. 7a) and formed during the Precambrian. These layered complexes formed when mafic-ultramafic magmas where repeatedly injected into chambers at relatively shallow levels in the crust and then cooled very slowly. Because the magma in the chambers cooled slowly, different minerals crystallized from the magma at slightly different temperatures and accumulated at the bottom. At times, two or more minerals crystallized simultaneously and settled together. This differential crystallization of minerals led to the development of a series of distinct layers, some of which contain economic concentrations of metals such as chromium, platinum-group elements (PGE), and vanadium. The Bushveld Complex is the world's largest layered mafic-ultramafic complex, occupying an area of about 66,000 km^2 in the northeastern part of South Africa (fig. 10h), and hosts the largest chromium and PGE resources in the world. The Bushveld Complex has the form of an enormous,

irregularly shaped saucer about 370 km across (fig. 10h), with its center buried underground but its rim exposed. The layering is responsible for the relative ease of mining in the complex as the layers are regular, predictable, and generally gently dipping at no more than about a 25° angle. Chromite occurs in the Bushveld in layers varying in thickness from a few centimeters to more than 2 m. These chromite layers are confined essentially to one portion of the complex called the "Critical zone", which has been traced laterally around the complex (fig. 10h). Production from the Bushveld Complex accounted for over 46 percent of total world production in 2003 (USGS, 2004a). An extensive literature exists on the Bushveld Igneous Complex and the mineral resources contained within. More detailed descriptions can be found in Kinnaird and others, 2002, and Cawthorne and others, 2005).

Smaller, lens-like (podiform) chromite deposits (fig. 10g) are associated with mafic-ultramafic intrusions formed at spreading centers in oceanic crust such as along the Mid-Atlantic Ridge (fig. 3). During closure of the ocean basins and smaller basins formed behind island arcs (back-arc basins), the mafic-ultramafic rocks are thrust up onto colliding terranes along major fault (suture) zones. Thus, many chromium and associated nickel and PGE deposits are found along collision (suture) zones such as those in the Arabian shield and Tethysides. The chromite deposits of Turkey have produced for more than a century and Turkey remains an important exporter of chromite. The largest Turkish chromite deposit is Bati Kef (fig. 9e), in the Guleman district of eastern Turkey, with reserves of approximately 2 million tonnes of chromite (Engin, 2003). Many smaller deposits of chromite and locally related nickel and PGE's are found in the mafic-ultramafic rock sequences in the Troodos complex of Cyprus, in the Oman Mountains, and in the numerous suture zones of the Arabian shield (fig. 2). More thorough descriptions of chromium, nickel, and PGE deposits related to mafic-ultramafic rocks are found in Naldrett (2004) and Stowe (1994).

Cobalt

Cobalt is a bluish-gray, shiny, brittle metallic element. Some applications of cobalt include: catalysts, cemented carbides for cutting tools and drill bits, drying agents for paints, magnets, and super alloys for jet engine components. Identified world cobalt resources are about 15 million tonnes (USGS, 2004a).

Table 7. Cobalt—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Democratic Republic of the Congo	21.3	2	48.6	36.1
Morocco	2.8	8	0.29	NA
Zambia	25.6	1	3.9	5.2

The vast majority of the world's cobalt resources are associated with nickel-bearing laterite deposits, magmatic nickel-copper sulfide deposits and hydrothermal sediment-hosted copper-cobalt deposits. The Central African Copperbelt, located in the northern part of Zambia and the southern part of Congo-(Kinshasa) (fig. 10i), is the largest sediment-hosted copper district in the world and is notable for its cobalt content. The copperbelt is approximately 500 km long and 30–50 km wide, and is estimated to contain a total resource of more than 4.9 billion tonnes grading 3.37 percent copper (165 Mt Cu metal and 4.4 Mt Co) (Freeman, 1986). The present-day arcuate geometry of the copperbelt is the result of northward directed thrusting and deformation related to the pan-African Luffilian orogeny. The ore, contained within fine-grained clastic sedimentary rocks of the Katanga Supergroup that formed about 1 billion years ago in an intracratonic or epicontinental setting, occurs as single layers and in multiple stacked layers.

Individual ore zones may measure several kilometers long and tens of meters in thickness. Copper and cobalt have been produced from the Central African Copperbelt since the early decades of the 20th century from a multitude of large and small mines along the 500-km length of the belt. However, mining and exploration were seriously compromised in the latter part of the 20th century because of economic and political instabilities in the region. Since 2000, with the re-privatization of the copper mines in Zambia, production has again begun to increase and exploration renewed. Distribution of cobalt in the area of this report is shown on figure 9b.

Columbium (Niobium)

Columbium and niobium are synonymous names for the chemical element with atomic number 41. Almost all columbium is used to make specialty steels and super alloys. Most of the region's identified resources of this element are located in the eastern Congo River basin (figs. 2 and 9e). World resources are more than adequate to supply demand; there was no significant United States mine production in 2003 (USGS, 2004a).

Table 8. Columbium—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Democratic Republic of the Congo	0.17	5	NA	NA
Ethiopia	0.02	7	NA	NA
Mozambique	0.02	7	NA	NA
Nigeria	0.10	6	NA	NA
Rwanda	0.27	4	NA	NA
Uganda	0.01	8	NA	NA

The world's largest sources of columbium are associated with carbonatites. Carbonatites are igneous rocks that contain more than 50 percent by volume carbonate minerals. These are

minerals containing a molecule that is one part carbon and three parts oxygen. Magmas that can crystallize large amounts of carbonate minerals are unusual; about 330 carbonatites are known worldwide with about half located in Africa (Wooley, 1989). Igneous intrusions with carbonatite occur mainly on continents; they are rarely in an oceanic setting. The intrusions generally are found near large fractures in continental crust because at the time the carbonate-rich magmas were emplaced, the continental crust was undergoing stretching or extension. The largest number of carbonatite intrusions in Africa is associated with the East African rift system (fig. 2). Burundi, Zambia, and Zimbabwe also produce (or are believed to produce) columbium mineral concentrates but available information is inadequate to make reliable output estimates (USGS 2004a).

Copper

Copper is mined mainly from ore minerals also containing iron and sulfur. Because of copper's high ductility, malleability, thermal and electrical conductivity, and resistance to corrosion, it has become a major industrial metal; it ranks third after iron and aluminum in terms of quantities consumed. About one-half of the copper produced is used in building construction, and about one-fourth in electrical and electronic products. World resources are estimated to be in excess of 1.6 billion tonnes of copper, and 2003 world production was about 13.9 million tonnes (USGS, 2004a).

Table 9. Copper—proportion of world mine production, reserves, reserve base, and resource base for countries covered by this report (USGS, 2004a; Singer, 1995).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base	
Zambia	2.4	11	4.0	3.7	

Most of the copper production in Africa is derived from the Central African Copperbelt (see description in the section on cobalt). However, Africa's largest copper mine and the world's second largest is the Palabora mine located in the Phalaborwa Complex in South Africa (fig. 9b). The complex represents the remains of an ancient (~2 billion years old) volcano, whose core contains a pipe-like ore body enriched in iron, copper, uranium, phosphate, zirconium, rare earth elements and precious metals (Wilson and Anhaeusser, 1998). The Phalaborwa Complex is unique in that its copper mineralization is hosted by a carbonate-rich igneous rock known as carbonatite. Production at the Palabora mine began in 1966 with development of an open-pit mine that operated through 2002, when it was replaced by an underground mine.

Most of the copper in the Middle East is derived from large, relatively low-grade ore deposits called porphyry copper deposits. These porphyry copper deposits form beneath stratovolcanoes (fig. 10b) where copper becomes concentrated in hot, salty fluids (hydrothermal fluids) within the molten igneous rock of the volcano. The copper either is deposited in the cooling and solidifying molten rock and (or) is expelled with the hydrothermal fluids and deposited in adjacent rocks as the fluids cool and release their metal load. An average porphyry copper ore body contains 140 million tonnes of ore containing 0.5 percent copper (Singer and others, 2002). The largest deposit of this type, El Teniente in Chile, contains over 11 billion tonnes of ore averaging 0.9 percent copper. Despite the considerable size and importance of individual deposits in Africa and the Middle East, such as the Palabora mine, only the production from the Zambian copperbelt constitutes a significant portion of the world's 2003 total (USGS, 2004a).

A recently recognized but still poorly understood type of copper-gold deposit is the iron oxide-copper-gold-type (IOCG). Possible examples of this deposit type in the region of this report includes the Guelb Moghrein deposit in Mauritania (fig. 9b) and regional iron-copper-

cobalt-uranium occurrences associated with the Hook granites in Zambia (Nisbet and others, 2000). Guelb Moghrein contains 23.6 million tonnes at 1.88 percent copper, 1.41 grams per tonne gold, and 143 grams per tonne cobalt (Kolb and others, 2006). As discussed above, the Phalaborwa Carbonatite Complex in South Africa is also known for its production of iron, apatite (source of phosphorous), vermiculite and by-product gold, uranium, and rare earth elements and is regarded by some as a variant of the IOCG class of deposits (Vielreicher and others, 2000). These deposit share several common features with the huge Olympic Dam deposit of this type in Australia. The deposits are characterized by having large concentrations of iron in the minerals magnetite or hematite along with copper-iron sulfide minerals (generally chalcopyrite) and pyrite (iron sulfide). The deposits also contain light rare earth elements (lanthanum and cerium), uranium, and thorium (Haynes, 2002).

Copper deposits related to granitic intrusions in the Middle East region are found exclusively in the Tethysides. Though deposits of this type may have formed during evolution of the Precambrian Arabian shield, the greater erosion of the Arabian shield and other shield areas worldwide generally precludes preservation of deposits of this type that form in the shallow parts of the Earth's crust. Through time, these and related mineral deposits would be eroded away or consumed during destructive tectonic processes. These types of deposits, which include some of the largest copper-gold deposits in the world, occur as disseminated and stockwork ore bodies in and adjacent to granitic intrusions, that often contain significant amount of by-product gold and molybdenum and are mined by open-pit methods. In the Tethysides, the best examples of this deposit type are Cenozoic age and include the Sar Cheshmeh deposit, Iran (8.4 million tonnes of copper, 0.36 million tonnes of molybdenum, 324 tonnes of gold; fig. 10p) (Waterman and Hamilton, 1975) and the Sungun deposit, Iran (4.6 million tonnes of copper, 66,000 tonnes of

molybdenum) (table 2) (Singer and others, 2002). A more thorough description and world database of copper deposits related to granitic intrusion is found in Singer and others (2002).

Copper deposits related to sedimentary rocks in the Middle East region are found primarily in Paleozoic sedimentary rocks of the Arabian Platform in Israel, southwest Jordan and northwest Saudi Arabia. These deposits occur as tabular, hydrothermal ore bodies of disseminated copper minerals within sandstone and carbonate rocks, with dimensions often only meters thick but kilometers to tens of kilometer in length and width. The best examples of this deposit type in the region are the Fenan deposit in Jordan (780,000 tonnes of copper) and the Timna deposit of Israel (290,000 tonnes of copper) (table 2) (Hayes and others, 1999; Cox and others, 2003). A more thorough description and world database of copper deposits related to sedimentary rocks is found in Cox and others (2003).

Deposits rich in copper, zinc, and lead related to volcanic rocks form underwater primarily in island arc environments (where adjacent tectonic plates are colliding) and at spreading centers in ocean basins. Deposits of this type, called volcanogenic massive sulfide deposits (VMS), are found in submarine volcanic sequences in Precambrian sequences throughout Africa, and in the Arabian shield and Tethysides in the Middle East region. These deposits form as lenticular to tabular bodies of massive accumulations of copper, zinc, and lead minerals rich in sulfur (sulfide minerals), and can also contain commercial quantities of gold, silver, barite, and sulfur. In Africa, small VMS deposits have been found in greenstone belts in Zimbabwe and South Africa, and potential exists for similar deposits in greenstone belts throughout Africa. In the Tethysides, these deposits are late Mesozoic age and include the Cayelli deposit, Turkey (1.8 million tonnes of zinc, 1.2 million tonnes of copper, 1,600 tonnes of silver), and the Murgul deposit, Turkey (880,000 tonnes of copper, 2,000 tonnes of gold) (Leaman and Staude, 2002). The copper deposits of Cyprus and Oman are also related to

volcanic rocks. These deposits were formed in the upper parts of ocean-floor mafic-ultramafic sequences at spreading centers (ophiolites) (fig. 10g) and were later pushed up along the suture zones between two colliding plates. The best examples of these deposit types include the Mathiati deposit, Cyprus (7,200 tonnes of copper, 990,000 tonnes of sulfur), the Skouriotissa deposit, Cyprus (59,000 tonnes of copper) (Constantinou and Govett, 1973), and the Lasail deposit, Oman (172,000 tonnes of copper) (Batchelor, 1992) (fig. 9b). A more thorough description of copper, lead, and zinc sulfide deposits related to submarine volcanic rocks is found in Franklin (1993).

Gold

Gold is a metallic element that is beautiful, durable, and easily worked. It has been used throughout human history for jewelry and as currency. It is chemically stable, does not corrode or rust, and efficiently conducts heat and electricity. Gold is easily hammered into thin foils and drawn into long, thin wires. Gold is used primarily in coins and jewelry and is stored by many countries to support their currencies. It is also used in dentistry and in electrical and electronic applications.

About 190,000 tonnes of gold have been discovered in deposits around the world throughout history (Singer, 1995), enough to form a cube of gold 22 m on an edge. Total remaining world gold resources are currently estimated to be about 100,000 tonnes. South Africa accounts for about half of this total, and Brazil and the United States each account for 9 percent (USGS, 2004a).

Table 10. Gold—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
South Africa	17.3	1	18.6	40.4

Discovered in 1886 and mined continuously since 1887, the Witwatersrand Basin, South Africa, a sedimentary basin covering an area 350 x 200 km (fig. 10j), is the single largest repository of gold in the world. Production between 1887 and 1998 yielded 45,500 tonnes of gold. Estimates suggest that the Witwatersrand still contains over 50 percent of the world's gold reserves (Amey, 2000). In addition, the gold ores are rich in uranium (most contain greater than 15 times more uranium than gold) and produced approximately 125,600 tonnes U_3O_8 between 1952 and 1987, about 14 percent of the uranium produced during this period in the western world (Roscoe and Minter, 1993). Production of gold from the Witwatersrand deposits has maintained South Africa as the world's leading gold producer. However, faced with decreasing ore grades and the increasing costs associated with deep underground mining, gold production has steadily declined for several years.

The goldfields of the Witwatersrand Basin resemble huge alluvial fans containing thin sheets of gold-uranium-bearing pebble beds. These alluvial fans are fan-shaped sedimentary deposits formed 3 billion years ago by southwest-flowing streams situated in valleys of basement granitic rocks. Mine workings are centered on so-called "paystreaks" or "reefs" oriented down the slope of the rock units and represent former alluvial (stream) placer deposits. Some paystreaks can be followed for more than 10 km. The East Rand fan, the largest of the seven goldfields in the Witwatersrand Basin (fig. 10j), extends for some 40 km down the central section of the fan. Drill exploration has been extended in places to depths of nearly 5 km and mining to nearly 4 km. Gold grades vary both in and between deposits, but average ore grade for all production to 1972 was reported as 9.2 grams of gold per tonne (0.30 ounces of gold per

tonne) (Pretorius, 1974). Other ancient alluvial deposits are known in Africa and elsewhere, but none are as large or as enriched in gold as the deposits of the Witwatersrand Basin.

Although gold has been mined and explored for in the Witwatersrand Basin for some 120 years, discoveries of new ore bodies are still being made. Recent exploration by Anglo Vaal (now Avgold) located three new ore bodies at depths in excess of 3,000 m within the Bothaville Gap of the Witwatersrand Basin. In addition, extensions of known Witwatersrand ore bodies are constantly being sought using a combination of surface and underground drilling. AngloGold has predicted an additional 30 million ounces at depths of between 3,000 and 5,000 m at the Western Ultra Deep Levels deposit.

Groups of rocks called "greenstone belts" are important host rock for gold deposits worldwide. During the 19th century, geologists discovered these areas of deformed and metamorphosed volcanic and sedimentary rocks surrounded by granites in what is now recognized as the oldest continental crust, the Archean cratons in North America, southern Africa, India, and Australia (DeWit and Ashwahl, 1997). The predominance of green-colored metamorphosed volcanic rocks led to these areas being called greenstone belts. Greenstone belts are linear to irregular in shape and consist of groups of metamorphosed volcanic and sedimentary rocks that average 20 to 100 km in width and extend for distances of several hundred kilometers (Windley, 1977). Most greenstone belts formed in a variety of geologic and tectonic settings early in Earth's history at the time when continental crust was first developing. Commonly, more than one tectonic setting is represented in a single greenstone belt. Some belts appear to have formed by plate tectonic processes at continental margins. Within a greenstone belt, hydrothermal gold-rich quartz vein deposits are spatially clustered near large fault zones (Robert, 1996; Roberts, 1988; Yeats and Vanderhor, 1998). These fault zones are up to several kilometers wide, can be over 100 km long, and are nearly vertical. The quartz vein deposits

occur in faults, fractures, and folds that developed near the large fault zones and formed late in the sequence of events that compressed and metamorphosed the greenstone belts. Mineralization in some veins can be traced over two kilometers in depth. The fault zones were the pathways for flow of the hydrothermal fluids that formed the vein deposits.

Gold vein deposits potentially can occur in any deformed and metamorphosed volcanic, plutonic, or clastic sedimentary rock. However, gold is more commonly concentrated if the rocks next to the veins are iron-rich and difficult to deform, such as banded iron-formation (sedimentary deposits generally consisting of alternating iron-rich and quartz-rich layers). Banded iron-formation is described in the section on iron in this document. Examples of quartz-carbonate-gold veins associated with banded iron-formation include the Sheba mine (fig. 9c) in the Barberton Mountain Land of South Africa (Anhaeusser and Maske, 1986). Archean greenstone belts with hydrothermal quartz-carbonate-gold vein deposits are found on all continents. Important gold bearing greenstone belts of Africa and the Middle East include the Birrimian of Ghana, the Hoggar of Algeria, the Lake Victoria belt of Tanzania, the Midlands and numerous other belts in Zimbabwe, and the Murchison and Barberton belts of South Africa (Goldfarb and others, 2001).

The origin of some of the larger gold deposits, particularly in the Arabian shield, remains controversial among researchers. Some researchers call upon a granitic-intrusion-related origin whereas others believe they are related to broad orogenic and perhaps metamorphic processes. Nevertheless, it is clear that these types of gold deposits are concentrated along or proximal to major crustal-scale structural zones that often correspond to suture zones between different crustal blocks. The suture zones are the end result of amalgamation or collision of terranes along the zone of subduction of two tectonic plates. These types of gold deposits occur in the form of gold-bearing quartz veins and stockwork vein zones and are mined by both open-pit and

underground methods. The Sukhaybarat deposit (21 tonnes of gold) (Albino and others, 1995) and the Ad Duwayhi deposit (> 30 tonnes of gold) (Doebrich and others, 2004) are important deposits of this type in the Arabian shield of Saudi Arabia (table 2 and fig. 9c). A more thorough description of gold deposits related to granitic intrusion and orogenic processes is found in Lang and Baker (2001) and Groves and others (1998), respectively.

Gold deposits related to sedimentary rocks have recently been identified in the northwestern part of Iran. These deposits, called Carlin-type deposits after the Carlin mine in Nevada, generally are mined by bulk-mining techniques in large open-pit mines (Thompson, 2002; Bettles, 2002). These deposits are characterized by submicroscopic gold disseminated in receptive sedimentary rock units and concentrated in fault zones that channel gold-bearing fluids from depth. Where gold-bearing hydrothermal fluids have permeated the rock, dispersed, low-grade deposits of extremely fine-grained gold are produced. Deposits of this type have been identified at Zarshuran (25 tonnes of gold) and Agh Darreh (24 tonnes of gold), both in northwestern Iran (table 2 and fig. 9c) (Asadi and others, 2000; Zarcan International Resources, Inc., 2003). A more thorough description of gold deposits related to sedimentary rocks is found in Hofstra and Cline (2000).

Gold (and silver) deposits also are commonly associated with igneous and hydrothermal processes related to volcanic rocks. Significant quantities of gold are recovered from mining porphyry copper deposits (see copper discussion) and certain other types of sulfide deposits (see lead-zinc discussion). Very rich gold deposits also form in the roots of hot-spring systems, usually as veins in volcanic rocks.

Gold, silver, antimony, and mercury deposits are found in geologic environments similar to copper deposits related to granitic rocks, but are located in the volcanic rocks that surround or cover the granitic intrusions. Thus, in the Middle East region, these types of deposits are found

primarily in the Tethysides but have also been locally preserved in the Arabian shield. These deposits generally form as vein, stockwork, or disseminated ore bodies and can be mined by either open pit or underground methods. In the Tethysides, the best examples of these deposits are in Turkey, and include the Kisladag deposit (106 tonnes of gold), the Efemcukuru deposit (32 tonnes of gold), and the Ovacik deposit (27 million tonnes of gold, 33 million tonnes of silver) (table 2 and fig. 9c); Engin, 2003), all late Cenozoic age (Leaman and Staude, 2002; Engin, 2003). In the Arabian shield, the Mahd adh Dhahab deposit is a rare preserved Neoproterozoic deposit of this type (fig. 10q). This deposit has produced gold periodically since 1000 B.C., continues to produce today, and is estimated to have a gold endowment of greater than 100 tonnes of gold (Doebrich, 1999). A more thorough description of gold, silver, antimony, and mercury deposits related to volcanic rocks is found in Sillitoe (1993) and Hedenquist and others (2000).

Iron Ore

Iron is one of the most abundant elements on Earth, but it does not occur in nature in its useful pure-metallic form. Iron is utilized for its physical properties that include hardness, strength, malleability, ductility, durability, and its ability to be cast into many useful forms. Iron is also easily alloyed with other elements such as carbon, manganese, silicon, chrome, nickel, and molybdenum to produce a variety of steels. "Iron ore" is the term applied to a natural iron-bearing mineral or rock in which the content of iron is sufficiently high to be commercially extractable. Iron ore associated with banded iron-formations is the source of most primary iron for the world's iron and steel industries. More than 95 percent of the world's iron resources occur in banded iron-formation (Gross, 1996a). World resources are estimated to exceed 800 billion tonnes of crude ore containing more than 230 billion tonnes of iron. Banded iron-formation has been found on all continents except Antarctica. The largest deposits of banded

iron-formation in Africa and the Middle East are located in South Africa, Iran, and Mauritania (table 2; fig. 9d). South Africa is ranked eighth in the world in iron ore production (China is now first) and produced 3.4 percent of the world's iron ore in 2003 (table 11; USGS, 2004a).

Table 11. Iron ore—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Iran	0.98	13	1.2	0.76
Mauritania	0.89	14	0.47	0.45
South Africa	3.4	8	0.67	0.70

The iron mined in South Africa principally comes from banded iron-formation within Proterozoic Transvaal sedimentary rocks in the Northern Cape Province (fig. 9d). Major districts include those at Sishen and Thabazimbi. Iron in Mauritania comes from the Zouerate district. The banded iron-formation is characterized by alternating iron-rich and quartz-rich layers and has greater than 15 percent metallic iron by weight. The thickness of individual layers varies from less than a millimeter to meters; overall, these layered rocks may be hundreds of meters thick. The principal iron minerals are hematite and magnetite (Clout and Simonson, 2005).

Although iron deposits are widespread geographically, the largest ones formed almost exclusively during Precambrian time (Gross, 1996a). The extensive deposits of banded iron-formations are associated with marine sedimentary units and formed during Neoarchean to Paleoproterozoic (2.7 to 1.8 Ga). The oldest deposits tend to be smaller and are associated with volcanic rocks.

The iron resources are large because the deposits are laterally extensive. The iron minerals were precipitated from ocean water and were deposited uniformly over large areas. At the time they were formed, the deposits of iron-formation associated with sedimentary rocks may

have covered over 100,000 km^2 (Trendall, 2002). Individual layers can be traced for over 100 km (Trendall, 2002). The deposits may have formed on submerged continental shelves surrounding Archean continents.

The origin of banded iron-formation is still partly unresolved. These deposits often are studied because they provide insight into the early evolution of the Earth's atmosphere and oceans (Konhauser and others, 2002). They also provide insight on biological processes early in Earth's history because of their close association with early biological organisms. The iron minerals we see today are not those that were chemically deposited from seawater. These rocks were buried in sedimentary basins where they formed new minerals because of increased temperature and pressure. Subsequently, these rocks were exposed by erosion where weathering in tropical climates leached silica from some deposits thereby enriching the iron content in these rocks and changed the original iron minerals to those we mine today.

Lead and Zinc

Lead is a blue-gray, dense, ductile, malleable, very corrosion-resistant metal. More than three-fourths of the lead produced is used by the transportation industry, mainly for lead-acid batteries. Remaining uses include ammunition; electrical, electronic, and communication applications; and radiation shields. Zinc also is a blue-gray metallic element. Because of its anticorrosion properties, more than one-half of all zinc metal is used for galvanizing followed by the production of zinc-based alloys, brass, and bronze. Lead and zinc minerals commonly occur together in deposits; hence, they are considered together here.

About 350 million tonnes of lead has been discovered (Singer, 1995). Identified lead resources of the world total more than 1.5 billion tonnes (USGS, 2004a). The United States ranks third in lead production for 2003 with 450,000 tonnes, compared to Australia with 715,000 tonnes and China with 650,000 tonnes (USGS, 2004a).

Table 12.. Lead—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Morocco	2.1	7	0.75	0.71
South Africa	1.4	10	0.60	0.50

About 710 million tonnes of zinc has been discovered (Singer, 1995). Identified zinc resources of the world are about 1.9 billion tonnes (USGS, 2004a). Worldwide, the United States ranks fifth in production of zinc but is one of the largest consumers (USGS, 2004a). Of the countries covered by this report, Morocco ranks 7th in world production of lead and South Africa ranks 10th. Although zinc is also produced, the region is currently not a significant world supplier of zinc.

Zinc and lead commonly occur in ore deposits that form from low-temperature hydrothermal fluids. Several types of deposits are recognized based on how the hydrothermal fluids were generated and where they moved, the distribution of ore minerals in the ore deposit, and the geologic setting. Two deposit types formed on or near the ancient ocean floor where hydrothermal fluids moved upward toward the bottom of the sea bed along fractures and vented to form hot springs (fig. 10d). The hydrothermal solutions mixed with ocean water and deposited quantities of iron, zinc, and lead minerals onto mounds and layers on the sea floor. One of these deposit types is called a volcanogenic massive sulfide (VMS) deposit (fig. 10e). It forms where cooling magma, either as volcanic rocks erupted on the ocean floor or emplaced at depth in shallow intrusions, supplies the heat needed to generate and mobilize hydrothermal solutions (Lydon, 1988; Franklin, 1993, 1996). For the type called sedimentary exhalative (sedex) deposits (fig.10f), the hydrothermal solutions are generated as water-rich sediments are

deeply buried in basins within the Earth, later to be expelled when pressure is released during folding and faulting (Goodfellow and others, 1993; Lydon, 1996).

Like porphyry copper deposits, many VMS deposits are associated with magmas generated at convergent plate boundaries. However, the volcanogenic deposits are associated with the eruption of volcanic rocks underwater. These deposits are found in rocks of all ages, unlike porphyry copper deposits, which are concentrated in Mesozoic and Cenozoic rocks. The oldest VMS deposits are in Archean rocks and have less lead than younger deposits. Deposits of all ages also may contain recoverable amounts of copper, gold, and silver.

VMS deposits are a common deposit type but are not currently important for metal production in Africa. They are classified as hydrothermal deposits in figure 9b. Small volcanic massive sulfide deposits have been discovered in greenstone belts in Zimbabwe such as the Sunyati deposit in the Magondi belt (Franklin and others, 2005) and South Africa, such as the Maranda Cu-Zn deposit in the Murchison greenstone belt and the Bien Venue Zn-Ba-Pb-Ag-Au deposit in the Barberton greenstone belt (fig. 9b; du Toit, 1998a). Similar deposits are present in the other African cratons such as the Perkoa zinc deposit in Burkina Faso, the Bisha deposit in Eritrea, and the Gorob, Matchless, and Otjihase deposits in Namibia (fig. 9b; Franklin and others, 2005). In the Arabian shield of Saudi Arabia a number of Neoproterozoic VMS zinc-copper deposits have been discovered including the Al Masane, Jabal Sayid, and Khnaiguiyah deposits. Mesozoic VMS deposits are also present in the Tethys belt, particularly in the Eastern Pontides in Turkey (for example, the Cayelli deposit (fig. 9b).

Sedimentary exhalative lead and zinc deposits, sedex deposits, are a type of hydrothermal deposit found in sedimentary basins (figs. 9b and 10f; Goodfellow and others, 1993; Lydon, 1996). These basins commonly form as continents are pulled apart by rifting. Sedex deposits typically occur in large basins filled with more than 10 km of sediments. Silver, and less

commonly copper, may be present in economic amounts in sedex deposits. Globally, sedex deposits are younger than 1,800 million years. Examples of sedex deposits in Africa include the Rosh Pinah lead-zinc deposit in Namibia and the Gamsberg, Big Syncline, Broken Hill, and Black Mountain zinc deposits of the Aggeneys district in South Africa (fig. 9b; Leach and others, 2005).

Another type of lead-zinc deposit also forms from hydrothermal fluids related to sedimentary basins. However, in these deposits, the hydrothermal fluids move through aquifers, mix with other fluids, and deposit minerals in open cavities in carbonate sedimentary rocks such as limestone. These ore bodies are referred to as Mississippi Valley type (MVT) after the important deposits of this type in the central United States. The geology of these deposits is described by Sangster (1996a and b) and Leach and others (2005). The movement of hydrothermal fluids in the sedimentary basins is driven by forces resulting from plate boundary interactions. These deposits form in relatively undeformed sedimentary rocks that generally occur inland from the mountain belts formed at convergent plate margins (fig. 5). The known MVT deposits are younger than 500 million years. Jurassic carbonate rocks in the Touissit-Bou Beker-El Abed district of the High Atlas Mountains in northeastern Morocco and adjacent Algeria (fig. 9b) host the largest known MVT deposits in Africa. The ore district includes five major deposits, four in Morocco and one in Algeria, and more than 30 subeconomic occurrences (Bouabdellah and others, 1999). Production between 1926 and 1997 resulted in 67 million tonnes of ore averaging 7 percent lead, 3 percent zinc, and up to 600 grams per tonne silver (Bouabdellah and others, 1999).

Lead and zinc deposits related to sedimentary rocks are found in all of the geologic provinces of the Middle East, except the Arabian shield. These deposits occur as tabular ore bodies of massive to disseminated lead and zinc minerals in shale, sandstone and carbonate

rocks, with dimensions typically only meters thick but many kilometers in length and width. The largest of these in the region are in the Tethysides and include the Mehdiabad deposit, Iran (9.6 million tonnes of zinc, 2.4 million tonnes of lead, and 4,800 tonnes of silver) (Leaman and Staude, 2002), and the Angouran deposit, Iran (4.8 million tonnes of zinc, 1.2 million tonnes of lead) (White and others, 2001).

Other types of lead and zinc deposits are present in the regions of this report. Many of these deposits occur in favorable carbonate (limestone and dolomite) sedimentary rocks where these rocks are thickest. Important examples of these deposits are called "polymetallic replacement" deposits (fig. 5). This deposit type commonly forms near igneous intrusions where hydrothermal fluids emanating from the intrusion selectively replace the adjacent carbonate rocks with ore and other associated minerals (Nelson, 1996). This replacement process forms orebodies having a variety of irregular shapes. Orebodies deposited parallel to sedimentary layering in carbonate rocks often are called "mantos," which is the Spanish word for blanket. Conversely, orebodies that form in fractures and other inhomogeneous parts of the sedimentary rock that cut across the sedimentary layers have a variety of names including "veins," when they form sheet-like and tabular masses in fractures; and "pipes," or "chimneys," when they have the shape of nearly vertical cylinders. Polymetallic replacement deposits contain variable amounts of silver, lead, zinc, and other metals.

Manganese

Manganese is a very brittle, but hard metallic element that is essential for improving the properties of iron and steel. Manganese is also used in aluminum alloys, batteries, colorants, and fertilizers. South Africa is by far the largest producer of manganese in the world, and accounts for 80 percent of the global identified resource. Gabon ranked second in 2003 with over 3 percent of the global resource (USGS, 2004a).

Table 13. Manganese—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Gabon	12.5	2	6.7	3.2
South Africa	20.4	1	10.7	80

Manganese is mostly used in the steel industry and is not mined in the United States. South Africa has the largest world manganese reserves with over 370 million tonnes and more than 80 percent of all world manganese resources in the giant Kalahari manganese field in the Northern Cape Province (fig. 10k). Gabon ranks third in world reserves with 45 million tonnes. While South Africa outproduces its nearest competitors by a factor of nearly 5 in chromium and about 3 in PGM, the world production figures for manganese are more balanced. China and Gabon produce nearly as much manganese as South Africa, and Australia is not very far behind. Thus, U.S. dependence on Africa for manganese is not as great as it is for chromium and PGM, at least in the short term.

Manganese deposits are classified into three general types: hydrothermal, sedimentary, and supergene (Roy, 1992). Hydrothermal manganese deposits are generally of minor economic importance to the global supply and are not discussed further. Sedimentary manganese deposits are the largest and most economically important class of deposits and can be divided into volcanogenic and nonvolcanogenic subtypes. The volcanogenic subtype is generally small in size and occur in volcano-sedimentary sequences of primarily Phanerozoic age. The larger, nonvolcanogenic subtype occurs in clastic, carbonate, or iron-formation-dominated sedimentary sequences of various ages. Supergene manganese deposits form as a result of surficial weathering of in situ concentrations of manganese-rich lithologies such as Mn-carbonates. In South Africa, manganese deposits are hosted by the Paleoproterozoic Transvaal Supergroup in

the Northern Cape Province. Two types of deposits are present: smaller supergene accumulations occur within karst-fill features in the dolomites of the Campbellrand Subgroup in the Postmasburg Fe-Mn field, and the world-class sediment-hosted deposits of the Kalahari manganese field that occur as carbonate-rich manganese-bearing sediments interbedded with banded iron-formation of the Voelwater Subgroup (Astrup and Tsikos, 1998).

The Kalahari manganese field is exposed in a 90-km-long north-south belt over an area of about 400 km^2 (fig. 10k). It contains three distinct manganese units, which are interlayered with iron-rich units over a thickness of approximately 150 m. The manganese- and iron-rich units are flat lying and particularly fine grained. Production comes from secondarily enriched high-grade deposits and from lower-grade primary sedimentary manganese layers such as those in the large open-pit Mamatwan mine (fig. 10k; Nel and others, 1986). The manganese deposits are thought to have formed between 2.3 and 2.1 billion years ago in a shallow marine environment.

Mercury

Mercury is a silver-colored metallic element that has the unusual property of being the only metal that is liquid at room temperatures. Mercury is derived mainly from the mineral cinnabar (mercury and sulfur) and to a lesser extent from native mercury. The largest use of mercury is as an electrolyte in the making of chlorine-caustic soda chemicals. Other uses include automobile convenience switches, barometers, computers, mercury vapor and fluorescent lamps and thermostats, in cleansers, pesticides, folk medicine, and in gold processing. The use of mercury in household items such as thermometers and batteries has been discontinued in the United States due to health concerns.

Table 14. Mercury—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Algeria	25.0	2	1.7	1.2

In 2003, Algeria ranked second after Spain in world production of mercury with 25 percent (table 14; USGS, 2004a). The world reserve base of mercury is estimated to be about 240,000 tonnes, and the total mercury production in 2003 was 1,600 tonnes. In 2003, production occurred from major deposits in Algeria, Italy, Kyrgyzstan, Spain, and the United States (USGS, 2004a). Spain led the world with over 30 percent of the production from the famous igneous related deposit near the town of Almaden, which also contains over half of the known world reserves of mercury.

Mercury deposits most commonly occur in three major settings (fig. 5): (1) in areas of modern or ancient near-surface hot springs, (2) in layers in volcanic rocks along major, deep fault zones (Almaden-type), and (3) along zones of hydrothermal alteration in fault-bounded sequences of mafic (magnesium and iron rich) and ultramafic igneous rocks that are preserved in subduction zone complexes (Rytuba, 2002).

The most important mercury deposits in Africa are in the Assaba region of Algeria, where a number of hydrothermal, fault-controlled deposits occur in predominantly Cretaceous and Tertiary sedimentary rocks. Mercury production has fallen steadily from 750-500 tonnes in the late 1980s, to 475-430 in the early 1990s, and to 320-215 tonnes from 1999-2002. In 2003, a precipitous drop in production was attributed to a severe shipping flask shortage (Hammerbeck, 1998; USGS, 2004a). Other known mercury deposits in the region of this report include the Richmond deposit in Zimbabwe and the Monarch Kop mine in the Murchison greenstone belt of South Africa. The mercury deposits in Zimbabwe and South Africa are related to mafic and ultramafic igneous rocks of Archean age (Hammerbeck, 1998).

Molybdenum

Molybdenum is a metallic element used principally as an alloying agent in cast iron, steel, and super alloys to enhance hardness, strength, toughness, and wear and corrosion resistance. Identified molybdenum resources of the world are about 18 million tonnes, of which 5.4 million tonnes are located in the United States (USGS, 2004a). Iran is the world's ninth largest producer of molybdenum.

Table 15. Molybdenum—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Iran	1.3	9	0.6	0.7

Generally, molybdenum is produced as a byproduct of mining copper, especially mining of porphyry copper deposits, which are discussed in the section on copper. Iranian production of molybdenum is mostly as a by-product from porphyry copper deposits. Molybdenum also is mined in certain types of igneous intrusions (porphyry molybdenum deposits) in which it is the principal metallic sulfide mineral.

Nickel

Nickel is a silvery-white metallic element that is mostly (~65 percent) used to manufacture stainless steels. Twenty percent is used in other steel and nonferrous (including "super") alloys, often for highly specialized industrial, aerospace, and military applications. About 9 percent is used in plating. The remaining 6 percent has other uses, including coins and a variety of nickel chemicals. Identified on-land resources averaging one percent nickel or greater contain at least 130 million tonnes of nickel (USGS, 2004a).

Table 16. Nickel—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Botswana	1.3	15	0.79	0.66
South Africa	2.9	10	6.0	8.6
Zimbabwe	0.57	16	0.02	0.19

Most nickel and cobalt come from two general types of deposits: nickel laterite and igneous (magmatic) nickel-sulfide deposits. Nickel laterite (fig. 10a) forms by the weathering of nickel-bearing rock in areas with a tropical climate and good drainage (Freyssinet and others, 2005). During this process, silica and other components are leached from the rocks, leaving a soil enriched in nickel, cobalt, and iron. The principal nickel minerals are garnierite (hydrous nickel silicate) and nickeliferous limonite (hydrated nickel-bearing iron oxide). Igneous (magmatic) nickel-sulfide deposits are found associated with igneous rocks rich in magnesium, nickel, and chromium; these mafic and ultramafic rocks form as magmas solidify in characteristically layered igneous complexes like the Bushveld Complex in South Africa (see section on chromite above). As the magmas cool and crystallize, a separate liquid rich in sulfur, iron, nickel, copper, and occasionally platinum-group elements can form within the magma. Once formed, the sulfur-rich liquid, which is denser than the silicate-rich magma, will not remix with the silicate-rich magma (like the separation of oil and vinegar in a salad dressing). Eventually, the sulfur-iron-nickel-copper-rich liquids accumulate separately and solidify forming a variety of minerals that include pentlandite (iron nickel sulfide), which is mined for its high nickel content (Naldrett, 2004; Arndt and others, 2005).

Nickel laterite deposits are present throughout equatorial Africa, wherever tropical weathering conditions and rocks rich in nickel exist together. These are the surficial nickel

deposits shown in figure 9e. The large nickel laterite deposit at Ambatovy, Madagascar, was formed by weathering of peridotite and related rocks. Peridotite is a dark, low-silica high-magnesium rock typically rich in nickel and chrome. The most important nickel laterite deposits in the region of this report are at Musongati in Burundi, and in the Biankouma district of Cote D'Ivoire (Hammerbeck and Schurmann, 1998).

Most nickel production in southern Africa comes from nickel sulfide ore deposits, which are classified as igneous deposits in figure 9e. These sulfide ores contain important by-product metals such as copper, cobalt, gold, silver, platinum-group elements, selenium, and tellurium. In Botswana and Zimbabwe, nickel-copper sulfide orebodies are associated with small layered igneous complexes and with lavas of ultramafic composition, called komatiites. In South Africa, most nickel production is a byproduct of PGE recovery at mines in the Bushveld Complex. The otherwise subeconomic nickel sulfides are associated with a layer called the Merensky reef, which has an average nickel content of 0.24 percent. Because of the size of the Bushveld Complex, this makes it one of the world's major repositories of nickel resources (Hammerbeck and Schurmann, 1998).

Platinum-Group Elements

The platinum-group elements (PGE) are iridium, osmium, palladium, platinum, rhodium, and ruthenium. In general, platinum-group elements exhibit high density, high electrical conductivity, high melting points, and low reactivity. Platinum and palladium are used in automobile pollution abatement systems (catalytic converters). Platinum is also used in jewelry and as a catalyst in the production of industrial chemicals. World resources of platinum-group elements in mineral concentrations that can be mined economically are estimated to total more than 100 million kilograms, the vast majority being found in South Africa (USGS, 2004a).

Table 17. Platinum-group elements—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Platinum: Percent of world production, 2003	Palladium: Percent of world production, 2003	Rank of world production	PGE: Percent of world reserves	PGE: Percent of world reserve base
South Africa	72.2	37.9	1	88.7	87.5

South Africa currently produces about 72 percent of the platinum and 38 percent of all the palladium in the world, all from the Bushveld Complex (see description of the Bushveld Complex in the chromium section). In addition, the Bushveld contains at least 70 million kilograms of PGE reserves compared to 10 million kilograms of reserves in the rest of the world. There are two principal platinum layers or "reefs" in the Bushveld Complex, the Merensky reef and the Upper Group 2 (UG2) chromitite reef, both of which are about 1 m thick and occur consistently around the eastern and western sides of the Bushveld (fig. 10h). A third PGE-rich layer, the Platreef, varying between 5 and 90 meters is only found in the northeastern edge of the complex (the Potgietersrus "Limb"). Ore grades of the reefs are typically between 4-7 grams of platinum per tonne, requiring that between 7 and 12 tonnes of ore must be processed to obtain a single ounce of platinum. Although the Merensky reef has been the principal source of production since the early days of platinum mining in the Bushveld, its importance has begun to wane because most near-surface, high-grade deposits have been mined. Production began from the UG2 in the 1970s and has been increasing in importance ever since. Current operations mining the Merensky reef and UG2 chromite reef for platinum are located on both the Western and the Eastern Limbs (fig. 10h; Viljoen and Schurmann, 1998). The Platreef on the Northern (Potgietersrus) Limb of the complex, although briefly mined in the 1920s, was the last reef to be exploited on a large scale. Currently, the Platreef is experiencing an exploration boom of an

intensity not seen since the 1920's, including perhaps the largest drilling program for PGE's ever conducted in South Africa (Matier, 2004). However, the PPRust (Potgietersrust) mine, which began operations in 1992, is the only mine currently in operation in the Platreef (fig. 10h).

Silver

Silver is a white, ductile, malleable metal that has been used for thousands of years in jewelry, ornaments, and utensils, and as the basis of many monetary systems. It is a precious metal that is resistant to oxidation and has very high thermal and electrical conductivity. Industrial applications of silver include: electrical and electronic products, mirrors, and photography, which is the largest single end use of silver. Silver's catalytic properties make it ideal for use as a catalyst.

The major ore minerals for silver are silver metal, electrum (gold and silver alloy), argentite (silver sulfide), cerargyrite (silver chloride), various sulfides of arsenic, antimony, and silver, such as pyrargerite and tetrahedrite, and in minor amounts in galena (lead sulfide) and pyrite (iron sulfide). Over 1.7 million tonnes of silver have been discovered (Singer, 1995), and the world reserve base of silver is estimated to be about 570,000 tonnes. In 2003, world production was estimated at 19,000 tonnes from major deposits in Australia, Canada, Chile, China, Mexico, Peru, Poland, and the United States (USGS, 2004a).

Although silver does occur as the major commodity in some deposits such as the sediment-hosted silver-lead-zinc deposit Real de Angeles in Mexico, and the silver-cobalt-arsenide veins of Cobalt, Ontario in Canada, more than two-thirds of world silver resources are produced as a by-product associated with a variety copper, lead, and zinc deposits. The remainder is associated with hydrothermal gold deposits.

None of the deposits in the region of this report are major world silver producers. However, significant production of silver as a primary commodity from the region has occurred

from deposits in Morocco (the Imiter mine in the Anti-Atlas Mountains, figs. 2, 9c; table 2). The Imiter mine is a hydrothermal vein deposit in felsic volcanic rocks of Neoproterozoic age that is one of the largest silver deposits in the world. Current estimated resources at Imiter are 8,000 tonnes of silver metal (Cheilletz and others, 2002). The Zgounder deposit is also a silver-rich hydrothermal vein deposit in the same area of Morocco that has been exploited since the 12th century (Petruk, 1977) but has been closed since 1990 due to low silver prices (Essarraj and others, 1998).

Numerous mineral deposits of various types throughout the region of this report produce silver as a by-product of both base metal and gold mining. Notable examples include: (1) the cobalt-nickel-arsenide (copper-gold-silver) hydrothermal vein deposits Bou Azzer, Bleida, Tiouit, and Bou Madine in the Anti-Atlas region of Morocco (fig. 9b); (2) the Mississippi Valley-type massive lead-zinc sulfide districts of Beddiane and Toussit-Bou Bekkar in Morocco and the Pering district in South Africa; (3) sediment-hosted and variably metamorphosed lead-zinc deposits such as those in the Aggeneys and Gamsberg districts of the Namaqua Mobile Belt of South Africa and the Rosh Pinnah deposit in Namibia (fig. 9b); (4) gold deposits of the Witwatersrand in South Africa; (5) the Phalaborwa carbonatite deposit of South Africa (fig. 9d); and (6) numerous volcanogenic sulfide deposits throughout the region such as those in greenstone belts in South Africa, Namibia, Zimbabwe, Ethiopia, Egypt, and many others.

Tantalum

Tantalum is a hard, heavy, grayish-silver metal that is nearly immune to chemical attack at room temperatures and retains great strength to very high temperatures. In pure form, tantalum is ductile and can be drawn into fine wire, enabling its use as filaments. The metal is predominantly used in the electronics industry in capacitors for medical appliances such as hearing aids and pacemakers, airbag protection systems, ignition and motor control modules,

laptop computers, cell phones, play stations, and in video and digital still cameras. Tantalum also has high electrical resistivity and the interesting ability to conduct alternating current (AC) in only one direction. Its very high melting point results in its use in high temperature furnace parts and as a component in super alloys with cobalt, iron, and nickel for use in turbine engines.

The primary ore mineral of tantalum is tantalite, which mostly occurs in association with columbite as disseminations in granitic rocks and pegmatites. Minor amounts occur in carbonatite deposits in association with the niobium-bearing mineral pyrochlore and in alkaline intrusions. Both columbite and tantalite are iron-black to brownish minerals with hardness close to that of glass and of moderately high density. Microlite and wodginite are the other important ore minerals of tantalum. Other sources of tantalum minerals include sedimentary placer deposits resulting from the erosion of columbite-tantalite-rich rocks and minor byproduct recovery from tin mining in Malaysia and South Africa (Boelema, 1998; Boelema and Hira, 1998; Tantalum-Niobium International Study Center, 2005).

The single largest supplier of tantalum metal is Australia, which accounts for over 50 percent of world production from two mines in Western Australia. Additional operating mines are in Canada, China, Brazil, and the Kenticha mine in Ethiopia. The Kenticha rare metal field is located in the eastern Adola area that forms a segment of the north-south trending Mozambique orogenic belt of Pan-African (710-530 Ma) age in southern Ethiopia. Tantalum-niobium mineralization occurs in zoned beryl-columbite-bearing pegmatite bodies associated with biotite granite, two-mica granite and alaskite that were deformed and metamorphosed to upper greenschist and amphibolite grade. The main Kenticha pegmatite, as well as numerous smaller pegmatites in the area, occurs as zoned veins and dikes located on deep-seated north-south-trending faults that parallel the rare metal field (Tadesse and Zerihun, 1996).

The central African countries of Burundi, Congo-(Kinshasa), Rwanda, and Uganda used to be a source of significant tonnages, however, civil war in the region and the use of the "coltan" trade, the local name for columbite-tantalite mining, as a source for funding of militias has adversely impacted the industry in recent years (Tantalum-Niobium International Study Center, 2005). An estimate of columbite-tantalite production from Congo (Kinshasa) suggests that it was not more than 10 percent of world mine production (Wickens, 2004).

Table 18. Tantalum—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Burundi	1.2	8	NA	NA
Democratic Republic of the Congo	2.4	5	NA	NA
Ethiopia	3.2	4	NA	NA
Mozambique	0.98	9	NA	NA
Nigeria	0.81	10	NA	NA
Rwanda	1.6	6	NA	NA
Uganda	0.41	11	NA	NA
Zimbabwe	1.4	7	NA	NA

Tin

Tin is a soft, highly malleable, chemically stable and nontoxic silvery-white metallic element that is used predominantly in tinplate for tin cans. It is also used to make a variety of alloys, such as brass, bronze, solder, and in pewter for drinking vessels and other decorative wares. Tin is rarely used in unalloyed form except in pipes for distilleries and in tinfoil.

The tin oxide mineral cassiterite (SnO_2) is the only significant tin ore mineral. It usually has a deep brown to black color and is less frequently red, yellow, or rarely colorless (du Toit,

1998b). Primary tin deposits are found in greisens, granitic pegmatites, and as disseminated aureoles to highly evolved granite intrusions. Tin is often associated with tungsten in much of the world and is more commonly associated with resources of niobium and tantalum in Africa where tungsten is relatively rare. Due to the high specific gravity of cassiterite, tin resources are also commonly concentrated in alluvial placers in areas where pegmatites and tin-bearing granites have been eroded. Tin resources from the region of this report are located primarily in western Africa (USGS, 2004b), although the total output from the region is not significant on a global scale. Historically, 80 percent of Africa's tin production was evenly split between Nigeria and the eastern Democratic Republic of the Congo. Rwanda and South Africa each accounted for an additional 7 percent (de Kun, 1965). Granites enriched in tin are locally present in the Arabian shield, but there has been no recent tin production from these occurrences.

Titanium

Titanium is a hard silvery-white metallic element that naturally combines with oxygen to form a variety of oxide minerals. Titanium dioxide is one of the chemical compounds derived from these minerals and the world's premier white pigment in the coatings and plastics industry, which accounts for nearly all of its industrial applications. Titanium dioxide is nontoxic and biologically inert, so it also is used for coloring in foodstuffs like flour, icing sugar, sweets, cosmetics, and toothpaste. Titanium metal is strong yet lightweight. About 65 percent of titanium metal is used in aerospace applications; the remaining 35 percent is used in medical, sporting goods, and other applications. Ilmenite (iron titanium trioxide) supplies about 90 percent of the world's demand for titanium. World ilmenite resources total about 1 billion tonnes of titanium dioxide (USGS, 2004a). Identified world resources of other titanium minerals (primarily rutile, titanium dioxide) total about 230 million tonnes of contained titanium dioxide.

Table 19. Titanium concentrate (ilmenite)—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
South Africa	22.1	2	15.0	29.7

Economic titanium deposits can be formed during the crystallization of igneous rocks. Such deposits are called "primary" deposits. Deposits formed when primary deposits are reworked and concentrated by weathering and sedimentary processes are called "secondary" deposits. In primary titanium deposits, concentrations of titanium-enriched minerals form during the crystallization of magma (molten igneous rock) (Gross, 1996b). The titanium-bearing minerals can crystallize directly from magma as crystals of titanium oxides and be concentrated into layers or zones in the cooled and crystallized igneous rocks. In some situations, an immiscible liquid will separate during the cooling and crystallization of the magma. The separated liquid is rich in iron, titanium, and phosphorus, and is denser than the magma. Once formed, this liquid seldom remixes with the magma again. The iron-, titanium-, and phosphorus-rich liquid accumulates and solidifies separately.

Primary igneous titanium deposits form by the separation of iron-titanium-rich liquids from magma that crystallized to form a distinctive igneous rock called "anorthosite." This unusual rock is composed dominantly of a common rock-forming mineral called "labradorite." Large masses of igneous rocks consisting mostly of a single mineral are uncommon in Earth's geologic record. Very large (10,000-20,000 km^2) anorthosite-dominated igneous intrusions appear to have formed only between 0.9 and 1.7 billion years ago and are concentrated in two broad trans-oceanic belts (Windley, 1977). One belt includes anorthosite intrusions in north-central (Wyoming) and northeastern (New York) United States, eastern Canada, Norway, Sweden, Finland, Latvia, Lithuania, Estonia, Poland, and Ukraine. The other belt, called the

Pan-African belt, includes intrusions in Brazil, Angola, Tanzania, Madagascar, Antarctica, India, and Australia. Iron-titanium ilmenite deposits typically are associated with these belts of igneous anorthosite intrusions.

The anorthosite intrusions were emplaced along major crustal boundaries that represent the zones where tectonic plates have collided. Anorthosite intrusions, like the one that hosts the Abu Ghalaga titanium deposit in Egypt, form a linear cluster associated with the Pan-African belt. Overall, this orogen extends from western France, through eastern Africa, to Madagascar, southern India and Sri Lanka, and into Antarctica, and formed by a complex series of plate events associated with the collision of continental plates (of east and west Gondwana) between about 650 and 550 Ma (Condie, 2003). The anorthosite intrusions were emplaced late in the development of the orogen. The ascending magmas appear to have collected and crystallized near the base of the Earth's crust. The anorthosite intrusions then were emplaced into higher levels of the crust along major vertical fault zones. Although magmatism is a defining characteristic of the collision of tectonic plates, the unusual composition of these rocks distinguishes them from the igneous rocks found with all other orogenic magmatic arcs.

An additional important source of primary igneous titanium occurs in association with vanadium in titanium-vanadium-rich magnetite deposits associated with ultramafic complexes and carbonatites. In South Africa, the Bushveld Igneous Complex contains the world's largest resource of vanadium-bearing titaniferous magnetite in the Upper Zone of the Rustenburg Layered Suite (Wipplinger, 1998). Between 10 and 30 titaniferous magnetite-bearing layers have been identified along a strike length of 175 km from Pretoria to the Crocodile River, and along a strike length of 165 km in the eastern Bushveld Complex. Although not currently mined for their titanium content, the titaniferous magnetite layers in the Upper Zone represent a future resource that could become economically viable when the ilmentite beach placers become

depleted. Additional titanium resources are contained in plugs or pipes of similar chemical composition that are associated with the magnetite seams. In some of these pipes, the magnetite is coarse grained enough to allow for the concentration of ilmentite and magnetite (Wipplinger, 1998).

At Phalaborwa, titaniferous magnetite is recovered as a by-product of copper and phosphate production. Up to 50 percent by weight of the Foskorite orebody and 25 percent of the entire carbonatite body consists of titaniferous magnetite. At present, there is no viable metallurgical technique for recovering the titanium content of the stockpiled high titanium magnetite ores (Wipplinger, 1998).

In contrast, secondary deposits form as titanium-rich minerals are weathered from rocks such as those described above and are transported and concentrated by streams, rivers, ocean currents, and most importantly, by eolian processes to form shoreline beach placers. Titanium-enriched minerals are heavier than other minerals. Consequently, the interaction of flowing water and wind will concentrate these and other minerals (like gold) as placer deposits in sediments, particularly in coastal environments (Harben and Kužvart, 1996; Wipplinger, 1998). Placer deposits in eolian shoreline environments contain the bulk of the world's titanium resource.

Numerous shoreline beach placer deposits occur along the coastline of eastern and southern Africa from Egypt to South Africa (for example, Abu Ghalaga and Nile Delta-Rosetta in Egypt, Kwale in Kenya, Corridor Sands in Mozambique, and Namaqua Sands and Richards Bay in South Africa), along the west Africa coast in The Gambia, Sierra Leone, Namibia and South Africa (for example, Sanyang in The Gambia, Sierra Rutile and Rotifunk in Sierra Leone, Walvis Bay in Namibia), and along the southwestern and eastern coasts of Madagascar (for example, Toliara and Fort Dauphin).

Sierra Rutile in southwestern Sierra Leone is thought to be the world's largest known rutile deposit. It covers an area of 580 km^2 and was responsible for about 25 percent of world production of rutile at the time it ceased production in 1995 due to civil war. Following the cessation of hostilities, Sierra Rutile has restarted production based on proven and probable reserves of 278 million tonnes of ore grading 1.43 percent TiO_2 (Titanium Resources Group, 2005). The Richards Bay deposit in South Africa is located on the southeastern coast north of Durban and consists of a 17 km long by 4 km wide area of dune sands of Quaternary age containing an original resource of 770 million tonnes of ore. Ten percent of the dune sand consists of heavy minerals, of which 70 percent are economically recoverable minerals; including ilmenite, rutile, zircon, leucoxene, and magnetite. Existing reserves are expected to last until about the year 2017 (Wipplinger, 1998).

Vanadium

More than 95 percent of the vanadium consumed in the United States is for metallurgical use, primarily as an alloying agent for iron and steel. South Africa provided 91 percent of U.S. imports of vanadium pentoxide (V_2O_5) from 1999 to 2002 from its mines in the Bushveld Complex. Vanadium occurs in quantities varying between 0.3 and 2 percent in layers of titanium-rich magnetite in the Upper Zone of the Bushveld Complex and in pipes (fig. 10h; see titanium section). Of the 38 million tonnes of vanadium reserves in the world, 12 million are in the Bushveld Complex. However, because vanadium is usually recovered as a byproduct or co-product from other mining operations, demonstrated world resources of the element are not fully indicative of available supplies.

Table 20. Vanadium—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
South Africa	25.0	2	23.1	31.6

Zirconium and Hafnium

Zirconium and hafnium are considered twin elements because they are always found together mostly in the minerals zircon (zirconium silicate) and baddeleyite (zirconium dioxide). The largest use of zirconium is in ceramics, opacifiers, refractories, and foundry applications. Other uses include abrasives, chemicals, metal alloys, welding rod coatings, and sandblasting. Hafnium is mostly used as an addition in super alloys. Australia is the world's largest producer of zirconium-hafnium followed by South Africa and the United States.

Table 21. Zirconium—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
South Africa	31.5	2	36.8	19.4

Table 22. Hafnium—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
South Africa	NA	NA	45.9	26.4

Zircon originates as a trace mineral in many igneous and metamorphic rocks particularly those that are quartz- and feldspar-rich such as granites. Because zircon is extremely resistant to weathering, it is present in many ancient to recent beach sands and placer deposits along with titanium minerals, monazite, and other heavy minerals. Some beach sands and placer deposits

are particularly rich in these heavy minerals and are the principal source of zircon. In South Africa, mineral-sands production is dominated by the Richard's Bay operations on the southeastern coast (see titanium section), some 190 km north of Durban (fig. 9f). These titanium-rich eolian dune sands and well-layered beach deposits extend for about 110 km along the Indian coast (Wipplinger, 1998).

Industrial Minerals

Asbestos

"Asbestos" refers to a small number of minerals that form as flexible fibers and have the useful physical property of being very heat and fire resistant. Asbestos is used mainly in gaskets and roofing shingles. Asbestos mineral fibers are flexible and can be woven to make fabrics for heat-resistant and insulating materials. Chrysotile (hydrated magnesium silicate) constitutes 98 percent of current world production of asbestos. Russia has been the largest producer of asbestos minerals with Zimbabwe ranked sixth (table 23). The world has about 200 million tonnes of identified asbestos resources (USGS, 2004a).

Table 23. Asbestos—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Zimbabwe	5.8	6	Moderate	Moderate

Asbestos (chrysotile) deposits typically are associated with magnesium-rich igneous rocks such as ultramafic rocks in layered igneous complexes and some metamorphic rocks formed by reaction with mafic-ultramafic igneous intrusions. The formation of asbestos minerals results from reaction of the magnesium-rich rocks with hydrothermal fluids during

periods of deformation. Ultramafic rocks are widespread in Africa and the Middle East, particularly in Archean greenstone belts and fragments of oceanic crust that have been emplaced into continental crust during the collision of convergent tectonic plates. As a result, asbestos deposits occur throughout the region, though of varying size and quality. The Shabanie deposit in Zimbabwe has the largest reserves of fiber asbestos in southern Africa (Virta and Mann, 1994) and is associated with alteration along the base of an ultramafic intrusion.

Barite

Barite is a relatively soft mineral composed of barium and sulfur. It is chemically inert and insoluble and is unusually heavy for a nonmetallic mineral. These properties are responsible for its value in many applications. Nearly 98 percent of the barite used in the United States is used as a weighting agent in oil- and gas-well drilling fluids. Because barite looks opaque on X-ray film, it is used in medicine to diagnose gastrointestinal problems. The world's barite resources are about 2 billion tonnes, but only about 740 million tonnes are in identified reserves.

Table 24. Barite—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Algeria	0.75	14	4.5	2.0
Iran	3.7	5	NA	NA
Morocco	7.0	4	5.0	1.5
Turkey	1.5	8	2.0	2.7

Commercial deposits of barite are classified geologically into three types—vein and cavity filling deposits, residual deposits, and bedded deposits (Brobst, 1994). Barite is a common mineral in veins and cavity fillings formed from hydrothermal solutions especially in association with lead, zinc, gold, silver, fluorite, and minerals containing rare earth elements.

Residual barite deposits form by weathering of preexisting deposits associated with sedimentary rocks. Barite also occurs as bedded layers that were chemically precipitated on the sea floor. Vein deposits have been the biggest source of barite in Morocco and Algeria, and bedded deposits associated with massive sulfide deposits are an important source in Iran and Turkey (Brobst, 1994). A more thorough description of barite deposits is found in Brobst (1994).

Boron

Boron is a semimetallic element that is a dark, amorphous (noncrystalline), nonreactive solid. Boron is mined from a variety of borate minerals and compounds composed mostly of boron and oxygen in combination with sodium, calcium, and magnesium. Borates have a wide variety of uses, including the manufacture of glass, ceramic glazes, fertilizers, fire retardants, and soaps and detergents.

Table 25. Boron—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Turkey	34.5	1	35.3	36.6

Deposits of borate (a source of boron) are found in on-land continental basins of the western part of Turkey. The continental basins were formed through extension of continental crust and are filled with upper Cenozoic sedimentary and volcanic rocks. Borate deposits are characterized by concentrations of borate minerals (most commonly colemanite (hydrous calcium borate) and ulexite (hydrous sodium calcium borate) within selected sedimentary units that were deposited in a lake environment. The source of the boron is believed to be the volcanic rocks that were being erupted at the time of basin and lake formation (Helvaci, 1995; Helvaci and Orti, 1998; fig. 10l). The deposits generally consist of lenticular-shaped concentrations of

borate minerals within ore zones that are typically tens of meters thick and hundreds to thousands of meters in lateral dimensions. These deposits, which are mined both by open-pit and underground methods, are concentrated in four major districts in western Turkey (fig. 9d; Kirka, Emet, Bigadic, and Kestelek) and collectively represent about 650 million tonnes of borate, or 60 percent of the world's borate reserve (Engin, 2003). A more thorough description of borate deposits related to sedimentary rocks is found in Barker and Lefond (1985) and Garret (1998).

Bromine

Bromine is the only nonmetallic element that is liquid at room temperatures and volatilizes to a red vapor that is very irritating to the eyes, nose, and throat. Because it is a highly reactive element, it exists in nature only as bromide compounds. Bromine is primarily used in fire retardants, drilling fluids, pesticides, water-treatment chemicals, and other products (USGS, 2004a). Resources of bromine are virtually unlimited because it is found in recoverable quantities in the oceans. However, most production comes from brines because they have a higher bromine concentration than seawater. Israel ranks second behind the United States in the production of bromine (USGS, 2004a).

Table 26. Bromine—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Israel	36.1	2	NA	NA
Jordan	3.5	6	NA	NA

Seawater contains about 65 parts per million bromine while the Dead Sea contains 4,000 to 5,000 parts per million. However, bromine production is mostly from Dead Sea brines, which

have concentrations of 12,000 parts per million (0.12 percent) and also produce potash. The Dead Sea is estimated to contain 1 billion tonnes of bromine (USGS, 2004a).

Clay (Bentonite and Kaolin)

Bentonite is the general name given to a group of clay minerals (smectites) that have very high (sodium type) to moderate-low (calcium type) swelling capacity and form gel-like masses when added to water. It is the swelling (absorbent) capacity of bentonite that has led to uses for pet waste absorbent (25 percent), drilling mud (21 percent), foundry sand bond (21 percent), iron ore pelletizing (15 percent), and other uses (18 percent) (USGS, 2004). Of the countries covered in this report, Turkey ranked fourth in world production of bentonite in 2003. World resources of bentonite are extremely large (USGS, 2004).

Table 27. Clay (Bentonite)—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Turkey	5.9	4	NA	NA

Bentonite most commonly forms through the alteration of fine-grained volcanic fragmental deposits (ash and tuff). The alteration of ash to bentonite involves hydration reactions as well as addition of various chemical elements. As a result, most bentonite is found in marine sequences where interlayered volcanic ash has been altered in contact with sea water (Elzea and Murray, 1994).

Kaolin is a term for a group of clay minerals that might best be described as kaolinite-bearing clays. This group of clays includes commercial varieties (or subgroups) such as ball clay, halloysite, kaolin, and refractory or flint clay. Although best known as the main component

in porcelain and other ceramics, kaolin has diverse uses in the production of paper, refractories, cosmetics, bricks, and drain tiles.

Table 28. Clay (Kaolin) — proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Turkey	0.78	9	NA	NA

Kaolin forms by the hydrothermal alteration of rocks by natural acidic solutions and by the weathering and erosion of rocks with the resultant clays accumulating in sedimentary basins. Many of its uses are determined by its whiteness and chemical composition.

Diamonds (Industrial)

Diamonds are composed of carbon in a cubic form and are the hardest known material. Natural industrial diamonds come in many shapes and sizes that largely determine their uses, which include computer chip production, construction, machinery manufacturing, mine drilling, stone cutting/polishing, and transportation systems (infrastructure and vehicles) (USGS, 2004a). Today more than 90 percent of the industrial diamond market uses synthetic industrial diamond because of greater control of the quality and properties than with natural industrial diamonds. The origin and occurrence of diamonds in Africa and the Middle East are described below under gemstones.

Table 29. Diamonds (Industrial)—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Botswana	13.7	4	22.4	18.0

Democratic Republic of the Congo	22.9	2	25.9	28.0
South Africa	10.2	5	12.1	12.0

Fluorspar

Fluorspar is a calcium and fluorine compound formed as a byproduct of industrial processes. The naturally occurring mineral of the same composition is called "fluorite." Most of the use of fluorspar is for the manufacture of hydrofluoric acid, which is a key ingredient in the manufacture of aluminum and uranium. Hydrofluoric acid also can be used to make water fluoridation chemicals that are added to municipal water supplies to help reduce tooth decay. Identified world fluorspar resources were approximately 500 million tonnes of contained fluorspar (USGS, 2004a).

Table 30. Fluorspar — proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Kenya	2.2	8	0.87	0.62
Morocco	2.1	9	NA	NA
Namibia	1.9	10	1.3	1.0
South Africa	5.3	3	17.8	16.7

The Vergenoeg deposit in South Africa (fig. 9c) is one of the most important fluorspar deposits in the world, although the present open-pit mine is approaching the end of its projected life span. The main ore body formed in a volcanic vent in silica-rich volcanic rocks associated with the Bushveld Igneous Complex. The hydrothermal deposit is funnel shaped and consists on average of 20-40 percent fluorite and 50-60 percent iron (hematite). The deposit was originally

mined for its iron. Indicated resources are over 20 million tonnes of contained fluorite (Martini and Hammerbeck, 1998).

Gemstones

The terms "gem" and "gemstone" mean any mineral or organic material (for example, pearl and petrified wood) used for personal adornment, display, or objects of art because it possesses beauty, durability, and rarity (Mineral Information Institute, USGS, and American Coal Foundation, undated). Examples of minerals that are used as gemstones include amethyst (purple variety of quartz), beryl, diamond, garnet, malachite, topaz, and tourmaline. Blue topaz is considered a gemstone even though the brilliant blue color usually is produced by irradiation and heating of drab topaz. Tanzanite, a new gem mineral first discovered in 1967 in Tanzania, is also generally heat treated to generate the beautiful violet-blue color this stone is known for. Because gemstones within the region often are produced by artisanal miners and small-scale mining operations, it can be difficult to identify true production levels or quantify the size of reserves or potential resources. Most of the gemstone production of Africa comes from countries within the Neoproterozoic Mozambique belt and include Kenya, Tanzania, Mozambique, Malawi, Zimbabwe, and Madagascar.

Diamond is a crystalline form of elemental carbon that forms at extremely high temperature and pressure conditions that are possible only very deep in the Earth's upper mantle. Large diamonds, particularly large diamonds without flaws, are extremely rare and are very valuable as gemstones. The vast majority of diamonds, however, are small, flawed, and colored by dark impurities. These small impure diamonds have a variety of industrial uses, particularly as abrasives to coat saw blades for stone cutting and highway building (Mineral Information Institute, USGS, and American Coal Foundation, undated). The majority of the world's gem diamond reserves are in southern Africa, Australia, Canada, and Russia. In addition to the

countries listed below, in the region of this report Cote d'Ivoire, Gabon, and Liberia are also known to produce gem diamonds (USGS, 2004a).

Table 31. Gem diamonds—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Angola	6.6	5	NA	NA
Botswana	26.4	1	NA	NA
Central African Republic	0.66	11	NA	NA
Democratic Republic of the Congo	5.3	7	NA	NA
Ghana	1.1	9	NA	NA
Guinea	0.49	14	NA	NA
Namibia	1.8	8	NA	NA
Sierra Leone	0.86	10	NA	NA
South Africa	6.2	6	NA	NA
Tanzania	0.58	13	NA	NA

Diamond deposits can be classified as either igneous or surficial (table 3). Most diamonds are transported to the surface from deep in the Earth's interior (>180 km) by highly explosive, rapidly injected magmas known as kimberlites (named after the famous Kimberly diamond mining district near Kimberly, South Africa)(fig. 10j), which occur as volcanic pipe-like bodies and dikes (fig. 10n). Kimberlite bodies range in size from small pipes or dikes only a few meters in diameter to ones a kilometer or more across. Only about 30 percent of the more than 5,000 kimberlite bodies known in the world contain diamonds and only about 1 percent contain diamonds in mineable concentrations. Most diamond-bearing kimberlites are found in continental crust older than 2.5 billion years (that is, the most ancient parts of cratons called archons). In contrast, some non-kimberlite diamond-bearing bodies have been found in crust as

young as 1.6 billion years; no primary diamond deposits are recognized from continental areas younger than 1.6 billion years. Erosion of primary diamond deposits can result in alluvial (placer) diamond deposits. Because they involve transport by rivers, placer diamond deposits can be found long distances from their primary sources. Because the grade and quality of diamonds tend to be greatest in the upper parts of kimberlite bodies that are susceptible to erosion, a sizeable fraction of the diamonds from kimberlite bodies can end up transported by streams and deposited in placer deposits (Gurney and others, 2005).

The African continent contains three principal areas with crust older than 1.6 billion years in the South African (Kalahari), Central African (Kasai), and West African cratons (fig. 7a). All three cratons contain primary diamond deposits with the Kalahari craton containing the majority of the world's active major kimberlite diamond mines in South Africa, Botswana, Zimbabwe, and Swaziland. Large placer diamond deposits are also found and mined along the Orange River (Lower Orange River alluvials) and the Atlantic coast of South Africa and Namibia (fig. 10m). In central Africa, primary kimberlite diamond deposits are located in Angola, Congo-(Kinshasa), and Tanzania (figs. 9e and 10m). This region also contains several large placer mining areas in Angola (Lunda and Cuango Valley), Congo (Mbuji-Mayi and Tshikapa), and the Central African Republic (fig. 10m). In the West African craton, diamondiferous kimberlites are present in Sierra Leone, Guinea, Liberia and Mali (figs. 9e and 10m). Placer deposits immediately downstream from the kimberlites are mined in Sierra Leone, Guinea, and Liberia, and new occurrences of kimberlite bodies and placer deposits are being evaluated in Mali. Primary diamond deposits were mined in the past in Côte d'Ivoire, and large placer deposits, which have not been traced to their primary host rocks, are mined in Ghana and Côte d'Ivoire. Six African countries rank among the top ten diamond producers of the world, and Botswana continues to lead with regards to production of the largest amount of diamonds by value. Although

production from newly discovered diamond deposits in northern Canada will impact world diamond production, Africa is expected to maintain its prominent position in diamond production for the foreseeable future (USGS, 2004a).

Emeralds are the deep green, transparent form of the relatively common mineral beryl, which is composed of beryllium, aluminum, silicon, and oxygen. Aquamarine is also a form of beryl but its blue color results from trace impurities of iron. Deposits of beryl are igneous in origin. As granitic magma cools and crystallizes, common rock-forming minerals grow from chemical elements in the magma. Chemical elements that don't fit into the growing mineral's atomic structure, because the atoms are too large or don't have the right electrical charge, remain and concentrate in the residual silicon-rich fluid. This fluid sometimes crystallizes as a rock called pegmatite, which is composed of large mineral crystals that often include beryl, tourmaline, and other exotic minerals.

Amethyst, citrine, rose quartz, and smoky quartz all are color variants of the common mineral quartz, which is composed mainly of silicon and oxygen. Amethyst's purple color is due to trace amounts of a special form of iron (Fe^{+4}) that absorbs all colors of light except blue and red, which are reflected back to us (Post, 1997).

Tanzanite, a variety of the metamorphic mineral zoisite (calcium aluminum silicate hydroxide), was first discovered in 1967 in Tanzania (hence the name). When first mined, most stones have a muted green color, and the stones are heat treated to produce the unique blue-lavender color valued as a gemstone. The only known source of tanzanite is a small hilltop area at Merelani, about 16 km south of the Kilimanjaro International Airport in Tanzania (fig. 9e).

Graphite

Graphite is a gray to black, opaque, flexible but not elastic, soft crystalline form of carbon with a metallic luster. Graphite is considered a semimetal because it exhibits the

chemical properties of a metal and a nonmetal, which make it suitable for many industrial applications. The metallic properties include thermal and electrical conductivity. The nonmetallic properties include chemical inertness, lubrication qualities, and high thermal resistance. Graphite is used mainly in brake linings and in refractories, which are heat-resistant materials such as those used in the brick lining of furnaces and kilns. Graphite also is an important component in steel. The world's inferred reserve base exceeds 800 million tonnes of recoverable graphite (USGS, 2004a).

Table 32. Graphite—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Madagascar	1.3	10	1.1	0.34

Economic graphite deposits are metamorphic deposits (fig. 9f) in which graphite occurs in three forms that can have different applications. Flake graphite is composed of flat, plate-like grains disseminated in metamorphosed sedimentary rocks. Lump graphite is a high-crystalline form that occurs in veins. Amorphous graphite is a microcrystalline form of graphite that occurs in thermally metamorphosed sedimentary rocks and coal (Oosterhuis, 1998a). Madagascar is one of the most important producers of graphite because of the size and quality of its flake graphite. Present production comes from deposits along its eastern coast (fig. 9f) where the deposits are associated with rocks that have been recrystallized at very high temperatures and pressures. Production comes mostly from residual material formed through the extensive tropical weathering of the graphite-bearing metamorphic source rocks (USGS, 2004b).

Gypsum

The mineral gypsum is composed of calcium, sulfur, and oxygen in the form of hydrated calcium sulfate. It is the most common of the approximately 150 sulfate minerals (Mineral Information Institute, USGS, and American Coal Foundation, undated). More than two-thirds of the gypsum mined is used for plaster and wallboard in houses and other buildings. Data on world reserves and reserve base are not available.

Table 33. Gypsum—proportion of world mine production for countries covered by this report (USGS, 2004).

Country	Percent of world production, 2003	Rank of world production
Egypt	2.0	12
Iran	11.3	2

The principal resources of gypsum are located in sedimentary evaporite deposits. Iran ranks second in world production of gypsum while Egypt ranks 12th (USGS, 2004a). In the Middle East, gypsum deposits are associated with salt flats, or sabkhas, such as those along the margins of the Persian Gulf (figs. 3, 9d). Sabkhas are tidal flats that form where sea water flows in during high tide and gets trapped in pools. During low tide, the sea water in the pools is concentrated by evaporation and sinks into the ground where it deposits gypsum. Through time, this process can deposit a large thickness of gypsum-rich material.

Halite (Salt)

Salt is necessary to support life. In its most commonly used form, salt occurs as the mineral halite (sodium and chlorine), which forms in sedimentary deposits. The chemical industry produces about 40 percent of the world's salt, which is also a major source of chlorine.

About 35 percent of salt produced is for highway deicing (Mineral Information Institute, USGS, and American Coal Foundation, undated). World resources of salt are practically unlimited, and the salt content of the oceans is virtually inexhaustible (USGS, 2004a). Data are not available to report individual countries' percent of world production or percent of world reserve base. World salt production figures for 2003 do not include production from any of the countries from the region of this report.

Halite is crystallized when sea water gets trapped in shallow basins and evaporates. The shallow basins can be tectonically formed collapse features (rifts) at or near continental margins, or interior, tectonic basins that have no egress, such as the Great Salt Lake in Utah. The evaporation process is greatly aided by a dry (arid) climate. Production of salt is by dissolving old, sedimentary layers of salt with hot water and evaporating the solution, or by trapping sea water in shallow ponds on tidal flats. Old salt beds, or layers, also can be mined, and the salt that is produced is suitable for highway deicing. Salts are produced at some level by most countries in the region.

Deposits of salt, potash (a source of potassium), bromine, iodine, boron, and magnesium are found primarily in upper Cenozoic sedimentary rock sequences of the Red Sea Basin and the eastern part of the Arabian Platform. These types of deposits are concentrated in the Dead Sea Basin area of Israel and Jordan, the eastern Red Sea coastal plain of Saudi Arabia, and in the Zagros Mountains of southern Iran (fig. 2). These commodities concentrate in and precipitate from brines that form from evaporation of the waters that carry them. Salt and some related potash deposits often are found as salt domes that have risen from bedded salt deposits at depth. A more thorough description of potash, salt, and associated deposits related to sedimentary rocks is found in Sonnenfeld (1991).

Helium

Helium is a noble gas and the second lightest element after hydrogen. It is processed from natural gas deposits and is used for cryogenics (24 percent), pressurizing and purging (20 percent), welding (18 percent), controlled atmospheres (16 percent), leak detection (6 percent), breathing mixtures (3 percent), and other uses (13 percent) (USGS, 2004a). Algeria ranked second behind the United States in the production of helium in 2003 (USGS, 2004a).

Table 34. Helium—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Algeria	15.6	2	NA	12.0

Kyanite and Related Minerals

Kyanite and its related minerals andalusite and sillimanite are aluminosilicate polymorph (chemical substances with the same composition but different crystal structure) minerals that convert to the highly refractory compound mullite at high temperature. As a result, kyanite and related minerals are important raw materials for the production of high-alumina refractories and ceramics. Of the refractory uses, about 60-65 percent is used in iron making and steelmaking, and the remainder in the manufacture of chemicals, glass, nonferrous metals, and other materials (USGS, 2004a). South Africa ranked first in world production of kyanite and related minerals in 2003.

Table 35. Kyanite—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
South Africa	53.7	1	NA	NA
Zimbabwe	1.2	5	NA	NA

South Africa possesses the world's largest known deposits of andalusite. Andalusite is a low temperature/low pressure mineral with identical composition to kyanite, but with a different crystal structure. Most of the South African andalusite deposits have developed in aluminum-rich sediments that were metamorphosed by the magmas of the Bushveld Complex (Oosterhuis, 1998b; see discussion under chromium above). South Africa reports a reserve base of about 51 million tonnes of aluminosilicate ore (andalusite and sillimanite; USGS, 2004a).

Limestone and Other Carbonate Rocks

Limestone and other carbonate rocks have diverse uses from high-volume, low-value construction aggregate, to lower-volume, higher-value uses for the production of lime, food, paper and plastic manufacturing, metal-ore processing, and clean air, water, and sewage. These uses are essential to maintain our infrastructure, public health, and industries. For many years, commodities such as limestone have been considered to be common materials that are readily available from nearby deposits. However, a variety of factors are changing that situation, including increased standards for chemical and physical qualities, increasingly diverse uses, depletion of the best local resources, and the economies of large-scale production. Consequently, huge new quarries are being developed to supply distant markets (USGS, 2004a). Limestone and other carbonate rocks such as dolomite are a common rock type of marine and lacustrine

sedimentary sequences worldwide. They form primarily in ocean basins by chemical precipitation of calcium and magnesium carbonate from seawater.

Table 36. Lime—proportion of world mine production for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production
Iran	1.7	11
South Africa	1.4	15

Lithium

Lithium is a metallic element that is widely distributed in Earth's crust at low concentrations. The use of lithium compounds in ceramics, glass, and primary aluminum production represents more than 60 percent of estimated consumption (Mineral Information Institute, USGS, and American Coal Foundation, undated). Other major end uses for lithium are in the manufacture of lubricants and greases, pharmaceuticals, batteries, and synthetic rubber. The identified lithium resources total 760,000 tonnes in the United States and more than 13 million tonnes in other countries (USGS, 2004).

Table 37. Lithium—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Zimbabwe	4.5	6	0.56	0.24

Lithium is concentrated in nature dominantly by two processes, igneous and sedimentary. During the crystallization of magmas of certain compositions, some elements are concentrated in the residual fluids, which are the last to crystallize. Lithium is one of those elements. The rock

that crystallizes from this residual fluid is characterized by large, exotic minerals and is called a pegmatite. Most lithium that is produced today is from lithium-rich brines in sedimentary basins. These brines were formed by weathering of certain kinds of volcanic rocks followed by concentration of the solution under conditions of extreme evaporation.

Production in Zimbabwe is from a pegmatite deposit in the Bikita tinfields, located about 75 km east of Fort Victoria (fig. 9d). The lithium-rich pegmatite body is about 1,700 meters long and varies in width from 30 to 70 meters. The pegmatite is zoned and contains a variety of important lithium-rich minerals. Proven reserves are 12 million tonnes grading 1.4 percent lithium (Kunasz, 1994).

Magnesium (Magnesite)

Magnesium is mined mostly as the mineral magnesite (magnesium carbonate) that occurs in metamorphic deposits. Magnesium is also produced from seawater, brines in sedimentary basins, dolomite (iron-magnesium carbonate), and brucite (magnesium hydroxide). Magnesite is mostly used by the refractories industry to make high-temperature bricks for furnaces, for industrial chemicals, for agricultural, chemical, and environmental applications, and as a source of metallic magnesium used for making aluminum alloys. Identified world resources of magnesite total 12 billion tonnes, and of brucite, several million tonnes (USGS, 2004a). Resources of dolomite and magnesium-bearing evaporite minerals are enormous, and magnesia-bearing brines are estimated to constitute a resource in billions of tonnes.

Table 38. Magnesium compounds—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Turkey	17.3	2	2.9	4.4

Turkey is the major producer of magnesia in the region, ranking second in world production of magnesium compounds. Israel ranks fourth in world production of magnesium metal with 6.7 percent and accounted for 11 percent of U.S. imports of magnesium metal from1999-2002. Also, the Republic of the Congo is developing a 60,000 tonne-per-year magnesium plant that is scheduled for initial production in 2007, with magnesium to be recovered from a deposit of magnesium salts (USGS, 2004a).

Perlite

Perlite is a natural volcanic glass that is similar to obsidian, but has distinctive concentric cracks and relatively high water content. Perlite forms by the hydration of obsidian, volcanic glass formed by the very rapid cooling of silica-rich lava (rhyolite). Perlite is used mostly in the construction industry, in gardening as horticultural aggregate, and in water filters. The world reserve base for perlite is estimated to be 7.7 million tonnes of which 74 percent is in Turkey (USGS, 2004a). Perlite deposits are associated with young (Tertiary to Holocene) rhyolite volcanic fields.

Table 39. Perlite—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Turkey	9.4	5	NA	74.0

Phosphate

Phosphorus is an essential element for plant and animal nutrition and is indispensable for world food production. It is mined from rocks so enriched in phosphorus that they are called

phosphate rock or phosphorites. Most phosphate rock mined is converted to phosphate fertilizers. From 1999-2002, the United States obtained 99 percent of its imported phosphate from Morocco (USGS, 2004a).

Table 40. Phosphate rock—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Egypt	1.1	13	0.56	1.5
Israel	2.9	8	1.0	1.6
Jordan	5.2	6	5.0	3.4
Morocco and Western Sahara	17.4	2	31.7	42.0
Senegal	1.1	13	0.28	0.32
South Africa	1.8	9	8.3	5.0
Syria	1.7	10	0.56	1.6
Togo	1.5	12	0.17	0.12
Tunisia	5.6	5	0.56	1.2

About 80 percent of the world's phosphate (P_2O_5) production comes from sedimentary deposits of phosphate rock that form on or near the margins of continents where organic productivity is high and there is a limited influx, and dilution by, other sediments (Harben, 2002; Harben and Kužvart, 1996). High marine biological productivity often is associated with upwelling ocean currents along continental margins. These currents bring phosphorus-rich cold waters from deeper ocean levels nearer the surface. This nourishes and stimulates growth of plants and animals whose remains accumulate on the sea bottom as concentrations of

phosphorus-rich organic debris. This phosphate-rich debris forms extensive layers that cover thousands of square kilometers and eventually may become phosphate-rock deposits that we mine today. The largest deposits are found in northwestern Africa, China, the Middle East, and the United States (USGS, 2004b). In 2003, countries from the region of this report accounted for 38.3 percent of world production and contain 56.7 percent of the world's reserve base.

The largest deposits in Africa are located in Morocco and Western Sahara. Morocco's enormous measured phosphorite resources of 85,000 million tonnes are hosted in Upper Cretaceous, Paleocene and Eocene sedimentary rocks. Sequences comprising clays, marls, limestones, and cherts contain several phosphate-rich beds. Used mainly in the manufacture of fertilizers, phosphate rock comes from mines located in Khouribga, Benguérir, Youssoufia, and Boucraa-Laayoune (in Western Sahara). The Benguérir deposit occurs in the north-central part of the Ganntour reserves, and the Youssoufia deposit occurs in the western part of the Ganntour reserves (31,000 million tonnes; Office Cherifien des Phosphates Group, 2008).

Additional phosphate production in western Africa comes from sedimentary phosphorite deposits in Senegal. There are several phosphate occurrences and deposits in Senegal. The four main phosphate deposits are (1) the Neoproterozoic/Cambrian phosphates in the Namel area, southeast Senegal, (2) the Eocene phosphate deposits along the Senegal River, including the Matam deposits, (3) the Eocene primary phosphate deposits in western Senegal, mined at Taiba and Lam Lam, and (4) the aluminous phosphates of Thies, weathering products of the Eocene phosphates, found also in western Senegal. In 1997, the total phosphate production from Senegal was 616,700 tonnes, down from approximately 1 million tonnes of phosphate concentrate in 1993, which were exported to Canada, Australia, Mexico, and China (van Straaten, 2002).

The most significant phosphate deposits in the Middle East region are found in Mesozoic and Cenozoic sedimentary rock sequences of the Arabian platform in the northern Arabian peninsula. Phosphate is the most valuable nonfuel mineral resource in the petroleum-rich Arabian peninsula. The deposits are characterized by phosphate-rich bedded units that are often only meters thick but kilometers to tens of kilometers in length and width. The deposits are mined by open-pit methods, and the phosphate ore is used to generate phosphatic acid, which is primarily used for fertilizer. The Middle East contains a significant proportion of the world's phosphate resources. The largest of these resources include the Sawab deposit, Iraq (770 million tonnes of phosphate); the Esh Shidiya deposit, Jordan (314 million tonnes of phosphate; Jallad and others, 1989); and the Al Jalamid deposit, Saudi Arabia (100 million tonnes of phosphate; fig. 10o; Collenette and Grainger, 1994) (fig. 9d) (Chernoff and Orris, 2002; Orris and Chernoff, 2002). A more thorough description and worldwide database of phosphate deposits related to sedimentary rocks are found in Notholt (1994), Chernoff and Orris (2002), and Orris and Chernoff (2002).

A small percentage of the world supply of phosphate comes from deposits formed from the mineral apatite particularly during the intense weathering of igneous rocks of unusual composition (Mariano, 1989). Apatite is composed principally of calcium, phosphorous, fluorine, and oxygen, and usually is present in only very small amounts in most igneous rocks. However, apatite can be abundant in rocks that are low in silicon, such as carbonate-rich igneous rocks known as carbonatite. The Phalaborwa (Palabora mine) Carbonatite Complex in South Africa (fig. 9d), the world's only carbonatite complex with economic concentrations of copper mineralization, contains up to 25 percent apatite with inferred reserves of over 2 million tonnes at a grade of 7.45 percent phosphorous pentoxide (P_2O_5) (Wilson, 1998). The Complex represents the remains of an alkaline volcano that was active about 2 billion years ago.

Potash (Potassium)

"Potash" refers to a group of water-soluble salts that contain the chemical element potassium. Like phosphorous, potassium is an essential element for animal and plant nutrition and food production; it is present in all living cells. Over 95 percent of potash production is used for fertilizers. Estimated world resources total about 250 billion tonnes (USGS, 2004a).

Table 41. Potassium—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

[Note: Total reserves and reserve base in the Dead Sea are arbitrarily divided equally between Israel and Jordan for tabulation]

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Israel	7.5	5	0.48	3.4
Jordan	4.4	6	0.48	3.4

Potash production in the region comes from brine deposits of the Dead Sea. Brine deposits form by the evaporation of salt water, either sea water or water that has had chemical components dissolved from adjacent rocks and washed into a basin. Brine deposits tend to form in arid climates, are relatively inexpensive to mine, and often have the potential for co-production of other commodities.

Pumice

Pumice is a volcanic rock characterized by a cellular structure (vesicles) that results from the release of dissolved gases from silica-rich lava to generate a froth that cools and solidifies

into rigid foam. The abundant vesicles lower the density and increase the porosity of pumice, and as these vesicle walls are broken, sharp cutting edges are continually generated. It is these properties that are the basis for pumice's commercial value as lightweight aggregates, insulators, absorbents, and abrasives. Stonewashing or laundry use has been the most rapidly growing segment of the pumice industry and most of the pumice produced in Turkey has been supplied to European markets for stonewashing (Geitgey, 1994). Commercial pumice deposits mostly are associated with young (Tertiary to Holocene) rhyolitic volcanic fields in the region.

Table 42. Pumice and pumicite—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Algeria	3.5	9	NA	NA
Iran	5.4	6	NA	NA
Turkey	6.1	5	NA	NA

Soda Ash (NaCO)

Soda ash is the common name given to sodium carbonate (Na_2CO_3), an important industrial compound used to manufacture glass, chemicals, soaps and detergents, pulp and paper, and many other consumer products. It has been used at least since about 3,500 B.C., when the Egyptians are known to have used natural soda ash in making glass. Natural sodium carbonate resources commonly occur as precipitates in shallow, nonmarine alkaline lakes and marshes and usually are found in association with various chloride and sulfate salts. Because sodium carbonate minerals are soft and soluble in water, economic deposits are relatively rare and geologically young (less than 50 million years old).

Table 43. Soda ash (natural)—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
Botswana	2.5	3	1.7	NA
Kenya	2.8	2	0.03	NA
Turkey	--	--	0.83	0.6
Uganda	NA	NA	0.08	NA

Africa and the Middle East have numerous sodium carbonate occurrences, in part because the arid to semiarid climates in the region prevent the dissolution and transport of the soluble carbonate minerals. Many of these occurrences are small and are of local interest only. However, several major sodium carbonate deposits are present such as those associated with lakes along the East African rift system (figs. 3 and 9d). The largest deposit in the East African rift is at Lake Magadi in Kenya (fig. 9d) where the lake bed is underlain by about 45 meters of relatively pure sodium carbonate minerals over a 65 km^2 area (Kostick, 1994). Warm alkaline springs deliver sodium carbonate to Lake Magadi. The alkaline waters are the result of ground waters leaching minerals in the abundant volcanic rocks that form the highlands surrounding the lake. The same process appears to be responsible for alkaline waters at other lakes along the East African rift. The Sua Pan deposit in the Makgadikgadi Basin, northwest Botswana (fig. 9d) produces soda ash from underground brines that also produce sodium chloride (salt).

Sodium Sulfate

Sodium sulfate (Na_2SO_4) is a common constituent of many mineral waters, as well as seawater. Sodium sulfate is an important industrial chemical used especially in the production of soap and detergents, pulp and paper, textiles, glass, and other uses. Sodium sulfate resources are

estimated to be sufficient to last hundreds of years at present rates of world consumption (USGS, 2004a).

Table 44. Sodium sulfate—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world reserves	Percent of world reserves	Percent of world reserve base
Turkey	NA	4	3.0	NA

Most commercial deposits of sodium sulfate formed through the accumulation and evaporation of surface and ground waters in basins with interior drainage (nonmarine) called playas. Playas are found in arid to semiarid regions around the world including much of Africa and the Middle East. Several saline lakes in southwestern Turkey contain appreciable amounts of sodium sulfate with concentrations up to eight percent. Iran and Egypt also contain commercial deposits of sodium sulfate associated with playas.

Strontium

Strontium is a metallic element that commonly occurs in nature; however, only two minerals, celestite (strontium sulfate) and strontianite (strontium carbonate) contain strontium in sufficient quantities to make its recovery practical. Celestite is processed into a variety of strontium chemicals that are used mainly in the faceplate glass of color television picture tubes and to a lesser degree for specialty magnets and pyrotechnics. World resources are thought to exceed 1 billion tonnes, but are not thoroughly evaluated (USGS, 2004a).

Table 45. Strontium—proportion of world mine production for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production

Iran	0.54	6
Morocco	1.1	5
Turkey	18.9	3

Most deposits of celestite formed as sedimentary deposits in lakes and coastal lagoons. It forms in evaporite deposits where it is one of the last minerals to be formed as the salty water (brine) evaporates.

Sulfur

Most sulfur is used to manufacture sulfuric acid, which is used to produce agricultural chemicals and for a variety of industrial applications. Sulfur is also used for medicinal purposes, manufacture of plastics, and explosives. Most sulfur is obtained as a byproduct from oil production. Other principal sources of sulfur are sedimentary evaporite deposits (sulfate minerals such as anhydrite), hydrothermal sulfide ore deposits (pyrite), and native sulfur from volcanoes.

Table 46. Sulfur—proportion of world mine production for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production
Iran	1.9	13
Kuwait	1.0	21
Saudi Arabia	3.9	6
United Arab Emirates	3.4	8

Vermiculite

Vermiculite is the mineralogical name applied to a group of hydrated platy silicate minerals similar in size and shape to mica, but possessing distinct chemical and physical

properties that give it commercial value. One important characteristic of vermiculite is that it increases in volume when heated to high temperature. This produces a lightweight product that has a variety of uses in various construction products, agriculture, horticulture and other industrial applications. In addition, its chemical properties make it useful for gaskets, inorganic films, and in the treatment of nuclear and other toxic waste. South Africa is the world's largest producer of vermiculite (USGS, 2004a).

Table 47. Vermiculite—proportion of world mine production, reserves, and reserve base for countries covered by this report (USGS, 2004a).

Country	Percent of world production, 2003	Rank of world production	Percent of world reserves	Percent of world reserve base
South Africa	45.8	1	3.0	NA
Zimbabwe	4.2	7	3.0	NA

Most commercial deposits of vermiculite are the result of near surface weathering of iron-magnesium-rich micas (biotite and phlogopite). The Phalaborwa Complex is a carbonatite deposit (see copper discussion) that is South Africa's largest vermiculite producer (figs. 9b and 9d). Some rocks associated with this ancient volcano contain abundant biotite and phlogopite that have weathered to vermiculite in the arid to semiarid environment of northeast South Africa (Wilson *in* Wilson and Anhaeusser, 1998). The Palabora mine produces about half of the world's vermiculite and also is an important source of copper and phosphate (see discussions above).

Regional Exploration History and Significant Recent Discoveries

Africa

Worldwide expenditures for nonfuel mineral exploration increased significantly in 2003 following 5 years of decline (Wilburn, 2004). The increase reflects changing exchange rates, rising commodity prices, low metal inventories, and an improving global economy (Wilburn, 2004). Gold continued to lead global exploration activity in 2003, with budget increases of about 34.5 percent; diamonds increased by 36 percent, nickel increased 29 percent, and platinum-group elements increased 26 percent (Wilburn, 2004). The top three geographic areas for mineral exploration, based on projected exploration budgets in 2003, were Latin America, Canada, and Africa. For Africa this represented a 46 percent increase in exploration budgets over 2002 (Wilburn, 2004) with the greatest increases going to diamond and platinum-group element exploration. The African countries experiencing the highest levels of exploration activity in 2003, in decreasing order by exploration activity in 2003, were South Africa, Mali, Ghana, Burkina Faso, Tanzania, Botswana, and Sierra Leone (Wilburn, 2004).

Africa has a long history of mining that dates back at least 4,000 years to the reign of the Pharaohs in Egypt when dimension stone, gold, iron, copper, precious stones, and other minerals were already in production. The oldest known geologic map is of an Egyptian gold mining area and is of early Pharonic age. The Egyptian Haroeris is the first recorded economic geologist (Corrans, 1994). Africa also contains some of the most prospective areas for new mineral resource discoveries in the world. However, with some of the most inhospitable terrain in the world and a lack of infrastructure in many areas, Africa still has large regions that have not received any systematic, modern, regional-scale geologic mapping or mineral exploration. Thus,

while most accessible and geologically perspective areas in countries like Canada and Australia have undergone successive stages of intensive, multi-phase exploration over the past 100 years, many geologically equivalent areas in Africa have had no modern exploration completed on them. As a result, some areas of Africa lack a reliable and integrated geological database with which to make detailed evaluations of the exploration potential for very large tracts of ground. For the minerals industry, perhaps even more daunting than the natural challenges to exploration in Africa is the plethora of mineral policies promulgated by the forty-nine states that make up the continent and the continued political instability in some regions. As a result, except perhaps for the area south of the Zambezi River, the African continent still remains largely unexplored for minerals, particularly base metals.

Mineral exploration activity can be divided into low risk and high risk types. Low risk exploration focuses on finding extensions to existing deposits, or new ore bodies, within a known trend or cluster of major deposits. This type of exploration activity often is driven by the depletion of reserves in the known deposits. In Africa, examples include discovery of new deposits of platinum-group elements in the Bushveld Complex in South Africa, new nickel, copper, and platinum-group element deposits in the northern portion of the Bushveld Complex (the Platreef), and discoveries of additional copper-cobalt deposits in the Central African Copperbelt. High risk exploration looks for ore deposits where none have been discovered previously. Many discoveries are made as the result of exploration programs based on geologic models that are both descriptive and predictive. Current diamond exploration in parts of northwest Africa, and exploration for iron oxide-copper-gold-uranium deposits in Zambia and South Africa are examples.

Mineral exploration is cyclical over time. Measures used to assess trends in minerals exploration activities include the number of active exploration properties, number of mining

claims staked, expenditures, and number of discoveries. When plotted by year for a given area, these types of information reveal cyclic patterns superimposed on a base level of activity. Some of these cycles appear to be global, others regional.

Cycles of exploration are event-driven. These events include rapid fluctuations in commodity price, new information and technology, consolidation of the mining industry, changes in the investment climate, and changes in public policy. For example, between 1997 and 2000, the price of palladium increased from less than $200 per ounce to over $1,000 per ounce (Johnson Matthey, 2004). This resulted in a surge of exploration activity in areas where deposits of platinum-group elements can be found. In Africa, this activity was focused principally in South Africa and Zimbabwe. Although palladium prices have dropped, platinum prices recently increased and will sustain interest in exploration for the platinum-group metals.

New information that can stimulate a cycle of mineral exploration includes the discovery of a well known deposit type in a new area or the discovery of a completely new style of mineralization. An example of a new cycle of exploration stimulated by the discovery of a well known deposit type in a new area is the discovery of quartz vein related gold deposits in Tanzania. The geology of the Lake Victoria greenstone belt in northwestern Tanzania is very similar to that in gold-bearing regions in other parts of Africa and elsewhere. This area in Tanzania has seen considerable exploration activity in recent years, resulting in the discovery of a number of significant gold deposits and a continued high level of exploration (Foster, 2000). Tanzania is now the third largest gold producer in Africa as a result.

Systematic collection of many kinds of new geoscience information, both within and outside of areas of known potential for the occurrence of undiscovered mineral deposits, can stimulate mineral exploration and new discoveries. Work supported by government, industry, and universities continually is generating and refining the scientific infrastructure needed by the

mining industry to find new deposits. In addition, the World Bank has recognized the need for improved geologic and related information in Africa to advance mining sector investment and economic development. In recent years the World Bank has funded major programs to upgrade geoscience information including in Congo-Kinshasa, Madagascar, Mauritania, Mozambique, and Uganda.

Although geology determines whether particular types of mineral deposits can occur in an area, government policies and programs have a significant impact on whether minerals exploration and development take place. As previously discussed, governments can efficiently support exploration by gathering and then providing geoscience information to all. However, laws on mineral rights, ownership, taxation, and environmental protection have an even stronger effect on stimulating or discouraging mineral exploration. For example, in 2003 the Democratic Republic of Congo (Congo-(Kinshasa)) implemented new mineral regulations that established a mineral exploration and mining lease process. In addition, they also imposed a set of environmental obligations and increased opportunities for foreign investment in mining operations (Wilburn, 2004). Ghana took steps to encourage exploration including supporting the merger of Ashanti Goldfields and AngloGold, and granting five mining companies permission to apply for mining permits in protected forest areas. During 2002 and 2003, South Africa put forward new mineral rights legislation and an empowerment charter designed to change the regulation of access to, and ownership of, mineral resources in South Africa (Wilburn, 2005).

Middle East

The Middle East region is rich in mining history and contains numerous ancient mines that were worked from perhaps as early as 7000 B.C., and through the Islamic empire, about 800-1200 A.D. (Engin, 2003). In the countries of the Arabian peninsula and Iran, modern exploration and exploitation has focused primarily on the region's vast energy resources.

Exploration for nonfuel mineral resources has been of secondary importance to many of the petroleum-rich countries of the region; however, the need to diversify natural resource industries of the region have recently been acknowledged by some countries.

The Arabian shield, Arabian platform, and Red Sea Basin margin of Saudi Arabia have undergone extensive first-generation exploration by U.S., French, and British geological missions working with and training Saudi geologists for the past fifty years. During this time the nonfuel mineral inventory of Saudi Arabia was established, and several significant discoveries were made. Exploration was primarily focused on gold, phosphate, and base metals (copper, lead, zinc). Significant discoveries include (1) the phosphate deposits in the Arabian platform of northern Saudi Arabia (1970s and 1980s), (2) the Mahd adh Dhahab (1975), Al Amar (1985), Sukhaybarat (1983), Bulgah , and Al Hajar (1987; fig. 9c) gold deposits of the Arabian shield, (3) the Al Masane (1974) , Jabal Sayid (1970), and Khnaiguiyah (1975; fig. 9b) zinc and copper deposits of the Arabian shield, and (4) the Wadi Sawawin (1967; fig. 9d) iron deposit in the Arabian shield (Collenette and Grainger, 1994). Exploration of all of the above deposits advanced through the feasibility stage, yet only Mahd adh Dhahab, Sukhaybarat, and Al Hajar deposits are in production (Ma'aden, 2003). The lack of a mining infrastructure (smelters, railway system, extensive power grid) and scarcity of water has adversely affected the economics of many deposits and delayed their development. Furthermore, lack of incentive for foreign investment in the Saudi mining industry and on-going revision to the country's mining code has kept foreign mining companies uninterested in developing identified resources.

Over the past 5 years, exploration activity in the Arabian shield, Arabian platform, and Red Sea Basin have included (1) advanced-stage exploration with positive results at the Ad Duwayhi gold deposit in the Arabian shield (fig. 9c), (2) exploration for zinc and lead related to sedimentary rocks at the Jabal Dhaylan deposit on the Red Sea Basin margin of Saudi Arabia

(fig. 9b), (3) exploration for copper, zinc, and gold in volcanic rocks of the southern Arabian shield north of the Yemen border, (4) exploration for tantalum, niobium, and rare earth metals at the Ghurayyah deposit in the Arabian shield of northwest Saudi Arabia (fig. 9e), (5) continued exploration for phosphate in the northern border region of Saudi Arabia, (6) exploration for gold and copper-nickel-cobalt-platinum in the Arabian shield of Yemen, and (7) exploration for gold in Cenozoic volcanic rocks of western Yemen (Wilburn, written commun., 2003; Cantex Mine Development Limited, 2003)

The Tethysides, and particularly Turkey, has been the focus of much of the recent exploration activity in the Middle East region. In 1985, a new mining law was introduced in Turkey that provided foreign companies an incentive to form joint venture companies with Turkish counterparts to develop mineral resources in Turkey. Since then, exploration activity has increased dramatically, resulting in numerous significant discoveries in the past 10 years and many on-going advanced stage projects (Anatolia Minerals Development Limited, 2003; Eldorado Gold Corporation, 2003; Odyssey Resources Limited, 2003). Exploration activity has taken place throughout Turkey but much has been concentrated along the Pontide belt of the Black Sea coast (the Pontide arc) (fig. 2). Exploration has been primarily for gold and base metals related to volcanic rocks (epithermal gold and volcanogenic massive sulfide), and copper related to granitic intrusions (porphyry copper). Significant recent discoveries include the Ovacik, Kisladag, Efemcukuru, Kucukdere, and Kaymaz gold deposits related to volcanic rocks (fig. 9c); the Cayelli, Murgul, and Cerateppe zinc and copper deposits (with silver and gold, fig. 9b) related to volcanic rocks; and the Derekoy, GŸzelyayla, and Gümüşhane copper deposits (figs. 9b and 9c) related to granitic intrusions (Anatolia Minerals Development Limited, 2003; Eldorado Gold Corporation, 2003; Odyssey Resources Limited, 2003; Wilburn, written commun., 2003; Leaman and Staude, 2002).

The Tethysides from Iran through Afghanistan and Pakistan is relatively underexplored. Little exploration has been conducted in this region since the 1970s and only very recently have western companies been again exploring in Iran. This activity has occurred in the last 5 years and has focused on exploration for copper related to granitic intrusions, gold related to volcanic and sedimentary rocks, and zinc and lead related to sedimentary rocks (Wilburn, written commun., 2003). Significant discoveries include the Agh Darreh gold deposit (fig. 9c) related to volcanic and sedimentary rocks (Leaman and Staude, 2002; or Zarcan International Resources, 2003). Exploration for extension to known resources has occurred at the Angouran zinc-lead deposit, and a prefeasibility study has been conducted at the Mehdiabad zinc-lead-silver deposit (fig. 9b, Wilburn, written commun., 2003). Exploration for copper related to granitic intrusions is ongoing in the southeast part of Iran, immediately west of the Afghanistan border (Zarcan International Resources, 2003). This area is underlain by the continuation of the central magmatic arc that hosts the Sar Cheshmeh and other copper deposits farther to the northwest (fig. 9b).

Elsewhere in the Tethysides of the Middle East, exploration for copper, zinc, and gold related to volcanic rocks has been ongoing in Cyprus (Oxiana Limited, 2003), and recent exploration for copper and gold has occurred in the Oman Mountains (Wilburn, written commun., 2003; Metal Mining Agency of Japan, 2003).

Potential for Undiscovered Mineral Resources in Africa

The prospects for significant undiscovered nonfuel mineral resources in Africa and the Middle East are high. Mineral resources are produced there from some of the largest and richest mineral deposits in the world. The mere presence of such mineral deposits suggests that others are likely to exist because the processes that mineralize rock commonly form clusters and linear

belts of mineral deposits. We should be asking different questions. Where will new deposits be found? What commodities will be present? How difficult will it be to find them? What are the environmental and societal issues related to discovering and developing new deposits, and how can they be addressed?

From our discussion of mineral commodities, we hope the reader has come away with two major points. **First, *mineral deposits are associated with large-scale geologic processes that reoccur in time and place.*** The decay of radioactive elements deep within the Earth provides the heat needed to drive the movement of materials in the Earth's mantle and tectonic plates. This movement of materials generates the magmas and hydrothermal fluids, fractures and faults, mountain ranges, and sedimentary basins that are locally and critically important to localizing mineral deposits.

Second, *mineral deposits do not occur randomly; their distribution is intimately related to the geologic history of each continent.* The movement of molten and solid rocks in the mantle and tectonic plates is responsible for the development of cratons, orogens, faults, and rifts that are characteristic of continental crust. The geologic architecture of each continent uniquely reflects the sequence of events that culminated in the distribution of rocks and mineral deposits we see today. The more we know about the geologic fabric of each continent and the processes that control the regional and local distribution of mineral deposits, the better we can answer where new deposits will be found and what they will contain.

Our ability to find undiscovered mineral deposits is affected by many factors. For example, how well has the geology of the continent been mapped? In Africa there still are large areas where the geologic framework is poorly mapped or largely unknown. Terrain and access limit field investigations; in other regions, thick vegetation, soils, and younger rocks conceal the underlying geology that might suggest the presence and locations of undiscovered mineral

deposits. In some cases, the policies of governments have restricted access to information about geology and mineral resources. The less that is known about an area, the more likely that ore deposits are left undiscovered. For example, much of North Africa and the Congo River basin in central Africa are exploration frontiers. The remoteness of these areas, together with overlying deposits of sand in the Sahel and cover by vegetation and young sediments in the Congo, obscure much detail and have curtailed exploration activity.

How well are the types of mineral deposits of interest understood? Robust exploration models can be developed from the shared characteristics and associations of many deposits. If geologists understand the ore-forming process, a variety of geologic, geochemical, and geophysical tools can be developed to identify areas where undiscovered deposits may occur. Porphyry copper deposits and volcanogenic massive sulfide deposits are well understood styles of mineralization. It is hard to create effective models for styles of mineralization known from only one or two deposits. The large iron oxide-copper-gold-uranium deposit at Olympic Dam in South Australia occurs in a unique geologic setting; geologists still are unsure how to extend their knowledge about this deposit to find others like it in other Proterozoic provinces like those in Africa and the Middle East.

How difficult will it be to find new deposits? The approach that involves the least apparent risk to the exploration companies is to search in well known areas with known mineral deposits, with well characterized geology, and using exploration techniques that have worked well on similar deposits in the past. However, the expected returns from such exploration may be lower because the remaining concealed deposits will be harder to find and may not be as large as those already found. The most exciting discoveries, and some of the largest, are often in areas where no mineral deposits have previously been found. However, the opportunities for these

"grass-roots" discoveries usually are in those areas with the least amount of information, which increases the cost of exploration and reduces the chances for a major discovery.

The geologic history of an area is paramount to the occurrence of mineral deposits. The basic requirements to form a mineral deposit involve source and process. There must be a source area of the mineral material, a mechanism to transport it, and a means to concentrate and preserve it. If any part of this ore-forming system is missing, a mineral deposit will not be formed or exist today. Certain types of mineral deposits are only found in specific geologic settings. If that setting is not present, that type of mineral deposit will not be found. The geologic evolution of each continent has developed a unique set of environments in which ore deposits may be found.

Detailed analysis of the potential for undiscovered nonfuel mineral resources is not possible for large tracts of Africa, because of lack of adequate geologic and mineral resource information. However, it is clear from the distribution of known deposits and by analogy with areas of similar geology elsewhere in the world that Africa has some of the most prospective areas for new discoveries of mineral resources in the world. As noted above, Africa is composed principally of crust formed during the Precambrian, before about 540 million years ago. Precambrian areas around the world are noted for their mineral wealth, particularly of deposits of gold, platinum-group metals, chromium, nickel, copper, zinc, iron, manganese, uranium, and rare metals. In addition, primary diamond deposits are confined to crustal areas older than 1.6 billion years. It is clear from the known deposits in Africa, particularly in southern Africa, that significant potential for undiscovered deposits exists throughout the Precambrian areas of Africa. A particular challenge for Africa is exploration of the concealed parts of the Precambrian cratons where they are covered by younger rock, sand, and vegetation. Application of airborne

geophysical surveys (magnetic, gravity, and radiometric) will be particularly important for exploration in these areas.

Younger sedimentary basins in Africa are known to host a variety of mineral deposits rich in zinc, lead, phosphorous, aluminum, nickel, and titanium, and also various industrial mineral commodities. However, these sedimentary basins are still largely underexplored. In addition, the mineral resource and geothermal potential of the great East African rift system, which extends for about 4,000 km from the Gulf of Suez down to the Mozambique Channel, remains to be evaluated. This great rift, a zone of extension (thinning and faulting of the crust) and volcanism since about 25 million years ago, could host a variety of base and precious metal deposits as well as geothermal waters adequate for power generation and heating.

Gold

Almost 70 percent of all exploration dollars spent in Africa have been devoted to exploration for new gold deposits. Potential for important new gold deposits of the Witwatersrand-type is primarily confined to the Witwatersrand Basin in South Africa and to a much lesser extent in rocks similar in nature but younger than those of the Witwatersrand Basin found elsewhere in Africa, particularly the Tarkwaian Formation in Ghana. Despite the dominance of the Witwatersrand gold production, most exploration for new gold deposits has focused on lode-type deposits (gold mineralized faults and related structures). Lode deposits are the most common gold deposit type found in ancient cratons and provide potential for both open-pit and higher-grade underground mining operations. Significant potential exists for lode gold deposits in cratons throughout Africa as shown by the recent discoveries in both East and West African countries.

Southern Africa

The Kalahari craton of southern Africa has received considerable exploration activity for gold deposits in recent years, particularly in Zimbabwe, which has supported a high level of gold mining activity during the twentieth century. Given the intensity of past exploration, the greatest likelihood for new discoveries in the region will probably come from re-evaluation of known deposits, particularly those deposits with a past history as medium-size deposits (production >250,000 oz) that offer potential for application of new mining methods to lower-grade ores, and extension of known mineralization through step-out drilling. Potential also exists for new discoveries, particularly in those areas concealed beneath the Kalahari sands.

East Africa

The Lake Victoria region of northwestern Tanzania (fig. 3) has seen considerable recent exploration activity with the outcome of the delineation of several significant new gold deposits. Exploration remains at a high level and several other prospects are being drilled in this highly prospective region. The gold-bearing geologic units of northwest Tanzania extend northward into Kenya, where both historical and recent exploration have been less intense, thus offering significant potential for undiscovered gold deposits.

Central Africa

Exploration for gold has been generally less intense in Central Africa than in other parts of Africa. However, vein gold mineralization is recognized in the region, with the northeast part of Congo-(Kinshasa) hosting the historically important Kilo and Moto lode (vein) deposits (fig. 9c). The exploration potential for new gold deposits appears to be high for at least parts of the Kasai craton in Central Africa.

West Africa

Unlike the other parts of Africa where lode gold deposits are associated principally with rock units formed prior to 2.5 billion years ago, the major source of gold in West Africa has been rock units formed between 2.5 and 1.6 billion years ago. In West Africa, these younger rock units and related structures trend north to northeast and underlie much of western Ghana, Côte d'Ivoire, and Burkina Faso and extend into the western part of Nigeria and southern Mali (figs. 2 and 7a). It is in these areas that many of the recent important gold discoveries have been made and that are most prospective for new discoveries.

Chromium and Platinum-Group Metals (PGM)

Africa's chromium and PGM resources are contained in the Bushveld Complex of South Africa and to a lesser extent in the Great Dyke of Zimbabwe (fig. 10h). Given the restricted distribution in Africa of rock units similar to those associated with the mineralization in the Bushveld Complex, potential for new discoveries outside the Bushveld Complex and Great Dyke appear limited, particularly for chromium. However, recent discoveries of a new type of PGM deposits in Greenland and Labrador, Canada, both associated with intrusive complexes distinct from the Bushveld-Great Dyke-type, suggest that potential for new discoveries of PGM deposits are possible in Africa, particularly in association with rocks like those of the 183-million-year-old Karoo Igneous Province in Namibia and South Africa.

Nickel

Many regions in Africa have been subjected to deep weathering, and the potential for lateritic nickel deposits is being recognized. Large lateritic nickel deposits are known in Burundi, Côte d'Ivoire, and Madagascar. The Biankouma-Touba deposit in Côte d'Ivoire (fig. 9e) has a resource of 169 Mt at 1.77 percent nickel and 0.08 percent cobalt, but requires massive

capitalization and is remote from railway and port facilities (Foster, 2000). Known primary nickel (sulfide) deposits in Africa are mostly associated with intrusive rocks high in magnesium (ultramafic rocks). However, the recent discovery of the Voisey's Bay deposit in Labrador, Canada, which is a nickel-copper-cobalt±PGM deposit associated with rocks lower in magnesium and higher in aluminum than other known nickel deposits, offers potential for new discoveries of similar deposits elsewhere, including Africa. Rocks of the type associated with mineralization at Voisey's Bay are reported from various parts of Africa but have generally not been considered permissive for important mineralization. However, some of these rock units, like the Kunene Anorthosite Complex in southern Angola, warrant evaluation for mineralization and may undergo exploration in the future.

Diamonds

The potential for new production from, and future discoveries of, both primary kimberlite-hosted diamond deposits and alluvial deposits in Africa remains high. Currently, the largest number and richest kimberlite diamond deposits are located in southern Africa (fig 10m). However, this probably reflects greater intensity of exploration and development of infrastructure as well as more natural rock exposures in this region than exist in other parts of Africa. The world's largest diamond resources may lie on the continental shelf off the coasts of Namibia and Namaqualand (Janse, 1996) where efforts are currently underway to evaluate and mine alluvial diamonds. It is possible that production from these deposits will overtake that of all other sources in southern Africa, except perhaps the largest primary kimberlite deposits such as Jwaneng and Orapa in Botswana (Janse, 1996). The potential reserves of both kimberlite and alluvial diamond deposits in Angola appear also to be large and production from these deposits in the next decade may overtake production from South Africa (Janse, 1996). In West Africa, the diamond potential of the central part of the West African craton, which lies buried beneath

the sands of the Sahara, is still to be evaluated. Recent exploration in Mauritania has, for the first time, found commercial-size diamonds (larger than 1mm) and work continues to locate the kimberlite source rocks.

Potential for Undiscovered Mineral Resources in the Middle East

Because nonfuel minerals have been of secondary importance to many of the petroleum-rich countries of the region, The countries of the Middle East are considered underexplored for nonfuel mineral resources. Although much exploration has occurred, particularly in Saudi Arabia, over the last fifty years, much of it can be considered first generation and primarily focused on areas of known occurrences (ancient mines and workings). Thus, the potential for undiscovered resources of gold, copper, and zinc in the Arabian shield, copper, lead, zinc, and silver in the Arabian platform, and zinc, lead, and gold in the Red Sea Basin margins are significant. As second generation exploration proceeds, with techniques to address areas of cover and new deposit models to consider, it is expected that new resources will be discovered.

The Tethysides is comparable in age and extent to some circum-Pacific magmatic arcs (for example the Cordillera of the Americas), yet it is less well explored. Turkey has been the focus of much of the recent exploration activity, and the numerous recent discoveries has made Turkey, and particularly the Pontide belt of the Black Sea coast, one of the most prospective places on Earth. Yet relatively little exploration has been conducted in Iran, where similar geology and mineral resource potential exists. Thus the potential for undiscovered metallic resources in the Tethysides of the Middle East is very high, particularly for gold related to volcanic and sedimentary rocks in northwestern Iran (in the Zarshuran Agh Darreh area; fig. 9c),

for copper and gold related to granitic intrusions, and for zinc, copper, and lead (with gold and silver) related to volcanic rocks.

The potential for undiscovered resources of phosphate in the Arabian platform and potash in the Red Sea Basin is high, particularly in areas of Saudi Arabia and Iraq, where petroleum resources have overshadowed the need to explore for and develop other resources. Significant phosphate deposits already exist in the northern Arabian peninsula, making this area very prospective. Many of the potash resources in the Red Sea Basin have only been inferred through remote geophysical means. The geologic environment and salt dome tectonics of the Red Sea Basin is very prospective for undiscovered potash resources.

Building stone and construction resources (limestone for cement, aggregate for roads) has been sufficient to meet local demand. Saudi Arabia exports building stone, and the potential for undiscovered building stone and construction resources is good.

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References

Aghanabati, A., 1986, Geological map of the Middle East**:** Commission for the geological map of the world: Subcommission for the Middle East, Geological Survey of Iran, scale 1:5,000,000.

Albino, G.V., Jalal, S., and Christensen, K., 1995, Neoproterozoic mesothermal gold mineralization at Sukhaybarat East mine, Saudi Arabia: Trans. Inst. Min Metall. (Sect. B: Appl. Earth sci.), v. 104, p. B157–B170.

Amey, E.B., 2000, Gold: U.S. Geological Survey, Mineral Commodity Summaries 2000, p. 74–75.

Anatolia Minerals Development, Ltd., 2003, Projects, accessed October 13, 2003, at *http://www.anatolia-minerals.com/projects.html*.

Anhaeusser, C.R., and Maske, S., eds., 1986, Mineral deposits of southern Africa, v. I and II: Geological Society of South Africa, 2,376 p.

ACP Mining Data Bank, undated, http://mines.acp.int/html/accueil_en.html.

Arndt, N.T., Lesher, C.M., and Czamanske, G.K., 2005, Mantle-derived magmas and magmatic Ni-Cu-(PGE) deposits: Economic Geology 100th Anniversary Volume, p. 5–23.

Asadi, H.H., Voncken, J.H.L., Kuehnel, R.A., and Hale, M., 2000, Petrography, mineralogy, and geochemistry of the Zarshuran Carlin-like gold deposit, Northwest Iran: Mineralium Deposita, v. 35, no. 7, p. 656–671.

Astrup, J., and Tsikos, H., 1998, Manganese, *in* Wilson, M.G.C., and Anhaeusser, C.R., eds., 1998, The mineral resources of South Africa: Handbook, Council for Geoscience, 16, p. 450–460.

Barker, J.M., and Lefond, S.J., eds., 1985, Borates: Economic geology and production: Proceedings of a symposium held on October 24, 1984, at the fall meeting of SME-AIME in Denver, Colo., Society of Mining Engineers, AIME, New York, 274 p.

Batchelor, D.A.F., 1992, Styles of metallic mineralization and their tectonic setting in the Sultanate of Oman: Trans. Inst. Min. Metall. (Sect. B: Appl. Earth sci.) v. 101, p. B108–B120.

Bayraktar, I., and Cakir, U., 2002, Quality feldspar production at Cine Akmaden: Industrial Minerals, no. 416, p. 56–59.

Bear, L.M., 1963, The mineral resources and mining industry of Cyprus: Ministry of Commerce and Industry, Geological Survey Department, Republic of Cyprus, Bulletin No. 1, 208 p.

Berker, E., 1989, The Mardin-Mazidagi-Derik phosphate deposits, southeastern Turkey, *in* Notholt, A.J.G., Sheldon, R.P., and Davidson, D.F., eds., Phosphate deposits of the world, v. 2, Phosphate rock resources: Cambridge, Cambridge University Press, p. 380–386.

Bettles, Keith, 2002, Carlin-type gold deposits: a summary, *in* Cooke, D.R., and Pongratz, June, eds., Giant ore deposits: characteristics, genesis and exploration: Centre for Ore Deposit Research, University of Tasmania, GPO Box 252-79, Hobart, Tasmania, Australia 7001, p.191–194.

Boelema, R., 1998, Tantalum and niobium, *in* Wilson, M.G.C., and Anhaeusser, C.R., eds., 1998, The mineral resources of South Africa: Handbook, Council for Geoscience, 16, p. 604–606.

Boelema, R., and Hira, H., 1998, Pegmatite deposits, *in* Wilson, M.G.C., and Anhaeusser, C.R., eds., 1998, The mineral resources of South Africa: Handbook, Council for Geoscience, 16, 740 p.

Bowen, Robert, and Jux, Ulrich, 1987, Afro-Arabian geology: A kinematic view: London, Chapman and Hall, 295 p.

Breese, R.O.Y., 1994, Diatomite, *in* Carr, D.D. and others, eds., Industrial mineral and rocks, 6th ed: Littleton, Colo., Society of Mining, Metallurgy, and Exploration, p. 397–412.

Briskey, J.A., Schultz, K.J., Mosesso, J.P., Horwitz, L.R., and Cunningham, C.G., 2001, It's time to know the planet's mineral resources: Geotimes, v. 46, no. 3, (March), p. 14–19.

Briskey, J.A., Schulz, K.J., Mosesso, J.P., Horwitz, L.R., and Cunningham, C.G., 2002, Environmental planning issues and a conceptual global assessment of undiscovered nonfuel mineral resources, *in* Briskey, J.A. and Schulz, K.J., eds., Agenda, extended abstracts and bibliographies for a workshop on deposit modeling, mineral resources assessment, and their role in sustainable development—31st International Geological Congress, Rio de Janeiro, Brazil [extended abstract]: U. S. Geological Survey Open–File Report 02–423, p. 7–10.

Brobst, D.A., 1994, Barium minerals, *in* Carr, D.D., ed., Industrial minerals and rocks, 6th ed: Littleton, Colo., Society of Mining, Metallurgy, and Exploration, p. 125–134.

Brown, G.F., Schmidt, D.L., and Huffman, A.C., Jr., 1989, Geology of the Arabian peninsula, shield area of western Saudi Arabia: U.S. Geological Survey Professional paper 560–A, 188 p.

Bouabdellah, M., Fontboté, L., Haeberlin, Y., Llinares, L., Leach, D., and Spangerberg, J., 1999, Zoned sulphur isotope signatures at the Mississippi Valley-type Touissit-Bou Beker-El Abed district (Morocco-Algeria)—Evidence for thermochemical sulphate reduction and mixing of sulfur sources, *in* Stanley, C.J., ed., Mineral deposits: processes to processing: Amsterdam, Balkema, p. 821–824.

Burke, Kevin, 1996, The African plate: South African Journal of Geology, v. 99, p. 339–409.

Burollet, P.-F., 2004, African geology—A bibliographic synthesis, Occasional Publication 40: International Center for Training and Exchanges in the Geosciences, Orleans, France, 153 p.

Cahen, L., Snelling, N.J., Delhal, J., and Vail, J.R., 1984, The geochronology and evolution of Africa: Oxford, Clarendon Press, 512 p.

Cailteux, J.L.H., Kampunzu, A.B., Lerouge, C., Kaputo, A.K., and Milesi, J.P., 2005, Genesis of sediment-hosted stratiform copper-cobalt deposits, Central African Copperbelt: Journal of African Earth Sciences, v. 42, p. 134–158.

Cantex Mine Development Limited, 2003, News releases: accessed October 13, 2003, at *http://www.cantex.ca/*.

Castor, S.B., 1994, Rare earth minerals, *in* Carr, D.D., ed., Industrial minerals and rocks, 6th ed: Littleton, Colo., Society of Mining, Metallurgy, and Exploration, p. 827–839.

Cawthorn, R.G., Barnes, S.J., Ballhaus, C., and Malitch, K.N., 2005, Platinum group element, chromium, and vanadium deposits in mafic and ultramafic rocks: Economic Geology 100th Anniversary Volume, p. 215–249.

Chartry, G., and Franceschi, G., 2004, Mineral occurrences database and GIS map of the Democratic Republic of Congo: Royal Museum for Central Africa and GF Consult, Tervuren, Belgium, 1:2,000,000 scale, CD-ROM.

Cheilletz, A., Levresse, G., Gasquet, D., Azizi Samir, M.R., Zyadi, R., and Archibald, D.A., 2002, The lmiter epithermal deposit (Morocco): new petrographic, microtectonic and geochronological data. Importance of the Precambrian-Cambrian transition for major precious metals deposits in the Anti-Atlas: Mineralium Deposita v. 37, p. 772–781.

Chernoff, C.B., and Orris, G.J. 2002, Data set of world phosphate mines, deposits, and occurrences – Part A. Geologic data: U.S. Geological Survey Open–File Report 02–156–A, 352 p.

Clout, J.M.F., and Simonson, B.M., 2005, Precambrian iron formations and iron formation-hosted iron ore deposits: Economic Geology 100th Anniversary Volume, p. 643–679.

Cochran, J.R., 1983, A model for development of Red Sea: American Association of Petroleum Geologists Bulletin, v. 67, no. 1, p. 41–69.

Collenette, P. and Grainger, D.J. (comps.), 1994, Mineral resources of Saudi Arabia: Directorate General of Mineral Resources Special Publication DGMR-SP-2, 322 p.

Commission for Geological Map of the World, 1982, Carte métallogénique de l'Europe; Liste de gites mineraux, feuille 9: Proche –Orient (ANKARA): Bureau de Recherche Géologiques et Minières and United Nations Educational Scientific and Cultural Organization, 19 p.

Commission for Geological Map of the World, 1983, Carte métallogénique de l'Europe; Liste de gites mineraux, feuille 8: Europe Sud et Sahara méditerranéen (ATHENES): Bureau de Recherche Géologiques et Minières and United Nations Educational Scientific and Cultural Organization, 27 p.

Condie, K.C., 1997, Plate tectonics and crustal evolution, 4th ed: Oxford, UK, Butterworth-Heinemann, 282 p.

Condie, K.C., 2003, Supercontinents, superplumes and continental growth: the Neoproterozoic record, *in* Yoshida, M., Windley, B.F., and Dasgupta, S., eds., Proterozoic east Gondwana: Supercontinent assembly and breakup: Geological Society, London, Special Publications, 206, p. 1–21.

Constantinou, G., 1980, Metallogenesis associated with Troodos ophiolite, *in* Panayiotou, A., ed., Ophiolites: Proceedings of the International Ophiolite Symposium, Cyprus, 1979, p. 663–674..

Constantinou, G., and Govett, G.J.S., 1973, Geology, geochemistry, and genesis of Cyprus sulfide deposits: Economic Geology, v. 68, p. 843–858.

Corrans, R.D., 1994, Mineral exploration in Africa: Exploration and Mining Geology, no. 4, p. 311–314.

Coulibaly, Saifa, 1992, Industrial minerals of Guinea: Industrial Minerals, no. 296, p. 141–143.

Cox, D.P., Lindsey, D.A., Singer, D.A., and Diggles, M.F., 2003, Sediment-hosted copper deposits of the world: Deposit models and databases: U.S. Geological Survey Open–File Report 03–107. [Available online at *http://geopubs.wr.usgs.gov/open-file/of03-107/*].

Cox, D.P., and Singer, D.A., eds., 1986, Mineral deposit models: U.S. Geological Survey Bulletin 1693, 379 p.

Crockett, R.N., Chapman, G.R., and Forrest, M.D., 1987, International strategic minerals inventory summary report—Cobalt: U.S. Geological Survey Circular 930–F, 54 p.

Daliran, F., 2002, Kiruna-type iron-oxide apatite ores and "apatitites" of the Bafq district, Iran, with an emphasis on the REE geochemistry of their apatites, *in* Porter, T.M., ed., Hydrothermal iron oxide copper-gold and related deposits: A global perspective, v. 2: Adelaide, PGC Publishing, p. 303–320.

Dallmeyer, R.D. and Lecorché, J.P., 1991, The west african orogens and circum-Atlantic correlations, Berlin, Springer-Verlag, 405 p.

Dawson, K.M., 1996, Skarn zinc-lead-silver, *in* Eckstrand, O.R., Sinclair, W.D., and Thorpe, R.I., eds., Geology of Canadian mineral deposit types: Geological Survey of Canada, Geology of Canada, no. 8, p. 448–459.

DeBeers, undated, Diamond Geology, 33p. [Available online at *http://debeersgroup.com/exploration/content/diamondGeology.pdf*].

de Kun, Nicolas, 1965, The mineral resources of Africa: Amsterdam, Elsevier Publishing Company, 740 p.

Derry, Duncan, R., 1980, A concise world atlas of geology and mineral deposits: Mining Journal Books, Limited, London, 110 p.

DeWit, M.J., and Ashwal, L.D., eds., 1997, Greenstone belts: Oxford Monographs on Geology and Geophysics no. 35: Oxford, Clarendon Press, 809 p.

DeYoung, J.H., Jr., Sutphin, D.M., and Cannon, W.F., 1984, International strategic minerals inventory summary report—Manganese: U.S. Geological Survey Circular 930–A, 22 p.

DeYoung, J.H., Jr., Sutphin, D.M., Werner, A.B.T., and Foose, M.P., 1985, International strategic minerals inventory summary report—Nickel: U.S. Geological Survey Circular 930–D, 62 p.

Doebrich, J.L., 1999, Mahd adh Dhahab gold deposit, Kingdom of Saudi Arabia: IUGS/UNESCO Deposit Modeling Workshop, November 12–19, 1999, Jiddah, Saudi Arabia, Field Trip Guidebook, 28 p.

Doebrich, J.L., Zahony, S.G., Leavitt, J.D., Portacio, J.S., Jr., Siddiqui, A.A., Wooden, J.L., Fleck, R.J., and Stein, H.J., 2004, Ad Duwayhi, Saudi Arabia: Geology and geochronology of a Neoproterozoic intrusion-related gold system in the Arabian shield: Economic Geology, v. 99, p. 713–741.

du Toit, M.C., 1998a, Zinc, *in* Wilson, M.G.C., and Anhaeusser, C.R., eds., 1998, The mineral resources of South Africa: Handbook, Council for Geoscience, 16, p. 676–682.

du Toit, M.C., 1998b, Tin, *in* Wilson, M.G.C., and Anhaeusser, C.R., eds., 1998, The mineral resources of South Africa: Handbook, Council for Geoscience, 16, p. 613–620.

Earth Impact Database, 2003, accessed January 13, 2004, at http://www.unb.ca/passc/ImpactDatabase/.

Eckstrand, O.R., 1996, Nickel-copper sulphide, *in* Eckstrand, O.R., Sinclair, W.D., and Thorpe, R.I., eds., Geology of Canadian mineral deposit types: Geological Survey of Canada, Geology of Canada, no. 8, p. 584–605.

Eckstrand, O.R., Sinclair, W.D., and Thorpe, R.I., eds., 1995, Geology of Canadian mineral deposit types: Geological Survey of Canada, Geology of Canada, no. 8, 640 p.

Einaudi, M.T., Meinert, L.D., and Newberry, R.J., 1981, Skarn deposits: Economic Geology, 75th Anniversary Volume, p. 330–333.

Eldorado Gold Corporation, 2003, Properties, Turkey: accessed October 14, 2003, at *http://www.eldoradogold.com/s/Home.asp*

Elias, M., 2002, Nickel laterite deposits—geological overview, resources, and exploitation: *in* Cooke, D.R., and Pongratz, June, eds., Giant ore deposits: characteristics, genesis and exploration: Centre for Ore Deposit Research, University of Tasmania, GPO Box 252-79, Hobart, Tasmania, Australia 7001, p. 205–220.

Elzea, J., and Murray, H.H., 1994, Bentonite, *in* Carr, D.D., ed., Industrial minerals and rocks, 6th ed: Littleton, Colo., Society of Mining, Metallurgy, and Exploration, p. 233–246.

Engin, T., 2003, Mineral deposits of Turkey, *in* Tvalchrelidze, A.G., and Morizot, G., eds., Proceedings of NATO advanced research workshop: mineral resource base of the Caucasus and systems for its management in the XXI century: Tbilisi, Georgian Republic, April 3–6, 2001, NATO Science Series, Series IV, Earth and Environmental Series, v.17, p. 81–104.

Essarraj, S., Boiron, M.C., Cathelineau, M., Banks, D.A., El Boukhari, A., and Chouhaidi, M.Y., 1998, Brines related to Ag deposition in the Zgounder silver deposit (Anti-Atlas, Morocco): European Journal of Mineralogy, v. 10, p. 1,201–1,214.

Fernandes, T.R.C., 1989, The phosphate industry of Zimbabwe: Industrial Minerals, no. 266, p. 71–77.

Francois, A., 1974, Stratigraphie, tectonique et mineralisations dans l'arc cuprifere du Shaba (Rep. Du Zaire), in Bartholome, P., ed., Gisements stratiformes et Provinces Cupriferes: Centenaire de la Societe Geologique de Belgique, Liege, p. 79–101.

Franklin, J.M., 1993, Volcanic associated massive sulfide deposits, *in* Kirkham, R.V., Sinclair, W.D., Thorpe, R.I., and Duke, J.M., eds., Mineral deposit modeling: Geological Association of Canada Special Paper 40, p. 315–334.

Franklin, J.M., 1996, Volcanic-associated massive sulphide base metals, *in* Eckstrand, O.R., Sinclair, W.D., and Thorpe, R.I., eds., Geology of Canadian mineral deposit types: Geological Survey of Canada, Geology of Canada, no. 8, p.158–183.

Franklin, J.M., Gibson, H.L., Jonasson, I.R., and Galley, A.G., 2005, Volcanogenic massive sulfide deposits: Economic Geology 100th Anniversary Volume, p. 523–560.

Fredrickson, L., 2002, Annual survey of mining companies 2002/2003: The Fraser Institute accessed January 30, 2004, at *http://www.fraserinstitute.ca./shared/readmore.asp?sNav=pb&id=459*.

Freeman, P.V., 1986, Some statistics on Zambian (and Zairean) copper and cobalt: Note for file, Zambia Consolidated Copper Mines Limited, Lusaka, 3 p.

Freyssinet, Ph, Butt, C.R.M., Morris, R.C., and Piantone, P., 2005, Ore-forming processes related to lateritic weathering: Economic Geology 100th Anniversary Volume, p. 681–722.

Council for Geoscience and Commission for the Geological Map of the World (CGMW), 2003, Digital international metallogenic map of Africa (beta-version), Veselinovic-Williams, M., Frost-Killian, S., Wolmarans, L.G., and Oosterhuis, W.R., comps.: Council for Geoscience, Pretoria, South Africa, 1:5,000,000 scale, CD-ROM.

Foster, R.P, 2000, Destination Africa: new frontiers, new mineral exploration opportunities: International Mining and Minerals, v. 3, no. 26, p. 47–53.

Garrett, D.E., 1992, Natural soda ash: New York, Van Nostrand Reinhold, 636 p.

Garrett, D.E., 1998, Borates: handbook of deposits, processing, properties, and use: San Diego, Academic Press, 483 p.

Geitgey, R.P., 1994, Pumice and volcanic cinder, *in* Carr, D.D., ed., Industrial minerals and rocks, 6th ed: Littleton, Colo., Society of Mining, Metallurgy, and Exploration, p. 803–813.

Geological Survey of Canada, 1995, Generalized geological map of the world and linked databases: Geological Survey of Canada Open File 2915d, on CD.

Goldberg, I., Hammerbeck, E.C.I., Labuschagne, L.S., and Rossouw, C., 1992, International strategic mineral inventory summary report – vanadium: U.S. Geological Survey Circular 930–K, 45 p.

Goldfarb, R.J., Groves, D.I., and Gardoll, S., 2001, Orogenic gold and geologic time: a global synthesis: Ore Geology Reviews, v. 18, p. 1–75.

Goodfellow, W.D., Lydon, J.W., and Turner, R.J.W., 1993, Geology and genesis of stratiform sediment-hosted (SEDEX) zinc-lead-silver sulphide deposits, *in* Kirkham, R.V., Sinclair, W.D., Thorpe, R.I., and Duke, J.M., eds., Mineral deposit modeling: Geological Association of Canada Special Paper 40, p. 201–252.

Gross, G.A., 1996a, Lake Superior-type iron-formations, *in* Eckstrand, O.R., Sinclair, W.D., and Thorpe, R.I., eds., Geology of Canadian mineral deposit types: Geological Survey of Canada, Geology of Canada, no. 8, p. 54–66.

Gross, G.A., 1996b, Mafic intrusion-hosted titanium-iron, *in* Eckstrand, O.R., Sinclair, W.D., and Thorpe, R.I., eds., Geology of Canadian mineral deposit types: Geological Survey of Canada, Geology of Canada, no. 8, p. 573–582.

Groves, D.I., Goldfarb, R.J., Gebre-Mariam, M., Hagemann, S.G., and Robert, F., 1998, Orogenic gold deposits: A proposed classification in the context of their crustal distribution and relationship to other gold deposit types: Ore Geology Reviews, v. 13, p. 7–27.

Gurney, J.J., Helmstaedt, H.H., Le Roex, A.P., Nowicki, T.E., Richardson, S.H., and Westerlund, K.J., 2005, Diamonds: crustal distribution and formation processes in time and space and an integrated deposit model: Economic Geology 100th Anniversary Volume, p. 143–177.

Hammerbeck, E.C.I., 1998, Mercury, *in* Wilson, M.G.C., and Anhaeusser, C.R., eds., 1998, The mineral resources of South Africa: Handbook, Council for Geoscience, 16, p. 461–465.

Hammerbeck, E.C.I., and Schurmann, L.W., 1998, Nickel, *in* Wilson, M.G.C., and Anhaeusser, C.R., eds., 1998, The mineral resources of South Africa: Handbook, Council for Geoscience, 16, p. 471–482.

Harben, P.W., 2002, The industrial minerals handbook—4th ed.: A guide to markets, specifications & prices: Surrey, U.K., Industrial Minerals Information, 412 p.

Harben, P.W., and Kužvart, M., 1996, Industrial minerals—A global geology: London, Industrial Minerals Information Ltd., p. 289–303.

Hayes, T.S., Balkhyyur, M., Beshir, Z., Kadi, K., and Siddiqui, A., 1999, Phanerozoic sediment-hosted base-metal mineralization in Saudi Arabia, *in* Stanley, C.J., and others, eds., Mineral deposits: Process to processing: Proceedings of the Fifth Biennial SGS Meeting and the Tenth Quadrennial IAGOD Symposium, London, United Kingdom, 22–25 August, 1999, p. 865–868.

Hayes, T.S., Sutley, S.J., Al-Shanti, M., Al-Shammary, A., Al-Eissa, A., Nadra, A., and Siddiqui, A.A., 2001, Jabal Dhaylan district, Saudi Arabia: Salt-related carbonate-hosted zinc-lead deposits, *in* Piestrzynski, A., and others, eds., 2001, Mineral deposits at the beginning of the 21st Century: Proceedings of the Joint Sixth Biennial SGA-SEG Meeting, Krakow, Poland, 26–29 August, 2001, p. 137–140.

Haynes, D.W., 2002, Giant iron oxide-copper-gold deposits: are they in distinctive geological settings?, *in* Cooke, D.R., and Pongratz, June, eds., Giant ore deposits: Chacteristics, genesis and exploration: Hobart, Tasmania, Australia, University of Tasmania, p. 57–77.

Hedenquist, J.W., Arribas R., A., and Gonzalez-Urien, E., 2000, Exploration for epithermal deposits, *in* Haggemann, S.G., and Brown, P.E., eds., Gold in 2000: Society of Economic Geologists Reviews in Economic Geology, v. 13, p. 245–278.

Hedrick, J.B., 1997, Rare earths: U.S. Geological Survey Minerals Yearbook 1996, 6 p.

Helvaci, C., 1995, Stratigraphy, mineralogy, and genesis of the Bigadic borate deposits, western Turkey: Economic Geology, v. 90, p. 1,237–1,260.

Helvaci, C., and Orti, F., 1998, Sedimentology and diagenesis of Miocene colemanite-ulexite deposits, (Western Anatolia, Turkey): Journal of Sedimentary Research, v. 68, n. 5, p. 1,021–1,033.

Hester, B., Barnard, F., and Johnson, A., 1991, Tanzania: Opportunities for mineral resource development: Ministry of Water, Energy and Minerals, United Republic of Tanzania, VISIONPRINT, Denver, Colo., 108 p.

Hitzman, M.W., 2000, Iron-oxide Cu-Au deposits: What, where, when, and why, *in* Porter, T.M., ed., Hydrothermal iron oxide copper-gold and related deposits: A global perspective, v. 1: Adelaide, PGC Publishing, p. 9–25.

Hitzman, M.W., Oreskes, N., and Einaudi, M.T., 1992, Geological characteristics and tectonic setting of Proterozoic iron oxide (Cu-U-Au-REE) deposits: Precambrian Research, v. 58, p. 241–287.

Hofstra, A.H., and Cline, J.S., 2000, Characteristics and models for Carlin-type gold deposits: Reviews in Economic Geology, v. 13, p. 163–220.

Houssa, Charles-Etienne, 1999, Opportunities in the Algerian mineral industry: "Now is the time to invest": Industrial Minerals, no. 376, p. 19.

Hussein, A.A.A., 1990, Mineral deposits, *in* Said, Rushdi, The geology of Egypt: Brookfield, Vt., A.A. Balkema Publishers, p. 511–566.

Ibrahim, S.S., 2002, Egyptian silica—Current status and profitable trends: Industrial Minerals, no. 412, p. 34–37.

International Nickel Study Group, undated, The world of nickel, accessed January 25, 2004, at *http://www.insg.org/nickel.htm*.

Jallad, I.S., Abu Murrey, O.S., and Sadaqah, R.M., 1989, Upper Cretaceous phosphorites of Jordan, *in* Notholt, A.J.G., Sheldon, R.P., and Davidson, D.F., eds., Phosphate deposits of the world, v. 2, Phosphate Rock Resources: Cambridge University Press, p. 344–351.

Janković, S., 1977, The copper deposits and geotectonic setting of the Tethyan Eurasian metallogenic belt: Mineralium Deposita, v. 12, p. 37–47.

Janković, S., and Petrascheck, W.E., 1987, Tectonics and metallogeny of the Alpine-Himalayan belt in the Mediterranean area and western Asia: Episodes, v. 10, p. 169–175.

Janse, A.J.A., 1996, A history of diamond sources in Africa: Part II: Gems and Gemology, 32, no. 1, p. 2–30.

Johnson, Matthey, 2004, Platinum today, price charts: accessed January 31, 2004, at *http://www.platinum.matthey.com/prices/price_charts.html*.

Kamel, M.A., 1984, Glass sand, *in* Chew, R.T., ed., Potential mineral resources of Egypt—Proceedings of the second seminar of minerals, petroleum, and groundwater assessment program (Aid Project 263–0105): Cairo, Egypt, Egyptian Geological Survey and Mining Authority, p. 94–106.

Kennedy, Bernard, 2002, Race is on to develop Turkish trona deposits: Industrial Minerals, no. 422, p. 16–17.

Kesse, G.O., 1985, The mineral and rock resources of Ghana: Rotterdam, A.A. Balkema, 610 p.

Kinnaird, J.A., Kruger, F.J., Nex, P.A.M., and Cawthorn, R.G., 2002, Chromitites of the Bushveld Complex—Process of formation and PGE enrichment: Economic Geology Research Institute Information Circular no. 369, 28 p.

Kious, W.J., and Tilling, R.I., 1996, This dynamic Earth: The story of plate tectonics. accessed January 30, 2004, at *http://pubs.usgs.gov/publications/text/dynamic.html#anchor19309449*.

Kirkham, R.V, Carriere, J.J., Laramee, R.M., and Garson, D.F., 1994, Global distribution of sediment-hosted stratiform copper deposits and occurrences: Geological Survey of Canada Open File 2915b, 256 p.

Kirkham R.V., Chorlton, L.B., and Carrière, J.J., comps., 1995, Generalized geology of the world, *in* Geological Survey of Canada, Generalized geological map of the world and linked databases: Geological Survey of Canada Open File 2915d, CD-ROM.

Kirkham R.V. and Sinclair W.D., 1996, Porphyry copper, gold, molybdenum, tungsten, tin, silver, *in* Eckstrand, O.R., Sinclair, W.D., and Thorpe, R.I., eds., Geology of Canadian mineral deposit types: Geological Survey of Canada, Geology of Canada, no. 8, p. 421–446.

Kirkham, R.V., and Raefer, A.B., 2003, Selected world mineral deposits database: Geological Survey of Canada Open File 1801. CD-ROM.

Kogbe, C.A., ed., 1976, Geology of Nigeria, Lagos, Nigeria, Elizabeth Publishing Company, 436 p.

Kolb, J., Sakellaris, G.A., and Meyer, F.M., 2006, Controls on hydrothermal Fe oxide-Cu-Au-Co mineralization at the Guelb Moghrein deposit, Akjoujt, Mauritania: Mineralium Deposita, v. 41, p. 68–81.

Konhauser, K.O., Hamade, Tristan, Raiswell, Rob, Morris, R.C., Ferris, F.G., Southam, Graham, and Canfield, D.E., 2002, Could bacteria have formed the Precambrian banded iron formations?: Geology, v. 30, p. 1,079–1,082.

Kostick, D.S., 1994, Soda ash, *in* Carr, D.D., ed., Industrial minerals and rocks, 6th ed: Littleton, Colo., Society of Mining, Metallurgy, and Exploration, p. 929–958.

Krauss, U.H., Schmidt, H.W., Taylor, H.A., Jr., and Sutphin, D.M., 1988, International strategic minerals inventory summary report—Natural graphite: U.S. Geological Survey Circular 930–H, 29 p.

Krauss, U.H., Saam, H.G., and Schmidt, H.W., 1984, International strategic minerals inventory summary report—Phosphate: U.S. Geological Survey Circular 930–C, 41 p.

Kunasz, I.A., 1994, Lithium resources, *in* Carr, D.D., ed., Industrial minerals and rocks, 6th ed: Littleton, Colo., Society of Mining, Metallurgy, and Exploration, p. 631–642.

Lachelt, Siegfried, 2004, The geology and mineral resources of Mozambique: Direccao Nacional de Geologia Mocambique, 515 p.

Lang, J.R., and Baker, T., 2001, Intrusion-related gold systems: the present level of understanding: Mineralium Deposita, v. 36, p. 477–489.

Laznicka, P., 1999, Quantitative relationships among giant deposits of metals: Economic Geology, v. 94, p. 455–474.

Leach, D.L., Sangster, D.F., Kelley, K.D., Large, R.R., Garven, G., Allen, C.R., Gutzmer, J., and Walters, S., 2005, Sediment-hosted lead-zinc deposits: A global perspective: Economic Geology 100th Anniversary Volume, p. 561–608.

Leaman, P., and Staude, J.-M., 2002, Metallogenic evolution of the western Tethys of Turkey and Iran, *in* Metal Mining Agency of Japan, Presentation from forum on mineral potential of Asia: Mineral Resource Information Center, 42p., CD ROM.

Lehmann, Bernd, 1990, Metallogeny of tin: Berlin, Springer-Verlag, Lecture Notes in Earth Sciences, 211 p.

Lydon, J.W., 1988, Volcanogenic massive sulphide deposits part 1: A descriptive model, *in* Roberts, R.G. and Sheahan, P.A., eds., Ore deposit models: Geoscience Canada Reprint Series 3, p. 145–153.

Lydon, J.W., 1996, Sedimentary exhalative sulphides (sedex), *in* Eckstrand, O.R., Sinclair, W.D., and Thorpe, R.I., eds., Geology of Canadian mineral deposit types: Geological Survey of Canada, Geology of Canada, no. 8, p. 130–152.

Ma'aden (Saudi Arabian Mining Company), 2003, Operation: accessed October 14, 2003, at *http://www.maaden.com.sa/.*

Mariano, A.N., 1989, Nature of economic mineralization in carbonatites and related rocks, *in* Bell, Keith, ed., Carbonatites: genesis and evolution: Boston, Unwin Hyman, p. 149 – 176.

Martini, J.E.J., and Hammerbeck, E.C.I., 1998, Fluorspar, *in* Wilson, M.G.C., and Anhaeusser, C.R., eds., 1998, The mineral resources of South Africa: Handbook, Council for Geoscience, 16, p. 269–279.

Matier, K.W.J., 2004, History of exploration on the Platreef from 1925 to today: Geoscience Africa 2004, Abstract Volume, Johannesburg, South Africa, University of the Witwatersrand, p. 427–428.

McCombe, D.A., Fernette, G.L., and Alawi, A.J., comps., 1994, The geology and mineral resources of Yemen: Ministry of Oil and Mineral Resources, Geological Survey and Mineral Exploration Board, Yemen Mineral Sector Project, Technical Report, 128 p., 34 figs.

Mertie, J.B., Jr., 1969, Economic geology of the platinum metals: U.S. Geological Survey Professional Paper 630, 120 p.

Metal Mining Agency of Japan, 1998, List of the metallic mineral deposits in Asia: Metal Mining Agency of Japan, 43 p.

Metal Mining Agency of Japan, 2002, Mineral Potential of Asia: Mineral Resource Information Center, 42 p., CD-ROM.

Metal Mining Agency of Japan, 2003, Projects, Middle East and Central Europe, Turkey, Oman: accessed October 8, 2003, at *http://www.mmaj.go.jp/mmaj_e/project/mece.html*.

Mineral Information Institute, USGS, and American Coal Foundation, undated, Minerals in your world: Golden, Colo., Mineral Information Institute, CD ROM.

Mining Activity Digest, 1986, International mine/plant activity: v. 13, no. 4.

Mitarbeiterstab der Bergbauabteilung, 1987, World mining map of copper, lead, zinc, tin, nickel and aluminum: Metallgesellschaft AG, Frankfurt, map and booklet, scale 1:27,500,000.

Mitchell, R.H., 1986, Kimberlites: mineralogy, geochemistry, and petrology: New York, Plenum Press, 442 p.

Mitchell, R.H., 1993, Kimberlites and lamproites: primary sources of diamond, *in* Sheahan, P.A. and Cherry, M.E., eds., Ore deposit models, v. II: Geoscience Canada Reprint Series 6, p. 13–28.

Morteani, G., and Satir, M., 1989, The bastnaesite-fluorite-barite deposit of the Kizilcaoren district, Eskisehir, Turkey, *in* Moeller, P., Cerny, P., and Saupe, F., eds., Lanthanides, tantalum, and niobium; mineralogy, geochemistry, characteristics of primary ore deposits, prospecting, processing and application: New York, Springer, p. 189–194.

Murray, Roger, 1989, Namibia's mineral potential—Independence brightens development prospects: Industrial Minerals, no. 266, p. 85–89.

Mutschler, F.E., Ludington, Steve, and Bookstrom, A.A., 1999, Giant porphyry-related metal camps of the world—a database: U.S. Geological Survey Open–File Report 99–556, available online at *http://geopubs.wr.usgs.gov/open-file/of99-556/*.

Muyunda, Cris, 1992, Zambia—An outline of industrial minerals potential: Industrial Minerals, no. 296, p. 137–139.

Naldrett, A.J., 2004, Magmatic sulfide deposits: Geology, Geochemistry and Exploration: Springer Verlaag, 728 p.

Nel, C.J., Beukes, N.J., and de Villiers, J.P.R., 1986, the Mamatwan manganese mine of the Kalahari manganese field *in* Anhaeusser, C.R., and Maske, S., eds., Mineral deposits of Southern Africa, v. I and II: Johannesburg, Geological Society of South Africa, p. 963–978.

Nelson, J.L., 1996, Polymetallic mantos Ag-Pb-Zn, *in* Lefebure, D.V. and Hoy, T., eds., Selected British Columbia mineral deposit profiles, v. 2 – Metallic deposits: British Columbia Ministry of Employment and Investment Open–File 1996–13, p. 101–104.

Nisbet, B., Cooke, J., Richards, M., and Williams, C., 2000, Exploration for iron oxide copper gold deposits in Zambia and Sweden: Comparison with the Australian experience, *in* Porter, T.M., ed., Hydrothermal iron oxide copper-gold and related deposits: A global perspective, v. 1: Adelaide, PGC Publishing, p. 297–308.

Notholt, A.J.G., 1994, Phosphate rock in developing countries: a review of geology, resources and development, *in* Mothers, S.J., and Notholt, A.J.G., eds., Industrial minerals in developing countries: British Geological Survey and Association of Geoscientists for International Development, AGID Report Series Geosciences in International Development 18, p. 193–222.

Notholt, A.J.G., Highly, D.E., and Deans, T., 1990, Economic minerals in carbonatites and associated alkaline igneous rocks: Transactions of the Institution of Mining and Metallurgy, Section B—Applied Earth Science, v. 99, p. B59–B124.

Notholt, A.J.G., Sheldon, R.P., and Davidson, D.F., eds., 1989, Cambridge University Press, Phosphate Deposits of the World, v. 2, Phosphate Rock Resources, 566 p.

O'Driscoll, Mike, 1988, Rare earths—enter the dragon: Industrial Minerals, no. 254, p. 21–55.

Odyssey Resource, Limited, 2003, Projects: accessed October 7, at *http://www.odysseyresources.com/s/Projects.asp*

Office Cherifien des Phosphates Group, 2008, Introduction: accessed October 8, 2008 at http://www.ocpgroup.ma/english/jsp/qui_sommes/activite.jsp.

Olson, D.W., 2002, Diamond, industrial: U.S. Geological Survey Minerals Yearbook 2001, 9 p.

Oosterhuis, W.R., 1998a, Graphite, *in* Wilson, M.G.C., and Anhaeusser, C.R., eds., 1998, The mineral resources of South Africa: Handbook, Council for Geoscience, 16, p. 387–393.

Oosterhuis, W.R., 1998b, Andalusite, sillimanite and kyanite, *in* Wilson, M.G.C., and Anhaeusser, C.R., eds., 1998, The mineral resources of South Africa: Handbook, Council for Geoscience, 16, p. 53–58.

Orris, G.J., and Chernoff, C.B., 2002, Data set of world phosphate mines, deposits, and occurrences – Part B. Location and mineral economic data: U.S. Geological Survey Open–File Report 02–156–B, 328 p.

Orris, G.J., and Grauch, R.I., 2002, Rare earth element mines, deposits, and occurrences: U.S. Geological Survey Open–File Report 02–198, 167 p.

Oxiana Limited, 2003, Exploration, accessed October 7, 2003, at *http://www.oxiana.com.au/Projects/Cyprus/*

Pearson, Karine, 1999, A TiO_2 feedstock review: Industrial Minerals, no. 378, p. 42–53.

Pell, Jennifer, 1996, Chapter 13—Mineral deposits associated with carbonatites and related alkaline igneous rocks, *in* Mitchell, R.H., ed., Undersaturated alkaline rocks: Mineralogy, petrogenesis, and economic potential: Mineralogical Association of Canada Short Course 24, p. 271–310.

Pelletier, R.A., 1964, Mineral resources of south-central Africa, Cape Town, Oxford University Press, 277 p.

Petruk, W., 1975, Mineralogy and geology of the Zgounder silver deposit in Morocco: The Canadian Mineralogist, v. 13, no. 1, p. 43–54.

Petters, S.W., 1991, Regional geology of Africa: Berlin, Springer-Verlag, 722 p.

Porter, T.M., ed., 2000, Hydrothermal iron oxide copper-gold and related deposits: A global perspective, v. 1: Adelaide, PGC Publishing, 349 p.

Porter, T.M., ed., 2002, Hydrothermal iron oxide copper-gold and related deposits: A global perspective, v. 2: Adelaide, PGC Publishing, 377 p.

Post, J.E., 1997, The national gem collection: National Museum of Natural History (U.S.), Harry N. Adams, Inc., 100 Fifth Avenue, New York, NY 10011, 144 p.

Poulsen, K.H., and Hannington, M.D., 1996, Volcanic-associated massive sulphide gold, *in* Eckstrand, O.R., Sinclair, W.D., and Thorpe, R.I., eds., Geology of Canadian mineral deposit types: Geological Survey of Canada, Geology of Canada, no. 8, p. 183–196.

Power, Tim, 1986, Tunisia—Developing downstream industries: Industrial Minerals: no. 225, p. 20–27.

Powers, R.W., Ramirez, L.F., Redmond, C.D., and Elberg, E.L., 1966, Geology of the Arabian peninsula, Sedimentary geology of the Arabian peninsula: U.S. Geological Survey Professional paper 560–D, 147 p.

Premoli, Camillo, 1994, Industrial minerals in Angola and Mozambique—a multi-country approach, *in* Mathers, S.J., and Notholt, A.J.G., eds., Industrial minerals in developing countries: British Geological Survey and Association of Geoscientists for International Development (AGID) Report Series Geosciences in International Development 18, p. 135–144.

Pretorius, D.A., 1974, The nature of the Witwatersrand gold-uranium deposits: Johannesburg, Economic Geology Research Unit, University of the Witwatersrand, Information Circular 96, 50 p.

Reckling, K., Hoy, R.B., Lefond, S.J., Fullerton, D.G., and Rowell, U.H., 1994, Diamonds, industrial, *in* Carr, D.D. and others, eds., Industrial minerals and rocks, 6th ed: Littleton, Colo., Society of Mining, Metallurgy, and Exploration, p. 379–295.

Roscoe, S.M., and Minter, W.E.L., 1993, Pyritic paleoplacer gold and uranium deposits, *in* Kirkham, R.V., Sinclair, W.D., Thorpe, R.I., and Duke, J,M., eds., Mineral deposit modeling: Geological Association of Canada, Special Paper 40, p. 103–124.

Rio Tinto, 2001, Fact sheet series: Industrial Minerals, accessed January 26, 2004 at *http://www.riotinto.com/library/reports/PDFs/corpPub_FactSheet_IndustMin.pdf*.

Robb, L.J., and Robb, V.M., 1998, Gold in the Witwatersrand basin, *in* Wilson, M.G.C., and Anhaeusser, C.R., eds., 1998, The mineral resources of South Africa: Handbook, Council for Geoscience, 16, p. 294–349.

Robert, Francois, 1996, Quartz-carbonate vein gold, *in* Eckstrand, O.R., Sinclair, W.D., and Thorpe, R.I., eds., Geology of Canadian mineral deposit types: Geological Survey of Canada, Geology of Canada, no. 8, p. 350–366.

Roberts, R.G., 1988, Archean lode gold deposits, *in* Roberts, R.G, and Sheahan, P.A. eds., Ore deposit models: Geoscience Canada Reprint Series 3, p. 1–20.

Roscoe, S.M., 1996, Paleoplacer uranium, gold, *in* Eckstrand, O.R., Sinclair, W.D., and Thorpe, R.I., eds., Geology of Canadian mineral deposit types: Geological Survey of Canada, Geology of Canada, no. 8, p. 10–23.

Roskill Information Services, 1989, The economics of potash: London, England, variously paginated.

Roy, S., 1992, Environments and processes of manganese deposition: Economic Geology, v. 87, p. 1,218–1,236.

Russell, Alison, 1987, Phosphate rock—Trends in processing and production: Industrial Minerals, no. 240, p. 25–57.

Ruzicka, V., 1996, Unconformity-associated uranium, *in* Eckstrand, O.R., Sinclair, W.D., and Thorpe, R.I., eds., Geology of Canadian mineral deposit types: Geological Survey of Canada, Geology of Canada, no. 8, p. 197–210.

Rytuba, J.J., 2002, Mercury from mineral deposits and potential environmental impact: Environmental Geology, v. 43, p. 326–338.

Said, Rushdi, ed., 1990, The geology of Egypt: Rotterdam, A.A. Balkema, 734 p.

Salehi, H., 1989, The apatite-magnetite deposit of Esfordi, Bafq, central Iran, *in* Notholt, A.J.G., Sheldon, R.P., and Davidson, D.F., eds., Phosphate deposits of the world, v. 2: Cambridge University Press, Phosphate Rock Resources, p. 329–331.

Sangster, D.F., 1996a, Mississippi Valley-type lead-zinc, *in* Eckstrand, O.R., Sinclair, W.D., and Thorpe, R.I., eds., Geology of Canadian mineral deposit types: Geological Survey of Canada, Geology of Canada, no. 8, p. 253–261.

Sangster, D.F., ed., 1996b, Carbonate hosted lead-zinc deposits: Society of Economic Geologist Special Publication Number 4, 664 p.

Schluter, Thomas, 1997, Geology of East Africa: Berlin, Stuttgart, Gebruder Borntraeger, 484 p.

Schulter, Thomas, 2006, Geologic atlas of Africa: Berlin, Springer, 272 p.

Scholten, J.C., Stoffers, P., Garbe-Schoenber, D., and Moammar, M., 2000, Hydrothermal mineralization in the Red Sea, *in* Cronan, D.S., ed., Handbook of marine mineral deposits, Boca Raton, Fla., CRC Press, p. 369–395.

Schurmann, L.W., Grabe, P-J., and Steenkamp, C.J., 1998, Chromium, *in* Wilson, M.G.C., and Anhaeusser, C.R., eds., 1998, The mineral resources of South Africa: Handbook, Council for Geoscience, 16, p. 90–105.

Shigley, J.E., Dirlam, D.M., Laurs, B.M., Beohm, E.W., Bosshart, George, and Larson, W.F., 2000, Gem localities of the 1990s: Gems & Gemology, Winter, p. 292–335.

Siebert, L., and Simkin, T., 2002, Volcanoes of the world: an illustrated catalog of Holocene volcanoes and their eruptions: Smithsonian Institution, Global Volcanism Program Digital Information Series, GVP-3, accessed January 16, 2004 at *http://www.volcano.si.edu/gvp/world/*.

Sillitoe, R.H., 1993, Epithermal models; Genetic types, geometric controls, and shallow features, *in* Kirkham, R.V., Sinclair, W.D., Thorpe, R.I., and Duke, J.M., eds., Mineral deposit modeling: Geological Association of Canada Special Paper 40, p. 403–418.

Sillitoe, R.H., 2000, Gold-rich porphyry deposits: descriptive and genetic models and their role in exploration and discovery, *in* Hagemann, S.G., and Brown, P.E., eds., Gold in 2000: Reviews in Economic Geology, v. 13, p. 315–345.

Şengör, A.M.C., and Natal'in BA, 1996a, Paleotectonics of Asia: fragments and synthesis, *in* Yin, A., and Harrison, M., eds., The tectonic evolution of Asia: Cambridge, Cambridge University Press, p. 486–640.

Şengör, A.M.C., and Natal'in BA, 1996b, Turkic-type orogeny and its role in the making of the continental crust: Annual Review Earth Planetary Science, v. 24, p. 263–337.

Seyhan, I., 1989, The apatite-magnetite deposits of the Bingöl and Bitlis areas, eastern Turkey, *in* Notholt, A.J.G., Sheldon, R.P., and Davidson, D.F., eds., Phosphate deposits of the world, v. 2, Phosphate rock resources: Cambridge, Cambridge University Press, p. 376–379.

Singer, D.A., 1995, World class base and precious metal deposits—a quantitative analysis: Economic Geology v. 90, p. 88–104.

Singer, D.A., Berger, V.I., and Moring, B.C., 2002, Porphyry copper deposits of the world: database, maps, and preliminary analysis: U.S. Geological Survey Open–File Report 02–268, available online at *http://geopubs.wr.usgs.gov/open-file/of02-268/*.

Singer, D.A., Mosier, D.L., and Menzie, D.W., 1993, Digital grade and tonnage data for 50 types of mineral deposits: U.S. Geological Survey Open–File Report 93–280, available online at *http://pubs.usgs.gov/of/1993/ofr-93-0280/*.

Skillen, Andy, 1993, Fluorspar producers—cracks in the Chinese wall?: Industrial Minerals, no. 307, p. 36–49.

Sonnenfeld, P., 1991, Evaporite basin analysis, *in* Force, E.R., Eidel, J.J., and Maynard, J.B., eds., Sedimentary and diagenetic mineral deposits: A basin analysis approach to exploration: society of Economic Geologists Reviews in Economic Geology, v. 5, p. 159–170.

Stacey, J.S., and Stoeser, D.B., 1983, Distribution of oceanic and continental leads in the Arabian-Nubian shield: Contributions to Mineralogy and Petrology, v. 84, p. 91–105.

Stoeser, D.B., and Camp, V.E., 1985, Pan-African microplate accretion of the Arabian Shield: Geological Society of America Bulletin, v. 96, p. 817–826.

Stowe, C.W., 1994, Compositions and tectonic settings of chromite deposits through time: Economic Geology, v. 89, p. 528–546.

Sutphin, D.M., Sabin, A.E., and Reed, B.L., 1990, International strategic minerals inventory summary report—Tin: U.S. Geological Survey Circular 930–J, 52 p.

Tadesse, S., and Zerihun, D., 1996, Composition, fractionation trend and zoning accretion of the columbite-tantalite group of minerals in the Kenticha rare-metal field (Adola, southern Ethiopia): Journal of African Earth Sciences, v. 23, p. 411–431.

Tankard, A.J., Jackson, M.P.A, Eriksson, K.A., Hobday, D.K., Hunter, D.R., and Minter, W.E.L., 1982, Crustal evolution of southern Africa: New York, Springer-Verlag, 523 p.

Tantalum-Niobium International Study Center, 2005, Accessed June 1, 2006 at http://www.tanb.org/index.html.

Tawadros, E., 2001, Geology of Egypt and Libya: Rotterdam, A.A. Balkema, 468 p.

Thompson, T.B., 2002, Geology of Carlin-type gold deposits: insights from the Great Basin deposits, Nevada, *in* Cooke, D.R., and Pongratz, June, eds., Giant ore deposits: characteristics, genesis and exploration: Centre for Ore Deposit Research, University of Tasmania, GPO Box 252-79, Hobart, Tasmania, Australia 7001, p. 161–174.

Tsikos, H., and Moore, J.M., 1998, The Kalahari manganese field: an enigmatic association of iron and manganese: South African Journal of Geology, v. 101, p. 287–290.

Titanium Resources Group Ltd., 2005, World's largest rutile (titanium dioxide) mine to restart Sierra Leone production, Freetown, Sierra Leone: Titanium Resources Group Ltd., Press release, February 28, 2 p.

Towner, R.R., Gray, Jonathan, M., and Porter, L.M., 1988, International strategic mineral inventory summary report – titanium: U.S. Geological Survey Circular 930–G, 58 p.

Trendall, A.F., 2002, The significance of iron-formation in the Precambrian stratigraphic record: Special Publications of the International Association of Sedimentologists, v. 33, p. 33–66.

UNESCO, 1982, Metallogenic map of Europe and neighboring countries, sheet 9: Near East (Ankara), plus mineral deposit list, scale: 1:2,500,000.

UNESCO, 1983, Metallogenic map of Europe and neighboring countries, sheet 8: South Europe and Mediterranean Sahara (Athens), plus mineral deposit list, scale: 1:2,500,000.

United Nations Development Program, 1987, Mineral Resources of Mali, UNDP/DTCD Project MLI/85/007, 64 p.

U.S. Geological Survey, 2004a, Mineral Commodity Summaries 2004: U.S. Government Printing Office, Washington, D.C., 197 p., available online at http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf.

U.S. Geological Survey, 2004b, Minerals yearbook, area reports: International 2002, Africa and the Middle East, v. III: U.S. Government Printing Office, Washington, D.C., 275 p., available online at http://minerals.usgs.gov/minerals/pubs/country/africa.html.

van Straaten, P., 2002, Rocks for crops: Agrominerals of sub-Saharan Africa: ICRAF, Nairobi, Kenya, 338 p.

Vielreicher, N.M., Groves, D.I., and Vielreicher, R.M., 2000, The Phalaborwa (Palabora) deposit and its potential connection to iron-oxide copper-gold deposits of Olympic dam type, *in* Porter, T.M., ed., Hydrothermal iron oxide copper-gold and related deposits: A global perspective, v. 1: Adelaide, PGC Publishing, p. 297–308.

Viljoen, M.J., and Schürmann, L.W., 1998, Platinum-group metals, *in* Wilson, M.G.C., and Anhaeusser, C.R., eds., 1998, The mineral resources of South Africa: Handbook, Council for Geoscience, 16, p. 532–568.

Virta, R.L., and Mann, E.L., 1994, Asbestos, *in* Carr, D.D., ed., Industrial minerals and rocks, 6th ed: Littleton, Colo., Society of Mining, Metallurgy, and Exploration, p. 97–124.

Ward, J.H.W., 1998, Antimony, *in* Wilson, M.G.C., and Anhaeusser, C.R., eds., 1998, The mineral resources of South Africa: Handbook, Council for Geoscience, 16, p. 59–65.

Waterman, G.C., and Hamilton, R.L., 1975, The Sar Cheshmeh porphyry copper deposit: Economic Geology, v. 70, p. 568–576.

Webber, B.N., 1953, Geologic reconnaissance of the metallic mineral and sulfur deposits of Iraq: U.S. Geological Survey report, prepared in cooperation with the Ministry of Economics,

Government of Iraq, under the auspices of the technical Cooperation Administration, U.S. Department of State, 45 p.

Wegener, A., 1912, Die Entstehung der Kontinente: Geologische Rundschau, v. 3, no. 4, p. 276–292.

Wendorff, Marek, and Tack, Luc, eds., 1995, Late Proterozoic Belts in central and southwestern Africa: IGCP Project 302, Annales Sciences Geologiques, v. 101, Royal Museum of Central Africa, Tervuren, Belgium, 161 p.

White, N.C., Hedenquist, J.W., and Kirkham, R.V., 2001, Asia: The waking giant: Mining Journal supplement, March 2001, 12 p.

Wickens, J., 2004, Developments in the tantalum market: The Tantalum-Niobium International Study Center, available online at http://www.tanb.org/minor_metals_2004.html.

Wilburn, D.R., 2000, Exploration: Mining Engineering, v. 52, no. 5, p. 38–48.

Wilburn, D.R., 2004, Nonfuel mineral exploration 2003: Mining Engineering, v. 56, p. 25–37.

Wilburn, D.R., 2005, Nonfuel mineral exploration 2004: Mining Engineering, v. 57, p. 37–48.

Willis, Mark, 2003, Ti-ming it right: Industrial Minerals, no. 424, p. 40–45.

Wilson, M.G.C., 1998, Phosphate, *in* Wilson, M.G.C., and Anhaeusser, C.R., eds., 1998, The mineral resources of South Africa: Handbook, Council for Geoscience, 16, p. 525–531.

Wilson, M.G.C., and Anhaeusser, C.R., eds., 1998, The mineral resources of South Africa: Handbook, Council for Geoscience, 16, 740 p.

Windley, B.F., 1977, The evolving continents: New York, John Wiley & Sons, 385 p.

Wooley, A.R., 1989, The spatial and temporal distribution of carbonatites, *in* Bell, Keith, ed., Carbonatites: genesis and evolution: Boston, Unwin Hyman, p. 15 – 37.

Wooley, A.R., 2001, Alkaline rocks and carbonatites of the world-- Part 3: Africa: London, The Geological Society, 372 p.

Wright, J.B., Hastings, D.A., Jones, W.B., and Williams, H.R., 1985, Geology and mineral resources of West Africa: London, George Allen and Unwin, Ltd., 187 p.

Yeats, C.J., and Vanderhor, Fop, 1998, Archaean lode-gold deposits: AGSO Journal of Australian Geology and Geophysics, v. 17, no. 4, p. 253–258.

Yoshida, M., Windley, B.F., and Dasgupta, S., eds., 2003, Proterozoic east Gondwana: Supercontinent Assembly and Breakup: Geological Society, London, Special Publications, 206, 472 p.

Zarcan International Resources, Inc., 2003, Projects, Iran: accessed October 8, 2003, at *http://www.zarcan.com/projects.html*.

Table 1. Major nonfuel mineral commodities in each country in Africa and the Middle East.

Country	Commodities
Algeria	bentonite, celestite, cement, gold, iron, lead, phosphate, silver, uranium, zinc
Angola	bauxite, cement, copper, diamonds, feldspar, gold, iron, phosphates, uranium
Benin	cement, gold, limestone, marble
Botswana	cobalt, copper, diamonds, gold, iron, nickel, potash, salt, silver, soda ash
Burkina Faso	antimony, bauxite, cement, copper, gold, lead, limestone, manganese, marble, nickel, phosphates, silver, zinc
Burundi	cobalt, copper, gold, nickel, platinum, REE, tantalum, tin, tungsten, uranium, vanadium
Cameroon	aluminium, bauxite, cement, iron, gold, tin
Cape Verde	basalt rock, kaolin, limestone, salt
Central African Republic	diamonds, gold, uranium
Chad	gold, kaolin, natron, uranium
Comoros	No significant nonfuel mineral resources
Cote D'Ivoire	bauxite, cement, cobalt, copper, diamonds, gold, iron, manganese
Democratic Republic of the Congo (Kinshasa)	bauxite, cement, cadmium, cobalt, columbium (niobium)-tantalum, copper, diamonds, germanium, gold, iron, manganese, radium, silver, tin, uranium, zinc
Djibouti	No significant nonfuel mineral resources
Egypt	aluminium, asbestos, cement, gypsum, ilmenite, iron, lead, limestone, manganese, phosphate, soda ash, talc, zinc
Equatorial Guinea	gold, iron, manganese, titanium, uranium
Eritrea	cement, copper, gold, potash, salt, zinc
Ethiopia	cement, copper, gold, platinum, potash, tantalum
Gabon	cement, diamonds, gold, iron, manganese, uranium
Gambia, The	No significant nonfuel mineral resources
Ghana	aluminium, bauxite, cement, diamonds, gold, manganese, silver
Guinea	bauxite, cement, gold, diamonds
Guinea-Bissau	bauxite, phosphate
Kenya	aluminium, cement, fluorite, garnets, gemstones, gold, ilmenite, iron, limestone, salt, soda ash, trona
Lesotho	diamonds
Liberia	cement, diamonds, gold, iron
Libya	cement, gypsum
Madagascar	bauxite, cement, chromite, gold, gemstones, graphite, ilmenite, mica, quartz, salt, scandium
Malawi	bauxite, cement, gemstones, limestone, uranium
Mali	bauxite, cement, copper, diamonds, gold, iron, kaolin, limestone, manganese, phosphate, salt, silver, tin, uranium
Mauritania	cement, copper, diamonds, gold, gypsum, iron, phosphate
Mauritius	No significant nonfuel mineral resources
Morocco	barite, cement, cobalt, copper, gold, iron, lead, manganese, phosphate, salt, silver, zinc
Mozambique	aluminium, bauxite, cement, gold, graphite, ilmenite, tantalum
Namibia	cadmium, copper, diamonds, fluorite, gold, lead, lithium, salt, silver, tin, uranium, vanadium, zinc

Table 1. Major nonfuel mineral commodities in each country in Africa and the Middle East.

Country	Commodities
Niger	cement, gold, iron, phosphate, tin, uranium
Nigeria	aluminium, cement, columbite, gold, iron, lead, limestone, tantalum, tin, zinc,
Republic of the Congo (Brazzaville)	cement, copper, gold, lead, phosphate, potash, uranium, zinc,
Reunion	No significant nonfuel mineral resources
Rwanda	cement, columbium (niobium)-tantalum, gold, tin, tungsten,
Sao Tome and Principe	No significant nonfuel mineral resources
Senegal	cement, gold, iron, phosphate,
Seychelles	No significant nonfuel mineral resources
Sierra Leone	bauxite, cement, chromite, diamonds, gold, ilmenite, iron, rutile, zirconium
Somalia	bauxite, copper, gypsum, iron, salt, tin, uranium
South Africa	antimony, aluminium, asbestos, cement, chromite, cobalt, copper, corundum, diamonds, fluorite, gold, iron, ilmenite, lead, manganese, nickel, phosphate, palladium, platinum, REE, salt, silicon, silver, thorium, tin, uranium, vanadium, vermiculite, zinc
Sudan	cement, chromite, copper, gold, mica, silver, tungsten, zinc
Swaziland	asbestos, clay, diamonds, gold, quarry stone, talc, tin
Tanzania	cement, copper, diamonds, gemstones, gold, iron, nickel, phosphate, soda ash, silver, tin
Togo	cement, limestone, marble, phosphate
Tunisia	cement, fertilizer, iron, lead, salt, silver, zinc, phosphate,
Uganda	cement, cobalt, columbium (niobium)-tantalum, copper, gold, iron, limestone, phosphate, soda ash, salt, tin, tungsten
Western Sahara	iron, phosphate
Zambia	cement, cobalt, copper, emeralds, gemstones, gold, lead, silver, tin, uranium, zinc
Zimbabwe	asbestos, cement, chromite, cobalt, copper, corundum, diamonds, gold, graphite, iron, lithium, nickel, phosphate, palladium, platinum, tantalum, tin vanadium, vermiculite
Bahrain	No significant nonfuel mineral resources
Cyprus	asbestos, copper, gypsum
Iran	copper, chromium, iron, lead, manganese, sulfur, zinc
Iraq	phosphate, sulfur
Israel	clays, copper, magnesium bromide, phosphate, potash, sand
Jordan	phosphate, potash
Kuwait	sulfur
Lebanon	iron, limestone, salt
Oman	asbestos, copper, chromium, gypsum, limestone, marble
Qatar	No significant nonfuel mineral resources
Saudi Arabia	building stone, copper, gold, salt, sulfur, zinc
Syria	asphalt, chromium, gypsum, iron, manganese, marble, phosphate, salt
Turkey	antimony, borate, chromium, copper, iron, mercury, soda ash, sodium sulfate, sulfur
United Arab Emirates	sulfur
Yemen	building stone, copper, gold, lead, marble, nickel, salt

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Algeria	Affensou	36.66670	4.23330	Barite	Hydrothermal
Algeria	Ain Mimoun	35.85000	7.11670	Barite	Hydrothermal
Algeria	Bou Caid	35.60000	1.66670	Barite	Hydrothermal
Algeria	Gouraya	36.56667	1.91667	Barite	Hydrothermal
Algeria	Keddara	36.61670	3.47500	Barite	Hydrothermal
Algeria	Mekla	36.65000	4.35000	Barite	Hydrothermal
Algeria	Sidi Kamber	36.71670	6.58330	Barite	Hydrothermal
Algeria	Kieselghur	35.55000	-0.05000	Clay	Surficial
Algeria	Maghnia	34.83330	-1.75000	Clay (Bentonite)	Surficial
Algeria	Mostaganem	35.90000	0.00140	Clay (Bentonite)	Surficial
Algeria	Djebel Debagh	36.51670	7.46670	Clay (Kaolin)	Surficial
Algeria	Tamazert	36.81670	6.23330	Clay (Kaolin)	Surficial
Algeria	Bou Soufa	36.75000	5.58330	Copper	Hydrothermal
Algeria	Djebel Haddid	36.48330	2.26670	Copper, Iron	Hydrothermal
Algeria	El Maden	36.60000	3.28330	Copper, Iron	Hydrothermal
Algeria	Ghar Rouban	34.60000	-1.78330	Copper, Lead	Hydrothermal
Algeria	Ain Barbar	36.98330	7.56670	Copper, Zinc	Hydrothermal
Algeria	Medea	36.25000	2.75000	Gypsum	Sedimentary
Algeria	Sebket Oran (Sebkra d-Oran)	35.5833	-0.8333	Halite	Sedimentary
Algeria	Ain Ben Merouane	36.88330	7.10000	Iron	Unclassified
Algeria	Beni Douala	36.63330	4.06670	Iron	Hydrothermal
Algeria	Beni Saf	35.28330	-1.38330	Iron	Unclassified
Algeria	Beni-Felkal	36.50000	4.66670	Iron	Unclassified
Algeria	Bou Khadra	35.76670	8.04440	Iron	Sedimentary
Algeria	Fondouk	36.41670	2.25000	Iron	Unclassified
Algeria	Ghara Djebilet	26.76670	-7.33330	Iron	Unclassified
Algeria	Khanguet	35.58000	8.10000	Iron	Unclassified
Algeria	Kristel	34.81670	-1.33330	Iron	Unclassified
Algeria	Rouina	36.23330	1.80000	Iron	Sedimentary
Algeria	Sidi Marouf	36.56670	6.46670	Iron	Sedimentary
Algeria	Temoulga	36.50000	2.16670	Iron	Unclassified
Algeria	Timezrit	36.58330	4.76670	Iron	Sedimentary
Algeria	Zaccar	36.3167	2.2000	Iron	Unclassified
Algeria	Ouenza	35.96667	8.11667	Iron, Copper	Sedimentary
Algeria	Tazout	35.83330	-0.46670	Iron, Lead	Unclassified
Algeria	Affalou	36.50000	4.66670	Iron, Manganese	Sedimentary
Algeria	Djebel Ichmoul	35.28330	6.50000	Lead	Hydrothermal
Algeria	Chellala	35.61670	6.13330	Lead, Zinc	Hydrothermal
Algeria	Djebel Filaoucine	35.01670	-1.61670	Lead, Zinc	Hydrothermal
Algeria	Djebel Gustar	36.01670	5.55000	Lead, Zinc	Hydrothermal
Algeria	Djebel Maasser	34.60000	-1.78330	Lead, Zinc	Hydrothermal
Algeria	El Abed	34.51670	-1.68330	Lead, Zinc	Hydrothermal
Algeria	Maaziz	34.88330	-1.80000	Lead, Zinc	Hydrothermal
Algeria	M'Cid Aiaba	36.58330	6.36670	Lead, Zinc	Hydrothermal
Algeria	Batna	36.93330	6.76670	Limestone	Sedimentary
Algeria	Blida	36.46670	2.80000	Limestone	Sedimentary
Algeria	Bouira	36.36670	3.91670	Limestone	Sedimentary
Algeria	Constantine	36.83330	6.65000	Limestone	Sedimentary
Algeria	Djelfa	34.71670	3.23330	Limestone	Sedimentary
Algeria	El Asnam	36.50000	1.98330	Limestone	Sedimentary
Algeria	Oran	35.66670	-0.60000	Limestone	Sedimentary

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Algeria	Bendjerah	36.33330	7.66670	Limestone (marble)	Sedimentary
Algeria	Bou Hanifia	35.21670	0.16670	Limestone (marble)	Sedimentary
Algeria	Filfila	36.88330	7.11670	Limestone (marble)	Sedimentary
Algeria	Am'Rasma	36.61670	7.10000	Mercury	Hydrothermal
Algeria	Ismail	36.70000	7.10000	Mercury	Hydrothermal
Algeria	Bordj Redir	35.90810	4.90610	Phosphate	Sedimentary
Algeria	Djebel Kouif (Le Kouif)	35.48333	8.31667	Phosphate	Sedimentary
Algeria	Djebel Onk	34.71667	7.88333	Phosphate	Sedimentary
Algeria	M'zaita	35.93333	4.95000	Phosphate	Sedimentary
Algeria	Arzew	35.70000	-0.31670	Sodium sulfate	Sedimentary
Algeria	El Outaya	35.05000	5.60000	Sodium sulfate	Sedimentary
Algeria	Gerboun Lamri	36.78330	7.50000	Sodium sulfate	Sedimentary
Algeria	Great Sebkha	35.50000	-0.75000	Sodium sulfate	Sedimentary
Algeria	Sidi Bouziane	35.78330	6.83330	Sodium sulfate	Sedimentary
Algeria	Beni Mansour	36.36670	4.76670	Strontium	Sedimentary
Algeria	Karezas	36.80000	7.65000	Tungsten, Tin	Igneous
Algeria	Ain Bou Hamada	35.36670	6.68330	Zinc	Hydrothermal
Algeria	Amarko	36.25000	7.13330	Zinc	Hydrothermal
Algeria	Azrou N'Bechar	36.73330	4.08330	Zinc	Hydrothermal
Algeria	Bou Douka	36.75000	6.40000	Zinc	Hydrothermal
Algeria	El Ouasta	36.15000	8.28330	Zinc	Hydrothermal
Algeria	Fej Hassen	36.83330	3.00000	Zinc	Hydrothermal
Algeria	Ghazaouet	35.10000	-1.93330	Zinc	Hydrothermal
Algeria	Hammam N'Rails	36.33330	7.65000	Zinc	Hydrothermal
Algeria	Kherzet-Youssif	35.76670	5.60000	Zinc	Hydrothermal
Algeria	Ouarsenis Mountains	35.86670	1.63330	Zinc	Hydrothermal
Algeria	Sakamody	36.50000	3.30000	Zinc	Hydrothermal
Algeria	El Abed (Oued Zaunder)	35.00000	1.00000	Zinc, Lead, Copper, Silver, Cobalt, Gold	Hydrothermal
Angola	Cachoeiras De Binga	-10.97140	14.08560	Copper	Hydrothermal
Angola	Tetelomavajo Tetelo	-6.41670	14.86670	Copper	Hydrothermal
Angola	Lunda District	8.41666	20.25000	Diamond	Igneous/Surficial
Angola	Camafuca Camazamba	-8.4525	20.5131	Diamond	Igneous
Angola	Camatchia	-8.9500	20.4833	Diamond	Igneous
Angola	Catoca	-9.4167	20.3333	Diamond	Igneous
Angola	Cuango (Kwango) Valley	-9.00000	17.50000	Diamond	Igneous
Angola	Lucapa area	-8.00000	21.50000	Diamond	Unclassified
Angola	Cassala-Quintungo	-9.50000	14.83330	Iron	Sedimentary
Angola	Cassinga North	-14.66670	16.03330	Iron	Sedimentary
Angola	Cassinga South	-15.20000	16.13330	Iron	Sedimentary
Angola	M'Bassa Deposit	-9.36667	14.38333	Iron	Igneous
Angola	Lueca	-6.83333	14.91667	Vanadium, Lead	Unclassified
Benin	Loumbou-Loumbou	12.20000	2.97000	Iron	Sedimentary

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Benin	Madekali	11.70000	3.55000	Iron	Sedimentary
Botswana	Dikolakolane	-24.06667	24.89583	Clay	Surficial
Botswana	Lake Ngami	-20.41670	22.81670	Copper	Hydrothermal
Botswana	Matsitama	-20.98330	26.65000	Copper	Hydrothermal
Botswana	Jwaneng	-24.75000	24.33333	Diamond	Igneous
Botswana	Letlhakane	-21.38333	25.66667	Diamond	Igneous
Botswana	Orapa	-21.28333	25.35000	Diamond	Igneous
Botswana	Map Nora / Tati/Golden Eagle	-24.75000	25.91670	Gold	Hydrothermal
Botswana	Shashe (Map Nora, Sashe)	-21.1833	27.5333	Gold	Hydrothermal
Botswana	Kgwakgwe	-24.96667	25.25000	Manganese	Sedimentary
Botswana	Lobatse	-25.21667	25.55000	Manganese	Sedimentary
Botswana	Ramotswa	-24.86667	25.66667	Manganese	Sedimentary
Botswana	Selkirk Mine	-21.26670	27.73330	Nickel, Cooper, PGE	Igneous
Botswana	Pikwe (Phikwe, Selebi-Phikwe - Selebi-Pakwe)	-21.91667	27.83333	Nickel, Copper, Cobalt	Igneous
Botswana	Phoenix Mine	-21.26670	27.73330	Nickel, Copper, PGE	Igneous
Botswana	Ranaka Quartz Vein	-24.92500	25.41667	Silver	Hydrothermal
Botswana	Sua Pan	-20.66667	26.00000	Soda ash, Halite	Sedimentary
Burkina Faso	Gurio	11.18330	-4.30000	Gold	Hydrothermal
Burkina Faso	Sebba	13.58330	0.53330	Gold	Hydrothermal
Burkina Faso	Poura	11.5872	-2.7636	Gold, Silver, Copper, Antimony	Hydrothermal
Burkina Faso	Tambao	14.78333	0.06667	Manganese	Sedimentary
Burkina Faso	Kodjari	11.85000	1.92580	Phosphate	Sedimentary
Burkina Faso	Perkoa	12.33330	-2.75000	Zinc, Silver	Hydrothermal
Burundi	Musongati	-3.75000	30.25000	Nickel, Copper, Cobalt, PGE	Surficial
Burundi	Karonge Gakara	-3.41670	29.41670	REE	Igneous
Cameroon	Bauxite	7.00000	13.00000	Aluminium	Surficial
Cameroon	Minim Martap	6.93330	12.96670	Aluminium	Surficial
Cameroon	Les Mamelles (Kribi)	2.60000	10.00000	Iron	Sedimentary
Central African Republic	Kotto (Haute et Moyenne Rivière	8.4667	23.3333	Diamond	Surficial
Central African Republic	Sangha (Bassin de la) - Sangha Amont, Sangoma	4.7833	15.9500	Diamond	Surficial
Congo (Brazzaville)	M'Fouati	-4.40000	13.81670	Lead, Zinc	Hydrothermal
Congo (Brazzaville)	M'Passa	-4.38333	14.16667	Lead, Zinc, Copper, Vanadium	Hydrothermal
Congo (Brazzaville)	Kouilou (Makola, Youbi)	-4.56670	12.13330	Magnesium, Potash	Sedimentary
Congo (Kinshasa)	Lueshe	-0.98330	29.11670	Columbium (Niobium)	Igneous

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Congo (Kinshasa)	Bingo	0.53330	29.31670	Columbium (Niobium), Phosphate	Igneous
Congo (Kinshasa)	Kinsenda	-12.3333	27.9667	Copper	Hydrothermal
Congo (Kinshasa)	Kov	-10.75000	25.41670	Copper	Hydrothermal
Congo (Kinshasa)	Dikuluwe	-10.73333	25.36667	Copper, Cobalt	Hydrothermal
Congo (Kinshasa)	Kakanda	-10.73333	26.38333	Copper, Cobalt	Hydrothermal
Congo (Kinshasa)	Kambove	-10.86667	26.60000	Copper, Cobalt	Hydrothermal
Congo (Kinshasa)	Kamoto	-10.71667	25.41667	Copper, Cobalt	Hydrothermal
Congo (Kinshasa)	Kazibizi	-10.83333	26.56667	Copper, Cobalt	Hydrothermal
Congo (Kinshasa)	Mashamba	-10.73333	25.36667	Copper, Cobalt	Hydrothermal
Congo (Kinshasa)	Mupine	-10.70000	25.41667	Copper, Cobalt	Hydrothermal
Congo (Kinshasa)	Musonoi	-10.70000	25.45000	Copper, Cobalt	Hydrothermal
Congo (Kinshasa)	Sesa (M'sesa)	-10.85000	26.58333	Copper, Cobalt	Hydrothermal
Congo (Kinshasa)	Shituru (Likasi)	-10.96670	26.78330	Copper, Cobalt	Hydrothermal
Congo (Kinshasa)	Tshinsenda	-12.26667	27.95000	Copper, Cobalt	Hydrothermal
Congo (Kinshasa)	Mutoshi (Ruwe)	-10.66667	25.55000	Copper, Cobalt, Gold, PGE, Vanadium	Hydrothermal
Congo (Kinshasa)	Musoshi	-12.26667	27.70000	Copper, Cobalt, Uranium	Hydrothermal
Congo (Kinshasa)	Kolwezi	-10.71670	25.48330	Copper, Cobalt, Zinc	Hydrothermal
Congo (Kinshasa)	Kipushi	-11.78333	27.23333	Copper, Zinc, Lead, Silver	Hydrothermal
Congo (Kinshasa)	Mbuji Mayi	-6.16667	23.58333	Diamond	Surficial
Congo (Kinshasa)	Talala	-10.33333333	27.9	Diamond	Igneous
Congo (Kinshasa)	Tshikapa area	-6.50000	21.00000	Diamond	Surficial
Congo (Kinshasa)	Kilo-Moto	3.35000	28.73330	Gold	Hydrothermal/Surficial
Congo (Kinshasa)	Kitotolo	-7.32500	27.38330	Lithium, Columbium (Niobium), Tin	Igneous
Congo (Kinshasa)	Manono	-7.27920	27.45000	Lithium, Tantalum, Tin	Igneous
Congo (Kinshasa)	Kisenge (Kamata, Kapolo)	-10.68333	23.18333	Manganese	Surficial
Congo (Kinshasa)	Miluba	-2.95000	27.30830	Tin	Unclassified
Congo (Kinshasa)	Minerga	-2.21670	27.75000	Tin	Unclassified
Congo (Kinshasa)	Punia-Kasese	-1.63330	27.11670	Tin	Surficial
Congo (Kinshasa)	Bukena	-7.71670	27.18330	Tin, Columbium (Niobium), Tantalum	Surficial
Congo (Kinshasa)	Kania	-7.46670	26.95830	Tin, Columbium (Niobium), Tantalum	Surficial
Congo (Kinshasa)	Kivu (Goma Kivu)	-26.00000	27.50000	Tin, Gold, Tungsten, Columbium (Niobium), Tantalum	Surficial
Congo (Kinshasa)	Mitwaba (Kiswa)	-8.37500	27.41670	Tin, Molybdenum, Columbium (Niobium)	Igneous

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Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Congo (Kinshasa)	Bishasha (Mumba and Kasangura deposits)	-1.66670	29.23330	Tin, Tungsten, Columbium (Niobium), Tantalum, Lithium, Gold)	Igneous
Congo (Kinshasa)	Kalima-Messaraba	-2.56670	26.61670	Tungsten, Tin	Igneous
Congo (Kinshasa)	Shinkolobwe (Shinkolobowe, Signal, Kasolo)	-11.00000	26.91667	Uranium, Nickel, Cobalt, Gold, PGE, Molybdenum	Hydrothermal
Côte D'Ivoire	Seguela (Bobi, Toubabouko, Legbo Rivière, Sequéla, Diarabana, Marahoué (riv.), Zuenoula)	7.6667	-6.1667	Diamond	Surficial
Côte D'Ivoire	Tortiya (Tortiya 55, Katiola-15)	8.7500	-5.5833	Diamond	Surficial
Côte D'Ivoire	Aféma (Asupiri Placer)	6.30000	-3.78330	Gold	Surficial
Côte D'Ivoire	Aféma (Asupiri, Aniuri, Kouamékro Toliesso, Jonction, Brahima, Adiopan, Bagnan)	6.30000	-3.78330	Gold	Hydrothermal
Côte D'Ivoire	Ity	6.61670	-8.45000	Gold	Hydrothermal
Côte D'Ivoire	Mt. Klahoyo	7.16000	-7.48000	Iron	Sedimentary
Côte D'Ivoire	Mokta (Dikodoua (Grand Lahou))	5.13333	-5.00000	Manganese	Sedimentary
Côte D'Ivoire	Biankouma (Touba)	7.90000	-7.93333	Nickel, Cobalt	Surficial
Cyprus	Apliki	35.06670	32.85000	Sulfur, Copper, Zinc	Hydrothermal
Cyprus	Kalavasos	34.78330	33.25000	Sulfur, Copper, Zinc	Hydrothermal
Cyprus	Mathiati	34.96670	33.35000	Sulfur, Copper, Zinc	Hydrothermal
Cyprus	Mavrovouni	35.01670	32.83330	Sulfur, Copper, Zinc	Hydrothermal
Cyprus	Skouriotissa	35.08330	32.88330	Sulfur, Copper, Zinc	Hydrothermal
Egypt	Gebel Abu Khruq	24.65000	34.26667	Aluminium	Surficial
Egypt	Nag Hammadi	26.06670	32.21670	Aluminium	Surficial
Egypt	Hafafit	24.83360	34.50030	Asbestos	Metamorphic
Egypt	Wadi Sifein	25.10000	34.71670	Chromium	Igneous
Egypt	Aswan Clay Quarries	24.08333	32.83333	Clay	Surficial
Egypt	Musaba Salama	29.10000	33.23333	Clay	Surficial
Egypt	Kom Oushim (Kom Ushim)	30.53330	30.91670	Clay (Bentonite)	Surficial
Egypt	Abu Natash	28.95000	33.31667	Clay (Kaolin)	Surficial
Egypt	Kalabsha	23.55000	32.86667	Clay (Kaolin)	Surficial
Egypt	Wadi Kalabsha	23.45833	32.83333	Clay (Kaolin)	Surficial
Egypt	Abu Dabbab	25.34080	34.54170	Columbium (Niobium), Tantalum	Igneous
Egypt	Nuweibi	25.19170	34.51670	Columbium (Niobium), Tantalum	Igneous
Egypt	El Atawi	25.63333	34.18333	Copper	Hydrothermal

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Egypt	Hamata	24.50000	35.00000	Copper	Hydrothermal
Egypt	Umm Samiuki	24.23333	34.83333	Copper, Zinc	Hydrothermal
Egypt	Wadi Sitra	25.51670	34.30000	Copper, Zinc, Lead	Hydrothermal
Egypt	Sikheit-Nugrus	24.64167	34.80000	Gem	Igneous
Egypt	Umm Kabu	24.59167	34.89444	Gem	Igneous
Egypt	Zabara	24.76806	34.71667	Gem	Igneous
Egypt	Ambaut (Anbaout)	24.85000	34.81670	Gold	Hydrothermal
Egypt	Hatit	23.45500	35.18611	Gold	Unclassified
Egypt	Um Ud (Umm 'Ud)	24.80944	34.69306	Gold	Hydrothermal
Egypt	Wadi Atalla	22.15000	33.46670	Gold	Hydrothermal
Egypt	Fatiri	26.70000	33.25000	Gold, Copper	Hydrothermal
Egypt	Hangaliya	24.83333	34.58333	Gold, Copper	Hydrothermal
Egypt	Semna	26.46667	33.59917	Gold, Copper	Hydrothermal
Egypt	Um Garaiat (Umm Geriat, Umm Qareiyat)	22.40000	33.38333	Gold, Copper	Hydrothermal
Egypt	Atud	25.01667	34.40000	Gold, Copper, Silver	Hydrothermal
Egypt	Haimur	22.63333	33.30000	Gold, Copper, Silver	Hydrothermal
Egypt	Barramiya	25.07333	33.78778	Gold, Silver	Unclassified
Egypt	El Sid	26.00000	33.60000	Gold, Silver	Hydrothermal
Egypt	Um Rus (Umm Rus)	25.45000	34.58333	Gold, Silver, Copper	Hydrothermal
Egypt	El Ballah	30.73333	32.21667	Gypsum	Sedimentary
Egypt	El Hammam	30.83333	29.41667	Gypsum	Sedimentary
Egypt	El Omayid	30.78333	29.16667	Gypsum	Sedimentary
Egypt	Gerza	28.81000	31.06000	Gypsum	Sedimentary
Egypt	Gharbanyat	30.83333	29.50000	Gypsum	Sedimentary
Egypt	Ras Malaab	29.16667	32.95000	Gypsum	Sedimentary
Egypt	Wadi El Rayan	29.83333	32.75000	Gypsum	Sedimentary
Egypt	Manzala, Manzallah	31.00030	32.00030	Halite	Sedimentary
Egypt	Aswan	24.25000	32.88333	Iron	Sedimentary
Egypt	Aswan (Aswan East)	24.08000	32.93000	Iron	Sedimentary
Egypt	Bahariya	24.10000	32.90000	Iron	Sedimentary

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Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Egypt	Baharlya (Bahariya Oasis)	28.46670	28.96670	Iron	Sedimentary
Egypt	El Gedida	28.45000	29.18333	Iron	Sedimentary
Egypt	El Harra	28.38444	29.08972	Iron	Sedimentary
Egypt	Ghorabi (Gebel Ghorabi)	29.03333	28.50000	Iron	Sedimentary
Egypt	Nasser	28.50000	29.01667	Iron	Sedimentary
Egypt	Gebel El Russas	25.20000	34.63333	Lead, Zinc	Hydrothermal
Egypt	Um Gheig (Umm Gheig)	25.71667	34.46667	Lead, Zinc	Hydrothermal
Egypt	Zug El Bahar	25.83333	34.28333	Lead, Zinc	Hydrothermal
Egypt	Beni Hassan	27.95000	30.95000	Limestone	Sedimentary
Egypt	Wadi Alaki	22.15000	33.20000	Limestone (dolomite)	Sedimentary
Egypt	Sagia	26.33360	33.71670	Magnesium	Hydrothermal
Egypt	Wadi Mialik (My'alik, Meialeik)	24.16667	35.30000	Manganese	Hydrothermal
Egypt	Um Bogma	28.98333	33.36667	Manganese, Iron	Sedimentary
Egypt	St John	23.62250	36.14278	Nickel, Iron, Copper	Unclassified
Egypt	El Hamrawein	26.20000	34.10000	Phosphate	Sedimentary
Egypt	El Mahamid	25.00000	32.00000	Phosphate	Sedimentary
Egypt	Qena	26.16670	32.86670	Phosphate	Sedimentary
Egypt	Quseir	26.16670	34.33330	Phosphate	Sedimentary
Egypt	Red Sea Phosphate District	26.16667	34.16667	Phosphate	Sedimentary
Egypt	Rifale	29.91670	31.36670	Phosphate	Sedimentary
Egypt	Sabayia East	25.16670	32.68330	Phosphate	Sedimentary
Egypt	Safaga	26.53333	33.90000	Phosphate	Sedimentary
Egypt	Sebaiya	25.16670	32.66670	Phosphate	Sedimentary
Egypt	Abu Tartur	25.43330	30.03330	Phosphate, Fluorspar	Sedimentary
Egypt	Idku	31.25000	30.25000	Soda ash	Sedimentary
Egypt	Wadi Natrun	30.35000	30.30000	Soda ash	Sedimentary
Egypt	Wadi el Natron	30.4167	30.3667	Soda ash, Sodium sulfate	Sedimentary

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Egypt	Abu Ghalaga	24.38333	35.06667	Titanium	Igneous
Egypt	Damietta	30.21670	30.80000	Titanium, Iron, Zirconium	Surficial
Egypt	Nile Delta-Rosetta	31.00000	31.00000	Titanium, REE	Surficial
Egypt	Rashid	31.41670	30.38330	Titanium, Zirconium	Surficial
Eritrea	Bisha	15.40000	37.50000	Zinc, Copper, Silver, Gold	Hydrothermal
Ethiopia	Lake Abiyata	7.58333	38.50000	Bromine, Soda ash	Sedimentary
Ethiopia	Lake Shala	7.41667	38.50000	Bromine, Soda ash	Sedimentary
Ethiopia	Asmaradebara	15.00000	38.75000	Copper	Hydrothermal
Ethiopia	Asmera Nippon	15.33333	38.88333	Copper, Lead, Zinc	Hydrothermal
Ethiopia	Adola Alluvial Deposits	5.66670	38.96670	Gold	Surficial
Ethiopia	Dimma	9.52000	35.86000	Gold	Surficial
Ethiopia	Tulu Kami	9.52000	35.53000	Gold	Hydrothermal
Ethiopia	Tulu Kapi	9.06000	35.58000	Gold	Hydrothermal
Ethiopia	Yubdo	8.97000	35.45000	Gold, PGE, Silver, Chromium, Nickel, Iron,	Surficial
Ethiopia	Adola	5.08000	39.23000	Gold, Silver	Hydrothermal
Ethiopia	Lega Dembi	5.58333	38.83333	Gold, Silver	Hydrothermal
Ethiopia	Budussa Mountain	5.50000	39.00000	Nickel, Chromium	Igneous
Ethiopia	Sidamo	5.00000	39.00000	Nickel, Copper	Unclassified
Ethiopia	Dallol	14.21667	40.23333	Potash, Halite	Sedimentary
Ethiopia	Kenticha	5.50000	40.00000	Tantalum, Columbium (Niobium)	Igneous
Gabon	Mabounie	-0.85000	10.6667	Columbium (Niobium), Phosphate, Zirconium, REE	Igneous
Gabon	Bélinga (Djadi)	13.23330	11.00000	Iron	Sedimentary
Gabon	Moanda	-1.56667	13.28333	Manganese	Surficial
Gabon	Mounana (Oklo, Boyindzi)	-2.00000	13.50000	Uranium	Hydrothermal
Ghana	Kibi Atewa	6.13330	-0.55000	Aluminium	Surficial
Ghana	Nyinahin (Aya)	6.64170	-2.21670	Aluminium	Surficial
Ghana	Tema	5.66670	-0.01670	Aluminium	Surficial
Ghana	Sefwi (Bekwai, Awaso)	6.2167	-2.2806	Aluminium, Iron, Titanium	Surficial
Ghana	Ghana Cons Diamonds	9.50000	-13.70000	Diamond	Unclassified
Ghana	Akwatia	6.0361	-0.8097	Diamond, Gold	Surficial
Ghana	Bogosu (Bogoso, Abogosu)	5.57500	-2.00420	Gold	Hydrothermal

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Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Ghana	Dunkwa Alluvial Operations	6.00830	-1.58750	Gold	Surficial
Ghana	Iduapriem	5.24170	-2.04170	Gold	Surficial
Ghana	Konongo/Obenemase/Pepe	6.62920	-1.14580	Gold	Hydrothermal
Ghana	Prestea	5.45000	-2.13333	Gold	Hydrothermal
Ghana	Sansu (Obuasi)	6.45000	-1.70830	Gold	Hydrothermal
Ghana	Tarkwa (Old Tarkwa, Pepe pit, Atuabo pit, Akontansi, Mantraim pit, Kottraverchy)	5.31667	-1.98333	Gold	Surficial
Ghana	Teberebie	5.26670	-2.05000	Gold	Surficial
Ghana	Ashanti	6.23333	-1.65000	Gold, Silver	Hydrothermal
Ghana	Kalimbi Hill - Three Hills Area	8.7986	-2.5431	Manganese	Surficial
Ghana	Nsuta	5.23333	-1.95000	Manganese	Sedimentary
Ghana	Odumase	6.62080	-1.21670	Manganese, Iror	Sedimentary
Guinea	Aye Koye	11.10000	-13.78330	Aluminium	Surficial
Guinea	Bauxite	11.16667	-13.75000	Aluminium	Surficial
Guinea	Bauxite	10.04000	-12.51000	Aluminium	Surficial
Guinea	Cbg, Boke Project	9.00000	-10.00000	Aluminium	Surficial
Guinea	Kindia	10.06667	-12.85000	Aluminium	Surficial
Guinea	Lelydorp (Onverdacht, Paranam)	11.16667	-13.91667	Aluminium	Surficial
Guinea	Sangaredi Boke	11.06670	-13.51670	Aluminium	Surficial
Guinea	Tougue	11.43330	-11.66670	Aluminium	Surficial
Guinea	Friguia (Fria, Friguiagbe)	10.50000	-13.66667	Aluminium	Surficial
Guinea	Fayalala	11.31670	-10.81670	Gold	Surficial
Guinea	Koron (Didi Sag Concession)	11.63330	-9.48330	Gold	Surficial
Guinea	Lero (Léro and Karta)	11.31670	-10.81670	Gold	Hydrothermal
Guinea	Siguiri (Sanou Tinti, Eureka Hill, Fatoya, Koron	11.46670	-9.11670	Gold	Surficial
Guinea	Conakry	9.50000	-13.71000	Iron	Surficial
Guinea	Pierre Richaud (Mt. Nimba)	7.62000	-8.41690	Iron	Sedimentary
Guinea	Simandou (Pic de Fon)	8.53000	-8.90000	Iron	Sedimentary
Iran	Darreh	33.88333	51.30833	Barite	Hydrothermal
Iran	Amir	27.53330	57.00000	Chromium	Igneous
Iran	Shahriar	27.26667	57.25000	Chromium	Igneous
Iran	Kale Kafi	33.46667	54.55000	Copper	Hydrothermal
Iran	Sungun	38.80833	46.37500	Copper	Hydrothermal
Iran	Sar Cheshmeh	29.91667	55.88333	Copper, Molybdenum, Silver, Gold	Hydrothermal
Iran	Agh Darreh	36.65000	47.03333	Gold	Hydrothermal
Iran	Zarshuran	36.73330	47.13330	Gold	Hydrothermal
Iran	Chadar malu	32.33333	55.50000	Iron	Hydrothermal
Iran	Golgohar	29.26667	55.58333	Iron	Sedimentary
Iran	Northern An	32.23333	55.76667	Iron	Sedimentary
Iran	Choghart	31.78333	55.33333	Iron, Phosphate	Hydrothermal
Iran	Mehdiabad	31.75000	55.80000	Lead, Zinc, Copper, Silver, Barite	Hydrothermal

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Iran	Afzalabad	31.01667	61.41667	Magnesium	Sedimentary
Iran	Behbehan area	30.56667	50.30000	Phosphate	Sedimentary
Iran	Nakhjir-Dashte Kavir (Molkabad)	34.53333	52.58333	Strontium	Sedimentary
Iran	Talhah	34.5	52.65833	Strontium	Sedimentary
Iran	Angouran	36.63333	47.50000	Zinc, Lead	Hydrothermal
Iraq	Akashat	33.80000	40.11667	Phosphate	Sedimentary
Iraq	Sawab	33.66000	39.50000	Phosphate	Sedimentary
Iraq	Badoosh	36.50000	43.33330	Sulfur	Sedimentary
Iraq	Mishraq Ash Shurah	36.00000	43.33330	Sulfur	Sedimentary
Israel	Timna	29.76667	34.95000	Copper	Hydrothermal
Israel	Beersheva	31.21667	35.05000	Phosphate, Uranium	Sedimentary
Israel	Oron	30.86667	35.98333	Phosphate, Uranium	Sedimentary
Israel	Zefa-Ef'e (Arad)	31.11667	35.18333	Phosphate, Uranium	Sedimentary
Israel	Zin (Nahal Zinam, Nahil Zin, Nahal Zin)	30.95000	35.31670	Phosphate, Uranium, Fluorspar	Sedimentary
Israel	Dead Sea	31.06667	35.4	Potash, Soda ash, Magnesium, Bromine	Sedimentary
Jordan	Fenan	30.60000	35.41667	Copper	Hydrothermal
Jordan	El Abyad (Wadi El Abayad, Al Abayad, El Abaid, Al Abaid)	30.90000	36.00000	Phosphate	Sedimentary
Jordan	Esh Shidiya (Es Shidiya, Esh Shidiya, Al Shidiyah, Shediyah)	29.80000	36.20000	Phosphate	Sedimentary
Jordan	Ruseifa	32.00000	36.03333	Phosphate, Uranium	Sedimentary
Jordan	Ghor Al-Safi	31.10000	35.51670	Potash	Sedimentary
Jordan	Dead Sea	31.0667	35.4333	Potash, Magnesium, Halite, Bromine	Sedimentary
Kenya	Telot West Pokot	1.65000	35.38330	Chromium, Nickel	Igneous
Kenya	Mrima Hill	-4.50000	39.26667	Columbium (Niobium), REE,	Igneous
Kenya	Kenya Fluorspar	1.16670	35.58330	Fluorspar	Hydrothermal
Kenya	Kerio Valley	0.35000	35.61667	Fluorspar, Iron	Hydrothermal
Kenya	Kinyiki	-2.6667	38.1667	Gem (sapphire)	Igneous
Kenya	Unknown	1.66667	35.50000	Gold	Unclassified

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Kenya	Chawia	-3.46667	38.38333	Graphite	Metamorphic
Kenya	Oldoinyo-Nyiro	0.75000	37.00000	Graphite	Metamorphic
Kenya	Ikutha (Kitui district)	-1.36670	38.01670	Iron, Phosphate	Unclassified
Kenya	Kinangoni Hill	-3.85000	39.65000	Lead	Hydrothermal
Kenya	Gilgia	-0.33333	36.33333	Manganese	Unclassified
Kenya	Ruri (Homa Mountain, Rangwa)	-0.50000	34.36670	REE	Igneous
Kenya	Magadi	-1.86670	36.25000	Soda ash	Sedimentary
Kenya	Lake Magadi	-1.86667	36.28333	Soda ash, Potash, Halite	Sedimentary
Kenya	Kwale	-4.42000	39.42000	Titanium, Zirconium	Surficial
Kenya	Mambrui	-3.11667	40.15000	Titanium, Zirconium	Surficial
Kenya	Sokoke	-3.3167	39.8667	Titanium, Zirconium	Surficial
Lesotho	Letseng la Terai	-29.03333	28.88333	Diamond	Igneous
Liberia	Gboror's Creek	7.00000	-9.50000	Gold, PGE	Surficial
Liberia	Bea Mountain	7.13330	-11.10000	Iron	Sedimentary
Liberia	Bomi Hills	6.90000	-10.83000	Iron	Sedimentary
Liberia	Bong	6.31056	-10.80472	Iron	Sedimentary
Liberia	Mano River	7.33444	-11.12472	Iron	Sedimentary
Liberia	Nimba (Nimba Mountains, Bitohn, Gbahm, Lamco mine, Yulitohn, Tokadeh, Western area)	7.43940	-8.65720	Iron	Sedimentary
Liberia	Wologisi (Wologosi)	7.50000	-10.50000	Iron	Sedimentary
Liberia	Yekepa	7.58390	-8.46690	Uranium, Iron	Unclassified
Libya	Al Qawasim	32.16670	13.00000	Clay (Kaolin)	Surficial
Libya	Gargaresh	32.86670	12.96670	Graphite	Metamorphic
Libya	Bi'R Al Ghanam-Yafran	32.26670	12.56670	Gypsum	Sedimentary
Libya	Wadi Ash Shatti	27.43330	14.21670	Iron	Sedimentary
Libya	Derna	32.66670	22.66670	Limestone	Sedimentary
Libya	Homs	32.75000	13.33330	Limestone	Sedimentary
Libya	Bengasi	32.08330	20.33330	Limestone (dolomite), Soda ash	Sedimentary
Libya	Sardalas	25.83330	10.53330	Potash	Sedimentary
Libya	Ghat	24.90000	10.18330	Sodium sulfate	Sedimentary
Libya	Mellaha	32.90000	13.33330	Sodium sulfate	Sedimentary
Libya	El Asruj (El Aswad)	27.41670	17.25000	Sulfur	Sedimentary
Libya	Sebcha Kebirah	30.23330	18.83330	Sulfur	Sedimentary
Madagascar	Andriamena	-17.41667	47.50000	Chromium	Igneous
Madagascar	Befandriana	-16.50000	48.16670	Chromium	Igneous
Madagascar	Bemanevika	-17.56670	47.53330	Chromium	Igneous

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Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Madagascar	Majunga	-17.50000	47.50000	Chromium	Igneous
Madagascar	Ranomena	-18.03330	49.18330	Chromium	Igneous
Madagascar	Ambatomitamba	-18.35000	48.98330	Graphite	Metamorphic
Madagascar	Ampangadiatany	-19.41670	49.21670	Graphite	Metamorphic
Madagascar	Andasifahatelo Mine	-18.90000	48.43330	Graphite	Metamorphic
Madagascar	Antsirakambo	-18.48330	49.15000	Graphite	Metamorphic
Madagascar	Antsiribe	-18.26670	49.13330	Graphite	Metamorphic
Madagascar	Faliarano	-18.88330	48.41670	Graphite	Metamorphic
Madagascar	Marovinsky	-19.23330	48.95000	Graphite	Metamorphic
Madagascar	Perinet-Ambatovy area	-18.93333	48.45000	Graphite	Metamorphic
Madagascar	Sahamamy	-18.58330	48.91670	Graphite	Metamorphic
Madagascar	Sahanavo	-18.45000	48.91670	Graphite	Metamorphic
Madagascar	Tamataue	-18.16670	49.38330	Graphite	Metamorphic
Madagascar	Tsaravoniany	-18.75000	48.43330	Graphite	Metamorphic
Madagascar	Vatomandry	-19.35000	49.01667	Graphite	Metamorphic
Madagascar	Valozoro	-21.85000	47.21667	Nickel, Chromium	Igneous
Madagascar	Ambatovy-Analamay	-18.78333	48.18333	Nickel, Cobalt, Chromium, Titanium	Igneous
Madagascar	Toalagnaro	-25.01670	47.00000	Titanium	Surficial
Madagascar	Toliara	-23.40000	43.70000	Titanium	Surficial
Madagascar	Fort Dauphin	-25.00000	47.00000	Titanium, REE	Surficial
Madagascar	Pebane	-17.33333	38.16667	Titanium, REE, Zirconium	Surficial
Madagascar	Tamatave	-18.00000	49.50000	Titanium, Zirconium	Surficial
Madagascar	Taolanaro	-25.00000	47.00000	Titanium, Zirconium	Surficial
Malawi	Mokanji Mountain	-15.96670	35.58330	Aluminium	Surficial
Malawi	Chilwa Island	-15.3167	35.5667	Columbium (Niobium), Manganese	Igneous
Malawi	Chimwadzulu Hill	-15.0333	34.6500	Gem (ruby, sapphire)	Igneous
Malawi	Changalumi	-15.38333	35.30000	Limestone, Limestone (marble)	Sedimentary
Malawi	Kangankunde	-15.12500	34.90830	REE, Strontium, Fluorspar, Barite	Igneous

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Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Malawi	Tundulu	-15.50000	35.83333	REE, Tantalum, Phosphate	Igneous
Mali	Western Mali Bauxites	12.61670	-11.41670	Aluminium	Surficial
Mali	Syama-Tabakoroni Bagoe Region (Fourou, Sikasso)	12.01670	-6.46670	Gold	Hydrothermal
Mali	Sinsinkourou	11.41670	-7.48330	Lithium	Igneous
Mali	Ansongo	15.66667	0.48333	Manganese, Iror	Sedimentary
Mauritania	Akjoujt (Guelb Moghrein)	19.50000	-14.58330	Copper, Gold	Hydrothermal
Mauritania	Akjoujt Tailings Project	19.50000	14.58330	Gold	Hydrothermal
Mauritania	F'Derik (Zouerate District)	22.68333	-12.71667	Iron	Sedimentary
Mauritania	Guelb El Rhein (Zouerate District)	22.87360	-12.33750	Iron	Sedimentary
Mauritania	Rouessa (Zouerate District)	22.66667	-12.66667	Iron	Sedimentary
Mauritania	Tazadit (Zouerate District)	22.66667	-12.66667	Iron	Sedimentary
Mauritania	Bou Naga	20.80000	-13.70000	REE	Igneous
Morocco	Timerhdoudine	32.98330	5.98330	Antimony	Hydrothermal
Morocco	Tourtite	32.48330	5.83330	Antimony	Hydrothermal
Morocco	Jbel Irhoud (Ighoud)	31.80000	-9.30000	Barite	Hydrothermal
Morocco	Seksaoua	30.89610	-9.20000	Barite	Hydrothermal
Morocco	Tessaout	31.69000	-7.50000	Barite	Hydrothermal
Morocco	Tizi N'Tichka	31.50000	-7.44060	Barite	Hydrothermal
Morocco	Zelmou (Jbel Zarouk)	32.10140	-2.55170	Barite	Hydrothermal
Morocco	Aghbar (Arhbar)	30.83333	-6.91667	Cobalt	Hydrothermal
Morocco	Bou Azzer	30.53333	-6.91667	Cobalt, Nickel	Hydrothermal
Morocco	Azegurazegour	34.03330	-6.85000	Copper	Hydrothermal
Morocco	Bou Skour	34.03330	-6.85000	Copper	Hydrothermal
Morocco	Diebel Klak	34.03330	-6.85000	Copper	Hydrothermal
Morocco	Ouansimi	34.03330	-6.85000	Copper	Hydrothermal
Morocco	Bleida	30.3333	-6.4500	Copper, Sulfur	Hydrothermal
Morocco	Djebel Tirremi	34.50000	-3.00000	Fluorspar	Hydrothermal
Morocco	El Hammam Area	33.90000	-5.55000	Fluorspar	Hydrothermal
Morocco	Taourirt	34.41000	-2.86390	Fluorspar	Hydrothermal
Morocco	Tiouine	30.9167	-7.2500	Fluorspar, Barite, Manganese	Hydrothermal
Morocco	Tiouit	31.16000	-5.79000	Gold, Silver, Copper	Hydrothermal
Morocco	Mohammedia	33.6167	-7.3333	Halite	Sedimentary
Morocco	Mines Del Rif	35.16670	-3.00000	Iron	Unclassified
Morocco	Aouli-Mibladen	33.00000	-4.66670	Lead	Hydrothermal
Morocco	Zeida	32.75000	-4.83330	Lead, Silver, Barite	Hydrothermal
Morocco	Oued El Heimer Zellidja	34.13330	-1.75000	Lead, Silver, Copper	Hydrothermal

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Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Morocco	Djebel Aouam	33.88333	-5.61667	Lead, Silver, Zinc	Hydrothermal
Morocco	Bou Madine	32.71670	-5.08330	Lead, Zinc	Hydrothermal
Morocco	Douar Hajar	31.23330	-7.91670	Lead, Zinc	Hydrothermal
Morocco	Sidi Lachen	33.42780	-6.20610	Lead, Zinc	Hydrothermal
Morocco	Bedaine	32.99900	-4.99980	Lead, Zinc, Copper, Silver	Hydrothermal
Morocco	Aouli	32.41667	-4.50000	Lead, Zinc, Silver	Hydrothermal
Morocco	Sidi Lahcen	34.1000	-2.6167	Lead, Zinc, Silver	Hydrothermal
Morocco	Touissit - Bou Bekker	34.41670	-1.83330	Lead, Zinc, Silver	Hydrothermal
Morocco	Aoufour	30.58333	-8.03333	Manganese	Unclassified
Morocco	Idikel	29.66667	-8.66667	Manganese	Unclassified
Morocco	Tiaratine	32.58333	-4.33333	Manganese	Unclassified
Morocco	Imini	30.73333	-6.90000	Manganese, Barite	Sedimentary
Morocco	Tasdremt	30.58333	-8.03333	Manganese, Lead	Sedimentary
Morocco	Daoui Nord	32.76670	-6.55000	Phosphate	Sedimentary
Morocco	Khouribga (Oulad-Abdoun, Meraa-El-Arech, Sidi-Daoui)	32.90000	-6.95000	Phosphate	Sedimentary
Morocco	Merra El Arech	32.66670	-6.79170	Phosphate	Sedimentary
Morocco	Meskala (Chichaoua)	31.5333	-9.4167	Phosphate	Sedimentary
Morocco	Youssoufia	32.25000	-8.53330	Phosphate	Sedimentary
Morocco	Ben-Guerir	32.25000	-7.76667	Phosphate, Fluorspar, Uranium	Sedimentary
Morocco	Sidi Daoui	32.86667	-6.63333	Phosphate, Fluorspar, Uranium	Sedimentary
Morocco	Bougaffer	31.10000	-5.40000	Silver	Hydrothermal
Morocco	Imiter	31.35000	-5.83360	Silver	Hydrothermal
Morocco	Zgounder	30.8000	-7.7500	Silver, Copper, Zinc	Hydrothermal
Morocco	Kettara	31.81000	-8.00000	Sulfur	Hydrothermal
Morocco	Taouz	30.90000	-3.98333	Vanadium, Lead, Zinc	Unclassified
Mozambique	Mavita	-19.50000	33.00000	Asbestos	Metamorphic
Mozambique	Mundongwara (Mundonguara)	-18.9000	32.7667	Copper, Silver	Hydrothermal
Mozambique	Macula	-15.90000	38.40830	Gem (beryl, aquamarine), Tantalum, Columbium (Niobium), Titanium	Igneous
Mozambique	Montepuez	-13.11667	39.00000	Limestone (marble, dolomite)	Sedimentary
Mozambique	Maridge	-15.71250	38.21250	Lithium	Igneous
Mozambique	Nanro	-15.77500	38.26250	Lithium	Igneous
Mozambique	Nahora (Nahoza)	-15.57920	38.33330	Lithium, Tantalum	Igneous
Mozambique	Nahia	-15.78750	38.49720	Tantalum	Igneous
Mozambique	Marupine (Marropino)	-16.5000	37.9167	Tantalum, Columbium (Niobium)	Igneous
Mozambique	Muiane (Alto Ligonha)	-15.73750	38.25420	Tantalum, Gem (emerald)	Igneous

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Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Mozambique	Moebase (Moebane)	-17.01667	38.48333	Titanium, REE	Surficial
Mozambique	Angoche Congolone	-16.00000	40.00000	Titanium, Zirconium	Surficial
Mozambique	Corridor Sands (Chibuto)	-24.6667	33.5667	Titanium, Zirconium	Surficial
Mozambique	Quelemane (Quelimane, Zambezi Estuary, Quelemane-Quinga coastline)	-15.7500	40.3333	Titanium, Zirconium	Surficial
Mozambique	Congolone	-16.33333	39.83333	Titanium, Zirconium, REE	Surficial
Mozambique	Moma (Namalope, Tupuito)	-16.8333	39.1667	Titanium, Zirconium, REE	Surficial
Namibia	Elbe Onganja	-22.11670	17.50000	Copper	Hydrothermal
Namibia	Gorob	-23.47000	15.33000	Copper	Hydrothermal
Namibia	Haib River	-28.71670	17.88330	Copper	Hydrothermal
Namibia	Matchless	-22.61670	16.83330	Copper	Hydrothermal
Namibia	Tschudi	-19.23330	17.71670	Copper	Hydrothermal
Namibia	Kobos	-23.30000	17.05000	Copper, Gold	Hydrothermal
Namibia	Kombat	-19.70000	17.70000	Copper, Lead	Hydrothermal
Namibia	Tsumeb	-19.22830	17.71220	Copper, Lead, Zinc, Silver	Hydrothermal
Namibia	Klein Aub	-23.70000	16.66670	Copper, Silver	Hydrothermal
Namibia	Oamites (Kamzwas, Blanks)	-22.95000	17.08333	Copper, Silver	Hydrothermal
Namibia	Otjihase	-22.33330	17.18330	Copper, Zinc, Sulfur, PGE, Gold	Hydrothermal
Namibia	Fluswa Kohero	-21.86670	15.16670	Fluorspar	Hydrothermal
Namibia	Marburg (Okorusu, Belvedere, Brandenburg)	-20.06667	16.76667	Fluorspar, Phosphate, Barite	Hydrothermal
Namibia	Usakos	-22.0000	15.6167	Gem (tourmaline, garnet, aquamarine, topaz), Lithium, Tantalum	Igneous
Namibia	Navachab	-21.98330	15.85000	Gold	Hydrothermal
Namibia	Karibib	-21.93333	15.25000	Limestone (marble)	Sedimentary
Namibia	Karibib District	-22.15000	16.00000	Lithium	Igneous
Namibia	Tantalite Valley	-28.71667	18.80000	Lithium, Columbium (Niobium), Tantalum	Igneous
Namibia	Otjosondu (Otjosundu, Otjosondo, Otjisondu)	-21.33333	18.16667	Manganese	Sedimentary
Namibia	Otjisazu	-21.9167	17.0833	Phosphate	Igneous
Namibia	Etaneno	-20.70000	16.20000	REE	Igneous
Namibia	Otjiwalundu (Otjivalunda)	-18.75000	15.58333	Soda ash	Sedimentary
Namibia	Uis	-21.21670	14.86670	Tin, Columbium (Niobium), Tantalum	Igneous
Namibia	Brandberg West	-21.02000	14.05000	Tin, Tungsten	Igneous
Namibia	Walvis Bay	-22.98330	14.51670	Titanium, Zirconium	Surficial
Namibia	Krantzberg	-20.16670	15.50000	Tungsten, Tin	Igneous
Namibia	Rossing (Roessing, Swakopmund)	-22.41667	15.01667	Uranium	Igneous
Namibia	Abenab	-19.29000	17.32000	Vanadium, Zinc, Lead, Copper, Silver	Hydrothermal

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Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Namibia	Rosh Pinah	-27.95000	16.76667	Zinc, Lead, Copper	Hydrothermal
Namibia	Berg Aukas	-19.45000	18.46667	Zinc, Lead, Vanadium	Hydrothermal
Niger	Koma Bangou	17.00000	-7.99970	Gold	Hydrothermal
Niger	Tapoa	12.4217	2.3450	Phosphate	Sedimentary
Niger	Arlit (Somair, Ariège, Arlette, Artois, Jonction Arlette/Artois, Tamou, Takriza)	18.7667	7.3333	Uranium, Vanadium, Molybdenum	Hydrothermal
Nigeria	Udegi Odegi	8.33330	7.88330	Columbium (Niobium)	Igneous
Nigeria	Dsc, Warri	5.60000	5.76670	Iron	Unclassified
Nigeria	Itakpe	7.60000	6.30000	Iron	Sedimentary
Nigeria	Nkalagu	6.5167	7.8167	Limestone	Sedimentary
Nigeria	Amalgamated Tin	9.90000	8.88000	Tin, Columbium (Niobium)	Igneous
Nigeria	Bukuru (Jos)	9.76000	8.85000	Tin, Columbium (Niobium), Tungsten,Tantalum	Surficial
Oman	Bayda	24.4167	56.4500	Copper	Hydrothermal
Oman	Lasail	24.27300	56.42500	Copper	Hydrothermal
Rwanda	Somirwa	-1.90000	30.06670	Columbium (Niobium), Tin, Tungsten	Igneous
Saudi Arabia	Az Zubirah	27.93333	43.71667	Aluminium	Surficial
Saudi Arabia	Ghurayyah	27.91667	35.80000	Columbium (Niobium), Tantalum, REE	Igneous
Saudi Arabia	Jabal Sayid	23.85000	40.93333	Copper	Hydrothermal
Saudi Arabia	Ad Duwayhi	22.28333	43.26667	Gold	Hydrothermal
Saudi Arabia	Bulgah	24.59000	41.36000	Gold	Hydrothermal
Saudi Arabia	Sukhaybarat	24.45000	42.01667	Gold	Hydrothermal
Saudi Arabia	Al Hajar	19.98333	42.01667	Gold, Copper	Hydrothermal
Saudi Arabia	Al Amar	23.78161	45.06954	Gold, Silver, Zinc, Copper	Hydrothermal
Saudi Arabia	Mahd Adh Dhahab	23.48333	40.85000	Gold, Silver, Zinc, Copper	Hydrothermal
Saudi Arabia	Jizan 0677	16.88333	42.55000	Halite	Sedimentary
Saudi Arabia	Wadi Sawawin	27.93333	35.78333	Iron	Hydrothermal
Saudi Arabia	Jabal Dhaylan 0335	25.56667	37.15000	Lead, Zinc	Hydrothermal
Saudi Arabia	Al Amud	30.58333	38.96667	Phosphate	Sedimentary
Saudi Arabia	Al Jalamid	31.53333	39.93333	Phosphate	Sedimentary
Saudi Arabia	Thaniyat	29.66667	38.00000	Phosphate	Sedimentary
Saudi Arabia	Umm Wu'al	31.61667	38.86667	Phosphate	Sedimentary

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Saudi Arabia	Umm Wu'al Area	31.50000	39.25000	Phosphate	Sedimentary
Saudi Arabia	Umm Wu'al North	32.00000	39.20000	Phosphate	Sedimentary
Saudi Arabia	West Thaniyat	29.75000	38.04583	Phosphate	Sedimentary
Saudi Arabia	Farasan Al Kabir South 0679	16.66667	42.00000	Potash, Halite	Sedimentary
Saudi Arabia	Khnaiguiyah	24.26667	45.08333	Zinc, Copper	Hydrothermal
Saudi Arabia	Al Masane	18.13333	43.85000	Zinc, Copper, Gold	Hydrothermal
Saudi Arabia	Atlantis II Deep	21.38330	38.06670	Zinc, Copper, Gold, Silver	Hydrothermal
Senegal	Sabodala	14.75000	-17.45000	Gold	Hydrothermal
Senegal	Faleme	13.96670	-12.75000	Gold, Diamond, Iron	Surficial
Senegal	Lam Lam	14.93330	-16.83330	Phosphate	Sedimentary
Senegal	Pallo Thies	14.80000	-17.08330	Phosphate	Sedimentary
Senegal	Taiba (Tobene, Keur Mor Fall, N'Domor Giop)	14.75000	-16.41670	Phosphate	Sedimentary
Sierra Leone	Moyamba	7.91670	-12.16670	Aluminium	Surficial
Sierra Leone	Port Loko	8.75000	-12.75000	Aluminium	Surficial
Sierra Leone	Koidu	8.60000	-10.96670	Diamond	Igneous
Sierra Leone	Tongo	8.2000	-11.0000	Diamond	Surficial
Sierra Leone	Yengema (Nimini Hills, Koidu)	8.6833	-11.0333	Diamond, Gold	Surficial
Sierra Leone	Marampa	8.70000	-13.30000	Iron	Sedimentary
Sierra Leone	Dalakaru-Worowaia (Dalakuru)	9.1833	-11.5167	Molybdenum, Copper, Lead, Zinc, Gold	Hydrothermal
Sierra Leone	Alako Water	8.33333	-13.16472	PGE	Surficial
Sierra Leone	Babadori Stream	8.46028	-13.27611	PGE	Surficial
Sierra Leone	Big Water	8.29694	-13.11972	PGE	Surficial
Sierra Leone	Freetown Layered Basic Complex Placers.	8.33333	-13.16667	PGE	Surficial
Sierra Leone	Glinda Water	8.30000	-13.13333	PGE	Surficial
Sierra Leone	Guma Water	8.37028	-13.20000	PGE	Surficial
Sierra Leone	Mogbwemo (Pejebu, Lanti, Gveni, Sembeh)	8.25000	-12.70000	Titanium	Surficial
Sierra Leone	Sierra Rutile	7.66667	-12.33333	Titanium	Surficial
Sierra Leone	Gbangbama-Mogbwemo	7.78333	-12.30000	Titanium, Zirconium	Surficial
Sierra Leone	Rotifunk	8.33330	-12.50000	Titanium, Zirconium	Surficial
Somalia	Darreh Hos	9.98333	44.91667	Columbium (Niobium)	Igneous
Somalia	Mur Bakayale	10.01667	44.86667	Columbium (Niobium)	Igneous
Somalia	Mait Island Guano	11.20000	47.21667	Phosphate	Surficial
Somalia	Dalan	11.08333	48.81667	Tin	Hydrothermal
South Africa	Consolidated Murchison Gravelotte	-24.00000	31.51670	Antimony, Gold	Hydrothermal
South Africa	Consolidated Murchinson	-23.80000	30.86667	Antimony, Gold, Silver	Hydrothermal
South Africa	African Chrysotilediepgezet	-26.00000	31.08330	Asbestos	Metamorphic

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
South Africa	Amianthus	-25.63330	30.75000	Asbestos	Metamorphic
South Africa	Bridgewaterzoutpansberg	-22.90830	29.61670	Asbestos	Metamorphic
South Africa	Bute	-26.11670	23.16670	Asbestos	Metamorphic
South Africa	Danielskuil	-28.11667	23.33333	Asbestos	Metamorphic
South Africa	Elcor	-27.20000	23.08330	Asbestos	Metamorphic
South Africa	Emmarentia	-28.03330	23.46670	Asbestos	Metamorphic
South Africa	Klipfontien	-28.00000	23.50000	Asbestos	Metamorphic
South Africa	Koegaswesterberg	-29.31670	22.36670	Asbestos	Metamorphic
South Africa	Kuruman Field	-27.28333	23.28333	Asbestos	Metamorphic
South Africa	Msauli	-25.90000	31.08330	Asbestos	Metamorphic
South Africa	Penge	-24.38330	30.28330	Asbestos	Metamorphic
South Africa	Pomfret	-25.83330	23.53330	Asbestos	Metamorphic
South Africa	Riries	-27.33330	23.16670	Asbestos	Metamorphic
South Africa	Senekal	-25.55000	31.46670	Asbestos	Metamorphic
South Africa	Stella	-25.53330	30.83330	Asbestos	Metamorphic
South Africa	Wandrag	-27.38330	23.28330	Asbestos	Metamorphic
South Africa	Whitebank	-27.41670	23.30000	Asbestos	Metamorphic
South Africa	Bathlako	-25.18330	26.90830	Chromium	Igneous
South Africa	Chroombronne	-25.71670	27.31670	Chromium	Igneous
South Africa	Dilokong	-24.58330	30.14170	Chromium	Igneous
South Africa	Eastern Bushveld: Steelpoort Sector	-24.53139	30.13139	Chromium	Igneous
South Africa	Grasvally	-24.33333	28.98333	Chromium	Igneous
South Africa	Grootboom	-24.75000	30.16667	Chromium	Igneous
South Africa	Kafferskraal 214	-25.66667	26.25000	Chromium	Igneous
South Africa	Mankwe-Bafokeng Sector	-25.18333	26.92111	Chromium	Igneous
South Africa	Millsell	-25.70830	27.29170	Chromium	Igneous

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
South Africa	Montrose Hendriksplaats	-24.61667	30.15000	Chromium	Igneous
South Africa	Mooinooi	-25.71000	27.57220	Chromium	Igneous
South Africa	Nietverdiend-Lehurutshe Sector	-25.08333	26.25000	Chromium	Igneous
South Africa	Nietverdiend-Marico Sector	-25.00000	26.20000	Chromium	Igneous
South Africa	Ntuane	-25.21667	26.91667	Chromium	Igneous
South Africa	Potgietersrus Sector	-24.34278	28.97000	Chromium	Igneous
South Africa	Ruighoek	-25.20000	26.93333	Chromium	Igneous
South Africa	Waterkop	-24.35830	30.01670	Chromium	Igneous
South Africa	Winterveld	-24.66667	30.16667	Chromium	Igneous
South Africa	Zwartkop (Zwartklip, Langran, Elandskool)	-24.78333	27.28333	Chromium, PGE	Igneous
South Africa	Groothoek	-24.53333	30.16667	Chromium, PGE, Iron, Silver	Igneous
South Africa	Henry Gould	-25.73333	27.58333	Chromium, PGE, Iron, Silver	Igneous
South Africa	Jagdlust	-24.26667	29.88333	Chromium, PGE, Iron, Silver	Igneous
South Africa	Kroondal (Booekenhoutfontein, Bultfontein, Rietfontein)	-25.75000	27.33333	Chromium, PGE, Iron, Silver	Igneous
South Africa	Marico	-25.08333	26.25000	Chromium, PGE, Iron, Silver	Igneous
South Africa	Waterkloof	-25.71667	27.28333	Chromium, PGE, Iron, Silver	Igneous
South Africa	Zeerust	-25.05000	26.25000	Chromium, PGE, Iron, Silver	Igneous
South Africa	Dorst Land 768	-23.83333	28.88333	Chromium, PGE, Nickel, Copper, Gold	Igneous
South Africa	Tweefontein	-24.89580	30.12500	Chromium, PGE, Nickel, Gold	Igneous
South Africa	Piet Retief Witkop 507	-27.00000	30.73330	Columbium (Niobium), Tantalum, Lithium	Igneous
South Africa	Campbell	-22.33000	30.05000	Copper	Hydrothermal

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
South Africa	Harper	-22.33000	30.05000	Copper	Hydrothermal
South Africa	Northern Transvaal Messina Copper Exploration Co	-22.43333	29.86000	Copper	Hydrothermal
South Africa	O'Okiep	-29.60000	17.88330	Copper, Gold, Silver, Sulfur, PGE	Hydrothermal
South Africa	Messina	-22.33000	30.05000	Copper, PGE	Hydrothermal
South Africa	Artonvilla	-22.33333	30.13333	Copper, PGE, Gold	Hydrothermal
South Africa	Prieska	-29.96670	22.28330	Copper, Zinc, Sulfur, Lead	Hydrothermal
South Africa	Belgravia	-27.16670	22.83330	Diamond	Igneous
South Africa	Bultfontein	-28.76667	24.86667	Diamond	Igneous
South Africa	De Beers	-28.73333	24.78333	Diamond	Igneous
South Africa	Dreiyers Pan (Annex Klein Zee	-29.58333	17.01667	Diamond	Surficial
South Africa	Dutoitspan	-28.76667	24.86667	Diamond	Igneous
South Africa	Finsch	-28.38333	23.45000	Diamond	Igneous
South Africa	Koffiefontein	-29.43333	25.01667	Diamond	Igneous
South Africa	Koingnaas (Hondeklip Bay, Namaqualand Diamond Mines)	-29.58333	17.05000	Diamond	Surficial
South Africa	Middlepunt	-25.5375	30.1083	Diamond	Igneous
South Africa	Premier	-25.70000	28.50000	Diamond	Igneous
South Africa	Roodepoort	-26.16670	27.88330	Diamond	Surficial
South Africa	Star	-28.36667	26.80000	Diamond	Igneous
South Africa	Uitvalgrond	-25.56670	27.87080	Diamond	Surficial
South Africa	Venetia (K1 Pipe)	-22.4303	29.3211	Diamond	Igneous
South Africa	Welgevonden	-24.50000	28.61667	Diamond	Surficial
South Africa	Wesselton	-28.76667	24.90000	Diamond	Igneous
South Africa	Kromdraai	-25.25000	28.30000	Fluorspar	Hydrothermal
South Africa	Kruidfontein	-25.16670	27.50000	Fluorspar	Hydrothermal
South Africa	Rhenosterfontein	-25.73330	26.13330	Fluorspar	Hydrothermal
South Africa	Saflor	-24.86670	27.88330	Fluorspar	Hydrothermal
South Africa	Slipfontein-Ruigtepoort	-25.00000	27.66667	Fluorspar	Hydrothermal
South Africa	Transvaal Fluorspar	-25.71670	26.08330	Fluorspar	Hydrothermal
South Africa	Van Den Heever	-25.75000	26.20000	Fluorspar	Hydrothermal
South Africa	Witkop (Oog van Malmanie, Buffelshoek)	-25.71667	26.06667	Fluorspar	Hydrothermal
South Africa	Zwartkloof	-24.91667	28.25000	Fluorspar	Hydrothermal
South Africa	Vergenoeg (Rust de Winter, Kromdraai)	-25.28333	28.28333	Fluorspar, Iron	Hydrothermal

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
South Africa	Marico District	-25.75000	26.10000	Fluorspar, Lead, Zinc	Hydrothermal
South Africa	Buffalo	-24.53333	28.60000	Fluorspar, REE	Igneous
South Africa	Barbrook	-25.72500	31.28060	Gold	Hydrothermal
South Africa	Benoni	-26.20000	28.30000	Gold	Unclassified
South Africa	Boksburg	-26.23330	28.21670	Gold	Unclassified
South Africa	Caritonville	-26.41670	27.41670	Gold	Unclassified
South Africa	East Rand Egoli Consolidated	-26.23330	28.36670	Gold	Surficial
South Africa	Erfdeel-Dankbaarheidfreegold S.	-28.00000	26.85000	Gold	Unclassified
South Africa	H.J.Joel	-28.30330	26.83330	Gold	Surficial
South Africa	Jurgenshof	-28.08330	26.76670	Gold	Unclassified
South Africa	Knights	-26.20000	28.20000	Gold	Unclassified
South Africa	Orange Free State	-27.98330	26.73330	Gold	Surficial
South Africa	Poortje Section	-26.67000	28.42000	Gold	Unclassified
South Africa	South Deep	-26.44170	27.65000	Gold	Surficial
South Africa	Village Main Reef	-26.23330	28.02500	Gold	Surficial
South Africa	West Wits Egoli Consolidated	-26.13330	27.70830	Gold	Surficial
South Africa	Murchison	-23.88889	30.75972	Gold, Antimony, PGE, Silver	Hydrothermal
South Africa	Brakpan	-26.22917	28.26667	Gold, PGE	Surficial
South Africa	Luipaardsvlei	-26.12500	27.83333	Gold, PGE	Surficial
South Africa	Modderfontein	-26.19167	28.40833	Gold, PGE	Surficial
South Africa	New Modder	-26.18750	28.37778	Gold, PGE	Surficial
South Africa	Nourse	-26.23333	28.11667	Gold, PGE	Surficial
South Africa	Orion (Minerva, Meyer, Black Reef, Cornucopia	-26.30917	28.22139	Gold, PGE	Surficial
South Africa	Rietfontein	-26.14583	28.20000	Gold, PGE	Surficial
South Africa	Robinson Deep	-26.23333	28.06667	Gold, PGE	Surficial
South Africa	Rose Deep	-26.21667	28.16667	Gold, PGE	Surficial
South Africa	Venterspost	-26.29167	27.66667	Gold, PGE	Surficial

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
South Africa	West Driefontein	-26.40000	27.46667	Gold, PGE	Surficial
South Africa	Wit G. M.	-26.17778	28.20000	Gold, PGE,	Surficial
South Africa	Van Ryn Deep	-26.16667	28.35556	Gold, PGE, Silver	Surficial
South Africa	Agnes (E. T. Cons)	-25.86667	30.96667	Gold, PGE, Silver	Hydrothermal
South Africa	Crown (City Deep, Cons. Main Reef)	-26.23333	28.01667	Gold, PGE, Silver	Surficial
South Africa	Dagga	-26.28056	28.48889	Gold, PGE, Silver	Surficial
South Africa	Durban Deep	-26.20000	27.86667	Gold, PGE, Silver	Surficial
South Africa	East Dagga	-26.29167	28.51111	Gold, PGE, Silver	Surficial
South Africa	East Driefontein	-26.40000	27.48333	Gold, PGE, Silver	Surficial
South Africa	East Rand Proprietary	-26.23333	28.21667	Gold, PGE, Silver	Surficial
South Africa	Govt. G. M. Areas	-26.20833	28.40000	Gold, PGE, Silver	Surficial
South Africa	Grootvlei	-26.23333	28.50000	Gold, PGE, Silver	Surficial
South Africa	Kinross	-26.46670	29.16670	Gold, PGE, Silver	Surficial
South Africa	Klerksdorp	-26.86670	26.65000	Gold, PGE, Silver	Surficial
South Africa	Kloof	-26.40000	27.60000	Gold, PGE, Silver	Surficial
South Africa	Langaagte Est.	-26.22917	28.00000	Gold, PGE, Silver	Surficial
South Africa	Leslie	-26.50000	29.03333	Gold, PGE, Silver	Surficial
South Africa	Libanon	-26.35000	27.61667	Gold, PGE, Silver	Surficial
South Africa	Marievale	-26.35000	28.51667	Gold, PGE, Silver	Surficial
South Africa	New Consort (E.T. Cons)	-25.63333	31.05000	Gold, PGE, Silver	Hydrothermal
South Africa	New State Areas	-26.23889	28.42222	Gold, PGE, Silver	Surficial

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
South Africa	Rand Leases	-26.18333	27.93333	Gold, PGE, Silver	Surficial
South Africa	Randfontein Estates (Cooke Section, West Rand Mine, East Champ D'or, Luipardsvlei Estates, South Roodeport)	-26.16667	27.76667	Gold, PGE, Silver	Surficial
South Africa	S. A. Lands	-26.31250	28.35556	Gold, PGE, Silver	Surficial
South Africa	Sheba (E. T. Cons)	-25.75000	31.20000	Gold, PGE, Silver	Hydrothermal
South Africa	Simmer And Jack	-26.23333	28.15000	Gold, PGE, Silver	Surficial
South Africa	Springs	-26.28333	28.42222	Gold, PGE, Silver	Surficial
South Africa	Sub Nigel	-26.37500	28.44444	Gold, PGE, Silver	Surficial
South Africa	Vaal Reefs	-26.91667	26.75000	Gold, PGE, Silver	Surficial
South Africa	Virginia (Harmony, Merriespruit)	-28.15000	26.88333	Gold, PGE, Silver	Surficial
South Africa	Vogelstruisbult	-26.33333	28.46667	Gold, PGE, Silver	Surficial
South Africa	Western Holdings	-27.98333	26.66667	Gold, PGE, Silver	Surficial
South Africa	Winkelhaak	-26.50000	29.16667	Gold, PGE, Silver	Surficial
South Africa	Wit Nigel	-26.51667	28.43333	Gold, PGE, Silver	Surficial
South Africa	Bracken	-26.51667	29.10000	Gold, Silver, PGE	Surficial
South Africa	Beatrix	-28.28330	26.76670	Gold, Silver, Uranium	Surficial
South Africa	Hartebeestfontein	-26.83330	26.83330	Gold, Silver, Uranium	Surficial
South Africa	Deelkraal	-26.46667	27.31667	Gold, Sulfur	Surficial
South Africa	Unisel	-28.06667	26.75000	Gold, Sulfur	Surficial
South Africa	Western Areas and Elsburg Sections	-26.36667	27.71667	Gold, Sulfur, PGE	Surficial
South Africa	Barberton (Fairview, Sheba, New Consort, Agnes, Princeton Complex)	-25.71667	31.10000	Gold, Sulfur, PGE, Silver	Hydrothermal

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
South Africa	Doornfontein	-26.40000	27.30000	Gold, Sulfur, PGE, Silver	Surficial
South Africa	Elandsrand	-26.46667	27.36667	Gold, Uranium	Surficial
South Africa	Harmony	-28.05000	26.83330	Gold, Uranium	Surficial
South Africa	St. Helena	-28.03330	26.66670	Gold, Uranium	Surficial
South Africa	Blyvooruitzicht	-26.40000	27.38333	Gold, Uranium, PGE, Silver	Surficial
South Africa	Buffelsfontein	-26.80000	26.87000	Gold, Uranium, PGE, Silver	Surficial
South Africa	Freddies Consolidated	-27.83333	26.66667	Gold, Uranium, PGE, Silver	Surficial
South Africa	Free State Geduld	-27.91667	26.73333	Gold, Uranium, PGE, Silver	Surficial
South Africa	Free State Saaiplaas	-27.98333	26.83333	Gold, Uranium, PGE, Silver	Surficial
South Africa	President Steyn	-28.00000	26.80000	Gold, Uranium, PGE, Silver	Surficial
South Africa	Welkom	-27.96667	26.75000	Gold, Uranium, PGE, Silver	Surficial
South Africa	West Rand Consolidated	-26.13333	27.76667	Gold, Uranium, PGE, Silver	Surficial
South Africa	Western Deep Levels	-26.41667	27.41667	Gold, Uranium, PGE, Silver	Surficial
South Africa	Western Ultra Deep Levels	-26.41667	27.41667	Gold, Uranium, PGE, Silver	Surficial
South Africa	President Brand	-28.03333	26.75000	Gold, Uranium, PGE, Silver, Sulfur	Surficial
South Africa	South African Land And Exploration Company	-26.28333	28.36667	Gold, Uranium, PGE, Silver, Sulfur	Surficial
South Africa	Odendaalsrus (Free State)	-27.83330	26.66670	Gold, Uranium, Silver	Surficial
South Africa	Ergo	-26.29170	28.39170	Gold, Uranium, Silver, Sulfur	Surficial
South Africa	Loraine	-27.75000	26.65000	Gold, Uranium, Silver, Sulfur, PGE	Surficial
South Africa	Dreifontein Consolidated	-26.38330	27.45000	Gold, Uranium, Sulfur, PGE	Surficial
South Africa	Stilfontein	-26.75000	26.83333	Gold, Uranium, Sulfur, PGE, Silver	Surficial
South Africa	Gumbu	-22.31667	30.66667	Graphite	Metamorphic

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
South Africa	Malonga	-22.65000	30.88333	Graphite	Metamorphic
South Africa	Beeshoek (Olynfontein farm)	-28.28330	23.00000	Iron	Sedimentary
South Africa	Krokodilkraal 4261	-25.60830	28.18330	Iron	Unclassified
South Africa	Lilyfield (Lylyveld)	-27.82720	23.03330	Iron	Unclassified
South Africa	Manganore	-28.13330	23.11670	Iron	Unclassified
South Africa	Omnia	-28.30000	22.90000	Iron	Unclassified
South Africa	Sishen	-27.77000	22.98000	Iron	Sedimentary
South Africa	Thabazimbi	-24.63333	27.36667	Iron	Sedimentary
South Africa	Gamagara	-27.79170	22.96670	Iron, Manganese	Unclassified
South Africa	Mapochs	-25.21667	29.91667	Iron, Vanadium, Titanium	Igneous
South Africa	Big Syncline Aggeneys Area	-29.20000	18.81670	Lead, Zinc	Hydrothermal
South Africa	Black Mountain (Aggeneys District)	-29.23333	18.83333	Lead, Zinc, Copper, Silver	Hydrothermal
South Africa	Broken Hill (Aggeneys District)	-29.05000	18.85000	Lead, Zinc, Copper, Silver	Hydrothermal
South Africa	Mooiplaats	-25.80700	28.07500	Limestone (dolomite)	Sedimentary
South Africa	Nyala (Mopani)	-22.52920	30.62500	Magnesium	Hydrothermal
South Africa	Strathmore	-25.52920	31.46250	Magnesium	Hydrothermal
South Africa	Annex Langdon	-27.20000	22.93330	Manganese	Unclassified
South Africa	Bishop	-27.16670	22.83330	Manganese	Unclassified
South Africa	Devon	-27.25000	23.00000	Manganese	Unclassified
South Africa	Gloria	-27.33330	23.00000	Manganese	Unclassified
South Africa	Glouchester	-27.16670	22.83330	Manganese	Unclassified
South Africa	Gopane (Gopani)	-25.25000	25.75000	Manganese	Sedimentary
South Africa	Kalahari Field	-27.18333	22.95000	Manganese	Sedimentary
South Africa	Middelplaats	-27.33333	22.86667	Manganese	Unclassified
South Africa	N'Chwaning (Kuruman)	-27.16670	22.83330	Manganese	Sedimentary
South Africa	Paling	-27.16670	22.83330	Manganese	Unclassified
South Africa	Postmasburg Field	-28.05000	23.05000	Manganese	Sedimentary

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
South Africa	Santoy	-27.16670	22.83330	Manganese	Unclassified
South Africa	Smartt	-27.33330	23.00000	Manganese	Unclassified
South Africa	Wessels (Adams, Mamatwan, Hotazel)	-27.10000	22.86667	Manganese	Sedimentary
South Africa	Western Transvaal Manganese	-26.25000	27.01667	Manganese	Sedimentary
South Africa	Black Rock	-22.83330	27.16670	Manganese, Iron	Sedimentary
South Africa	Hotazel	-27.21667	22.95000	Manganese, Iron	Sedimentary
South Africa	Lohathla	-28.05000	23.03333	Manganese, Iron	Sedimentary
South Africa	Mamatwan	-27.38333	22.95000	Manganese, Iron	Sedimentary
South Africa	Mokaning	-28.10000	23.05000	Manganese, Iron	Sedimentary
South Africa	Monarch Kop (Harrington Kop)	-23.88330	30.71250	Mercury	Hydrothermal
South Africa	Vlackfontein 902	-25.34167	27.01944	Nickel, Chromium	Igneous
South Africa	Nkomati	-25.66660	30.50000	Nickel, Chromium, Copper, PGE	Igneous
South Africa	Insizwa	-30.95000	29.30000	Nickel, Copper, Gold, Silver	Igneous
South Africa	Boschkoppie 104 Jq	-25.45000	27.13333	PGE	Igneous
South Africa	Crocodile River	-25.50000	27.49170	PGE	Igneous
South Africa	Der Brochen 7 Jt	-25.06667	30.11667	PGE	Igneous
South Africa	Eastern (Lonmin)	-26.05000	23.66670	PGE	Igneous
South Africa	Eland	-24.78333	27.28333	PGE	Igneous
South Africa	Elandsfontein 386 Kq	-25.46667	27.10000	PGE	Igneous
South Africa	Helena 6 Jt	-24.36667	30.00000	PGE	Igneous
South Africa	Karee	-25.68330	27.45000	PGE	Surficial
South Africa	Kennedy's Vale	-24.82920	30.09860	PGE	Igneous
South Africa	Maandagshoek (Driekop, Onverwacht)	-24.52500	30.17920	PGE	Igneous
South Africa	Winterveld 293 Kt	-24.18333	30.16667	PGE	Igneous
South Africa	Zeekoegat No. 421 Ks	-24.26667	29.83333	PGE	Igneous
South Africa	Driekop	-24.58167	30.17778	PGE,	Igneous

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
South Africa	Rustenburg (Amplats, Union Section, Amandelbult Section, RPM)	-25.66667	27.33333	PGE, Gold, Nickel, Copper	Igneous
South Africa	Western Bushveld	-25.70333	27.44611	PGE, Chromium, Gold, Nickel	Igneous
South Africa	Drenthe 778	-23.91667	28.88333	PGE, Chromium, Nickel, Copper, Gold	Igneous
South Africa	Mooihoek	-24.62917	30.15833	PGE, Copper	Igneous
South Africa	Onverwacht	-24.68167	30.16861	PGE, Copper	Igneous
South Africa	Bafokeng South	-25.50000	27.25000	PGE, Copper, Nickel	Igneous
South Africa	Blaavwbank	-25.41667	29.25000	PGE, Copper, Nickel	Igneous
South Africa	Pp Rust (Potgietersrus, Pots Plat, Sandsloot Pit, Zwartfontein Pits, Tweefontein Pits, Platreef Pit, Sterkwater, Sandfontein)	-24.02500	28.82080	PGE, Copper, Nickel, Gold	Igneous
South Africa	Vaalkop - Zwartfontein Section	-24.00000	28.85444	PGE, Copper, Nickel, Gold	Igneous
South Africa	Forest Hill 117 Kt	-24.46667	30.10000	PGE, Gold	Unclassified
South Africa	Impala	-25.55000	27.21667	PGE, Gold, Copper, Nickel	Igneous
South Africa	Western Platinum	-25.68333	27.53333	PGE, Gold, Copper, Nickel	Igneous
South Africa	Amandelbult	-24.78333	27.28333	PGE, Nickel, Copper	Igneous
South Africa	Atok (Lebowa, Leplats, Middelpunk Hill, Lobewa)	-24.32167	29.84139	PGE, Nickel, Copper	Igneous
South Africa	Eastern Bushveld Sector: Merensky Reef	-24.29167	29.87500	PGE, Nickel, Copper, Cobalt, Gold	Igneous
South Africa	Platreef	-24.00000	28.83333	PGE, Nickel, Copper, Gold	Igneous
South Africa	Merensky Reef	-24.50000	28.50000	PGE, Nickel, Copper, Gold, Chromium, Molybdenum, Lead	Igneous
South Africa	Northam	-24.82500	27.34310	PGE, Vanadium	Igneous
South Africa	Langebaan Area	-32.91000	18.11667	Phosphate	Sedimentary
South Africa	Phalaborwa (Palabora, Foskor)	-24.00000	31.13333	Phosphate, Copper, Vermiculite, Iron, Uranium, Zirconium, Gold, Silver	Igneous
South Africa	Schiel (Venda)	-23.16667	30.40000	Phosphate, Iron, Vermiculite	Igneous
South Africa	Glenover	-23.86667	27.13333	Phosphate, Vermiculite	Igneous
South Africa	Steenkampskraal	-30.96670	18.61670	REE, Copper, Zirconium, Uranium	Igneous
South Africa	Rooiberg (Leeuwpoort, Zanitplaats)	-24.78333	27.73333	Tin, Copper	Hydrothermal
South Africa	Union Tin	-24.48333	28.51667	Tin, Iron, Copper, Lead	Igneous
South Africa	Zaaiplaats	-24.05000	28.75000	Tin, Zinc, Tungsten, Copper	Hydrothermal

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
South Africa	Brand-Se-Baai (Namakwa)	-31.25000	17.83333	Titanium, Zirconium, Iron	Surficial
South Africa	Namaqua Sands	-31.25000	17.83333	Titanium, Zirconium, Iron	Surficial
South Africa	Cape Morgan	-32.70000	28.36667	Titanium, Zirconium, Iron, REE	Surficial
South Africa	Richards Bay	-28.83333	31.80000	Titanium, Zirconium, REE	Surficial
South Africa	Umgababa (Umkomaas, Usipingo)	-30.13333	30.85000	Titanium, Zirconium, REE, Iron	Surficial
South Africa	Orange River Belt West	-28.93333	17.88333	Tungsten	Unclassified
South Africa	Wallekraal	-28.33333	16.86944	Tungsten	Hydrothermal
South Africa	Wolfram Schist Belt	-29.58333	17.83333	Tungsten	Unclassified
South Africa	Orange River Belt East	-28.53333	20.50000	Tungsten, Tin	Unclassified
South Africa	Afrikander Lease Ltd.	-26.88333	26.50000	Uranium, Gold	Surficial
South Africa	Oryx (Beisa)	-28.21670	26.70420	Uranium, Gold, Silver	Surficial
South Africa	Brits	-25.65000	27.78330	Vanadium, Iron, Titanium	Igneous
South Africa	Maranda	-24.01000	30.42000	Zinc, Copper, Silver, Gold	Hydrothermal
South Africa	Gamsberg (Aggeneys Dsitrict)	-29.25000	18.96670	Zinc, Lead	Hydrothermal
South Africa	Pering	-27.43330	24.26670	Zinc, Lead	Hydrothermal
South Africa	Bien Venue	-25.68000	31.01000	Zinc, Lead, Copper, Silver, Gold	Hydrothermal
South Africa	Aggeneys #3	-29.05000	18.85000	Zinc, Lead, Silver	Hydrothermal
South Africa	North Natal Coast	-28.70000	32.16667	Zirconium	Surficial
South Africa	Umbababa	-30.13333	30.85000	Zirconium	Surficial
South Africa	West Cape Coast	-30.60000	17.60000	Zirconium, Titanium	Surficial
Sudan	Ingessana Hills (Nile Mining Operation)	11.28333	34.00000	Chromium, Asbestos, Magnesium	Igneous
Sudan	Kreiter	11.45170	33.96670	Chromium, Asbestos, Magnesium	Igneous
Sudan	Hofrat En Nahas	9.75000	24.31670	Copper	Hydrothermal
Sudan	Aberketieb (Abirkateib)	15.65000	32.53330	Gold, Copper	Hydrothermal
Sudan	Gebeit (Gabeit, Gabait)	21.06670	36.31670	Gold, Copper	Hydrothermal
Sudan	Hassai (Ariab)	15.65000	32.53330	Gold, Copper, Zinc, Lead, Silver	Hydrothermal
Swaziland	Havelock	-25.93330	31.13330	Asbestos	Metamorphic

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Swaziland	Gege	-27.03330	31.01670	Iron	Sedimentary
Swaziland	Ngwenya (Ngwenye, Bomvu Ridge, Bomwu Ridge)	-26.25000	31.00000	Iron	Sedimentary
Swaziland	Dwaleni	-26.61610	31.36610	Tin	Unclassified
Swaziland	Forbes Reef	-26.18310	31.10000	Tin	Unclassified
Syria	Eastern A and B (Sawwaneh)	34.71667	36.70000	Phosphate	Sedimentary
Tanzania	Pugu Hills	-6.8333	39.2833	Clay	Surficial
Tanzania	Panda Hill	-8.98750	33.23750	Columbium (Niobium)	Igneous
Tanzania	Kabanga	-1.50000	31.00000	Copper, Nickel	Unclassified
Tanzania	Alamasi	-3.51667	33.60833	Diamond	Igneous
Tanzania	Mwadui (Williamson)	-3.49167	33.66194	Diamond	Igneous
Tanzania	Merelani	-3.56667	37.03333	Gem, Graphite	Igneous
Tanzania	Bulyanhulu	-3.80000	32.60000	Gold	Hydrothermal
Tanzania	Buck Reef	-3.13333	32.08333	Gold, Molybdenum	Hydrothermal
Tanzania	Uruwira	-6.33333	31.25000	Gold, Silver	Surficial
Tanzania	Chambogo	-4.06667	37.73333	Magnesium	Igneous
Tanzania	Lugalla Hill	-6.75000	37.72000	Magnesium	Unclassified
Tanzania	Gelai	-2.63000	36.02000	Magnesium, Gem (peridot)	Igneous
Tanzania	Merkerstein Hill Deposit	-2.72810	36.50000	Magnesium, Gem (ruby)	Metamorphic
Tanzania	Minjingu	-3.66670	35.99861	Phosphate	Sedimentary
Tanzania	Wigu Hill	-7.1833	37.3000	REE, Phosphate, Zinc	Igneous
Tanzania	Lake Natron	-2.35000	36.16670	Soda ash	Sedimentary
Tanzania	Kaborishoke (Kwerya, Kyerwa)	-1.36670	30.79440	Tin, Tungsten	Hydrothermal
Tanzania	Liganga (Ligangu)	-9.90000	34.93000	Titanium, Iron, Vanadium	Igneous
The Gambia	Sanyang (Batukunku, Kartung	13.2500	-16.8000	Titanium, Zirconium	Surficial
Togo	Mt. Ahito	7.25830	-0.93330	Chromium	Igneous
Togo	Hahotoe-Kpogame	6.36670	1.38330	Phosphate	Sedimentary
Tunisia	Djebel Oust	26.58330	10.45830	Fluorspar	Hydrothermal
Tunisia	Djebel Sta	26.58330	10.45830	Fluorspar	Hydrothermal
Tunisia	Hammam Zriba	36.40000	10.13330	Fluorspar	Hydrothermal
Tunisia	Zariba	36.40000	10.15000	Fluorspar	Hydrothermal
Tunisia	Djerissa	35.83360	8.63330	Iron	Sedimentary
Tunisia	Douaria	36.81670	8.68330	Iron	Unclassified
Tunisia	Tamera	36.81670	8.68330	Iron	Sedimentary
Tunisia	Bechateur	37.31667	9.75000	Lead	Hydrothermal

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Tunisia	Bou Jabeur	36.51670	8.31670	Lead	Hydrothermal
Tunisia	Bougrine	36.50030	8.50030	Lead	Hydrothermal
Tunisia	Djebel El Adjered	35.45000	8.56670	Lead	Hydrothermal
Tunisia	Djebel Lazered	34.00000	9.00000	Lead	Hydrothermal
Tunisia	El Grefa	37.04170	9.21670	Lead	Hydrothermal
Tunisia	Fedj El Adhoum El Krib	36.37500	9.11670	Lead	Hydrothermal
Tunisia	Khanquet Kef Tou	34.00000	9.00000	Lead	Hydrothermal
Tunisia	Megrine	36.66670	10.08330	Lead	Hydrothermal
Tunisia	Usine De Megrine	36.66670	10.08330	Lead	Hydrothermal
Tunisia	Boujabeur	35.88333	8.31667	Lead, Zinc	Hydrothermal
Tunisia	Djebel Hallouf	36.73333	8.91667	Lead, Zinc	Hydrothermal
Tunisia	Fedjel	34.00000	9.00000	Lead, Zinc	Hydrothermal
Tunisia	Sidi Bou Aouane	36.70000	9.08333	Lead, Zinc	Hydrothermal
Tunisia	Sidi Driss	34.00000	9.00000	Lead, Zinc	Hydrothermal
Tunisia	Kef Eddour	34.15000	8.41670	Phosphate	Sedimentary
Tunisia	Kef Eschfair	34.38330	8.46670	Phosphate	Sedimentary
Tunisia	M'Dilla	34.30000	8.76670	Phosphate	Sedimentary
Tunisia	Metlaoui	34.31670	8.41670	Phosphate	Sedimentary
Tunisia	Moulares (Moulanes)	34.48330	8.26670	Phosphate	Sedimentary
Tunisia	M'Rata	34.48330	8.26670	Phosphate	Sedimentary
Tunisia	Oum El Khecheb	34.15000	8.41670	Phosphate	Sedimentary
Tunisia	Redeyef	34.36670	8.41670	Phosphate	Sedimentary
Tunisia	Sra Ouertane (Kef)	36.50030	9.50030	Phosphate	Sedimentary
Tunisia	Kalaa Khasba	35.68333	8.58333	Phosphate, Fluorspar	Unclassified
Tunisia	Sehib	34.20444	8.69028	Phosphate, Fluorspar	Unclassified
Tunisia	Fedj Assene	36.51670	8.53330	Zinc, Lead	Hydrothermal
Turkey	Bigadic District (Acep, Ankara, Begendikler, Salmanli, others)	39.46667	28.18333	Boron	Sedimentary
Turkey	Emet (Derekoy, Espey, Goktepe, Hamamkoy, Hisarcik, Killik)	39.26667	29.30000	Boron	Sedimentary
Turkey	Kestelek	39.66667	28.75000	Boron	Sedimentary
Turkey	Kirka	39.33333	30.50000	Boron	Sedimentary
Turkey	Guleman Mining Area (Bati Kef and Kefdag	38.41667	39.90000	Chromium	Igneous
Turkey	Kopdag Mining Area	40.01667	40.46667	Chromium	Igneous
Turkey	Koycegiz	36.95000	28.66670	Chromium	Igneous
Turkey	Derekoy	41.91667	27.31667	Copper	Hydrothermal

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Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Turkey	GŸzelyayla	40.83333	39.61667	Copper	Hydrothermal
Turkey	Gümüşhane	40.45110	39.41620	Copper, Gold	Hydrothermal
Turkey	Murgul	41.25000	41.55000	Copper, Gold	Hydrothermal
Turkey	Efemcukuru	38.28330	26.96660	Gold	Hydrothermal
Turkey	Kaymaz	40.92300	30.26800	Gold	Hydrothermal
Turkey	Kisladag	38.48333	29.15000	Gold	Hydrothermal
Turkey	Kucukdere	39.55000	27.13333	Gold	Hydrothermal
Turkey	Ovacik	39.36666	27.13333	Gold	Hydrothermal
Turkey	Bingöl and Bitlis Area	38.75000	40.50000	Phosphate, Iron	Hydrothermal
Turkey	Mazidagi	37.51667	40.50000	Phosphate, Uranium, Aluminium, Iron	Sedimentary
Turkey	Beypazari (Baypazari)	40.16667	31.93333	Soda ash	Sedimentary
Turkey	Cayelli	41.06670	40.80000	Zinc, Copper	Hydrothermal
Turkey	Cerateppe	41.18000	41.81000	Zinc, Copper, Silver	Hydrothermal
Uganda	Nakiloro	2.55000	30.83333	Chromium	Igneous
Uganda	Jinja	0.45000	33.23330	Copper	Hydrothermal
Uganda	Kilembe	0.23330	30.01670	Copper, Cobalt	Hydrothermal
Uganda	Gamba Hill Nampeyo	0.58330	32.91670	Lithium, Tantalum, Columbium (Niobium)	Igneous
Uganda	Sukulu Hills	0.68330	32.15000	Phosphate, Columbium (Niobium), Iron, Zirconium, Limestone	Igneous
Uganda	Bukusu	0.88330	34.25000	Phosphate, Copper, Barite, Strontium, Fluorspar	Igneous
Uganda	Nyamalilo (Nyamulilo, Mpororo, Ruhiza, Rushunga, Nyamuliro, Bjordal)	-1.24000	29.86667	Tungsten	Igneous
Western Sahara	Bou Craa	26.35000	-12.85000	Phosphate	Sedimentary
Yemen	Jabali	15.61670	44.60000	Zinc, Lead, Silver	Hydrothermal
Zambia	Bwana Mkubwa	-13.02280	28.69110	Copper	Hydrothermal
Zambia	Chambishi	-12.65560	28.04580	Copper	Hydrothermal
Zambia	Chimiwungo	-12.28330	25.88330	Copper	Hydrothermal
Zambia	Hippo	-14.67000	26.40000	Copper	Hydrothermal
Zambia	Kalengwa	-13.43000	24.93000	Copper	Hydrothermal
Zambia	Kansanshi	-12.10000	26.46670	Copper	Hydrothermal

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Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Zambia	Konkola	-12.30000	27.75000	Copper	Hydrothermal
Zambia	Luanshya	-13.13810	28.39080	Copper	Hydrothermal
Zambia	Malundwe	-12.23330	25.81670	Copper	Hydrothermal
Zambia	Baluba	-13.00000	28.16667	Copper, Cobalt	Hydrothermal
Zambia	Bancroft	-12.33333	27.75000	Copper, Cobalt	Hydrothermal
Zambia	Chibuluma	-12.82830	28.10560	Copper, Cobalt	Hydrothermal
Zambia	Nchanga	-12.53333	27.85000	Copper, Cobalt	Hydrothermal
Zambia	Nkana (Mindola)	-12.83333	28.20000	Copper, Cobalt	Hydrothermal
Zambia	Mkushi	-13.48000	29.45000	Copper, Gold	Hydrothermal
Zambia	Mtuga (Coloquo, Kolokwo, Munshiwemba)	-13.95000	29.12000	Copper, Gold	Hydrothermal
Zambia	Allies (Allies 2, Sisengo, Changwe)	-15.27000	28.65000	Copper, Iron	Hydrothermal
Zambia	Chongwe	-15.21000	28.42000	Copper, Silver	Hydrothermal
Zambia	Mufulira	-12.50000	28.00000	Copper, Silver, Gold	Hydrothermal
Zambia	Aries	-13.40000	29.28000	Gem (aquamarine, amethyst)	Igneous
Zambia	Miku	-13.13000	28.32000	Gem (emerald)	Igneous
Zambia	Dunrobin	-14.59000	27.04000	Gold, Silver, Copper	Hydrothermal
Zambia	Matala	-15.00000	27.01670	Gold, Silver, Copper	Hydrothermal
Zambia	Chongwe East	-15.35000	28.70000	Iron	Hydrothermal
Zambia	Pamba	-15.18000	27.48000	Iron	Sedimentary
Zambia	Shimyoka (Shimwyoka)	-15.48000	27.32000	Iron	Sedimentary
Zambia	Kampumba	-14.40000	28.55000	Iron, Manganese	Sedimentary
Zambia	Kabwe	-14.48330	28.41670	Lead, Zinc, Silver	Hydrothermal
Zambia	Broken Hill	-14.45000	28.43333	Lead, Zinc, Vanadium, Silver	Hydrothermal
Zambia	Chiwefwe	-13.38000	29.27000	Manganese, Iron	Sedimentary
Zambia	Nampundwe	-15.30000	27.55000	Sulfur, Copper	Hydrothermal
Zimbabwe	Boss	-20.12500	30.49170	Asbestos	Metamorphic
Zimbabwe	Gaths	-20.03330	30.53330	Asbestos	Metamorphic
Zimbabwe	King	-20.08330	30.53330	Asbestos	Metamorphic
Zimbabwe	Kudu	-20.30000	28.96670	Asbestos	Metamorphic
Zimbabwe	Mashaba	-20.02000	30.29000	Asbestos	Metamorphic

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Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Zimbabwe	Shabanie (Nil Desperandum)	-20.20000	30.01667	Asbestos	Metamorphic
Zimbabwe	Temeraire	-20.04170	30.52220	Asbestos	Metamorphic
Zimbabwe	Bat Claims (Ngezi Cooperative)	-18.78330	30.31670	Chromium	Igneous
Zimbabwe	Bee	-17.85000	29.88333	Chromium	Igneous
Zimbabwe	Caesar	-17.50000	30.71667	Chromium	Igneous
Zimbabwe	Cambrai	-19.33333	30.16667	Chromium	Igneous
Zimbabwe	Central Midlands	-19.16670	30.21670	Chromium	Igneous
Zimbabwe	Crown Divide North	-17.48330	30.61670	Chromium	Igneous
Zimbabwe	Divide (Francis)	-17.68330	30.58330	Chromium	Igneous
Zimbabwe	Glenapp	-17.00000	30.75000	Chromium	Igneous
Zimbabwe	Great Dyke	-17.85000	29.88333	Chromium	Igneous
Zimbabwe	Greenvale	-17.53330	30.60830	Chromium	Igneous
Zimbabwe	Impinge	-16.90000	30.83330	Chromium	Igneous
Zimbabwe	Inyala	-21.00000	30.12500	Chromium	Igneous
Zimbabwe	Iron Sides	-19.67310	30.00750	Chromium	Igneous
Zimbabwe	Iron Ton	-19.68060	30.00220	Chromium	Igneous
Zimbabwe	Lalapanzi	-19.31670	30.18330	Chromium	Igneous
Zimbabwe	Magazine Hill	-19.68170	30.00580	Chromium	Igneous
Zimbabwe	Magundi	-17.55000	30.55830	Chromium	Igneous
Zimbabwe	Maryland	-17.61670	30.54170	Chromium	Igneous
Zimbabwe	Mcgowan	-17.75000	30.55000	Chromium	Igneous
Zimbabwe	Mdindi (Mapanzuri, Chrome Hill)	-19.50830	30.10830	Chromium	Igneous
Zimbabwe	Netherburn	-19.28330	30.16670	Chromium	Igneous
Zimbabwe	Noro (Hay)	-17.05000	30.75000	Chromium	Igneous
Zimbabwe	Ore Recovery Tribute	-17.31670	30.61670	Chromium	Igneous
Zimbabwe	Pons	-19.95000	29.97500	Chromium	Igneous
Zimbabwe	Railway Block	-19.65830	29.98890	Chromium	Igneous
Zimbabwe	Rhodesia	-20.50000	30.00000	Chromium	Igneous
Zimbabwe	Rose (Seymore, Makamisa)	-19.78330	30.04170	Chromium	Igneous
Zimbabwe	Rutala	-18.40000	30.44170	Chromium	Igneous
Zimbabwe	Selukwe Peak	-19.72220	30.01220	Chromium	Igneous
Zimbabwe	Shurugwi Peak	-19.72220	30.01220	Chromium	Igneous
Zimbabwe	Spot	-20.00000	29.93330	Chromium	Igneous

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Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Zimbabwe	Sutton (Rodcamp)	-17.41670	30.58330	Chromium	Igneous
Zimbabwe	Umsweswe (Bee)	-18.66670	30.36670	Chromium	Igneous
Zimbabwe	Umvukwes Section	-17.16670	30.70000	Chromium	Igneous
Zimbabwe	Valley Chrome	-19.52500	30.07360	Chromium	Igneous
Zimbabwe	Vanad (Rhod African Chrom)	-17.08330	30.71670	Chromium	Igneous
Zimbabwe	Windsor	-17.80000	30.75000	Chromium	Igneous
Zimbabwe	York	-19.01670	30.28330	Chromium	Igneous
Zimbabwe	Ngezi (Bee)	-18.75000	30.32920	Chromium, Nickel, PGE, Gold	Igneous
Zimbabwe	Alaska	-17.24000	30.01000	Copper	Hydrothermal
Zimbabwe	Inyati	-18.22000	32.23000	Copper	Hydrothermal
Zimbabwe	Norah	-16.65000	29.91667	Copper	Hydrothermal
Zimbabwe	Sanyati	-16.70000	28.16000	Copper	Hydrothermal
Zimbabwe	Shackelton (Avondale, Angwa (Cu), Alaska)	-17.00000	29.91667	Copper, Silver	Hydrothermal
Zimbabwe	Mangula	-16.88330	30.16250	Copper, Silver, Gold	Hydrothermal
Zimbabwe	River Ranch	-22.11000	29.90000	Diamond	Igneous
Zimbabwe	Bell, (Riverlea)	-18.94170	29.72500	Gold	Hydrothermal
Zimbabwe	Blanket	-20.83330	28.57690	Gold	Hydrothermal
Zimbabwe	Commoner (Welcome Back, Colombina)	-18.42500	29.44170	Gold	Hydrothermal
Zimbabwe	Dalny (Colne, Pixie)	-18.05560	29.84580	Gold	Hydrothermal
Zimbabwe	Dawn (Queens Group, Barberton, Czarina, Queen's Mine)	-19.79580	28.75420	Gold	Hydrothermal
Zimbabwe	Eiffel Flats (Eiffel Blue)	-18.30560	29.93060	Gold	Hydrothermal
Zimbabwe	Elvington (Lone Star)	-18.84720	29.73750	Gold	Hydrothermal
Zimbabwe	Felixburg Gold Belt	-19.43330	30.83330	Gold	Unclassified
Zimbabwe	Freda Rebecca	-17.31470	31.34610	Gold	Hydrothermal
Zimbabwe	Gaika (Robin Hood)	-18.94440	29.80000	Gold	Hydrothermal
Zimbabwe	Globe and Phoenix	-18.92500	29.79170	Gold	Hydrothermal
Zimbabwe	Indarama (Futi, Broomstock)	-18.93330	29.81670	Gold	Hydrothermal
Zimbabwe	Isabella (Calcite 1)	-19.65000	28.90000	Gold	Hydrothermal
Zimbabwe	Kanyemba (Electra)	-18.47500	29.73330	Gold	Hydrothermal
Zimbabwe	Long John	-20.96670	29.06670	Gold	Hydrothermal
Zimbabwe	Marvel	-20.51670	29.46670	Gold	Hydrothermal
Zimbabwe	Old Nic	-20.18530	28.63470	Gold	Hydrothermal
Zimbabwe	Patchway (Brompto)	-18.25830	29.80830	Gold	Hydrothermal
Zimbabwe	Pickstone (Pitchstone, Peerless, Concession Hill (doublon), Duchess Hill, St Kilda)	-18.2833	30.2167	Gold	Hydrothermal
Zimbabwe	Rezende (Rezende Group, Elgin, Perthshire, Umtali)	-18.88330	32.70830	Gold	Hydrothermal
Zimbabwe	Sabi	-20.35560	30.17920	Gold	Hydrothermal

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Zimbabwe	Sebakwe	-18.85560	29.76940	Gold	Unclassified
Zimbabwe	Venice	-18.48190	29.71110	Gold	Hydrothermal
Zimbabwe	Vubachikwe	-20.85220	28.90280	Gold	Hydrothermal
Zimbabwe	Cam and Motor	-18.33330	29.98060	Gold, Antimony	Hydrothermal
Zimbabwe	Renco	-20.62920	31.17360	Gold, Copper	Hydrothermal
Zimbabwe	Athens	-19.31667	30.58333	Gold, Copper, Silver	Hydrothermal
Zimbabwe	Golden Kopje (Union Jack)	-17.50000	30.03890	Gold, Iron	Hydrothermal
Zimbabwe	Arcturus	-17.77920	31.34580	Gold, Silver	Hydrothermal
Zimbabwe	How	-20.25000	28.73330	Gold, Silver	Hydrothermal
Zimbabwe	Mazoe (Mazowe, Carn Brae, Birthday 3, Nucleus, Jumbo 1, Connaught, Bojum, Bucks 2, Flowing Bowl, Commonwealth)	-17.50000	30.92500	Gold, Silver	Hydrothermal
Zimbabwe	Redwing and Oldwest	-18.88890	32.67500	Gold, Silver	Hydrothermal
Zimbabwe	Shamva (Ashkirk, Cymric)	-17.33330	31.57640	Gold, Sulfur	Hydrothermal
Zimbabwe	Bulawayo District	-20.25000	28.58333	Gold, Tungsten	Hydrothermal
Zimbabwe	Golden Valley	-18.22220	29.80830	Gold, Tungsten	Hydrothermal
Zimbabwe	Bindura	-17.33330	31.35000	Gold, Tungsten, Copper	Hydrothermal
Zimbabwe	Lynx	-16.60000	29.43333	Graphite	Metamorphic
Zimbabwe	Buchwa (Buhwa, Doughnut, Fulano, Garrat-Diesel, Grandeux, Ironic, Norie, Vent, Whikwi	-20.50000	29.88333	Iron	Sedimentary
Zimbabwe	Mwanesi	-18.50000	30.60000	Iron	Sedimentary
Zimbabwe	Que Que Iron (Kwekwe District)	-19.01670	29.75000	Iron	Sedimentary
Zimbabwe	Ripple Creek	-19.1500	29.7000	Iron, Manganese	Sedimentary
Zimbabwe	Bikita (Mdara)	-19.95000	31.43333	Lithium, REE, Tantalum, Clay (Kaolin), Tin	Igneous
Zimbabwe	Richmond	-18.61848	29.76891	Mercury, Arsenic	Hydrothermal
Zimbabwe	Epoch	-20.41667	29.25000	Nickel	Igneous
Zimbabwe	Hunters Road	-14.33330	29.50000	Nickel, Cobalt, Copper	Igneous
Zimbabwe	Perseverence	-18.00000	29.90000	Nickel, Copper	Igneous
Zimbabwe	Empress	-18.46667	29.41667	Nickel, Copper, Cobalt	Igneous
Zimbabwe	Madziwa	-17.08333	31.83333	Nickel, Copper, Cobalt	Igneous
Zimbabwe	Trojan	-17.30000	31.33333	Nickel, Copper, Cobalt	Igneous
Zimbabwe	Shangani	-19.66667	29.25000	Nickel, Copper, PGE	Igneous
Zimbabwe	Hartley	-18.07500	30.45000	PGE	Igneous

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	DD latitude	DD longitude	Commodities (major, minor)	Simplified Deposit Type
Zimbabwe	Makwiro Platinum Field	-17.96389	30.42861	PGE, Copper	Unclassified
Zimbabwe	Wedza (Mimosa)	-20.29083	29.80833	PGE, Nickel, Copper, Gold	Igneous
Zimbabwe	Dorowa	-19.03330	31.75000	Phosphate, Iron	Igneous
Zimbabwe	Shawa	-19.1833	31.7167	Phosphate, Vermiculite	Igneous
Zimbabwe	Benson Pegmatites	-17.02000	32.26670	Tantalum	Igneous
Zimbabwe	Kamativi	-18.33333	27.06667	Tin, Tantalum, Tungsten, Columbium(Niobium)	Igneous
Zimbabwe	Sunyati	-17.83000	29.15000	Zinc, Copper, Lead, Silver, Gold	Hydrothermal

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Country	Deposit Name	References
Algeria	Affensou	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994. & MINING MAGAZINE, MINING ANNUAL REVIEW, JUNE, 1978, P. 51
Algeria	Ain Mimoun	
Algeria	Bou Caid	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994
Algeria	Gouraya	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P. 5
Algeria	Keddara	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994. & DE KUN, N., 1965. THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING CO., P. 57 & 405-406
Algeria	Mekla	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994
Algeria	Sidi Kamber	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994. & MINING MAGAZINE, AUG., 1969, P. 12
Algeria	Kieselghur	
Algeria	Maghnia	MINING MAGAZINE, AUG., 1993, VOL. 169, NO. 2, P. 65-67
Algeria	Mostaganem	
Algeria	Djebel Debagh	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994. & MINING MAGAZINE, AUG., 1969, P. 12
Algeria	Tamazert	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994
Algeria	Bou Soufa	CGS METALLOGENIC MAP OF AFRICA
Algeria	Djebel Haddid	
Algeria	El Maden	
Algeria	Ghar Rouban	
Algeria	Ain Barbar	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994. & MINING MAGAZINE, AUG., 1969, P. 12
Algeria	Medea	MINING MAGAZINE, AUG., 1993, V. 169, NO. 2, P. 65-67
Algeria	Sebket Oran (Sebkra d-Oran)	DE KUN, N., 1987, MINERAL ECONOMICS OF AFRICA, DEVELOPMENTS OF ECONOMIC GEOLOGY, V. 22. & CGS METALLOGENIC MAP OF AFRICA
Algeria	Ain Ben Merouane	
Algeria	Beni Douala	CGS METALLOGENIC MAP OF AFRICA
Algeria	Beni Saf	CGS METALLOGENIC MAP OF AFRICA & ECONOMIC GEOLOGY, 1927, V. 22, NO. 6, P. 537-540
Algeria	Beni-Felkal	
Algeria	Bou Khadra	CGS METALLOGENIC MAP OF AFRICA & MINING MAGAZINE, JAN., 1989, P. 49
Algeria	Fondouk	
Algeria	Ghara Djebilet	SURVEY OF WORLD IRON ORE RESOURCES, 1970, UNITED NATIONS, DEPT. OF ECONOMICS AND SOCIAL AFFAIRS. & MINING MAGAZINE, AUG., 1969, P. 126
Algeria	Khanguet	UNITED NATIONS, 1970, SURVEY OF WORLD IRON ORE RESOURCES—OCCURRENCE AND APPRAISAL: NEW YORK, NY, UNITED NATIONS, DEPT. OF ECONOMIC AND SOCIAL AFFAIRS, P. 66-67. & MINING MAGAZINE, JAN., 1989, P. 4
Algeria	Kristel	
Algeria	Rouina	CGS METALLOGENIC MAP OF AFRICA
Algeria	Sidi Marouf	CGS METALLOGENIC MAP OF AFRICA
Algeria	Temoulga	
Algeria	Timezrit	CGS METALLOGENIC MAP OF AFRICA & UNITED NATIONS, 1970, SURVEY OF WORLD IRON ORE RESOURCES—OCCURRENCE AND APPRAISAL: NEW YORK, NY, UNITED NATIONS, DEPT. OF ECONOMIC AND SOCIAL AFFAIRS, P. 66-6
Algeria	Zaccar	CGS METALLOGENIC MAP OF AFRICA & MINING MAGAZINE, JANUARY 1989, P. 4
Algeria	Ouenza	CGS METALLOGENIC MAP OF AFRICA & ZITZMANN, A., (ED.), 1978, THE IRON ORE DEPOSITS OF EUROPE AND ADJACENT AREAS, V. II, HANNOVER, FEDERAL INSTITUTE FOR GEOSCIENCES AND NATURAL RESOURCES
Algeria	Tazout	
Algeria	Affalou	CGS METALLOGENIC MAP OF AFRICA
Algeria	Djebel Ichmoul	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994. & MINING MAGAZINE, AUG., 1969, P. 12
Algeria	Chellala	
Algeria	Djebel Filaoucine	
Algeria	Djebel Gustar	
Algeria	Djebel Maasser	
Algeria	El Abed	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994
Algeria	Maaziz	
Algeria	M'Cid Aiaba	
Algeria	Batna	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994
Algeria	Blida	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994
Algeria	Bouira	MICHALSKI, B., 1993, CHAPTER ON ALGERIA, MINERALS YEARBOOK, U.S. BUREAU OF MINES
Algeria	Constantine	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994
Algeria	Djelfa	MICHALSKI, B., 1993, CHAPTER ON ALGERIA, MINERALS YEARBOOK, U.S. BUREAU OF MINES
Algeria	El Asnam	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994
Algeria	Oran	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994

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Country	Deposit Name	References
Algeria	Bendjerah	GALE, T., 1994, THE MIDDLE EAST AND NORTH AFRICA, EUROPA PUBLICATIONS LTD., LONDON. (SEE CHAPTER ON ALGERIA
Algeria	Bou Hanifia	
Algeria	Filfila	MINING MAGAZINE, AUG., 1969, P. 126
Algeria	Am'Rasma	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994
Algeria	Ismail	CGS METALLOGENIC MAP OF AFRICA & MINING MAGAZINE, AUG, 1969, P. 126
Algeria	Bordj Redir	CGS METALLOGENIC MAP OF AFRICA
Algeria	Djebel Kouif (Le Kouif)	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & CGS METALLOGENIC MAP OF AFRICA
Algeria	Djebel Onk	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & KRAUSS, U.H., SAAM, H.G., AND SCHMIDT, H.W., 1984, INTERNATIONAL STRATEGIC MINERALS INVENTORY: SUMMARY REPORT--PHOSPHATE: U.S. GEOLOGICAL SURVEY CIRCULAR 930-C
Algeria	M'zaita	CGS METALLOGENIC MAP OF AFRICA & OUSSEDIK, M., OUSMER, N., AND BELKHEDIM, M., 1979, LES MINERALIZATIONS PHOSPHATEES EOCENES EN ALGERIE, ET LE GISEMENT DE PHOSPHATE DU DJEBEL ONK, GEOLOGIE COMPAREE DES GISEMENTS DE PHOSPHATES ET DE PETROLE, DOCUMENTS DE BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES 24, ORLEANS, FRANCE P 141-154
Algeria	Arzew	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994. & MINING MAGAZINE, AUG., 1969, P. 12
Algeria	El Outaya	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994. & MINING MAGAZINE, AUG., 1969, P. 12
Algeria	Gerboun Lamri	MINING MAGAZINE, AUG., 1969, P. 126
Algeria	Great Sebkha	MINING MAGAZINE, AUG., 1969, P. 126
Algeria	Sidi Bouziane	MINING MAGAZINE, AUG., 1969, P. 126
Algeria	Beni Mansour	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC
Algeria	Karezas	CGS METALLOGENIC MAP OF AFRICA
Algeria	Ain Bou Hamada	
Algeria	Amarko	
Algeria	Azrou N'Bechar	
Algeria	Bou Douka	
Algeria	El Ouasta	
Algeria	Fej Hassen	
Algeria	Ghazaouet	
Algeria	Hammam N'Rails	
Algeria	Kherzet-Youssif	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P.235 AND 38
Algeria	Ouarsenis Mountains	MINING JOURNAL RESEARCH SERVICE, OCT. 6, 1994. & MINING MAGAZINE, AUG., 1969, P. 12
Algeria	Sakamody	
Algeria	El Abed (Oued Zaunder)	POPOV, A., 1968, LES TYPES MORPHOLOGIQUES ET LA REPARTITION DES GISEMENTS DE ZINC ET DE PLOMB EN ALGERIE & ANNALES DES MINES ET DE LA GEOLOGIE, NO. 23, P. 103-120 & RAUSCH, D.O., AND MARIACHER, B.C., (EDS.), 1970, MINING AND CONCENTRATING OF LEAD AND ZINC, V. 1, AIME, P. 894
Angola	Cachoeiras De Binga	METALS SOURCEBOOK, APRIL 23,1973, ITEM A2276
Angola	Tetelomavajo Tetelo	US BUREAU OF MINES, MINERAL TRADE NOTES, 1955, V. 40, NO. 6, P. 10. & METALS SOURCEBOOK, JULY 23, 1973, ITEM# A4010.
Angola	Lunda District	
Angola	Camafuca Camazamba	RECKLING, K., HOY, R.B., DEREK, S.J.L., AND ROWEL, U.H., 1994, INDUSTRIAL DIAMOND, IN CAR, D.D. (ED.), INDUSTRIAL MINERALS AND ROCKS, 6TH ED., P. 379-395. & CGS METALLOGENIC MAP OF AFRICA
Angola	Camatchia	RECKLING, K., HOY, R.B., DEREK, S.J.L., AND ROWEL, U.H., 1994, INDUSTRIAL DIAMOND, IN CAR, D.D. (ED.), INDUSTRIAL MINERALS AND ROCKS, 6TH ED., P. 379-395. & CGS METALLOGENIC MAP OF AFRICA
Angola	Catoca	RECKLING, K., HOY, R.B., DEREK, S.J.L., AND ROWEL, U.H., 1994, INDUSTRIAL DIAMOND, IN CAR, D.D. (ED.), INDUSTRIAL MINERALS AND ROCKS, 6TH ED., P. 379-395. & CGS METALLOGENIC MAP OF AFRICA
Angola	Cuango (Kwango) Valley	ACP WEBSITE
Angola	Lucapa area	
Angola	Cassala-Quintungo	ACP WEBSITE & UNITED NATIONS SURVEY OF WORLD IRON ORE RESOURCES, DEPT. OF ECONOMIC AND SOCIAL AFFAIRS, NEW YORK, 1970, P. 83
Angola	Cassinga North	ACP WEBSITE & HOOD,J.C., KORPERSHOEK, H.R., PROVING RESERVES AND MINE PLANNING OF THE PEBBLE DEPOSITS AT CASSINGA IRON ORE MINES, ANGOLA, TRANS. OF THE INST. OF MIN. AND MET., V.77, JULY, 196
Angola	Cassinga South	ACP WEBSITE & HOOD,J.C., KORPERSHOEK, H.R., PROVING RESERVES AND MINE PLANNING OF THE PEBBLE DEPOSITS AT CASSINGA IRON ORE MINES, ANGOLA, TRANS. OF THE INST. OF MIN. AND MET., V.77, JULY, 196
Angola	M'Bassa Deposit	ACP WEBSITE
Angola	Lueca	MILLMAN, A. P., 1960, THE DESCLOIZITE-MOTTRAMITE SERIES OF VANADATES FROM MINA DO LUECA, ANGOLA, AMERICAN MINERALOGIST, V. 45, P. 763-773
Benin	Loumbou-Loumbou	ACP WEBSITE

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Benin	Madekali	ACP WEBSITE
Botswana	Dikolakolane	GWOSDZ, W., 1985, A REVIEW OF INDUSTRIAL MINERALS IN THE GABORONE-LOBATSE-KANYE-MOLEPOLOLE AREA, BOTSWANA GEOLOGICAL SURVEY MINERAL RESOURCES, REPORT NO. 8
Botswana	Lake Ngami	
Botswana	Matsitama	
Botswana	Jwaneng	RECKLING, K., HOY, R.B., DEREK, S.J.L., AND ROWEL, U.H., 1994, INDUSTRIAL DIAMOND, IN CAR, D.D. (ED.), INDUSTRIAL MINERALS AND ROCKS, 6TH ED., P. 379-395. & MINING MAGAZINE, JAN., 1989, P. 49
Botswana	Letlhakane	RECKLING, K., HOY, R.B., DEREK, S.J.L., AND ROWEL, U.H., 1994, INDUSTRIAL DIAMOND, IN CAR, D.D. (ED.), INDUSTRIAL MINERALS AND ROCKS, 6TH ED., P. 379-395
Botswana	Orapa	RECKLING, K., HOY, R.B., DEREK, S.J.L., AND ROWEL, U.H., 1994, INDUSTRIAL DIAMOND, IN CAR, D.D. (ED.), INDUSTRIAL MINERALS AND ROCKS, 6TH ED., P. 379-395. & BALDOCK, J.W., HEPWORTH, J.V., AND MARENGWA, B.S.I., 1977, RESOURCE INVENTORY OF BOTSWANA: METALLIC MINERALS, MINERAL FUELS AND DIAMONDS, BOTSWANA GEOLOGICAL SURVEY MINERAL RESOURCES REPORT 4
Botswana	Map Nora / Tati/Golden Eagle	ACP WEBSITE
Botswana	Shashe (Map Nora, Sashe)	MINING MAGAZINE, JAN., 1989, P. 49. & CGS METALLOGENIC MAP OF AFRIC
Botswana	Kgwakgwe	DE KUN, N., 1987, MINERAL ECONOMICS OF AFRICA, DEVELOPMENTS OF ECONOMIC GEOLOGY, V. 22. & BALDOCK, J.W. (ED), 1977, RESOURCES INVENTORY OF BOTSWANA: METALLIC MINERALS, MINERAL FUELS AND DIAMONDS, GEOL. SURVEY OF BOTSWANA, MIN. RES. REPORT 4, P. 40-42
Botswana	Lobatse	BALDOCK, J.W., (ED.), 1977, RESOURCES INVENTORY OF BOTSWANA: METALLIC MINERALS, MINERAL FUELS AND DIAMONDS, GEOL. SURVEY OF BOTSWANA, MIN. RES. REPORT 4, P. 40-42
Botswana	Ramotswa	CGS METALLOGENIC MAP OF AFRICA & BALDOCK, J.W., (ED.), 1977, RESOURCES INVENTORY OF BOTSWANA: METALLIC MINERALS, MINERAL FUELS AND DIAMONDS, GEOL. SURVEY OF BOTSWANA, MIN. RES. REPORT 4, P. 40-42
Botswana	Selkirk Mine	ACP WEBSITE
Botswana	Pikwe (Phikwe, Selebi-Phikwe - Selebi-Pakwe)	CGS METALLOGENIC MAP OF AFRICA & GORDON, P.S.L., 1973, THE SELEBI-PIKWE NICKEL–COPPER DEPOSITS, BOTSWANA, IN LISTER, L.A. (ED.), SYMPOSIUM ON GRANITES, GNEISSES AND RELATED ROCKS, SPECIAL PUBLICATION, GEOLOGICAL SOCIETY OF SOUTH AFRICA, 3, P. 167–187
Botswana	Phoenix Mine	ACP WEBSITE
Botswana	Ranaka Quartz Vein	GWOSDZ, W., 1985, A REVIEW OF INDUSTRIAL MINERALS IN THE GABORONE-LOBATSE-KANYE-MOLEPOLOLE AREA, BOTSWANA GEOLOGICAL SURVEY MINERAL RESOURCES, REPORT NO. 8
Botswana	Sua Pan	GARRETT, D.E., 1992, NATURAL SODA ASH, 1ST EDITION, VAN NOSTRAND REINHOLD
Burkina Faso	Gurio	ACP WEBSITE
Burkina Faso	Sebba	ACP WEBSITE
Burkina Faso	Poura	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
Burkina Faso	Tambao	DEYOUNG, J.H, LEE, M.P., AND LIPIN, B.R., 1984, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT: CHROMIUM, U.S.G.S. CIRULAR 930-B. & INDUSTRIAL MINERALS, DEC., 1993, P. 10
Burkina Faso	Kodjari	NOTHOLT, A., 1990, BURKINA FASO, IN NORTH AND WEST AFRICA, MINING ANNUAL REVIEW, P. 135-136
Burkina Faso	Perkoa	MINING MAGAZINE, JAN., 1994, V. 170, NO. 1, P.32
Burundi	Musongati	ACP WEBSITE
Burundi	Karonge Gakara	ADERCA, B.M., VAN TASSEL, R., 1971, LE GISEMENT DE TERRES RARES DE LA KARONGE, ACAD. ROYAL SCIENCES D'OUTRE-MER, N.S., XVIII-5
Cameroon	Bauxite	BELINGA, S., 1970, GEOCHEMICAL STUDY OF WATER CIRCULATING IN THE ZONE OF BAUXITIC PLATEAUS OF THE HALEO SECTOR MINIM-MARTAP, ADAMAWA, CAMEROON, CAMEROUN, UNIV. FED., FAC. SCI., ANN., NO. 5, P. 33-37, (INCL. ENG. SUM.) & BELINGA, S., 1970, DECOUVERTE DE FORMATIONS BAUXITIQUES DANS LE MASSIF DU NGAOINDOUROU, DANS L'ADAMAOUA, AU CAMEROUN (DISCOVERY OF BAUXITIC FORMATIONS IN THE NGAOUNDOUROU MASSIF IN ADAMAWA, CAMEROON), CAMEROUN, UNIV. FED., FAC. SCI., A
Cameroon	Minim Martap	ENGINEERING AND MINING JOUNAL, NOVEMBER 1976, P. 196
Cameroon	Les Mamelles (Kribi)	ACP WEBSITE
Central African Republic	Kotto (Haute et Moyenne Rivière	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
Central African Republic	Sangha (Bassin de la) - Sangha Amont, Sangoma	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
Congo (Brazzaville)	M'Fouati	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P.390. & BIGOTTE, G. 1956, CONTRIBUTION A LA GEOLOGIE DU BASSIN DU NIARI: ETUDE SEDIMENTOLOGIQUE ET METALLOGENIQUE DE LA REGION MINIERE, THESIS, UNIVERSITY OF NANCY, FRANCE, GOUVERNEMENT GENERAL DE L'AFRIQUE EQUATORIALE FRANCAISE, 9, BULLETIN DE LA DIRECTION DES MINES ET DE LA GEOLOGIE
Congo (Brazzaville)	M'Passa	MINING MAGAZINE, JAN., 1987, P. 61
Congo (Brazzaville)	Kouilou (Makola, Youbi)	
Congo (Kinshasa)	Lueshe	MINING JOURNAL, JULY 19, 1985, ZAIRE REAPS SOME REWARDS, P. 39. & CARBONNEAU, C., AND CARON, J.C., 1965, THE PRODUCTION OF PYROCHLORE CONCENTRATES AT ST. LAWRENCE COLUMBIUM AND METALS CORP., CANADIAN MM. AND MET. BULL., LONDON, V. 58, NO. 635, P. 281-289.

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	References
Congo (Kinshasa)	Bingo	SAVAGE, C., (ED.), 1987, WORLD SURVEY OF PHOSPHATE DEPOSITS, BRITISH SULPHUR CORP., LTD, PURLEY PRESS, LONDON, P. 128.
Congo (Kinshasa)	Kinsenda	MINING MAGAZINE, JAN., 1989, P. 50. & CGS METALLOGENIC MAP OF AFRIC
Congo (Kinshasa)	Kov	ENGINEERING AND MINING JOURNAL, NOVEMBER 1979, P.188-206. & LOMBARD, J. AND NICOLINI, P. (EDS.), 1962, STRATIFORM COPPER DEPOSITS IN AFRICA, PARTS 1 AND 2, ASSOCIATION OF AFRICAN GEOLOGICAL SURVEYS, PARI
Congo (Kinshasa)	Dikuluwe	CROCKETT, R.N., CHAPMAN, G.R., AND FORREST, M.D., 1987, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - COBALT, USGS CIRCULAR 930-F. & MINING MAGAZINE, NOV., 1975, P. 341
Congo (Kinshasa)	Kakanda	WORLD MINING, OCT., 1974, P.53. & CROCKETT, R.N., CHAPMAN, G.R., AND FORREST, M.D., 1987, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - COBALT, USGS CIRCULAR 930-F
Congo (Kinshasa)	Kambove	CROCKETT, R.N., CHAPMAN, G.R., AND FORREST, M.D., 1987, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - COBALT, USGS CIRCULAR 930-F. & ENGINEERING AND MINING JOURNAL, NOV., 1979, P. 188-206
Congo (Kinshasa)	Kamoto	CROCKETT, R.N., CHAPMAN, G.R., AND FORREST, M.D., 1987, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - COBALT, USGS CIRCULAR 930-F. & ENGINEERING AND MINING JOURNAL, NOV., 1979 P. 188-206
Congo (Kinshasa)	Kazibizi	WORLD MINING, OCT., 1974, P. 53.
Congo (Kinshasa)	Mashamba	MINING MAGAZINE, NOV., 1975, P. 341. & CROCKETT, R.N., CHAPMAN, G.R., AND FORREST, M.D., 1987, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - COBALT, USGS CIRCULAR 930-F
Congo (Kinshasa)	Mupine	WORLD MINING, OCT., 1974, P.53. & CROCKETT, R.N., CHAPMAN, G.R., AND FORREST, M.D., 1987, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - COBALT, USGS CIRCULAR 930-F
Congo (Kinshasa)	Musonoi	CROCKETT, R.N., CHAPMAN, G.R., AND FORREST, M.D., 1987, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - COBALT, USGS CIRCULAR 930-F
Congo (Kinshasa)	Sesa (M'sesa)	TRURNIT, P., 1979, ROHSTOFFWIRTSCHAFTLICHE LAENDERBERICHTE (ZAMBIA), NO. 21, HANOVER, GERMANY
Congo (Kinshasa)	Shituru (Likasi)	ACP WEBSITE
Congo (Kinshasa)	Tshinsenda	
Congo (Kinshasa)	Mutoshi (Ruwe)	ACP WEBSITE
Congo (Kinshasa)	Musoshi	WORLD MINING, SEPT., 1977, P.146. & NOMA, S., HIDAKA, S., ABE, Y., AND HIRAYAMA, H., 1972, GEOLOGY AND COPPER DEPOSITS OF THE MUSOSHI AND KINSENDA MINES IN REPUBLIC OF ZAIRE, MINING GEOLOGY, SPECIAL ISSUE NO. 4, TOKY
Congo (Kinshasa)	Kolwezi	
Congo (Kinshasa)	Kipushi	GRAY, A. 1930, CORRELATION OF ORE-BEARING SEDIMENTS OF THE KATANGA AND RHODESIAN COPPER BELT, ECONOMIC GEOLOGY, V. 25, P. 78.
Congo (Kinshasa)	Mbuji Mayi	DE KUN, N., 1987, MINERAL ECONOMICS OF AFRICA, DEVELOPMENTS OF ECONOMIC GEOLOGY, V. 2
Congo (Kinshasa)	Talala	RECKLING, K., HOY, R.B., DEREK, S.J.L., AND ROWEL, U.H., 1994, INDUSTRIAL DIAMOND, IN CAR, D.D. (ED.), INDUSTRIAL MINERALS AND ROCKS, 6TH ED., P. 379-395
Congo (Kinshasa)	Tshikapa area	DE KUN, N., 1987, MINERAL ECONOMICS OF AFRICA, DEVELOPMENTS OF ECONOMIC GEOLOGY, V. 2
Congo (Kinshasa)	Kilo-Moto	MINING MAGAZINE, JAN., 1989, P. 52
Congo (Kinshasa)	Kitotolo	INTERNATIONAL DIRECTORY OF MINING AND MINERAL PROCESSING OPERATIONS, 1978, ENGINEERING AND MINING JOURNAL, MCGRAW HILL, NEW YORK, NY, P. 152 AND 356. & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM
Congo (Kinshasa)	Manono	INTERNATIONAL DIRECTORY OF MINING AND MINERAL PROCESSING OPERATIONS, 1978, ENGINEERING AND MINING JOURNAL, MCGRAW HILL, NEW YORK, NY, P. 152 AND 356. & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM
Congo (Kinshasa)	Kisenge (Kamata, Kapolo)	ACP WEBSITE & DOYEN, L., 1973, THE MANGANESE ORE DEPOSIT OF KISENGE-KAMATA (KATANGA), IN AMSTUTZ, G.C., AND BERNARD, A.J. (EDS.), ORES IN SEDIMENTS, SPRINGER-VERLAG, BERLIN-HEIDELBERG-NEW YORK, P. 93-100
Congo (Kinshasa)	Miluba	
Congo (Kinshasa)	Minerga	
Congo (Kinshasa)	Punia-Kasese	ANTHOINE, P., EVRARD, P., KHARKEVITCH, C., AND SCHAAR, G, 1967, THE SYMETAIN TIN DEPOSITS, GEOLOGY AND MINING, PAPER IN TECH. CONFERENCE ON TIN, LONDON, 1967. & CGS METALLOGENIC MAP OF AFRICA
Congo (Kinshasa)	Bukena	ENGINEERING AND MINING JOURNAL, 1978, INTERNATIONAL DIRECTORY OF MINING AND MINERAL PROCESSING OPERATIONS, SECTION 2C: INTERNATIONAL MINE/PLANT UNITS, P. 355
Congo (Kinshasa)	Kania	ENGINEERING AND MINING JOURNAL, 1978, INTERNATIONAL DIRECTORY OF MINING AND MINERAL PROCESSING OPERATIONS, SECTION 2C: INTERNATIONAL MINE/PLANT UNITS, P. 355
Congo (Kinshasa)	Kivu (Goma Kivu)	ACP WEBSITE
Congo (Kinshasa)	Mitwaba (Kiswa)	ACP WEBSITE & INTERNATIONAL DIRECTORY OF MINING AND MINERAL PROCESSING OPERATIONS,1978 MCGRAW HILL, N.Y., P. 334.

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	References
Congo (Kinshasa)	Bishasha (Mumba and Kasangura deposits)	ENGINEERING AND MINING JOURNAL, 1978, INTL. DIRECTORY OF MINING AND MINERAL PROCESSING OPERATIONS, MCGRAW HILL, NY, P. 355.
Congo (Kinshasa)	Kalima-Messaraba	ANTHOINE, P., EVRARD, P., KHARKEVITCH, C., AND SCHAAR, G, 1967, THE SYMETAIN TIN DEPOSITS, GEOLOGY AND MINING, PAPER IN TECH. CONFERENCE ON TIN, LONDON, 1967. & CGS METALLOGENIC MAP OF AFRICA
Congo (Kinshasa)	Shinkolobwe (Shinkolobowe, Signal, Kasolo)	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P. 11. & CGS METALLOGENIC MAP OF AFRICA
Côte D'Ivoire	Seguela (Bobi, Toubabouko, Legbo Rivière, Sequéla, Diarabana, Marahoué (riv.), Zuenoula)	RECKLING, K., HOY, R.B., DEREK, S.J.L., AND ROWEL, U.H., 1994, INDUSTRIAL DIAMOND, IN CAR, D.D. (ED.), INDUSTRIAL MINERALS AND ROCKS, 6TH ED., P. 379-395. & CGS METALLOGENIC MAP OF AFRICA
Côte D'Ivoire	Tortiya (Tortiya 55, Katiola-15)	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
Côte D'Ivoire	Aféma (Asupiri Placer)	ACP WEBSITE
Côte D'Ivoire	Aféma (Asupiri, Aniuri, Kouamékro Toliesso, Jonction, Brahima, Adiopan, Bagnan)	ACP WEBSITE
Côte D'Ivoire	Ity	ACP WEBSITE
Côte D'Ivoire	Mt. Klahoyo	ACP WEBSITE & SCHMIDT, R.C., & KENNEDY, B.E., 1979, GEOLOGY OF THE MONT KLAHOYO IRON ORE DEPOSIT, IVORY COAST, SOCIETY OF MINING ENGINEERS OF AIME, PRESENTED AIME ANNUAL MEETING
Côte D'Ivoire	Mokta (Dikodoua (Grand Lahou))	ACP WEBSITE & PUTZER, H., 1968, DIE MANGAN - ERZLAGERSTAETTE MOKTA, ELFENBEINKUESTE, ALS BEISPIEL FUER LATERITISCHE VERWITTERUNGSLAGERSTAETTEN IN DEN TROPEN, ERZBERGBAU UND METALLHUETTENWESEN, 21/10, P. 467-471.
Côte D'Ivoire	Biankouma (Touba)	HAMMERBECK, E.C.I. & SHERMAN, L.W., 1998 IN WILSON, M.G.C., AND ANHAEUSSER, C.R., (EDS.), 1998, THE MINERAL RESOURCES OF SOUTH AFRICA: HANDBOOK, COUNCIL FOR GEOSCIENCE, 16, 740PP. &
Cyprus	Apliki	BEAR, L.M., 1964, THE MINERAL RESOURCES AND MINING INDUSTRY OF CYPRUS, NICOSIA
Cyprus	Kalavasos	BEAR, L.M., 1964, THE MINERAL RESOURCES AND MINING INDUSTRY OF CYPRUS, NICOSIA
Cyprus	Mathiati	BEAR, L.M., 1964, THE MINERAL RESOURCES AND MINING INDUSTRY OF CYPRUS, NICOSIA
Cyprus	Mavrovouni	BEAR, L.M., 1964, THE MINERAL RESOURCES AND MINING INDUSTRY OF CYPRUS, NICOSIA
Cyprus	Skouriotissa	BEAR, L.M., 1964, THE MINERAL RESOURCES AND MINING INDUSTRY OF CYPRUS, NICOSIA
Egypt	Gebel Abu Khruq	MOUSTAFA, G.A., 1982, PROBLEMS AND REQUIREMENTS FOR IDENTIFYING, EXPLORING, AND DEVELOPING RESOURCES - THE OUTLOOK FOR EGYPT, IN WHITMORE, F.C., JR., AND WILLIAMS, M.E., (EDS.), RESOURCES FOR THE TWENTY-FIRST CENTURY, PROCEEDINGS OF THE INTERNATIONAL CENTENNIAL SYMPOSIUM OF THE USGS, USGS PROFESSIONAL PAPER 119
Egypt	Nag Hammadi	
Egypt	Hafafit	CGS METALLOGENIC MAP OF AFRICA & MINERAL MAP OF EGYPT, 1979, EGYPTIAN GEOLOGICAL SURVEY AND MINING AUTHORITY, CAIRO.
Egypt	Wadi Sifein	SAID, R., 1990, THE GEOLOGY OF EGYPT, ROTTERDAM, NETHERLANDS, A.A. BALKEMA PUBLISHERS, P. 511-566. & MINERAL MAP OF EGYPT, 1979, EGYPTIAN GEOLOGICAL SURVEY AND MINING AUTHORITY, CAIRO
Egypt	Aswan Clay Quarries	HUSSEIN, A.J., AND ABDALLAH, H.M., 1965, THE CONSTITUTION AND CHARACTERISTICS OF ASWAN CLAY, JOURNAL OF GEOLOGY, V. 9, NO. 2. & MOHARRAM, O. AND EL RAMLY, M. F. 1970, STUDIES ON SOME MINERAL DEPOSITS OF EGYP
Egypt	Musaba Salama	
Egypt	Kom Oushim (Kom Ushim)	CGS METALLOGENIC MAP OF AFRICA & MINERAL MAP OF EGYPT, 1979, EGYPTIAN GEOLOGICAL SURVEY AND MINING AUTHORITY, CAIRO.
Egypt	Abu Natash	
Egypt	Kalabsha	MOUSTAFA, G.A., 1982, PROBLEMS AND REQUIREMENTS FOR IDENTIFYING, EXPLORING, AND DEVELOPING RESOURCES - THE OUTLOOK FOR EGYPT, IN WHITMORE, F.C., JR., AND WILLIAMS, M.E., (EDS.), RESOURCES FOR THE TWENTY-FIRST CENTURY, PROCEEDINGS OF THE INTERNATIONAL CENTENNIAL SYMPOSIUM OF THE USGS, USGS PROFESSIONAL PAPER 1193. & SAID, R., 1990 THE GEOLOGY OF EGYPT ROTTERDAM NETHERLANDS A A BALKEMA PUBLISHERS P 511-56
Egypt	Wadi Kalabsha	IBRAHIM, T.M., 2002, GEOLOGICAL AND RADIOACTIVE STUDIES OF BASEMENT–SEDIMENTORY CONTACT IN THE AREA WEST GABAL EL -MISSIKAT EASTERN DESERT, EGYPT, PH.D. THESIS, EL MANSOURA UNIVERSITY, EL MANSOURA, EGYPT. & HASSAN, M.S., AND ABDEL-KHALEK, N.A., 1998, BENEFICATION AND APPLICATIONS OF EGYPTIAN BENTONITE, APPLIED CLAY SCIENCE 13, 99-115.
Egypt	Abu Dabbab	SAID, R., 1974, MINERAL DEPOSITS IN EGYPT UNDER INVESTIGATION, PAPER NO. 61, GEOLOGICAL SURVEY OF EGYPT. & AMIN, M.S., A TIN-TUNGSTEN DEPOSIT IN EGYPT, ECONOMIC GEOLOGY, NOV. 1947, V. 42, NO. 7, P. 637-67
Egypt	Nuweibi	SABET, A.H., TSOGOEV, V.B., BABURIN, L.M., RIAD, A.M., ZAKHARI, A., AND ARMANIUS, L.M., 1976, GEOLOGIC STRUCTURE AND LAWS OF LOCALIZATION OF TANTALUM MINERALIZATION AT THE NUWEIBI DEPOSIT, ANNALS OF THE GEOLOGICAL SURVEY OF EGYPT, V. 6, P. 119-156.
Egypt	El Atawi	EL-SHAZLY, E.M., AND SABET, A.H., 1955, A PRELIMINARY REPORT ON EL-ATAWI COPPER DEPOSIT, EASTERN DESERT, GEOLOGICAL SURVEY OF EGYPT, PAPER NO. 2

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	References
Egypt	Hamata	NESSIM, S., AFIA, M.S., FAHIM, M., AND FODA, A.A., 1956, REPORT OF THE PROSPECTING WORK CARRIED OUT IN WADI HAMATA AREA ,SOUTH EASTERN DESERT, GEOLOGICAL SUREVY OF EGYPT. & KOCHIN, G.G., BASSYUNI, F.A., ET AL, 1968, MINERAL RESOURCES OF THE U.A.R., PART I: METALLIC MINERALS, (INTERNAL REPORT), GEOLOGICAL SURVEY OF EGYPT, CAIRO.
Egypt	Umm Samiuki	KOCHIN, G.G., BASSYUNI, F.A., ET AL, 1968, MINERAL RESOURCES OF THE U.A.R., PART I: METALLIC MINERALS, (INTERNAL REPORT), GEOLOGICAL SURVEY OF EGYPT, CAIRO
Egypt	Wadi Sitra	AFIA, M.S., AND IMAM, I., 1979, MINERAL MAP OF EGYPT, EGYPTIAN GEOLOGICAL SURVEY AND MINING AUTHORITY, CAIR
Egypt	Sikheit-Nugrus	JENNINGS, R.H., KAMMERLING, R.C., KOVALTCHOUK, A., CALDERON, G.P., EL BAZ, M.K., AND KOIVULA, J.I., 1993, EMERALDS AND GREEN BERYLS OF UPPER EGYPT, GEMS AND GEMOLOGY, V. 29, NO. 2, P. 100-115
Egypt	Umm Kabu	JENNINGS, R.H., KAMMERLING, R.C., KOVALTCHOUK, A., CALDERON, G.P., EL BAZ, M.K., AND KOIVULA, J.I., 1993, EMERALDS AND GREEN BERYLS OF UPPER EGYPT, GEMS AND GEMOLOGY, V. 29, NO. 2, P. 100-115
Egypt	Zabara	JENNINGS, R.H., KAMMERLING, R.C., KOVALTCHOUK, A., CALDERON, G.P., EL BAZ, M.K., AND KOIVULA, J.I., 1993, EMERALDS AND GREEN BERYLS OF UPPER EGYPT, GEMS AND GEMOLOGY, V. 29, NO. 2, P. 100-115
Egypt	Ambaut (Anbaout)	CGS METALLOGENIC MAP OF AFRICA & MINERAL MAP OF EGYPT, 1979, EGYPTIAN GEOLOGICAL SURVEY AND MINING AUTHORITY, CAIRO.
Egypt	Hatit	MAHGOUB, O.M., EL RAMLY, M. F., AND OTHERS, 1970, STUDIES ON SOME MINERAL DEPOSITS OF EGYPT, GEOLOGICAL SUREVY OF EGYPT.
Egypt	Um Ud (Umm 'Ud)	CGS METALLOGENIC MAP OF AFRICA & MOHARRAM, O. AND EL RAMLY, M.F., 1970, STUDIES ON SOME MINERAL DEPOSITS OF EGYPT.
Egypt	Wadi Atalla	KOCHIN, G.G., BASSYUNI, F.A., ET AL, 1968, MINERAL RESOURCES OF THE U.A.R., PART I: METALLIC MINERALS, (INTERNAL REPORT), GEOLOGICAL SURVEY OF EGYPT, CAIRO. & CGS METALLOGENIC MAP OF AFRIC
Egypt	Fatiri	CGS METALLOGENIC MAP OF AFRICA & KOCHIN, G.G., BASSYUNI, F.A., ET AL, 1968, MINERAL RESOURCES OF THE U.A.R., PART I: METALLIC MINERALS, (INTERNAL REPORT), GEOLOGICAL SURVEY OF EGYPT, CAIRO
Egypt	Hangaliya	CGS METALLOGENIC MAP OF AFRICA & KOCHIN, G.G., BASSYUNI, F.A., ET AL, 1968, MINERAL RESOURCES OF THE U.A.R., PART I: METALLIC MINERALS, (INTERNAL REPORT), GEOLOGICAL SURVEY OF EGYPT, CAIRO
Egypt	Semna	MAHGOUB, O.M., EL RAMLY, M. F., AND OTHERS, 1970, STUDIES ON SOME MINERAL DEPOSITS OF EGYPT, GEOLOGICAL SUREVY OF EGYPT. & CGS METALLOGENIC MAP OF AFRICA
Egypt	Um Garaiat (Umm Geriat, Umm Qareiyat)	MAHGOUB, O.M., EL RAMLY, M. F., AND OTHERS, 1970, STUDIES ON SOME MINERAL DEPOSITS OF EGYPT, GEOLOGICAL SUREVY OF EGYPT. & CGS METALLOGENIC MAP OF AFRICA
Egypt	Atud	MAHGOUB, O.M., EL RAMLY, M. F., AND OTHERS, 1970, STUDIES ON SOME MINERAL DEPOSITS OF EGYPT, GEOLOGICAL SUREVY OF EGYPT. & CGS METALLOGENIC MAP OF AFRICA
Egypt	Haimur	MAHGOUB, O.M., EL RAMLY, M. F., AND OTHERS, 1970, STUDIES ON SOME MINERAL DEPOSITS OF EGYPT, GEOLOGICAL SUREVY OF EGYPT. & CGS METALLOGENIC MAP OF AFRICA
Egypt	Barramiya	MAHGOUB, O.M., EL RAMLY, M. F., AND OTHERS, 1970, STUDIES ON SOME MINERAL DEPOSITS OF EGYPT, GEOLOGICAL SUREVY OF EGYPT.
Egypt	El Sid	CGS METALLOGENIC MAP OF AFRICA & KOCHIN, G.G., BASSYUNI, F.A., ET AL, 1968, MINERAL RESOURCES OF THE U.A.R., PART I: METALLIC MINERALS, (INTERNAL REPORT), GEOLOGICAL SURVEY OF EGYPT, CAIRO
Egypt	Um Rus (Umm Rus)	MAHGOUB, O.M., EL RAMLY, M. F., AND OTHERS, 1970, STUDIES ON SOME MINERAL DEPOSITS OF EGYPT, GEOLOGICAL SUREVY OF EGYPT. & CGS METALLOGENIC MAP OF AFRICA
Egypt	El Ballah	
Egypt	El Hammam	ABDALLAH, A.M., 1966, GEOLOGY OF SOME GYPSUM DEPOSITS IN THE NORTH WESTERN DESERT OF EGYPT, GEOLOGICAL SURVEY OF EGYPT, PAPER NO. 41
Egypt	El Omayid	ABDALLAH, A.M., 1966, GEOLOGY OF SOME GYPSUM DEPOSITS IN THE NORTH WESTERN DESERT OF EGYPT, GEOLOGICAL SURVEY OF EGYPT, PAPER NO. 41. & ABDEL-AZIZ, M.G., GABRA, S., AND AHMES, S., 1971, EL OMAYID GYPSUM DEPOSIT, ANNALS OF THE GEOLOGICAL SURVEY OF EGYPT, VOL. 1.
Egypt	Gerza	
Egypt	Gharbanyat	TOSSON, S., 1963, NOTE ON EL GHORBANIAT GYPSUM DEPOSITS NEAR ALEXANDRIA, THE EGYPTIAN JOURNAL OF GEOLOGY, V. 7, NO. 1, P.72-77. & ABDALLAH, A.M., 1966, GEOLOGY OF SOME GYPSUM DEPOSITS IN THE NORTH WESTERN DESERT OF EGYPT, GEOLOGICAL SURVEY OF EGYPT, PAPER NO. 41
Egypt	Ras Malaab	CGS METALLOGENIC MAP OF AFRICA
Egypt	Wadi El Rayan	
Egypt	Manzala, Manzallah	CGS METALLOGENIC MAP OF AFRICA & POTENTIAL MINERAL RESOURCES OF EGYPT, 1984, EGYPTIAN GEOLOGICAL SURVEY AND MINING AUTHORITY, CAIRO
Egypt	Aswan	CGS METALLOGENIC MAP OF AFRICA & MALATI, M. AND AZAFA, M.A., 1965, J. CHEM. V. 8, NO. 3, P. 32
Egypt	Aswan (Aswan East)	CGS METALLOGENIC MAP OF AFRICA & MINING MAGAZINE, SEPT., 1976, TABLE B-1126, MINES ACCOUNTING FOR 90% OF ALL OUTPUT OTHER THAN COAL.
Egypt	Bahariya	CGS METALLOGENIC MAP OF AFRICA & HUME, W.F., 1962, OOLITHIC IRON ORE NEAR ASWAN, IN HUME, W.F., GEOLOGY OF EGYPT, VOL. 3, PART 1, P. 312-320, CAIRO G.P.O

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Egypt	Baharlya (Bahariya Oasis)	CGS METALLOGENIC MAP OF AFRICA & SAID, R., 1974, MINERAL DEPOSITS IN EGYPT UNDER INVESTIGATION, PAPER NO. 61, GEOLOGICAL SURVEY OF EGYPT
Egypt	El Gedida	CGS METALLOGENIC MAP OF AFRICA & EL-SHAZLY, E.M., 1962, REPORT ON THE RESULTS OF DRILLING IN THE IRON ORE DEPOSIT OF GEBEL GHORABI, BAHARIYA OASIS AND REPORT ON THE MINERALOGY OF THE LOW GRADE IRON ORES OF EL-HEIZ AREA, BAHARIYA OASIS
Egypt	El Harra	CGS METALLOGENIC MAP OF AFRICA
Egypt	Ghorabi (Gebel Ghorabi)	CGS METALLOGENIC MAP OF AFRICA & EL-SHAZLY, E.M., 1962, REPORT ON THE RESULTS OF DRILLING IN THE IRON ORE DEPOSIT OF GEBEL GHORABI, BAHARIYA OASIS AND REPORT ON THE MINERALOGY OF THE LOW GRADE IRON ORES OF EL-HEIZ AREA, BAHARIYA OASIS
Egypt	Nasser	CGS METALLOGENIC MAP OF AFRICA & EL-SHAZLY, E.M., 1962, REPORT ON THE RESULTS OF DRILLING IN THE IRON ORE DEPOSIT OF GEBEL GHORABI, BAHARIYA OASIS AND REPORT ON THE MINERALOGY OF THE LOW GRADE IRON ORES OF EL-HEIZ AREA, BAHARIYA OASIS
Egypt	Gebel El Russas	KOCHIN, G.G., BASSYUNI, F.A., ET AL, 1968, MINERAL RESOURCES OF THE U.A.R., PART I: METALLIC MINERALS, (INTERNAL REPORT), GEOLOGICAL SURVEY OF EGYPT, CAIRO
Egypt	Um Gheig (Umm Gheig)	CGS METALLOGENIC MAP OF AFRICA
Egypt	Zug El Bahar	SAID, R., 1974, MINERAL DEPOSITS IN EGYPT UNDER INVESTIGATION, PAPER NO. 61, GEOLOGICAL SURVEY OF EGYP
Egypt	Beni Hassan	CGS METALLOGENIC MAP OF AFRICA & MINERAL MAP OF EGYPT, 1979, EGYPTIAN GEOLOGICAL SURVEY AND MINING AUTHORITY, CAIRO.
Egypt	Wadi Alaki	POTENTIAL MINERAL RESOURCES OF EGYPT, 1984, EGYPTIAN GEOLOGICAL SURVEY AND MINING AUTHORITY, CAIRO. & MINERAL MAP OF EGYPT, 1979, EGYPTIAN GEOLOGICAL SURVEY AND MINING AUTHORITY, CAIRO
Egypt	Sagia	CGS METALLOGENIC MAP OF AFRICA & MINERAL MAP OF EGYPT, 1979, EGYPTIAN GEOLOGICAL SURVEY AND MINING AUTHORITY, CAIRO.
Egypt	Wadi Mialik (My'alik, Meialeik)	ATTIA, M.I., 1956, MANGANESE DEPOSITS OF EGYPT: SYMPOSIUM DE LA MANGANESO, 20TH INTERNATIONAL GEOLOGICAL CONGRESS, AFRICA , V. 2, P. 143–171. & CGS METALLOGENIC MAP OF AFRIC
Egypt	Um Bogma	CGS METALLOGENIC MAP OF AFRICA & EL SHARKAWI, M.A., EL AREF, M.M. AND ABDEL MOTELI, B.A., 1990, MANGANESE DEPOSITS IN A CARBONIFEROUS PALEOKARST PROFILE, UM BOGMA REGION, WEST-CENTRAL SINAI, EGYPT, MINERAL DEPOSITA, 25, P. 34.
Egypt	St John	MAHGOUB, O.M., EL RAMLY, M. F., AND OTHERS, 1970, STUDIES ON SOME MINERAL DEPOSITS OF EGYPT, GEOLOGICAL SUREVY OF EGYPT.
Egypt	El Hamrawein	OMARA, S., 1965, PHOSPHATIC DEPOSITS IN SYRIA AND SAFAGA DISTRICT, EGYPT, ECONOMIC GEOLOGY, V. 60, P.214-227. & BRITISH SULPHUR, LTD., 1980, WORLD SURVEY OF SULPHUR RESOURCES, 4TH ED
Egypt	El Mahamid	HUME, W.F., 1927, THE PHOSPHATE DEPOSITS IN EGYPT, GEOLOGICAL SUREVY OF EGYPT, PAPER NO. 41. & MAHGOUB, O.M., EL RAMLY, M. F., AND OTHERS, 1970, STUDIES ON SOME MINERAL DEPOSITS OF EGYPT, GEOLOGICAL SUREVY OF EGYPT.
Egypt	Qena	MEW, M.C., 1980, WORLD SURVEY OF PHOSPHATE DEPOSITS, 4TH ED., BRITISH SULPHUR CORPORATION LTD., LONDON. & EL-KAMMAR, A.M., ZAYED, M.A. AND AMER, S.A., 1979, RARE EARTHS OF THE NILE VALLEY PHOSPHORITES, UPPER EGYPT, CHEMICAL GEOLOGY 24, P. 69-81
Egypt	Quseir	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & HERMINA, M.H., 1974, REVIEW ON THE PHOSPHATE DEPOSITS OF EGYPT, 2ND ARAB CONFERENCE MINERAL RESOURCES, JEDDAH, PHOSPHATE SECTION, P.110-149
Egypt	Red Sea Phosphate District	KRAUSS, U.H., SAAM, H.G., AND SCHMIDT, H.W., 1984, INTERNATIONAL STRATEGIC MINERALS INVENTORY: SUMMARY REPORT--PHOSPHATE, USGS CIRCULAR 930-C. & HERMINA, M.H., 1974, REVIEW ON THE PHOSPHATE DEPOSITS OF EGYPT, 2ND ARAB CONF. MINERAL RESOURES, JEDDAH, PHOSPHATE SECTION, P.110-149
Egypt	Rifale	AFIA, M.S., AND IMAM, I., 1979, MINERAL MAP OF EGYPT, EGYPTIAN GEOLOGICAL SURVEY AND MINING AUTHORITY, CAIR
Egypt	Sabayia East	INDUSTRIAL MINERALS, NOV., 1976, P. 26. & MINING JOURNAL, OCT. 5, 1984, P. 24
Egypt	Safaga	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & KOTB, H., ABDEL AZIM, Y.Y., AND KAMEL, O.A., 1971, BENEFICATION OF SAFAGA LOW GRADE PHOSPHATE DEPOSIT, ANNALS GEOL. SURVEY OF EGYPT, V. 1, P. 135-146
Egypt	Sebaiya	MINING MAGAZINE, JAN., 1989, P. 49 & CGS METALLOGENIC MAP OF AFRICA
Egypt	Abu Tartur	ANON., 1980, INVESTIGATION OF EGYPTS ABU TARTUR PHOSPHATE DEPOSIT, PHOSPHORUS & POTASSIUM, NO.109, P.32-39. & MAHGOUB, O.M., EL RAMLY, M. F., AND OTHERS, 1970, STUDIES ON SOME MINERAL DEPOSITS OF EGYPT, GEOLOGICAL SUREVY OF EGYPT.
Egypt	Idku	SAID, R., 1990, THE GEOLOGY OF EGYPT, ROTTERDAM, NETHERLANDS, A.A. BALKEMA PUBLISHERS, P. 511-566. & MINERAL MAP OF EGYPT, 1979, EGYPTIAN GEOLOGICAL SURVEY AND MINING AUTHORITY, CAIRO
Egypt	Wadi Natrun	MINERAL MAP OF EGYPT, 1979, EGYPTIAN GEOLOGICAL SURVEY AND MINING AUTHORITY, CAIRO. & WALI, A.M.A., 1990, INDUSTRIAL MINERALS OF EGYPT, PAPER 90-77, PRESENTED AT SME ANNUAL MEETING, SALT LAKE CITY
Egypt	Wadi el Natron	CGS METALLOGENIC MAP OF AFRICA

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Country	Deposit Name	References
Egypt	Abu Ghalaga	GARNAR AND STANAWAY, 1994 & MOUSTAFA, G.A., 1982, PROBLEMS AND REQUIREMENTS FOR IDENTIFYING, EXPLORING, AND DEVELOPING RESOURCES-- THE OUTLOOK FOR EGYPT, IN WHITMORE, F.C., JR., AND WILLIAMS, M.E., (EDS.), RESOURCES FOR THE TWENTY-FIRST CENTURY-- PROCEEDINGS OF THE INTE
Egypt	Damietta	CGS METALLOGENIC MAP OF AFRICA & MINERAL MAP OF EGYPT, 1979, EGYPTIAN GEOLOGICAL SURVEY AND MINING AUTHORITY, CAIRO.
Egypt	Nile Delta-Rosetta	JACKSON, W.D., AND CHRISTIANSEN, G., 1993, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - RARE-EARTH OXIDES, USGS CIRC. 930-N. & CGS METALLOGENIC MAP OF AFRICA
Egypt	Rashid	CGS METALLOGENIC MAP OF AFRICA & SAID, R., 1990, THE GEOLOGY OF EGYPT, ROTTERDAM, NETHERLANDS, A.A. BALKEMA PUBLISHERS, P. 511-566
Eritrea	Bisha	GALLEY, A.G., HANNINGTON, M.D., AND JONASSON, I.R., 2007, VOLCANOGENIC MASSIVE SULFIDE DEPOSITS, in GOODFELLOW, W.D., ed., MINERAL DEPOSITS OF CANADA, GEOLOGIC ASSOC. OF CANADA, MINERAL DEPOSITS DIVISION, SPECIAL PUBLICATION NO. 5, P. 141-161.
Ethiopia	Lake Abiyata	SKILLINGS MINING REVIEW, 1994, MINERAL WEALTH OF ETHIOPIA - TANTALUM, SODA ASH, POTASH, NICKEL AND PLATINUM, V. 83, NO. 47, P. 5-7.
Ethiopia	Lake Shala	GARRETT, D.E., 1992, NATURAL SODA ASH, 1ST EDITION, VAN NOSTRAND REINHOLD
Ethiopia	Asmaradebara	MINERALS YEARBOOK, 1973, AREA REPORTS: INTERNATIONAL, VOL. III, US DEPT. OF INTERIOR, P.1078 & ENGINEERING & MINING JOURNAL, APRIL, 1972, P. 177
Ethiopia	Asmera Nippon	
Ethiopia	Adola Alluvial Deposits	ACP WEBSITE & TADESSE AND OTHERS, 2003, JAES &
Ethiopia	Dimma	ALLEN, A., AND TADESSE, G., 2003, GEOLOGICAL SETTING AND TECTONIC SUBDIVISION OF THE NEOPROTEROZOIC OROGENIC BELT OF TULUDIMTU, WESTERN ETHIOPIA, JOURNAL OF AFRICAN EARTH SCIENCES 36 & JELENC, D.A., 1966, MINERAL OCCURRENCES OF ETHIOPIA. P. 275
Ethiopia	Tulu Kami	JELENC, D.A., 1966, MINERAL OCCURRENCES OF ETHIOPIA, P. 209 & CGS METALLOGENIC MAP OF AFRICA
Ethiopia	Tulu Kapi	JELENC, D.A., 1966, MINERAL OCCURRENCES OF ETHIOPIA, P. 211. & CGS METALLOGENIC MAP OF AFRICA
Ethiopia	Yubdo	ALLEN, A., AND TADESSE, G., 2003, GEOLOGICAL SETTING AND TECTONIC SUBDIVISION OF THE NEOPROTEROZOIC OROGENIC BELT OF TULUDIMTU, WESTERN ETHIOPIA, JOURNAL OF AFRICAN EARTH SCIENCES 36 & JELENC, D.A., 1966, MINERAL OCCURRENCES OF ETHIOPIA, P. 275
Ethiopia	Adola	ACP WEBSITE & JELENC, D.A., 1966, MINERAL OCCURRENCES OF ETHIOPIA, P. 27
Ethiopia	Lega Dembi	MINING JOURNAL, 1988, GOLD PLANT FOR ETHIOPIA, V. 310, NO. 7954, P. 93. & MINING JOURNAL, 1987, ETHIOPIAN GOLD MINE FUNDING. V. 309. NO. 7945. P. 437-439
Ethiopia	Budussa Mountain	CGS METALLOGENIC MAP OF AFRICA & JELENC, DANILO A., 1966, MINERAL OCCURRENCES OF ETHIOPIA, MINISTRY OF MINES, ADDIS ABABA P. 60-64. 367. 412-13
Ethiopia	Sidamo	METALS WEEK, MARCH 26, 1973, P. 10
Ethiopia	Dallol	
Ethiopia	Kenticha	SKILLINGS MINING REVIEW, 1994, MINERAL WEALTH OF ETHIOPIA - TANTALUM, SODA ASH, POTASH, NICKEL AND PLATINUM, V. 83, NO. 47, P. 5-7.
Gabon	Mabounie	NOTHOLT, A.J.G., 1994, PHOSPHATE ROCK IN DEVELOPING COUNTRIES: A REVIEW OF GEOLOGY, RESOURCES AND DEVELOPMENT, IN MATHERS, S.J., AND NOTHOLT, A.J.G. (EDS.), INDUSTRIAL MINERALS IN DEVELOPING COUNTRIES, AGID REPORT SERIES. GEOSCINECES IN INTL. DEVELOPMENT 18. & CGS METALLOGENIC MAP OF AFRIC
Gabon	Bélinga (Djadi)	ACP WEBSITE & SIMS, S.J., 1973, THE BELINGA IRON ORE DEPOSIT (GABON), GENESIS OF PRECAMBRIAN IRON AND MANGANESE DEPOSITS, EARTH SCIENCE, PARIS, FRANCE, V. 9, PP 323-333
Gabon	Moanda	LECLERC, J. AND WEBER, F., 1976, GEOLOGY AND GENESIS OF THE MOANDA MANGANESE DEPOSITS, REPUBLIC OF GABON, INT. SYMP. GEOL. GEOCHEM. MANGANESE, SYDNEY. & NATIONAL MATERIALS ADVISORY BOARD, 1981, MANGANESE RESERVES AND RESOURCES OF THE WORLD AND THEIR INDUSTRIAL IMPLICATIONS: NMAB-374, NATIONAL ACADEMY OF SCIENCES, WASHINGTON DC P 34-38
Gabon	Mounana (Oklo, Boyindzi)	ACP WEBSITE
Ghana	Kibi Atewa	INTERNATIONAL BAUXITE ASSOCIATION, QUARTERLY REVIEW, FOCUS ON MEMBER COUNTRIES---THE REPUBLIC OF GHANA. & DUODU, S., 1991: MINERAL POTENTIAL AND INVESTMENT SCOPE IN GHANA, PAPER PRESENTED AT THE INTERNATIONAL SEMINAR ON MINING TAXATION, MONTREAL, SEPT. 30 TO OCT. 4
Ghana	Nyinahin (Aya)	COOPER, W.G., 1936, BAUXITE DEPOSITS OF THE GOLD COAST, GOLD COAST GEOL. SURVEY, BULLETIN NO. 7, P.22-2
Ghana	Tema	
Ghana	Sefwi (Bekwai, Awaso)	PATTERSON, S.H., 1986, WORLD BAUXITE RESOURCES, USGS PROFESSIONAL PAPER 1076-B. & CGS METALLOGENIC MAP OF AFRICA
Ghana	Ghana Cons Diamonds	MINING MAGAZINE, SEPT., 1976, TABLE B-1126, MINES ACCOUNTING FOR ALL OUTPUT OTHER THAN COAL. & MINING MAGAZINE, JAN., 1989. P. 52
Ghana	Akwatia	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & CGS METALLOGENIC MAP OF AFRICA
Ghana	Bogosu (Bogoso, Abogosu)	ACP WEBSITE

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Country	Deposit Name	References
Ghana	Dunkwa Alluvial Operations	
Ghana	Iduapriem	ACP WEBSITE & MINING MAGAZINE, 1993, V. 168, NO. 4, P. 219
Ghana	Konongo/Obenemase/Pepe	ACP WEBSITE
Ghana	Prestea	ACP WEBSITE & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM
Ghana	Sansu (Obuasi)	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
Ghana	Tarkwa (Old Tarkwa, Pepe pit, Atuabo pit, Akontansi, Mantraim pit, Kottraverchy)	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM. & CGS METALLOGENIC MAP OF AFRICA
Ghana	Teberebie	ACP WEBSITE
Ghana	Ashanti	ACP WEBSITE & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM
Ghana	Kalimbi Hill - Three Hills Area	CGS METALLOGENIC MAP OF AFRICA
Ghana	Nsuta	DEYOUNG, J.H, LEE, M.P., AND LIPIN, B.R., 1984, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT, USGS CIRULAR 930-B, P. 41. & CGS METALLOGENIC MAP OF AFRICA
Ghana	Odumase	CGS METALLOGENIC MAP OF AFRICA & MINING MAGAZINE, JAN., 1989, P. 49
Guinea	Aye Koye	DE KUN, N., 1987, MINERAL ECONOMICS OF AFRICA, DEVELOPMENTS OF ECONOMIC GEOLOGY, V. 22. & CGS METALLOGENIC MAP OF AFRICA & METALS WEEK, JAN. 27, 1975, P. 1
Guinea	Bauxite	CHRONIQUE DES MINES ET DE LA RECHERCHE MINIERE, 38E ANNEE, NO. 389, JAN., 1970, P.
Guinea	Bauxite	CHRONIQUE DES MINES ET DE LA RECHERCHE MINIERE, 38E ANNEE, NO. 396, OCTOBRE, 1970, P.
Guinea	Cbg, Boke Project	
Guinea	Kindia	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, BAUXITE, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P. 296-301. & ENGINEERING AND MINING JOURNAL, 1978, INTL. DIRECTORY OF MINING AND MINERAL PROCESSING OPERATIONS, MCGRAW HILL, NY.
Guinea	Lelydorp (Onverdacht, Paranam)	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC
Guinea	Sangaredi Boke	HOPPE, R.W., SANGAREDI PIT IN GUINEA CARVES UP A RICH DEPOSIT OF SOLID BAUXITE, ENGINEERING AND MINING JOURNAL, V. 178, NO. 6, JUNE 1977, PP. 138-140. & CGS METALLOGENIC MAP OF AFRIC
Guinea	Tougue	PATTERSON, S.H., 1967, BAUXITE RESERVES AND POTENTIAL ALUMINUM RESOURCES OF THE WORLD, USGS BULLETIN 1228, P. 84. & MINERALS YEARBOOK, 1978-79, AREA REPORTS: INTERNATIONAL, VOL. III, US DEPT. OF INTERIO
Guinea	Friguia (Fria, Friguiagbe)	PATTERSON, S.H., 1967, BAUXITE RESERVES AND POTENTIAL ALUMINUM RESOURCES OF THE WORLD, USGS BULLETIN 1228. & METALS BULLETIN, JUNE 17, 1993, P. 5
Guinea	Fayalala	ACP WEBSITE & AFRICA ENERGY & MINING, NOV, 1995
Guinea	Koron (Didi Sag Concession)	ACP WEBSITE
Guinea	Lero (Léro and Karta)	ACP WEBSITE
Guinea	Siguiri (Sanou Tinti, Eureka Hill, Fatoya, Koron	ACP WEBSITE
Guinea	Conakry	ACP WEBSITE
Guinea	Pierre Richaud (Mt. Nimba)	ACP WEBSITE
Guinea	Simandou (Pic de Fon)	ACP WEBSITE
Iran	Darreh	ROMAN'KO, Y.F., MOMENZADE, M., MOGAROVSKIY, V.V., YOKORIN, Y.G., LOFTI, M., AND ISHAN-SHO, G.A., 1985 [1986], O BARITOVYKH MESTOROZHDENIYAKH TSENTRAL'NOGO IRANA (BARITE DEPOSITS OF CENTRAL IRAN), DOKLADY AKADEMII NAUK SSSR, V. 281, NO. 3, P. 677-680.
Iran	Amir	
Iran	Shahriar	
Iran	Kale Kafi	SINGER, D.A., BERGER, V.I., AND MORING, B.C., 2002, PORPHYRY CU DEPOSITS OF THE WORLD: DATABASE,MAPS, AND PRELIMINARY ANALYSIS, USGS OPEN FILES REPORT 02-268
Iran	Sungun	SINGER, D.A., BERGER, V.I., AND MORING, B.C., 2002, PORPHYRY CU DEPOSITS OF THE WORLD: DATABASE,MAPS, AND PRELIMINARY ANALYSIS, USGS OPEN FILES REPORT 02-268
Iran	Sar Cheshmeh	SINGER, D.A., BERGER, V.I., AND MORING, B.C., 2002, PORPHYRY CU DEPOSITS OF THE WORLD: DATABASE,MAPS, AND PRELIMINARY ANALYSIS, USGS OPEN FILES REPORT 02-268
Iran	Agh Darreh	
Iran	Zarshuran	ASADI, H.H., 2000, THE ZARSHURAN GOLD DEPOSIT MODEL APPLIED IN A MINERAL EXPLORATION GIS IN IRAN, PHD DISSERTATION, UNIVERSITY OF DELFT AND ITC, THE NETHERLANDS & ASADI, H.H., VONCKEN J.H.L., KUHNEL R.A., AND HALE, M., 2000, PETROGRAPHY, MINERALOGY AND GEOCHEMISTRY OF THE ZARSHURAN CARLIN-LIKE GOLD DEPOSIT, MINERALIUM DEPOSITA 35, P 672–682
Iran	Chadar malu	FORSTER, H., AND JAFARZADEH, A., 1994, THE BAFQ MINING DISTRICT IN CENTRAL IRAN - A HIGHLY MINERALIZED INFRCAMBERIAN VOLCANIC FIELD, ECONOMIC GEOLOGY, VOL. 98
Iran	Golgohar	
Iran	Northern An	
Iran	Choghart	
Iran	Mehdiabad	

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	References
Iran	Afzalabad	INDUSTRIAL MINERALS, NO. 305, P. 65
Iran	Behbehan area	CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA, U.S.G.S. OPEN-FILE REPORT 02-0156A AND 02-0156B. & BUCKENHAM, M.H., 1988, ASSISTANCE IN PHOSPHATE ORE BENEFICIATION AND FERTILIZER MANUFACTURING-IRAN, UNITED NATIONS TECHNICAL SUPPORT TO GEOLOGICAL SURVEY UNDP PROJECT IRA/71/542
Iran	Nakhjir-Dashte Kavir (Molkabad)	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC
Iran	Talhah	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC
Iran	Angouran	
Iraq	Akashat	CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA, U.S.G.S. OPEN-FILE REPORT 02-0156A AND 02-0156
Iraq	Sawab	CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA, U.S.G.S. OPEN-FILE REPORT 02-0156A AND 02-0156
Iraq	Badoosh	
Iraq	Mishraq Ash Shurah	
Israel	Timna	COX, D.P., LINDSEY, D.A., SINGER, D.A., MORING, B.C., AND DIGGLES, M.F., 2003, SEDIMENT-HOSTED COPPER DEPOSITS OF THE WORLD: DEPOSIT MODELS AND DATABASE, U.S.G.S. OPEN-FILE REPORT 03-107
Israel	Beersheva	CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA, U.S.G.S. OPEN-FILE REPORT 02-0156A AND 02-0156
Israel	Oron	CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA, U.S.G.S. OPEN-FILE REPORT 02-0156A AND 02-0156
Israel	Zefa-Ef'e (Arad)	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & NOTHOLT, A.J.G., 1994, PHOSPHATE ROCK IN DEVELOPING COUNTRIES: A REVIEW OF GEOLOGY, RESOURCES AND DEVELOPMENT, IN MATHERS, S.J., AND NOTHOLT, A.J.G. (EDS.), INDUSTRIAL MINERALS IN DEVELOPING COUNTRIES, AGID REPORT SERIES, GEOSCINECES IN INTL DEVELOPMENT 18
Israel	Zin (Nahal Zinam, Nahil Zin, Nahal Zin)	CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA, U.S.G.S. OPEN-FILE REPORT 02-0156A AND 02-0156B. & CGS METALLOGENIC MAP OF AFRICA
Israel	Dead Sea	WARREN, J.K., 1999, EVAPORITES: THEIR EVOLUTION AND ECONOMICS, BLACKWELL SCIENTIFIC PUBLICATIONS, OXFORD.
Jordan	Fenan	COX, D.P., LINDSEY, D.A., SINGER, D.A., MORING, B.C., AND DIGGLES, M.F., 2003, SEDIMENT-HOSTED COPPER DEPOSITS OF THE WORLD: DEPOSIT MODELS AND DATABASE, U.S.G.S. OPEN-FILE REPORT 03-107
Jordan	El Abyad (Wadi El Abayad, Al Abayad, El Abaid, Al Abaid)	CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA, U.S.G.S. OPEN-FILE REPORT 02-0156A AND 02-0156
Jordan	Esh Shidiya (Es Shidiya, Esh Shidiya, Al Shidiyah, Shediyah)	BARTELS, J.J., AND GURR, T.M., 1994, PHOSPHATE ROCK, IN CARR, D.D. (ED.), INDUSTRIAL MINERALS AND ROCKS, 6TH EDITION, SOCIETY FOR MINING, METALLURGY AND EXPLORATION INC., LITTLETON, COLORADO. & CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA U S G S OPEN-FILE REPORT 02-0156A AND 02-0156B
Jordan	Ruseifa	CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA, U.S.G.S. OPEN-FILE REPORT 02-0156A AND 02-0156
Jordan	Ghor Al-Safi	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC
Jordan	Dead Sea	CGS METALLOGENIC MAP OF AFRICA & ABED, A.M., & OMARI, K., 1994, ROLE OF INDUSTRIAL ROCKS AND MINERALS IN THE DEVELOPMENT OF JORDAN, IN MATHERS, S.J., AND NOTHOLT, A.J.G., (EDS.), INDUSTRIAL MINERALS IN DEVELOPING COUNTRIES, BRITISH GEOLOGICAL SURVEY/ASSOCIATION OF GEOSCIENTISTS FOR INTERNATIONAL DEVELOPMENT, AGID REPORT SERIES GEOSCIENCES IN INTERNATIONAL DEVELOPMENT 18 P 181-192
Kenya	Telot West Pokot	DU BOISE, C.G.B., 1970, MINERALS OF KENYA, GEOL. SURV. OF KENYA, BULL. NO. 11, P. 10-11. & CGS METALLOGENIC MAP OF AFRICA
Kenya	Mrima Hill	COETZEE, G.L., AND EDWARDS, C.B., 1959, THE MRIMA HILL CARBONATITE, COAST PROVINCE, KENYA, TRANSACTIONS OF THE
Kenya	Kenya Fluorspar	MINING ANNUAL REVIEW, 1994, SECTION ON KENYA, P. 144. & REED, A.H., AND CLARKE, R.G., 1973, THE MINERAL INDUSTRY OF KENYA, TANZANIA, AND UGANDA, US BUREAU OF MINES, MINERALS YEARBOOK, VOL. 3, P. 533-54
Kenya	Kerio Valley	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & NYAMBO I.O., AND GACIRI, S.J., 1975, GEOLOGY OF THE FLUORITE DEPOSITS IN KERIO VALLEY, KENYA, ECONOMIC GEOLOGY, V. 70, NO. 2, P. 299.
Kenya	Kinyiki	DE KUN, N., 1987, MINERAL ECONOMICS OF AFRICA, DEVELOPMENTS OF ECONOMIC GEOLOGY, V. 22. & CGS METALLOGENIC MAP OF AFRICA
Kenya	Unknown	DU BOIS, C. G. B., 1966, MINERALS OF KENYA, GEOLOGICAL SURVEY OF KENYA, BULL. NO. 8, P. 123 & MILLER, J. M., 1956, GEOLOGY OF THE KITALE-CHERANGANI FILLS AREA, GEOLOGICAL SURVEY KENYA, REPORT NO. 35, NAIROBI, KENY

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	References
Kenya	Chawia	STEWART, A.L., 1963, GRAPHITE IN KENYA, MINISTRY OF NAT. RESOUR. GEOL. SURV. KENYA, BULL. NO. 6. & KRAUSS, U.H., SCHMITT, H.W., TAYLOR, H.A., JR., AND SUTPHIN, D.M., 1988, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT--NATURAL GRAPHITE: U.S. GEOLOGICAL SURVEY CIRCULAR 930-H, 29 P
Kenya	Oldoinyo-Nyiro	KRAUSS, U.H., SCHMITT, H.W., TAYLOR, H.A., JR. AND SUTHPHIN, D.M., 1988, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - NATURAL GRAPHITE, USGS, CIRC. 930-H
Kenya	Ikutha (Kitui district)	
Kenya	Kinangoni Hill	MINING MAGAZINE, APRIL, 1972, HIGHLIGHTS, P. 293. & WORLD MINING, MARCH, 1977, KENYA, P. 8
Kenya	Gilgia	PULFREY, W., 1956, MANGANESE DEPOSITS IN KENYA, INTERNATIONAL GEOLOGICAL CONGRESS, 20THM MEXICO, SYMPOSIUM ON MANGANES, V. 2, P. 197-201
Kenya	Ruri (Homa Mountain, Rangwa)	CLARKE, M.C.G., THE GEOLOGY OF THE SOUTHERN PART OF HOMA MOUNTAIN CARBONATITE COMPLEX, WESTERN KENYA, PH.D THESIS, UNIVERSITY OF LEICESTER, MARCH 1968. & FLEGG, A.M., THE GEOLOGY OF THE CARBONATITIC ROCKS OF THE NORTH O THE HOMA MOUNTAIN CARBONATITIC COMPLEX, WESTERN KENYA , IN LE BAS, J.M. (ED.), CARBONATITE-NEPHELINITE VOLCANISM AND AFRICAN CASE HISTORY WILEY-INTER-SCIENCE
Kenya	Magadi	MINING MAGAZINE, JAN., 1989, P. 52
Kenya	Lake Magadi	HARBEN, P.W. AND BATES, R.L., 1990, INDUSTRIAL MINERALS GEOLOGY AND WORLD DEPOSITS, INDUSTRIAL MINERALS DIVISION, METAL BULLETIN, LONDON. & MINING ANNUAL REVIEW 1990, P. 129
Kenya	Kwale	WILLIS, M., 2003, TI-MING IT RIGHT, INDUSTRIAL MINERALS, NO. 424, P. 40-45
Kenya	Mambrui	WILLIS, M., 2003, TI-MING IT RIGHT, INDUSTRIAL MINERALS, NO. 424, P. 40-45
Kenya	Sokoke	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
Lesotho	Letseng la Terai	RECKLING, K., HOY, R.B., DEREK, S.J.L., AND ROWEL, U.H., 1994, INDUSTRIAL DIAMOND, IN CAR, D.D. (ED.), INDUSTRIAL MINERALS AND ROCKS, 6TH ED., P. 379-395. & BLOOMER, A.G., AND NIXON, P.H., 1973, THE GEOLOGY OF LETSENG-LA TERAE KIMBERLITE PIPES, IN NIXON, P.H. (ED.), LESOTHO KIMBERLITES, P. 20-32, LESOTHO NATL. DEV. CORP
Liberia	Gboror's Creek	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P. 42
Liberia	Bea Mountain	ACP WEBSITE
Liberia	Bomi Hills	ACP WEBSITE & GRUSS, H., 1973, ITABIRITE IRON ORES OF LIBERIA AND GUYANA, IN GENESIS OF PRECAMBBIAN IRON AND MANGANESE DEPOSITS, EARTH SCIENCE, PARIS, FRANCE, NO. 9, P. 335-359
Liberia	Bong	RICHARDSON, N.R., JR., 1980, A BRIEF OUTLINE OF THE MINERAL OCCURRENCES OF LIBERIA, LIBERIAN GEOLOGICAL SURVEY, UN-NUMBERED REPORT, JULY, 1980
Liberia	Mano River	ACP WEBSITE & SUBAH, P., IRON ORE IN LIBERIA: PAST PRODUCTION AND FUTURE PROSPECTS, MINING MAGAZINE, V. 145, SEPTEMBER, 1981, PP 204-208
Liberia	Nimba (Nimba Mountains, Bitohn, Gbahm, Lamco mine, Yulitohn, Tokadeh, Western area)	BERGE, J.W., JOHANSSON, K., AND JACK, J., 1977, GEOLOGY AND ORIGIN OF THE HEMATITE ORES OF THE NIMBA RANGE, LIBERIA, ECONOMIC GEOLOGY, V. 72, P. 582-607. & CGS METALLOGENIC MAP OF AFRIC
Liberia	Wologisi (Wologosi)	ACP WEBSITE
Liberia	Yekepa	CGS METALLOGENIC MAP OF AFRICA
Libya	Al Qawasim	SALEM, M.J., AND BUSREWIL, M.T., (EDS.), GEOLOGY OF LIBYA, VOL. III, ACADEMIC PRES, LONDON, P. 993-110
Libya	Gargaresh	GOUDARZI, G.H., 1970, GEOLOGY AND MINERAL RESOURCES OF LIBYA - A RECONNAISSANCE, USGS PROF. PAPER 660. & SALEM, M.J., AND BUSREWIL, M.T., THE GEOLOGY OF LIBYA, VOL. III, P. 993-110
Libya	Bi'R Al Ghanam-Yafran	GOUDARZI, G.H., 1970, GEOLOGY AND MINERAL RESOURCES OF LIBYA - A RECONNAISSANCE, USGS PROF. PAPER 66
Libya	Wadi Ash Shatti	CGS METALLOGENIC MAP OF AFRICA & UNITED NATIONS, 1970, SURVEY OF WORLD IRON ORE RESOURCES—OCCURRENCE AND APPRAISAL: NEW YORK, NY, UNITED NATIONS, DEPT. OF ECONOMIC AND SOCIAL AFFAIRS, P. 64-66
Libya	Derna	DOLLEY, T., 1993, CHAPTER ON LIBYA, MINERALS YEARBOOK, U.S. BUREAU OF MINES
Libya	Homs	GOUDARZI, G.H., 1970, GEOLOGY AND MINERAL RESOURCES OF LIBYA - A RECONNAISSANCE, USGS PROF. PAPER 660. & SALEM, M.J., AND BUSREWIL, M.T., THE GEOLOGY OF LIBYA, VOL. III, P. 993-110
Libya	Bengasi	GOUDARZI, G.H., 1970, GEOLOGY AND MINERAL RESOURCES OF LIBYA - A RECONNAISSANCE, USGS PROF. PAPER 660.
Libya	Sardalas	GOUDARZI, G.H., 1970, GEOLOGY AND MINERAL RESOURCES OF LIBYA - A RECONNAISSANCE, USGS PROF. PAPER 660. & SALEM, M.J., AND BUSREWIL, M.T., THE GEOLOGY OF LIBYA, VOL. III, P. 993-110
Libya	Ghat	GOUDARZI, G.H., 1970, GEOLOGY AND MINERAL RESOURCES OF LIBYA - A RECONNAISSANCE, USGS PROF. PAPER 66
Libya	Mellaha	GOUDARZI, G.H., 1970, GEOLOGY AND MINERAL RESOURCES OF LIBYA - A RECONNAISSANCE, USGS PROF. PAPER 66
Libya	El Asruj (El Aswad)	BRITISH SULPHUR, LTD., 1985, WORLD SURVEY OF SULPHUR RESOURCES, 3RD ED., P. 157-158. & G.H. GOUDARZI, 1970, GEOLOGY AND MINERAL RESOURCES OF LIBYA-- A RECONNAISSANCE, USGS PROF. PAPER 660
Libya	Sebcha Kebirah	BRITISH SULPHUR, LTD., 1985, WORLD SURVEY OF SULPHUR RESOURCES, 3RD ED., P. 157-158. & G.H. GOUDARZI, 1970, GEOLOGY AND MINERAL RESOURCES OF LIBYA-- A RECONNAISSANCE, USGS PROF. PAPER 660
Madagascar	Andriamena	DEYOUNG, J.H, LEE, M.P., AND LIPIN, B.R., 1984, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT: CHROMIUM, U.S.G.S. CIRULAR 930-B. & MURDOCK, T.G., 1963, MINERAL RECOURCES OF THE MALAGASY REPUBLIC, U.S. BUREAU OF MINES, INF. CIRC. 8196, P. 74-76
Madagascar	Befandriana	WORLD MINING YEARBOOK, 1977, P. 151-152
Madagascar	Bemanevika	METALS SOURCEBOOK, OCT. 14, 1974, ITEM B4633. & WORLD MINING YEARBOOK, 1977, P. 151-15

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Madagascar	Majunga	
Madagascar	Ranomena	BESAIRIE, H., 1966, GITES MINERAUX DE MADAGASCAR, ANNALS OF THE GEOLOGY OF MADAGASCAR 34, P. 118-120. & CGS METALLOGENIC MAP OF AFRICA
Madagascar	Ambatomitamba	MURDOCK, T.G., 1963, MINERAL RECOURCES OF THE MALAGASY REPUBLIC, U.S. BUREAU OF MINES, INF. CIRC. 8196, P.119-120. & BESAIRIE, H., 1966, GITES MINERAUX DE MADAGASCAR, ANNALS OF THE GEOLOGY OF MADAGASCAR 34, P. 118-12
Madagascar	Ampangadiatany	MURDOCK, T.G., 1963, THE MINERAL RESOURCES OF THE MALAGASY REPUBLIC, U.S. BUREAU OF MINES, INF. CIRC. 8196, P. 121.
Madagascar	Andasifahatelo Mine	MURDOCK, T.G., 1963, MINERAL RECOURCES OF THE MALAGASY REPUBLIC, US DEPARTMENT OF THE INTERIOR, BUREAU OF MINES, INORMATION CIRC. 8196. & BESAIRIE, HENRI, 1966, GITES DE MINERAUX DE MADAGASCAR, FASCICULE XXXIV, VOLS. 1 & 2, TANANARIVE, MADAGASCAR, P. 187-216
Madagascar	Antsirakambo	MURDOCK, T.G., 1963, MINERAL RECOURCES OF THE MALAGASY REPUBLIC, U.S. BUREAU OF MINES, INF. CIRC. 819
Madagascar	Antsiribe	MURDOCK, T.G., 1963, THE MINERAL RESOURCES OF THE MALAGASY REPUBLIC, U.S. BUREAU OF MINES, INF. CIRC. 8196, P. 120.
Madagascar	Faliarano	MURDOCK, T.G., 1963, MINERAL RECOURCES OF THE MALAGASY REPUBLIC, US DEPARTMENT OF THE INTERIOR, BUREAU OF MINES, INORMATION CIRC. 8196. & BESAIRIE, HENRI, 1966, GITES DE MINERAUX DE MADAGASCAR, FASCICULE XXXIV, VOLS. 1 & 2, TANANARIVE, MADAGASCAR, P. 187-216
Madagascar	Marovinsky	MURDOCK, T.G., 1963, MINERAL RECOURCES OF THE MALAGASY REPUBLIC, US DEPARTMENT OF THE INTERIOR, BUREAU OF MINES, INORMATION CIRC. 8196. & BESAIRIE, HENRI, 1966, GITES DE MINERAUX DE MADAGASCAR, FASCICULE XXXIV, VOLS. 1 & 2, TANANARIVE, MADAGASCAR, P. 187-216
Madagascar	Perinet-Ambatovy area	BESAIRIE, H., 1956, CARTE MINIERE ET DES INDICES DE MADAGASCAR, (E'CHELLE 1/1,500,000), SERVICE GEOLOGIQUE, TANANARIVE. & RASOAMAHENINA, J.A., 1966, CONSIDERATIONS SUR LA GEOLOGIE GENERALE ET LES GISEMENTS DE GRAPHITE DE TAMATAVE ET MORAMANG
Madagascar	Sahamamy	BESAIRE, HENRI, GRAPHITE, IN GITES MINERAUX DE MADAGASCAR, ANNALS OF THE GEOLOGY OF MADAGASCAR 34, TANANARIVE, MADAGASCAR, P. 187-216. & CGS METALLOGENIC MAP OF AFRICA
Madagascar	Sahanavo	MURDOCK, T.G., 1963, MINERAL RECOURCES OF THE MALAGASY REPUBLIC, US DEPARTMENT OF THE INTERIOR, BUREAU OF MINES, INORMATION CIRC. 8196. & BESAIRIE, HENRI, 1966, GITES DE MINERAUX DE MADAGASCAR, FASCICULE XXXIV, VOLS. 1 & 2, TANANARIVE, MADAGASCAR, P. 187-216
Madagascar	Tamataue	
Madagascar	Tsaravoniany	BESAIRE, HENRI, GRAPHITE, IN GITES MINERAUX DE MADAGASCAR, ANNALS OF THE GEOLOGY OF MADAGASCAR 34, TANANARIVE, MADAGASCAR, P. 187-216. & CGS METALLOGENIC MAP OF AFRICA
Madagascar	Vatomandry	BESAIRIE, H., 1956, CARTE MINIERE ET DES INDICES DE MADAGASCAR, (E'CHELLE 1/1,500,000), SERVICE GEOLOGIQUE, TANANARIVE. & RASOAMAHENINA, J.A., 1966, CONSIDERATIONS SUR LA GEOLOGIE GENERALE ET LES GISEMENTS DE GRAPHITE DE TAMATAVE ET MORAMANG
Madagascar	Valozoro	MURDOCK, T.G., 1963, MINERAL RECOURCES OF THE MALAGASY REPUBLIC, US DEPARTMENT OF THE INTERIOR, BUREAU OF MINES, INORMATION CIRC. 8196. & BESAIRIE, HENRI, 1966, GITES DE MINERAUX DE MADAGASCAR, FASCICULE XXXIV, VOLS. 1 & 2, TANANARIVE, MADAGASCAR, P. 187-216
Madagascar	Ambatovy-Analamay	MURDOCK, T.G., 1963, MINERAL RECOURCES OF THE MALAGASY REPUBLIC, US DEPARTMENT OF THE INTERIOR, BUREAU OF MINES, INORMATION CIRC. 8196. & BESAIRIE, HENRI, 1966, GITES DE MINERAUX DE MADAGASCAR, FASCICULE XXXIV, VOLS. 1 & 2, TANANARIVE, MADAGASCAR, P. 187-216
Madagascar	Toalagnaro	MINING ANNUAL REVIEW, 1994, MADAGASCAR SECTION, P. 142
Madagascar	Toliara	
Madagascar	Fort Dauphin	GARNAR, T.E., AND STANAWAY, K.J., 1994, TITANIUM MINERALS, IN CARR, D.O. (ED.), INDUSTRIAL MINERALS AND ROCKS, 6TH ED. SOCIETY OF MINING METALLURGY EXPLORATION INC, LITTLETON CO, PP 1071–108
Madagascar	Pebane	TOWNER, R.R., GRAY, J.M., AND PORTER, L.M., 1988, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT—TITANIUM: U.S. GEOLOGICAL SURVEY CIRCULAR 930-G
Madagascar	Tamatave	TOWNER, R.R., GRAY, J.M., AND PORTER, L.M., 1988, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT—TITANIUM: U.S. GEOLOGICAL SURVEY CIRCULAR 930-G
Madagascar	Taolanaro	MINING MAGAZINE, JULY, 1986, DEVELOPMENT OF BEACH SAND DEPOSITS IN MADAGASCAR, P 11. & ADAMS, R., 1984, TITANIUM AND TITANIUM DIOXIDE, FINANCIAL TIMES INFORMATION LTD., LONDON, 244P
Malawi	Mokanji Mountain	PATTERSON, S.H., 1967, BAUXITE RESERVES AND POTENTIAL ALUMINUM RESOURCES OF THE WORLD, USGS BULLETIN 122
Malawi	Chilwa Island	CGS METALLOGENIC MAP OF AFRICA
Malawi	Chimwadzulu Hill	CGS METALLOGENIC MAP OF AFRICA
Malawi	Changalumi	NOTHOLT, A., 1990, MALAWI, IN CENTRAL AFRICA, MINING ANNUAL REVIEW, P. 129
Malawi	Kangankunde	JACKSON, W.D., AND CHRISTIANSEN, G., 1993, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - RARE-EARTH OXIDES, USGS CIRC. 930-N. & DE KUN, N., 1987, MINERAL ECONOMICS OF AFRICA, DEVELOPMENTS OF ECONOMIC GEOLOGY, V. 22

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Country	Deposit Name	References
Malawi	Tundulu	NOTHOLT, A., 1990, MALAWI, IN CENTRAL AFRICA, MINING ANNUAL REVIEW, P. 129. & DE KUN, N., 1987, MINERAL ECONOMICS OF AFRICA, NEW YORK, ELSEVIER
Mali	Western Mali Bauxites	MINING ANNUAL REVIEW, 1980, P. 533. & PATTERSON, S.H., 1967, BAUXITE RESERVES AND POTENTIAL ALUMINUM RESOURCES OF THE WORLD, USGS BULLETIN 1228
Mali	Syama-Tabakoroni Bagoe Region (Fourou, Sikasso)	MINING WEEKLY, JUNE 25, 1993, P. 6. & CGS METALLOGENIC MAP OF AFRIC
Mali	Sinsinkourou	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P. 78-7
Mali	Ansongo	ACP WEBSITE
Mauritania	Akjoujt (Guelb Moghrein)	MINING JOURNAL, OCT. 17, 1986, P. 290. & GOLD GAZETTE, 1995, V. 3, NO. 94, APRIL 10, 199
Mauritania	Akjoujt Tailings Project	
Mauritania	F'Derik (Zouerate District)	MINING MAGAZINE, JAN., 1987, P. 62. & MARELLE, ANDRE, 1970, IRON ORE DEPOSITS OF AFRICA, IN SURVEY OF WORLD IRON ORE RESOURCES—OCCURRENCE AND APPRAISAL, NEW YORK, NY, UNITED NATIONS, DEPT. OF ECONOMIC AND SOCIAL AFFAIRS, P. 63 79.
Mauritania	Guelb El Rhein (Zouerate District)	MINING MAGAZINE, THE GUELBS IRON ORE PROJECT IN MAURITANIA, FEB., 1979, P. 188. & MINING MAGAZINE, JAN., 1989, P. 49.
Mauritania	Rouessa (Zouerate District)	MINING MAGAZINE, JAN., 1987, P. 62. & MARELLE, A., 1970, IRON ORE DEPOSITS OF AFRICA, IN SURVEY OF WORLD IRON ORE RESOURCES, DEPARTMENT OF ECONOMICS AND SOCIAL AFFAIRS, UNITED NATIONS, NEW YORK, P. 63-79
Mauritania	Tazadit (Zouerate District)	MARELLE, ANDRE, 1970, IRON ORE DEPOSITS OF AFRICA, IN SURVEY OF WORLD IRON ORE RESOURCES—OCCURRENCE AND APPRAISAL, NEW YORK, NY, UNITED NATIONS, DEPT. OF ECONOMIC AND SOCIAL AFFAIRS, P. 63-79 & CGS METALLOGENIC MAP OF AFRICA
Mauritania	Bou Naga	
Morocco	Timerhdoudine	
Morocco	Tourtite	
Morocco	Jbel Irhoud (Ighoud)	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING CO., AMSTERDAM, P. 40
Morocco	Seksaoua	
Morocco	Tessaout	
Morocco	Tizi N'Tichka	PALLIX, G., 1978, BOU-AZZER, MORROCCO, THE MINERALOGICAL RECORD, V. 9, P. 69-73. & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P. 407
Morocco	Zelmou (Jbel Zarouk)	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & CGS METALLOGENIC MAP OF AFRICA
Morocco	Aghbar (Arhbar)	ANDREWS, R.W., 1962, COBALT-- OVERSEAS GEOLOGICAL SURVEYS: MINERAL RESOURCES DIVISION, HER MAJESTY'S STATIONERY OFFICE, LONDON
Morocco	Bou Azzer	ANDREWS, R.W., 1962, COBALT: OVERSEAS GEOLOGICAL SURVEYS, MINERAL RESOURCES DIVISION, LONDON, HER MAJESTY'S STATIONERY OFFICE, P. 143. & MINING JOURNAL, JUNE, 1993, P. 419
Morocco	Azegurazegour	
Morocco	Bou Skour	
Morocco	Diebel Klak	
Morocco	Ouansimi	
Morocco	Bleida	MINING MAGAZINE, JAN., 1989, P. 49 & LEBLANC, M. AND BILLAUD,P., A VOLCANO-SEDIMENTARY COPPER DEPOSIT ON A CONTINENTAL MARGIN OF UPPER PROTEROZOIC AGE; BLEIDA (ANTI-ATLAS, MOROCCO), ECONOMIC GEOLOGY, V. 73, NO. 6, P. 1101-1111.
Morocco	Djebel Tirremi	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P. 403-40
Morocco	El Hammam Area	FULTON, R.B., III, AND MONTGOMERY, G., 1994, FLUOUROSPAR, IN CARR, D.D. (ED.), INDUSTRIAL MINERALS AND ROCKS, 6TH ED., SOCIETY OF MINING, METALLURGY AND EXPLORATION, LITTLETON, COLORADO, P. 509-522. & DE KUN, N., 1987, MINERAL ECONOMICS OF AFRICA, DEVELOPMENTS OF ECONOMIC GEOLOGY, V. 22
Morocco	Taourirt	
Morocco	Tiouine	CGS METALLOGENIC MAP OF AFRICA
Morocco	Tiouit	
Morocco	Mohammedia	ROSKILL INFORMATION SERVICES, 1983, THE ECONOMICS OF SALT, 4TH ED., LONDON, ROSKILL INFORMATION SERVICE
Morocco	Mines Del Rif	MINING MAGAZINE, SEPT., 1976, TABLE B-1126, MINES ACCOUNTING FOR ALL OUTPUT OTHER THAN COA
Morocco	Aouli-Mibladen	INTERNATIONAL LEAD AND ZINC STUDY GROUP, LONDON, 1994, WORLD DIRECTORY: LEAD AND ZINC MINES AND PRIMARY METALLURGICAL WORKS.
Morocco	Zeida	STOWASSER, W.F., 1976, THE MINERAL INDUSTRY OF MOROCCO, US BUREAU OF MINES, MINERAL YEARBOOK, 1973, V. 3, P. 630. & MENZIE, W.D., AND MOSIER, D.L., 1985, GRADE, TONNAGE, AND LITHOLOGIC DATA FOR SEDIMENT-HOSTED SUBMARINE EXHALATIVE ZN-PB AND SANDSTONE-HOSTED PB-ZN DEPOSITS, USGS OPEN FILE REPORT 85-206
Morocco	Oued El Heimer Zellidja	MINING MAGAZINE, JAN., 1989, P. 49

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Morocco	Djebel Aouam	EMBERGER, A., 1968, SYNTHESE DESCRIPTIVE DES MINERALISATIONS PLOMBO-ZINCIFERES DU MAROC, ANN. MINES ET GEOL., TUNISIE, V. 23, P. 15-99. & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM.
Morocco	Bou Madine	ENGINEERING AND MINING JOURNAL, FEBRUARY 1982, P. 35 AND 39
Morocco	Douar Hajar	
Morocco	Sidi Lachen	MINING MAGAZINE, SEPT., 1982, P. 175. & MINING MAGAZINE, MAY, 1981, P. 40
Morocco	Bedaine	
Morocco	Aouli	EMBERGER, A., 1968, SYNTHESE DESCRIPTIVE DES MINERALISATIONS PLOMBO-ZINCIFERES DU MAROC, ANN. MINES ET GEOL., TUNISIE, V. 23, P. 15-99
Morocco	Sidi Lahcen	MINING MAGAZINE, JANUARY 1989, P. 49 & CGS METALLOGENIC MAP OF AFRIC
Morocco	Touissit - Bou Bekker	SAMSON, P., 1973, UN GISEMENT PLOMBO-ZINCIFERE EN MILIEU RECIFAL TOUISSIT (MAROC ORIENTAL), NOTES ET MEMOIRES DU SERVICE GEOL. MOROCCO, NO. 242. & CGS METALLOGENIC MAP OF AFRICA
Morocco	Aoufour	VINCIENNE, H., 1965, OBSERVATIONS GEOLOGIQUES SUR QUELQUES GITES MAROCAINES DE MANGANESE SYNGENETIQUE, XX. INT. GEOL. CONGR. MEXICO SYMP. YAC. MANGANESO, 2, P. 249-268
Morocco	Idikel	BOULADON, J., AND JOURAVSKY, G., 1956, LES GITES DE MANGANESE DU MAROC., 20TH INT. GEOL. CONGR., MANGANESE SYMP. 2 P. 217-248.
Morocco	Tiaratine	VINCIENNE, H., 1965, OBSERVATIONS GEOLOGIQUES SUR QUELQUES GITES MAROCAINES DE MANGANESE SYNGENETIQUE, XX. INT. GEOL. CONGR. MEXICO SYMP. YAC. MANGANESO, 2, P. 249-268
Morocco	Imini	INDUSTRIAL MINERALS, APRIL, 1978, VOL. 127, P. 57-59 & LESAVRE, A. 1975, LEGISEMENT DE MANGANESE D'IMINI (MAROC), THESIS, UNIVERSITE P & M CURIE, PARIS, FRANCE
Morocco	Tasdremt	CGS METALLOGENIC MAP OF AFRICA
Morocco	Daoui Nord	
Morocco	Khouribga (Oulad-Abdoun, Meraa-El-Arech, Sidi-Daoui)	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & CGS METALLOGENIC MAP OF AFRICA
Morocco	Merra El Arech	TODD, J.D., JULY, 1982, MOROCCO'S MAJOR PHOSPHATE DRIVE, ENGINEERING AND MINING JOURNAL, P. 35-37. & DEVOTO, R.H., AND STEVENS, D.N., 1979, URANIFEROUS PHOSPHATE RESOURCES AND TECHNOLOGY AND ECONOMICS OF URANIUM RECOVERY FROM PHOSPHATE RESOURCES, UNITED STATES AND FREE WORLD, EARTH SCIENCES INC., TECHNICAL REPORT GJBX-110(79)(VOL 1) GOLDEN COLORADO
Morocco	Meskala (Chichaoua)	KRAUSS, U.H., SAAM, H.G., AND SCHMIDT, H.W., 1984, INTERNATIONAL STRATEGIC MINERALS INVENTORY: SUMMARY REPORT--PHOSPHATE, USGS CIRCULAR 930-C. & CGS METALLOGENIC MAP OF AFRICA
Morocco	Youssoufia	MINING MAGAZINE, JAN., 1989, P. 49. & CGS METALLOGENIC MAP OF AFRIC
Morocco	Ben-Guerir	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC & BRITISH SULPHUR CORP. LTD., 1980, WORLD SURVEY OF PHOSPHATE DEPOSITS, 4TH ED., LONDON
Morocco	Sidi Daoui	KRAUSS, U.H., SAAM, H.G., AND SCHMIDT, H.W., 1984, INTERNATIONAL STRATEGIC MINERALS INVENTORY: SUMMARY REPORT--PHOSPHATE, USGS CIRCULAR 930-C & BRITISH SULPHUR CORP. LTD., 1980, WORLD SURVEY OF PHOSPHATE DEPOSITS, 4TH ED., LONDON.
Morocco	Bougaffer	
Morocco	Imiter	MINING MAGAZINE, JAN., 1989, P. 49
Morocco	Zgounder	MINING MAGAZINE, JAN., 1989, P. 49. & CGS METALLOGENIC MAP OF AFRICA
Morocco	Kettara	MINING MAGAZINE, JAN., 1989, P. 49. & CONNOR, K. 1986, US BUREAU OF MINES, MINERALS YEARBOOK, INTERNATIONAL AREA REPORTS, VOLUME 3, P. 599-608
Morocco	Taouz	EYSSAUTIER, L., 1952, L'INDUSTRIE MINIERE DU MOROC, NOTES ET MEMOIRES, MOROCCO SERVICE DES MINES ET DE LA CARTE GÉOLOGIQUE.
Mozambique	Mavita	CILEK, V.G., 1989, INDUSTRIAL MINERALS OF MOZAMBIQUE, CZECK GEOLOGICAL OFFICE SPECIAL PUBLICATION, PRAGU
Mozambique	Mundongwara (Mundonguara)	MINING MAGAZINE, JANUARY 1989, P. 49. & ACP WEBSITE
Mozambique	Macula	ACP WEBSITE & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM.
Mozambique	Montepuez	PRAST, W.G., 1990, MOZAMBIQUE, IN SOUTHERN AFRICA, MINING ANNUAL REVIEW, P. 117. & CILEK, V.G., 1989, INDUSTRIAL MINERALS OF MOZAMBIQUE, CZECK GEOLOGICAL OFFICE SPECIAL PUBLICATION, PRAGUE
Mozambique	Maridge	
Mozambique	Nanro	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM. & ACP WEBSIT
Mozambique	Nahora (Nahoza)	ACP WEBSITE & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM
Mozambique	Nahia	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM. & CGS METALLOGENIC MAP OF AFRICA
Mozambique	Marupine (Marropino)	
Mozambique	Muiane (Alto Ligonha)	ACP WEBSITE & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM

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Mozambique	Moebase (Moebane)	PREMOLI, C., 1994, INDUSTRIAL MINERALS IN ANGOLA AND MOZAMBIQUE - A MULTI-COUNTRY APPROACH, IN MATHERS, S.J., AND NOTHOLT, A.J.G., (EDS.), INDUSTRIALMINERALS IN DEVELOPING COUNTRIES, BRITISH GEOLOGICAL SURVEY AND ASSOCIATION OF GEOSCIENTISTS FOR INTERNATIONAL DEVELOPMENT (AGID) REPORT SERIES, GEOSCIENCES IN INTERNATIONAL DEVELOPMENT 18
Mozambique	Angoche Congolone	ACP WEBSITE & MINING JOURNAL, NOV. 3, 1989
Mozambique	Corridor Sands (Chibuto)	WILLIS, M., 2003, TI-MING IT RIGHT, INDUSTRIAL MINERALS, NO. 424, P. 40-45. & CGS METALLOGENIC MAP OF AFRIC
Mozambique	Quelemane (Quelimane, Zambezi Estuary, Quelemane-Quinga coastline)	HEDRICK, J.B., 1997, RARE EARTHS, USGS MINERALS YEARBOOK 1996. & ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
Mozambique	Congolone	WILLIS, M., 2003, TI-MING IT RIGHT, INDUSTRIAL MINERALS, NO. 424, P. 40-45. & MINING JOURNAL, 1989, ZIRCONIUM COMES OF AGE, V. 313, NO. 8045, P. 390
Mozambique	Moma (Namalope, Tupuito)	ACP WEBSITE
Namibia	Elbe Onganja	MINING JOURNAL, SEPT. 22, 1989, NAMIBIAN RETURN, P. 226. & MARTIN, H., 1965, THE PRECAMBRIAN GEOLOGY OF SOUTH WEST AFRICA & NAMAQUALAND, PRECAMBRIAN RESEARCH UNIT, UNIVERSITY OF CAPETOWN
Namibia	Gorob	GALLEY, A.G., HANNINGTON, M.D., AND JONASSON, I.R., 2007, VOLCANOGENIC MASSIVE SULFIDE DEPOSITS, in GOODFELLOW, W.D., ed., MINERAL DEPOSITS OF CANADA, GEOLOGIC ASSOC. OF CANADA, MINERAL DEPOSITS DIVISION, SPECIAL PUBLICATION NO. 5, P. 141-161.
Namibia	Haib River	MINING JOURNAL, JAN. 31, 1992, P.73-74. & METALS WEEK, JULY 28, 1992, P. 9
Namibia	Matchless	MINING MAGAZINE, JANUARY 1989, P. 49
Namibia	Tschudi	GOLD FIELDS NAMIBIA LTD., 1992 ANNUAL REPORT, P. 8
Namibia	Kobos	
Namibia	Kombat	PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON
Namibia	Tsumeb	PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON, P. 126-129. & CGS METALLOGENIC MAP OF AFRICA
Namibia	Klein Aub	HANDLEY, J.R.F., 1965, GENERAL GEOLOGICAL SUCCESSION ON THE FARM KLEIN AUB 350 AND ENVIRONS, REHOBOTH DISTRICT, SOUTH WEST AFRICA, TRANS. GEOL. SOC. SOUT AFRICA, V. 68, P. 211-224. & MINING MAGAZINE, JAN., 1987, P. 6
Namibia	Oamites (Kamzwas, Blanks)	LEE, J.E., AND GLENISTER, D.A., 1976, STRATIFORM SULFIDE MINERALIZATION OAMITES COPPER MINE, SOUTH WEST AFRICA, ECONOMIC GEOLOGY, V. 71, P. 369-383. & CGS METALLOGENIC MAP OF AFRIC
Namibia	Otjihase	COUSINS, C.A., AND VERMAAK, C.F., 1976, THE CONTRIBUTION OF SOUTH AFRICAN ORE DEPOSITS TO THE GEOCHEMISTRY OF THE PLATINUM-GROUP METALS, ECONOMIC GEOLOGY, V. 76, P. 287-305. & ACP WEBSIT
Namibia	Fluswa Kohero	GEOLOGIC MAP OF SOUTH WEST AFRICA, GOVERNMENT PRINTER, PRETORIA, 1963
Namibia	Marburg (Okorusu, Belvedere, Brandenburg)	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & INDUSTRIAL MINERALS, APRIL, 1993, NO. 307, P. 44
Namibia	Usakos	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
Namibia	Navachab	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
Namibia	Karibib	MINING JOURNAL, 1989, NAMIBIAN RETURN, V. 313, NO. 8038, P. 226
Namibia	Karibib District	ROERING, C. & GEVERS, T.W., 1964, LITHIUM- AND BERYLLIUM-BEARING PEGMATITES IN THE KARIBIB DISTRICT,SOUTH WEST AFRICA, IN HAUGHTON, S.H., (ED.), THE GEOLOGY OF SOME ORE DEPOSITS IN SOUTHERN AFRICA, 2, 463-495
Namibia	Tantalite Valley	MINING JOURNAL, 1989, NAMIBIAN RETURN, V. 313, NO. 8038, P. 226.
Namibia	Otjosondu (Otjosundu, Otjosondo, Otjisondu)	ROPER, H., 1956, THE MANGANESE DEPOSITS AT OTJOSONDU, SOUTH WEST AFRICA, IN SYMPOSIUM DEL MANGANESO, 20TH INTERNATIONAL GEOLOGICAL CONGRESS, MEXICO, 2. P. 115-122. & CGS METALLOGENIC MAP OF AFRIC
Namibia	Otjisazu	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
Namibia	Etaneno	JACKSON, W.D., AND CHRISTIANSEN, G., 1993, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - RARE-EARTH OXIDES, USGS CIRC. 930-N. & INDUSTRIAL MINERALS, NOV., 1989, P. 89
Namibia	Otjiwalundu (Otjivalunda)	MINING JOURNAL, 1989, NAMIBIAN RETURN, V. 313, NO. 8038, P. 226. & CGS METALLOGENIC MAP OF AFRIC
Namibia	Uis	MINING MAGAZINE, JAN., 1987, P. 62. & CGS METALLOGENIC MAP OF AFRICA
Namibia	Brandberg West	ACP WEBSITE & PELLETIER, 1965, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA
Namibia	Walvis Bay	MINING JOURNAL, OCT. 13, 1995, NAMIBIAN HEAVY MINERALS, P. 272
Namibia	Krantzberg	ACP WEBSITE & ENGINEERING AND MINING JOURNAL, 1974, INTERNATIONAL DIRECTORY OF MINING AND MINERAL PROCESSING OPERATIONS, 1973/1974, MCGRAW HILL, N.Y., 1974, P. 240
Namibia	Rossing (Roessing, Swakopmund)	BERNING, J., HIEMSUA, S.A., AND HOFFMAN, U., 1976, THE ROSSING URANIUM DEPOSIT, SOUTH WEST AFRICA, ECONOMIC GEOLOGY, V. 71, P. 351-368. & CGS METALLOGENIC MAP OF AFRIC
Namibia	Abenab	ACP WEBSITE & PELLETIER, 1965, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA.

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	References
Namibia	Rosh Pinah	PAGE, D. C., AND WATSON, M. D., 1976, THE PB-ZN DEPOSIT OF ROSH PINAH MINE, SOUTH WEST AFRICA, ECONOMIC GEOLOGY, V. 71, P. 306-327. & MENZIE, W.D., AND MOSIER, D.L., 1985, GRADE, TONNAGE, AND LITHOLOGIC DATA FOR SEDIMENT-HOSTED SUBMARINE EXHALATIVE ZN-PB AND SANDSTONE-HOSTED PB-ZN DEPOSITS, USGS OPEN FILE REPORT 85-206.
Namibia	Berg Aukas	PELLETIER, R. A., 1964, MINERAL RESOURCES OF SOUTH CENTRAL AFRICA & OXFORD U. PRESS, CAPETOWN. & PIRAJNO, F., & JOUBERT, B.D., 1993, AN OVERVIEW OF CARBONATE-HOSTED MINERAL DEPOSITS IN THE OTAVI MOUNTAIN LAND, NAMIBIA: IMPLICATIONS FOR ORE GENESIS, JOUR. AFRICAN EARTH SCI., V. 16, P. 265-272
Niger	Koma Bangou	CGS METALLOGENIC MAP OF AFRICA
Niger	Tapoa	DE KUN, N., 1987, MINERAL ECONOMICS OF AFRICA, DEVELOPMENTS OF ECONOMIC GEOLOGY, V. 22. & CGS METALLOGENIC MAP OF AFRICA
Niger	Arlit (Somair, Ariège, Arlette, Artois, Jonction Arlette/Artois, Tamou, Takriza)	MINING MAGAZINE, JAN., 1989, P. 49 & CGS METALLOGENIC MAP OF AFRICA
Nigeria	Udegi Odegi	ENGINEERING & MINING JOURNAL, 1978, INTL. DIRECTORY OF MINING AND MINERAL PROCESSING OPERATIONS, P. 32
Nigeria	Dsc, Warri	
Nigeria	Itakpe	ACP WEBSITE
Nigeria	Nkalagu	CGS METALLOGENIC MAP OF AFRICA
Nigeria	Amalgamated Tin	MINING MAGAZINE, SEPT., 1976, TABLE B-1126, MINES ACCOUNTING FOR ALL OUTPUT OTHER THAN COAL. & MINING MAGAZINE, JAN., 1989, P. 52
Nigeria	Bukuru (Jos)	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
Oman	Bayda	BATCHELOR, D.A.F., 1992, STYLES OF METALLIC MINERALIZATION AND THEIR TECTONIC SETTING IN THE SULTANATE OF OMAN, TRANS. INST. MIN.METALL., 101, B108-B120. & CGS METALLOGENIC MAP OF AFRICA
Oman	Lasail	
Rwanda	Somirwa	BERTOSSA, A., 1967, INVENTAIRE DES MINERAUX DU RWANDA, DU SERVICE GEOLOGIQUE, NO. 4, REPUBLIQUE RWANDAISE. & MINING MAGAZINE, JAN., 1989, P. 49
Saudi Arabia	Az Zubirah	COLLENETTE, P. AND GRAINGER, D.J., 1994, MINERAL RESOURCES OF SAUDI ARABIA, DIRECTORATE GENERAL OF MINERAL RESOURCES, SPECIAL PUBLICATION SP-2, 322P
Saudi Arabia	Ghurayyah	ORRIS, G.J., AND GRAUCH, R.I., 2002, RARE EARTH ELEMENT MINES, DEPOSITS, AND OCCURRENCES, USGS OPEN-FILE REPORT 02 189.
Saudi Arabia	Jabal Sayid	COLLENETTE, P. AND GRAINGER, D.J., 1994, MINERAL RESOURCES OF SAUDI ARABIA, DIRECTORATE GENERAL OF MINERAL RESOURCES, SPECIAL PUBLICATION SP-2, 322P
Saudi Arabia	Ad Duwayhi	COLLENETTE, P. AND GRAINGER, D.J., 1994, MINERAL RESOURCES OF SAUDI ARABIA, DIRECTORATE GENERAL OF MINERAL RESOURCES, SPECIAL PUBLICATION SP-2, 322P
Saudi Arabia	Bulgah	
Saudi Arabia	Sukhaybarat	COLLENETTE, P. AND GRAINGER, D.J., 1994, MINERAL RESOURCES OF SAUDI ARABIA, DIRECTORATE GENERAL OF MINERAL RESOURCES, SPECIAL PUBLICATION SP-2, 322P
Saudi Arabia	Al Hajar	COLLENETTE, P. AND GRAINGER, D.J., 1994, MINERAL RESOURCES OF SAUDI ARABIA, DIRECTORATE GENERAL OF MINERAL RESOURCES, SPECIAL PUBLICATION SP-2, 322P
Saudi Arabia	Al Amar	COLLENETTE, P. AND GRAINGER, D.J., 1994, MINERAL RESOURCES OF SAUDI ARABIA, DIRECTORATE GENERAL OF MINERAL RESOURCES, SPECIAL PUBLICATION SP-2, 322P
Saudi Arabia	Mahd Adh Dhahab	COLLENETTE, P. AND GRAINGER, D.J., 1994, MINERAL RESOURCES OF SAUDI ARABIA, DIRECTORATE GENERAL OF MINERAL RESOURCES, SPECIAL PUBLICATION SP-2, 322P
Saudi Arabia	Jizan 0677	COLLENETTE, P. AND GRAINGER, D.J., 1994, MINERAL RESOURCES OF SAUDI ARABIA, DIRECTORATE GENERAL OF MINERAL RESOURCES, SPECIAL PUBLICATION SP-2, 322P
Saudi Arabia	Wadi Sawawin	COLLENETTE, P. AND GRAINGER, D.J., 1994, MINERAL RESOURCES OF SAUDI ARABIA, DIRECTORATE GENERAL OF MINERAL RESOURCES, SPECIAL PUBLICATION SP-2, 322P
Saudi Arabia	Jabal Dhaylan 0335	COLLENETTE, P. AND GRAINGER, D.J., 1994, MINERAL RESOURCES OF SAUDI ARABIA, DIRECTORATE GENERAL OF MINERAL RESOURCES, SPECIAL PUBLICATION SP-2, 322P
Saudi Arabia	Al Amud	CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA, U.S.G.S. OPEN-FILE REPORT 02-0156A AND 02-0156
Saudi Arabia	Al Jalamid	CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA, U.S.G.S. OPEN-FILE REPORT 02-0156A AND 02-0156
Saudi Arabia	Thaniyat	CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA, U.S.G.S. OPEN-FILE REPORT 02-0156A AND 02-0156
Saudi Arabia	Umm Wu'al	NOTHOLT, A.J.G., 1994, PHOSPHATE ROCK IN DEVELOPING COUNTRIES: A REVIEW OF GEOLOGY, RESOURCES AND DEVELOPMENT, IN MATHERS, S.J., AND NOTHOLT, A.J.G. (EDS.), INDUSTRIAL MINERALS IN DEVELOPING COUNTRIES, AGID REPORT SERIES, GEOSCINECES IN INTL. DEVELOPMENT 18

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Saudi Arabia	Umm Wu'al Area	CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA, U.S.G.S. OPEN-FILE REPORT 02-0156A AND 02-0156
Saudi Arabia	Umm Wu'al North	CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA, U.S.G.S. OPEN-FILE REPORT 02-0156A AND 02-0156
Saudi Arabia	West Thaniyat	CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA, U.S.G.S. OPEN-FILE REPORT 02-0156A AND 02-0156
Saudi Arabia	Farasan Al Kabir South 0679	COLLENETTE, P. AND GRAINGER, D.J., 1994, MINERAL RESOURCES OF SAUDI ARABIA, DIRECTORATE GENERAL OF MINERAL RESOURCES, SPECIAL PUBLICATION SP-2, 322P
Saudi Arabia	Khnaiguiyah	COLLENETTE, P. AND GRAINGER, D.J., 1994, MINERAL RESOURCES OF SAUDI ARABIA, DIRECTORATE GENERAL OF MINERAL RESOURCES, SPECIAL PUBLICATION SP-2, 322P
Saudi Arabia	Al Masane	COLLENETTE, P. AND GRAINGER, D.J., 1994, MINERAL RESOURCES OF SAUDI ARABIA, DIRECTORATE GENERAL OF MINERAL RESOURCES, SPECIAL PUBLICATION SP-2, 322P
Saudi Arabia	Atlantis II Deep	COLLENETTE, P. AND GRAINGER, D.J., 1994, MINERAL RESOURCES OF SAUDI ARABIA, DIRECTORATE GENERAL OF MINERAL RESOURCES, SPECIAL PUBLICATION SP-2, 322P
Senegal	Sabodala	ACP WEBSITE
Senegal	Faleme	ACP WEBSITE & MAILLOT, R., THE FALEME IRON ORE PROJECT, MINING MAGAZINE, JULY, 1982, P. 50-5
Senegal	Lam Lam	CGS METALLOGENIC MAP OF AFRICA & MINING MAGAZINE, JANUARY 1989, P. 4
Senegal	Pallo Thies	ACP WEBSITE & BRITISH SULPHUR CORPORATION, 1980, WORLD SURVEY OF PHOSPHATE DEPOSITS
Senegal	Taiba (Tobene, Keur Mor Fall, N'Domor Giop)	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & CGS METALLOGENIC MAP OF AFRICA
Sierra Leone	Moyamba	MINERALS YEARBOOK, 1976, AREA REPORTS: INTERNATIONAL, VOL. III, US DEPT. OF INTERIOR, P. 920. & MINERALS YEARBOOK, 1978-79, AREA REPORTS: INTERNATIONAL, VOL. III, US DEPT. OF INTERIOR, P. 82
Sierra Leone	Port Loko	MINERALS YEARBOOK, 1976, AREA REPORTS: INTERNATIONAL, VOL. III, US DEPT. OF INTERIOR, P. 920. & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P. 301-30
Sierra Leone	Koidu	
Sierra Leone	Tongo	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & CGS METALLOGENIC MAP OF AFRICA
Sierra Leone	Yengema (Nimini Hills, Koidu)	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & CGS METALLOGENIC MAP OF AFRICA
Sierra Leone	Marampa	ACP WEBSITE
Sierra Leone	Dalakaru-Worowaia (Dalakuru)	TOOMBS, J.S., ELLIOT, I. AND MATHER, A., 1965, SECONDARY DISPERSION OF MOLYBDENUM FROM MINERALIZATION, SIERRA LEONA, ECONOMIC GEOLOGY, V. 60, P. 1478-149 & CGS METALLOGENIC MAP OF AFRICA
Sierra Leone	Alako Water	POLETT, J.D., 1951, THE GEOLOGY AND MINERAL RESOURCES OF SIERRA LEONE, COLONIAL GEOLOGY AND MINERAL RESOURCES, V. 2, NO. 1, P.13
Sierra Leone	Babadori Stream	
Sierra Leone	Big Water	CGS METALLOGENIC MAP OF AFRICA & POLLET, J.D., 1931, PLATINUM MINING IN SIERRA LEONE, ENGINEERING MINING WORLD 2, P. 407
Sierra Leone	Freetown Layered Basic Complex Placers.	WELLS, M.K., 1962, GEOL. SURV. DEPT. SIERRA LEONE, SHORT PAPER NO. 9 (BULL. OVERSEAS GEOL. MIN. RES. SUPPL. NO. 4) & POLLETT, J.D., 1951, COLON. GEOL. MIN. RESOURCES, V. 2, NO. 1, P. 3-28
Sierra Leone	Glinda Water	POLLET, J.D., 1931, PLATINUM MINING IN SIERRA LEONE, ENGINEERING MINING WORLD 2, P. 74
Sierra Leone	Guma Water	POLLET, J.D., 1931, PLATINUM MINING IN SIERRA LEONE, ENGINEERING MINING WORLD 2, P. 74
Sierra Leone	Mogbwemo (Pejebu, Lanti, Gveni, Sembeh)	MINING MAGAZINE, MAR. 1994, V. 170, NO. 3, P. 178. & INDUSTRIAL MINERALS, FEB., 1994, NO. 317, P. 7
Sierra Leone	Sierra Rutile	LYND, L.E., 1985, TITANIUM IN MINERAL FACTS AND PROBLEMS, US BUREAU OF MINES, BULLETIN 675, P. 859-880. & ACP WEBSITE
Sierra Leone	Gbangbama-Mogbwemo	TOWNER, R.R., GRAY, J.M., AND PORTER, L.M., 1988, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT—TITANIUM: U.S. GEOLOGICAL SURVEY CIRCULAR 930-G
Sierra Leone	Rotifunk	ACP WEBSITE
Somalia	Darreh Hos	HUNT, J.A., 1958, GEOLOGY OF THE ADADLEH AREA, HARGEISA AND BERBERA DISTRICTS, SOMALILAND BRITISH PROTECTORATE GEOLOGICAL SURVEY, REPORT NO. 2
Somalia	Mur Bakayale	MASON, J.E., 1962, GEOLOGY OF THE AREA NORTH OF HARGEISA AND LAFERUG & HARGEISA AND BERBERA DISTRICTS: SOMALIA GEOLOGICAL SURVEY REPORT NO. 7, 34 P
Somalia	Mait Island Guano	HUNT, J. A., 1951, A GENERAL SURVEY OF THE SOMALILAND PROTECTORATE 1944-1950, LONDON AND DUNSTABLE, WATERLOW AND SONS.
Somalia	Dalan	CGS METALLOGENIC MAP OF AFRICA & GREENWOOD, J.E.G.W., 1960, REPORT ON THE GEOLOGY OF THE LAS KHOREH-ELAYU AREA, ERIGAVO DISTRICT, SOMALILAND PROTECT., GEOL. SURV. REP. 3
South Africa	Consolidated Murchison Gravelotte	
South Africa	Consolidated Murchinson	PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON
South Africa	African Chrysotilediepgezet	

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	References
South Africa	Amianthus	
South Africa	Bridgewaterzoutpansberg	
South Africa	Bute	MANOS, A., NOV., 1977, THE INDUSTRIAL MINERALS OF SOUTH AFRICA, INDUSTRIAL MINERALS, NO. 122, P. 16-6
South Africa	Danielskuil	HARBEN, P.W., AND BATES, R.L., 1984, ASBESTOS, IN GEOLOGY OF THE NONMETALLICS, METAL BULLETIN INC., NEW YORK, P. 324-335 & MANOS, A., NOV., 1977, THE INDUSTRIAL MINERALS OF SOUTH AFRICA, INDUSTRIAL MINERALS, NO. 122, P. 16-6
South Africa	Elcor	
South Africa	Emmarentia	CORIN, E.R., JAN., 1977, MINERALS MARKETING INFORMATION, NON-METALLIC MINES IN SOUTH AFRICA, MINERALS BUREAU OF SOUTH AFRICA DEPT.OF MINES, BRAAMFONTEIN
South Africa	Klipfontien	
South Africa	Koegaswesterberg	DREYER, C.J.B., AND ROBINSON, H.A., 1981, OCCURRENCE AND EXPLORATION OF AMPHIBOLE ASBESTOS IN SOUTH AFRICA, IN RIORDAN, P.H., (ED.), GEOLOGY OF ASBESTOS DEPOSITS, NEW YORK, SOCIETY OF MINING ENGINEERS INC
South Africa	Kuruman Field	DREYER, C.J.B., AND ROBINSON, H.A., 1981, OCCURRENCE AND EXPLORATION OF AMPHIBOLE ASBESTOS IN SOUTH AFRICA, IN RIORDAN, P.H., (ED.), GEOLOGY OF ASBESTOS DEPOSITS: NEW YORK, SOCIETY OF MINING ENGINEERS OF THE AMERICAN INSTITUTE OF MINING, MET & DMA SERIES 1501.SHEET SG 34-16.SCALE 1:250,000. | LIST OF OPERATING MINING CONCERNS IN THE REPUBLIC OF SOUTH | AFRICA AS OF 1ST JANUARY,1976.GOVT.MINING ENGINEER.BOX | 1132 JOHANNESBURG,S.A. | MINERAL BUREAU S A DEPT OF MINES MINERALS MARKE
South Africa	Msauli	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON
South Africa	Penge	HARBEN, P.W., AND BATES, R.L., 1984, ASBESTOS, IN GEOLOGY OF THE NONMETALLICS, METAL BULLETIN INC., NEW YORK, P. 324-335. & DREYER, C.J.B., AND ROBINSON, H.A., 1981, OCCURRENCE AND EXPLOITATION OF AMPHIBOLE ASBESTOS IN SOUTH AFRICA IN RIORDON, P.H. (ED.), GEOLOGY OF ASBESTOS DEPOSITS, SOCIETY OF MINING ENGINEERS INC., NEW YORK, P. 25-44.
South Africa	Pomfret	HARBEN, P.W., AND BATES, R.L., 1984, ASBESTOS, IN GEOLOGY OF THE NONMETALLICS, METAL BULLETIN INC., NEW YORK, P. 324-335. & DREYER, C.J.B., AND ROBINSON, H.A., 1981, OCCURRENCE AND EXPLOITATION OF AMPHIBOLE ASBESTOS IN SOUTH AFRICA IN RIORDON, P.H. (ED.), GEOLOGY OF ASBESTOS DEPOSITS, SOCIETY OF MINING ENGINEERS INC., NEW YORK, P. 25-44.
South Africa	Riries	
South Africa	Senekal	SOUTH AFRICA DEPT. OF MINES, 1976, LIST OF OPERATING CONCERNS IN THE REP. OF SOUTH AFRICA, AS RECORDED BY THE GOVT.MINING ENGINEER ON THE 1ST JANUARY, 1976, GOVT. MINING ENGINEER, JOHANNESBURG, P. 27. & CGS METALLOGENIC MAP OF AFRICA
South Africa	Stella	ENGINEERING AND MINING JOURNAL, 1978, INTL. DIRECTORY OF MINING AND MINERAL PROCESSING OPERATIONS, MCGRAW HILL, NY, P. 27 AND 336
South Africa	Wandrag	
South Africa	Whitebank	
South Africa	Bathlako	MCDONALD, J.A., 1967, EVOLUTION OF PART OF THE LOWER CRITICAL ZONE, FARM RUIGHOEK, WESTERN BUSHVELD, JOURNAL OF PETROLOGY, V. 8, PART 2. & SILK, M.H., 1988, WORLD CHROMITE RESOUCES AND FERROCHROMIUM PRODUCTION, COUNCIL FOR MINING TECHNOLOGY, RANDBURG, SOUTH AFRICA
South Africa	Chroombronne	SILK, M.H., 1988, WORLD CHROMITE RESOUCES AND FERROCHROMIUM PRODUCTION, COUNCIL FOR MINING TECHNOLOGY, RANDBURG, SOUTH AFRICA.
South Africa	Dilokong	MINING MAGAZINE, JAN., 1989, P. 49
South Africa	Eastern Bushveld: Steelpoort Sector	VERMAAK, C.F., 1986, SUMMARY ASPECTS OF THE ECONOMICS OF CHROMIUM WITH SPECIAL REFERENCE TO SOUTHERN AFRICA, IN ANHAEUSSER, C.R., AND MASKE, S., (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, JOHANNESBURG, THE GEOLOGICAL SOCIETY OF SOUTH AFRICA, P. 1155-1181.& VON GRUENEWALDT, G., 1977, THE MINERAL RESOURCES OF THE BUSHVELD COMPLEX MINERALS SCIENCE AND ENGINEERING V 9 NO 2 P 83-95
South Africa	Grasvally	HULBERT, L.J., AND VON GRUENEWALDT, G., 1986, THE STRUCTURE AND PETROLOGY OF THE UPPER AND LOWER CHROMITITE LAYERS ON THE FARMS GRASVALLY AND ZOETVELD, SOUTH OF POTGIETERSRUS, IN ANHAEUSSER, C.R., AND MASKE, S. (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, GEOLOGICAL SOCIETY OF SOUTH AFRICA
South Africa	Grootboom	MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA, FIFTH EDITION, HANDBOOK 7 , DEPARTMENT OF MINES, GEOLOGICAL SURVEY, 1976. & CAMERON, E.N., AND DESBOROUGH, G.A., 1966, OCCURRENCE AND CHARACTERISTICS OF CHROMITE DEPOSITS, EASTERN BUSHVELD COMPLEX, IN MAGMATIC ORE DEPOSITS, ECONOMIC GEOLOGY, MONOGRAPH 4
South Africa	Kafferskraal 214	ACP WEBSITE
South Africa	Mankwe-Bafokeng Sector	VERMAAK, C.F., 1986, SUMMARY ASPECTS OF THE ECONOMICS OF CHROMIUM WITH SPECIAL REFERENCE TO SOUTHERN AFRICA, IN ANHAEUSSER, C.R., AND MASKE, S., (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, JOHANNESBURG, THE GEOLOGICAL SOCIETY OF SOUTH AFRICA, P. 1155-1181.& VON GRUENEWALDT, G., 1977, THE MINERAL RESOURCES OF THE BUSHVELD COMPLEX MINERALS SCIENCE AND ENGINEERING V 9 NO 2 P 83-95
South Africa	Millsell	MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA, FIFTH EDITION, HANDBOOK 7 , DEPARTMENT OF MINES, GEOLOGICAL SURVEY, 1976. & SILK, M.H., 1988, WORLD CHROMITE RESOUCES AND FERROCHROMIUM PRODUCTION, COUNCIL FOR MINING TECHNOLOGY, RANDBURG, SOUTH AFRICA.

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	References
South Africa	Montrose Hendriksplaats	HECKROODT, R.O., 1959, THE GEOLOGY AROUND THE DUNITE PIPE ON DRIEKOP (EASTERN TRANSVAAL), TRANSACTIONS OF THE GEOLOGICAL SOCIETY OF SOUTH AFRICA, V. 62, P. 59-73
South Africa	Mooinooi	SKILLEN, A., JUNE, 1995, WELCOME TO THE NEW SOUTH AFRICA, INDUSTRIAL MINERALS, P. 25-53. & ENGINEERING AND MINING JOURNAL, 1978, INTERNATIONAL DIRECTORY OF MINING AND MINERAL PROCESSING OPERATIONS, MCGRAW HILL, NEW YORK, P. 337.
South Africa	Nietverdiend-Lehurutshe Sector	VERMAAK, C.F., 1986, SUMMARY ASPECTS OF THE ECONOMICS OF CHROMIUM WITH SPECIAL REFERENCE TO SOUTHERN AFRICA, IN ANHAEUSSER, C.R., AND MASKE, S., (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, JOHANNESBURG, THE GEOLOGICAL SOCIETY OF SOUTH AFRICA, P. 1155-1181.& VON GRUENEWALDT, G., 1977, THE MINERAL RESOURCES OF THE BUSHVELD COMPLEX MINERALS SCIENCE AND ENGINEERING V 9 NO 2 P 83-95
South Africa	Nietverdiend-Marico Sector	VERMAAK, C.F., 1986, SUMMARY ASPECTS OF THE ECONOMICS OF CHROMIUM WITH SPECIAL REFERENCE TO SOUTHERN AFRICA, IN ANHAEUSSER, C.R., AND MASKE, S., (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, JOHANNESBURG, THE GEOLOGICAL SOCIETY OF SOUTH AFRICA, P. 1155-1181.& VON GRUENEWALDT, G., 1977, THE MINERAL RESOURCES OF THE BUSHVELD COMPLEX MINERALS SCIENCE AND ENGINEERING V 9 NO 2 P 83-95
South Africa	Ntuane	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA, P. 195. & BUCHANAN, D.L., 1979, CHROMITE PRODUCTION FROM THE BUSHVELD COMPLEX AND ITS RELATIONSHIP TO THE FERROCHROMIUM INDUSTRY, WORLD MINING, V. 32, NO. 10, P. 9
South Africa	Potgietersrus Sector	VERMAAK, C.F., 1986, SUMMARY ASPECTS OF THE ECONOMICS OF CHROMIUM WITH SPECIAL REFERENCE TO SOUTHERN AFRICA, IN ANHAEUSSER, C.R., AND MASKE, S., (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, JOHANNESBURG, THE GEOLOGICAL SOCIETY OF SOUTH AFRICA, P. 1155-1181.& VON GRUENEWALDT, G., 1977, THE MINERAL RESOURCES OF THE BUSHVELD COMPLEX MINERALS SCIENCE AND ENGINEERING V 9 NO 2 P 83-95
South Africa	Ruighoek	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA, P. 195
South Africa	Waterkop	
South Africa	Winterveld	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA, P. 195
South Africa	Zwartkop (Zwartklip, Langran, Elandskool)	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA, P. 195. & ACP WEBSIT
South Africa	Groothoek	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA, P. 195. & ANON., 1976, EXPANSION OF GOOTHOEK, COAL, GOLD AND BAS MINERALS OF SOUTH AFRICA, OCT. 1976, P. 23-25
South Africa	Henry Gould	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA, P. 117-122
South Africa	Jagdlust	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA. & CAMERON, E., CHROMITE DEPOSITS OF THE EASTERN PART OF THE BUSHVELD COMPLEX, IN HAUGHTON, S.H. (ED.), THE GEOLOGY OF SOME ORE DEPOSITS OF SOUTHERN AFRICA, V. 2, GEOLOGICAL SOCIETY OF SOUTH AFRICA P 136-168
South Africa	Kroondal (Booekenhoutfontein, Bultfontein, Rietfontein)	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA
South Africa	Marico	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA, P. 117-122. & MACGREGOR B I, A REFRACTORY CHROME ORE DEPOSIT IN THE GROOT MARICO DISTRICT, TRANSVAAL, IN HAUGHTON, S.H. (ED.), THE GEOLOGY OF SOME ORE DEPOSITS OF SOUTHERN AFRICA V 2 GEOLOGICAL SOCIETY OF SOUTH AFRICA P 203-207
South Africa	Waterkloof	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA. & FOURIE, G.P., 1959, THE CHROMITE DEPOSITS IN THE RUSTENBERG AREA, GEOLOGICAL SURVEY OF SOUTH AFRICA, BULLETIN 27
South Africa	Zeerust	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA, P. 117-122. & FOURIE, G.P., 1959, THE CHROMITE DEPOSITS IN THE RUSTENBERG AREA, GEOLOGICAL SURVEY OF SOUTH AFRICA, BULLETIN 27
South Africa	Dorst Land 768	WAGNER, P.A., 1929, THE PLATINUM DEPOSITS AND MINES OF SOUTH AFRICA, CAPE TOWN, C. STRUIK, 1973 (3RD ED.). & VON GRUENEWALDT, G., 1977, THE MINERAL RESOURCES OF THE BUSHVELD COMPLEX, MINERALS, SCIENCE AND ENGINEERING, V. 9, NO. 2, P. 83-95.
South Africa	Tweefontein	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
South Africa	Piet Retief Witkop 507	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA, P. 195. & CGS METALLOGENIC MAP OF AFRIC
South Africa	Campbell	VAN GRAAN, S.G., 1964, GEOLOGY OF THE MESSINA COPPER DEPOSIT, IN HAUGHTON, S.H. (ED.), THE GEOLOGY OF SOME ORE DEPOSITS OF SOUTHERN AFRICA, V. II, GEOLOGICAL SOCIETY OF SOUTH AFRICA

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	References
South Africa	Harper	VAN GRAAN, S.G., 1964, GEOLOGY OF THE MESSINA COPPER DEPOSIT, IN HAUGHTON, S.H. (ED.), THE GEOLOGY OF SOME ORE DEPOSITS OF SOUTHERN AFRICA, V. II, GEOLOGICAL SOCIETY OF SOUTH AFRICA & SÖHNGE, P.G., 1946, THE GEOLOGY OF THE MESSINA COPPER MINES AND SURROUNDING COUNTRY, GEOLOGICAL SURVEY OF THE UNION OF SOUTH AFRICA, MEMOIR 40, P. 122-126 AND 145-147
South Africa	Northern Transvaal Messina Copper Exploration Co	WAGNER, P.A., 1929, THE PLATINUM DEPOSITS AND MINES OF SOUTH AFRICA, CAPE TOWN, C. STRUIK, 1973 (3RD ED.), P. 3
South Africa	O'Okiep	PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON.
South Africa	Messina	MINING MAGAZINE, JUNE, 1974, ANNUAL REVIEW, P. 337. & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICAN INST. MINING METALL. JOURNAL, V. 73, P. 184-199
South Africa	Artonvilla	MIHALIK, P., JACOBSEN, J.B.E., AND HIEMSTRA, S.A., 1974, ECONOMIC GEOLOGY, V. 69, P. 257 - 262 & VAN GRAAN, S.G., 1964, GEOLOGY OF THE MESSINA COPPER DEPOSIT, IN HAUGHTON, S.H. (ED.), THE GEOLOGY OF SOME ORE DEPOSITS OF SOUTHERN AFRICA, V. II, GEOLOGICAL SOCIETY OF SOUTH AFRICA, P. 303 - 314
South Africa	Prieska	WORLD MINING, FEB., 1972, P. 40-43. & MIDDLETON, R.C., 1976, THE GEOLOGY OF PRIESKA COPPER MINES LIMITED, ECONOMIC GEOLOGY, V. 71, P. 328-350.
South Africa	Belgravia	ACP WEBSITE
South Africa	Bultfontein	PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON. & WILSON, A. N., 1971, MAKING SYNTHETIC GEM DIAMONDS - THE ALCHEMISTS DREAM, INTERNATIONAL DIAMOND ANNUAL, NO. 1, P. 164-16
South Africa	De Beers	PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON. & WILSON, A. N., 1971, MAKING SYNTHETIC GEM DIAMONDS - THE ALCHEMISTS DREAM, INTERNATIONAL DIAMOND ANNUAL, NO. 1, P. 164-16
South Africa	Dreiyers Pan (Annex Klein Zee)	ACP WEBSITE & PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON
South Africa	Dutoitspan	ACP WEBSITE & PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON
South Africa	Finsch	PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON. & RECKLING, K., HOY, R.B., DEREK, S.J.L., AND ROWEL, U.H., 1994, INDUSTRIAL DIAMOND, IN CAR, D.D. (ED.), INDUSTRIAL MINERALS AND ROCKS, 6TH ED., P. 379-395.
South Africa	Koffiefontein	PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON. & WILSON, A. N., 1971, MAKING SYNTHETIC GEM DIAMONDS - THE ALCHEMISTS DREAM, INTERNATIONAL DIAMOND ANNUAL, NO. 1, P. 164-16
South Africa	Koingnaas (Hondeklip Bay, Namaqualand Diamond Mines)	ACP WEBSITE & PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON.
South Africa	Middlepunt	MINING JOURNAL, 1969 , MIDDLEPUNT PT, V. 272 , P. 548. & MINING JOURNAL, 1969 , KLOCKNER'S PT PROSPECT, V. 273 , P. 541.
South Africa	Premier	PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON. & CGS METALLOGENIC MAP OF AFRICA
South Africa	Roodepoort	
South Africa	Star	ACP WEBSITE & PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON
South Africa	Uitvalgrond	ACP WEBSITE & COETZEE,C.B.,ED., 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA, HANDBOOK NO.7, 5TH ED., GEOL.SURV.OF S.A.
South Africa	Venetia (K1 Pipe)	RECKLING, K., HOY, R.B., DEREK, S.J.L., AND ROWEL, U.H., 1994, INDUSTRIAL DIAMOND, IN CAR, D.D. (ED.), INDUSTRIAL MINERALS AND ROCKS, 6TH ED., P. 379-395. & CGS METALLOGENIC MAP OF AFRICA
South Africa	Welgevonden	ACP WEBSITE
South Africa	Wesselton	PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON
South Africa	Kromdraai	CROCKER, I.T., 1977, FLUORITE DEPOSITS ON KROMDRAAI 209 JR (THE VERGENOEG FLUORITE MINE) AND NAAUPOORT 208 JR TRANSVAAL, GEOLOGICAL SURVEY, DEPT. OF MINERAL AND ENERGY AFFAIRS, REPUBLIC OF SOUTH AFRICA. & CHERMETTE, A., 1973, SPATH-FLUOR: PERSPECTIVES FRANCAIS ET INTERNATIONALES, METAL SERVICE, PARIS
South Africa	Kruidfontein	
South Africa	Rhenosterfontein	KENT, L.E., RUSSE, H.D., AND VAN ROOYEN, D.P., 1943, FLUORSPAR IN THE UNION OF SOUTH AFRICA AND SOUTH WEST AFRICA,.GEOL. SURV. OF SOUTH AFRICA, BULLETIN 14
South Africa	Saflor	KENT, L.E., RUSSE, H.D., AND VAN ROOYEN, D.P., 1943, FLUORSPAR IN THE UNION OF SOUTH AFRICA AND SOUTH WEST AFRICA,.GEOL. SURV. OF SOUTH AFRICA, BULLETIN 14, P. 22-26
South Africa	Slipfontein-Ruigtepoort	KENT, L.E., RUSSE, H.D., AND VAN ROOYEN, D.P., 1943, FLUORSPAR IN THE UNION OF SOUTH AFRICA AND SOUTH WEST AFRICA,.GEOL. SURV. OF SOUTH AFRICA, BULLETIN 14, P. 26-30. & CGS METALLOGENIC MAP OF AFRICA
South Africa	Transvaal Fluorspar	
South Africa	Van Den Heever	GOSSLING, H.H., 1978, FLUORSPAR, 1973–1980: A COMMODITY PROFILE, REPORT NO. 3, MINERAL BUREAU, DEPT. OF MINES, REPUBLIC OF SOUTH AFRICA.
South Africa	Witkop (Oog van Malmanie, Buffelshoek)	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & ACP WEBSITE
South Africa	Zwartkloof	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
South Africa	Vergenoeg (Rust de Winter, Kromdraai)	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & ACP WEBSITE

Table 2. Principal mineral deposits of Africa and the Middle East

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South Africa	Marico District	MARTINI, J.E.J., 1975, THE FLUORITE DEPOSITS IN THE DOLOMITE SERIES OF THE MARICO DISTRICT, TRANSVAAL, SOUTH AFRICA, ECONOMIC GEOLOGY, V. 71, P. 625-635 & KENT, L.E., RUSSE, H.D., AND VAN ROOYEN, D.P., 1943, FLUORSPAR IN THE UNION OF SOUTH AFRICA AND SOUTH WEST AFRICA,.GEOL. SURV. OF SOUTH AFRICA, BULLETIN 14
South Africa	Buffalo	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & GROGAN, R.M., CUNNINGHAM-DUNLOP, P.K., BARTLETT, H.F., AND CZEL, L.J., 1974, THE ENVIRONMENTS OF DEPOSITION OF FLUORSPAR, IN A SYMPOSIUM ON THE GEOLOGY OF FLUOROSPAR, PROCEEDINGS OF THE NINTH FORUM ON GEOLOGY OF INDUSTRIAL MINERALS V 22 P 4
South Africa	Barbrook	ACP WEBSITE
South Africa	Benoni	ACP WEBSITE
South Africa	Boksburg	INTERNATIONAL DIRECTORY OF MINING AND MINERAL PROCESSING OPERATIONS, 1979, ENGINEERING AND MINING JOURNAL, MCGRAW HILL, NEW YORK, NY, P. 335
South Africa	Caritonville	
South Africa	East Rand Egoli Consolidated	
South Africa	Erfdeel-Dankbaarheidfreegold S.	ANHAEUSSER, C.R. 1976, THE NATURE AND DISTRIBUTION OF ARCHAEN GOLD MINERALIZATION IN SOUTHERN AFRICA, MINERALS SCI. ENG., V. 8, NO. 1, PP. 46-84. & BOYLE, R.W., 1979, THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS, GEOL. SURV. OF CANADA, BULLETIN 280.
South Africa	H.J.Joel	ACP WEBSITE
South Africa	Jurgenshof	WORLD MINING, RAPID PROGRESS REPORTED AT NEW GOLD MINES, JAN., 1975, P.31. & METALS SOURCEBOOK, ITEM B5412, DEC. 9, 1974.
South Africa	Knights	ACP WEBSITE
South Africa	Orange Free State	CGS METALLOGENIC MAP OF AFRICA
South Africa	Poortje Section	
South Africa	South Deep	MINING JOURNAL, OCT. 1, 1993, P. 228. & ACP WEBSITE
South Africa	Village Main Reef	PARK, C.E., AND MACDIARMID, R.A., 1970 , ORE DEPOSITS, W.H. FREEMAN AND CO., SAN FRANCISCO, P. 441 & MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 4
South Africa	West Wits Egoli Consolidated	CGS METALLOGENIC MAP OF AFRICA
South Africa	Murchison	COUSINS AND VERMAAK, 1976, THE CONTRIBUTION OF SOUTHERN AFRICAN ORE TO THE GEOCHEMISTRY OF THE PLATINUM GROUP METALS, ECONOMIC GEOLOGY, V. 71, P. 287-305. & GEOLOGICAL MAP OF THE REPUBLIC OF SOUTH AFRICA AND THE KINGDOMS OF LESOTHO AND SWAZILAND, WITH EXPLANATION AND LIST OF WORKING MINES. 3RD EDITION: SPECIAL PUBLICATION NO 18 1970
South Africa	Brakpan	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Luipaardsvlei	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Modderfontein	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	New Modder	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Nourse	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Orion (Minerva, Meyer, Black Reef, Cornucopia	ACP WEBSITE & WAGNER, 1929, PLATINUM DEPOSITS AND MINES IN SOUTH AFRICA
South Africa	Rietfontein	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Robinson Deep	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Rose Deep	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Venterspost	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.

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South Africa	West Driefontein	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	Wit G. M.	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Van Ryn Deep	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Agnes (E. T. Cons)	MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA, FIFTH EDITION, HANDBOOK 7 , DEPARTMENT OF MINES, GEOLOGICAL SURVEY, 1976.
South Africa	Crown (City Deep, Cons. Main Reef)	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	Dagga	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Durban Deep	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48. & TOOMBS, R.B., 1962, A SURVEY OF THE MINERAL INDUSTRY OF SOUTH AFRICA, MINERAL INFORMATION BULLETIN MR 58, MINERAL RESOURCES DIVISION, DEPARTMENT OF MINES, OTTAWA
South Africa	East Dagga	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	East Driefontein	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48. & COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA
South Africa	East Rand Proprietary	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48. & COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA
South Africa	Govt. G. M. Areas	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Grootvlei	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	Kinross	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	Klerksdorp	
South Africa	Kloof	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	Langaagte Est.	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Leslie	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	Libanon	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	Marievale	PARK, C.E., AND MACDIARMID, R.A., 1970 , ORE DEPOSITS, W.H. FREEMAN AND CO., SAN FRANCISCO, P. 441 & MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 4
South Africa	New Consort (E.T. Cons)	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA
South Africa	New State Areas	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199

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South Africa	Rand Leases	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Randfontein Estates (Cooke Section, West Rand Mine, East Champ D'or, Luipardsvlei Estates, South Roodeport)	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48. & CGS METALLOGENIC MAP OF AFRICA
South Africa	S. A. Lands	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Sheba (E. T. Cons)	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA
South Africa	Simmer And Jack	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Springs	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Sub Nigel	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Vaal Reefs	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	Virginia (Harmony, Merriespruit)	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Vogelstruisbult	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C.A., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, JOURNAL OF THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY, V. 73, NO. 6, P. 184-199
South Africa	Western Holdings	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	Winkelhaak	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	Wit Nigel	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	Bracken	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	Beatrix	ANHAEUSSER, C.R. 1976, THE NATURE AND DISTRIBUTION OF ARCHAEN GOLD MINERALIZATION IN SOUTHERN AFRICA, MINERALS SCI. ENG., V. 8, NO. 1, PP. 46-84. & BOYLE, R.W., 1979, THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS, GEOL. SURV. OF CANADA, BULLETIN 280.
South Africa	Hartebeestfontein	ANHAEUSSER, C.R. 1976, THE NATURE AND DISTRIBUTION OF ARCHAEN GOLD MINERALIZATION IN SOUTHERN AFRICA, MINERALS SCI. ENG., V. 8, NO. 1, PP. 46-84. & BOYLE, R.W., 1979, THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS, GEOL. SURV. OF CANADA, BULLETIN 280.
South Africa	Deelkraal	ANHAEUSSER, C.R. 1976, THE NATURE AND DISTRIBUTION OF ARCHAEN GOLD MINERALIZATION IN SOUTHERN AFRICA, MINERALS SCI. ENG., V. 8, NO. 1, PP. 46-84. & BOYLE, R.W., 1979, THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS, GEOL. SURV. OF CANADA, BULLETIN 280.
South Africa	Unisel	ANHAEUSSER, C.R. 1976, THE NATURE AND DISTRIBUTION OF ARCHAEN GOLD MINERALIZATION IN SOUTHERN AFRICA, MINERALS SCI. ENG., V. 8, NO. 1, PP. 46-84. & BOYLE, R.W., 1979, THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS, GEOL. SURV. OF CANADA, BULLETIN 280.
South Africa	Western Areas and Elsburg Sections	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	Barberton (Fairview, Sheba, New Consort, Agnes, Princeton Complex)	ACP WEBSITE & PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON.

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	References
South Africa	Doornfontein	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	Elandsrand	ANHAEUSSER, C.R. 1976, THE NATURE AND DISTRIBUTION OF ARCHAEN GOLD MINERALIZATION IN SOUTHERN AFRICA, MINERALS SCI. ENG., V. 8, NO. 1, PP. 46-84. & BOYLE, R.W., 1979, THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS, GEOL. SURV. OF CANADA, BULLETIN 280.
South Africa	Harmony	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48. & COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA
South Africa	St. Helena	ANHAEUSSER, C.R. 1976, THE NATURE AND DISTRIBUTION OF ARCHAEN GOLD MINERALIZATION IN SOUTHERN AFRICA, MINERALS SCI. ENG., V. 8, NO. 1, PP. 46-84. & BOYLE, R.W., 1979, THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS, GEOL. SURV. OF CANADA, BULLETIN 280.
South Africa	Blyvooruitzicht	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-4
South Africa	Buffelsfontein	ANHAEUSSER, C.R. 1976, THE NATURE AND DISTRIBUTION OF ARCHAEN GOLD MINERALIZATION IN SOUTHERN AFRICA, MINERALS SCI. ENG., V. 8, NO. 1, PP. 46-84. & BOYLE, R.W., 1979, THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS, GEOL. SURV. OF CANADA, BULLETIN 280.
South Africa	Freddies Consolidated	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	Free State Geduld	COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5. & FEATHER, C.E., 1976, MINERALOGY OF THE PLATINUM GROUP MINERALS IN THE WITWATERSRAND, ECONOMIC GEOLOGY, V. 71, NO. 7.
South Africa	Free State Saaiplaas	ANHAEUSSER, C.R. 1976, THE NATURE AND DISTRIBUTION OF ARCHAEN GOLD MINERALIZATION IN SOUTHERN AFRICA, MINERALS SCI. ENG., V. 8, NO. 1, PP. 46-84. & BOYLE, R.W., 1979, THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS, GEOL. SURV. OF CANADA, BULLETIN 280.
South Africa	President Steyn	ANHAEUSSER, C.R. 1976, THE NATURE AND DISTRIBUTION OF ARCHAEN GOLD MINERALIZATION IN SOUTHERN AFRICA, MINERALS SCI. ENG., V. 8, NO. 1, PP. 46-84. & BOYLE, R.W., 1979, THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS, GEOL. SURV. OF CANADA, BULLETIN 280.
South Africa	Welkom	ANHAEUSSER, C.R. 1976, THE NATURE AND DISTRIBUTION OF ARCHAEN GOLD MINERALIZATION IN SOUTHERN AFRICA, MINERALS SCI. ENG., V. 8, NO. 1, PP. 46-84. & BOYLE, R.W., 1979, THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS, GEOL. SURV. OF CANADA, BULLETIN 280.
South Africa	West Rand Consolidated	ANHAEUSSER, C.R. 1976, THE NATURE AND DISTRIBUTION OF ARCHAEN GOLD MINERALIZATION IN SOUTHERN AFRICA, MINERALS SCI. ENG., V. 8, NO. 1, PP. 46-84. & BOYLE, R.W., 1979, THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS, GEOL. SURV. OF CANADA, BULLETIN 280.
South Africa	Western Deep Levels	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	Western Ultra Deep Levels	
South Africa	President Brand	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & COUSINS, C., 1973, PLATINOIDS IN THE WITSWATERSRAND SYSTEM, SOUTH AFRICA INST. MIN. AND METALL.JOURNAL, V. 73, NO. 6, P. 3-5.
South Africa	South African Land And Exploration Company	PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON.
South Africa	Odendaalsrus (Free State)	ACP WEBSITE
South Africa	Ergo	ACP WEBSITE & CHADWICK, J.R., JUNE, 1980, ERGO - GOLD TAILINGS RECLAMATION AND RETREATMENT, WORLD MINING, P. 48-52.
South Africa	Loraine	ANHAEUSSER, C.R. 1976, THE NATURE AND DISTRIBUTION OF ARCHAEN GOLD MINERALIZATION IN SOUTHERN AFRICA, MINERALS SCI. ENG., V. 8, NO. 1, PP. 46-84. & BOYLE, R.W., 1979, THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS, GEOL. SURV. OF CANADA, BULLETIN 280.
South Africa	Dreifontein Consolidated	ANHAEUSSER, C.R. 1976, THE NATURE AND DISTRIBUTION OF ARCHAEN GOLD MINERALIZATION IN SOUTHERN AFRICA, MINERALS SCI. ENG., V. 8, NO. 1, PP. 46-84. & BOYLE, R.W., 1979, THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS, GEOL. SURV. OF CANADA, BULLETIN 280.
South Africa	Stilfontein	ANHAEUSSER, C.R. 1976, THE NATURE AND DISTRIBUTION OF ARCHAEN GOLD MINERALIZATION IN SOUTHERN AFRICA, MINERALS SCI. ENG., V. 8, NO. 1, PP. 46-84. & BOYLE, R.W., 1979, THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS, GEOL. SURV. OF CANADA, BULLETIN 280.
South Africa	Gumbu	KRAUSS, U.H., SCHMITT, H.W., TAYLOR, H.A., JR. AND SUTHPHIN, D.M. (1988): INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - NATURAL GRAPHITE; U.S. GEOLOGICAL SURVEY, CIRCULAR 930-H. & WILKE, D.P., 1969, GRAFIETAFSETTINGS NOORD VAN DIE SOUTPANSBERG, TRANSVAAL, BULL. GEOL. SURV. SOUTH AFRICA,5

Table 2. Principal mineral deposits of Africa and the Middle East

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South Africa	Malonga	KRAUSS, U.H., SCHMITT, H.W., TAYLOR, H.A., JR. AND SUTHPHIN, D.M., 1988, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - NATURAL GRAPHITE, USGS, CIRC. 930-H. & WILKE, D.P., 1969, GRAFIETAFSETTINGS NOORD VAN DIE SOUTPANSBERG, NUCLEAR RAW MATERIAL INVESTIGATION, BULLETIN 52, GEOL. SURVEY SOUTH AFRICA
South Africa	Beeshoek (Olynfontein farm)	GEOLOGICAL MAP OF THE ORE DEPOSITS IN THE POSTMASBURG MANGANESE FIELD, GEOL. SURVEY OF SOUTH AFRICA, GOVT. PRINTER, PRETORIA, 1960. & ACP WEBSITE
South Africa	Krokodilkraal 4261	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA, P.241
South Africa	Lilyfield (Lylyveld)	DE VILLIERS, J., 1960, THE MANGANESE DEPOSITS OF THE UNION OF SOUTH AFRICA, GEOL. SURVEY OF S.A., HANDBOOK NO.2, PRETORIA, P. 67.
South Africa	Manganore	ENGINEERING MINING JOURNAL, 1978, INTERNATIONAL DIRECTORY OF MINING AND MINERAL PROCESSING OPERATIONS, MCGRAW-HILL, NY, P. 341. & TRUTER, F.C., BOARDMAN, L.G., AND VISSER, D.J.L., 1960, GEOLOGICAL MAP OF ORE DEPOSITS IN THE POSTMASBURG MANGANESE-FIELD, IN DE VILLIERS, J., 1960, THE MANGANESE DEPOSITS OF THE UNION OF SOUTH AFRICA, GEOL SURV OF THE UNION OF SOUTH AFRICA HANDBOOK 2
South Africa	Omnia	CORIN, E.R., JAN., 1977, MINERALS MARKETING INFORMATION, NON-METALLIC MINES IN SOUTH AFRICA, MINERALS BUREAU OF SOUTH AFRICA DEPT.OF MINES, BRAAMFONTEIN, P.37
South Africa	Sishen	STRAUSS, C.A., THE IRON ORE DEPOSITS IN THE SISHEN AREA, CAPE PROVINCE, IN HAUGHTON, S.H., (ED.), THE GEOLOGY OF SOME ORE DEPOSITS IN SOUTHERN AFRICA, V. 2. & CGS METALLOGENIC MAP OF AFRICA
South Africa	Thabazimbi	STRAUSS, C.A., THE IRON ORE DEPOSITS IN THE THABAZIMBI AREA, CAPE PROVINCE, IN HAUGHTON, S.H., (ED.), THE GEOLOGY OF SOME ORE DEPOSITS IN SOUTHERN AFRICA, V. 2. & CGS METALLOGENIC MAP OF AFRICA
South Africa	Gamagara	ACP WEBSITE & DE VILLIERS, J., 1960, THE MANGANESE DEPOSITS OF THE UNION OF SOUTH AFRICA, GEOL. SURVEY OF S.A., HANDBOOK NO.2, PRETORIA, P. 67
South Africa	Mapochs	ACP WEBSITE & COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA
South Africa	Big Syncline Aggeneys Area	MINING MAGAZINE, MARCH, 1979, PROGRESS CONTINUES AT AGGENEYS, P. 206-213. & COAL, GOLD AND BASE MINERALS OF SOUTHERN AFRICA, APRIL, 1974, P. 49-51
South Africa	Black Mountain (Aggeneys District)	RYAN, P.J., AND OTHERS, 1986, THE AGGENEYS BASE METAL SULPHIDE DEPOSITS, NAMAQUALAND DISTRICT, IN ANNHAEUSSER, C.R., AND MASKE, S., (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, P. 1447-1473
South Africa	Broken Hill (Aggeneys District)	ENGINEERING AND MINING JOURNAL, NOV., 1976, P. 204 & MINING MAGAZINE, JAN., 1987, P. 6
South Africa	Mooiplaats	SKILLEN, A., JUNE, 1995, WELCOME TO THE NEW SOUTH AFRICA, INDUSTRIAL MINERALS, P. 25-53
South Africa	Nyala (Mopani)	CGS METALLOGENIC MAP OF AFRICA & MANOS, A., NOV., 1977, THE INDUSTRIAL MINERALS OF SOUTH AFRICA, INDUSTRIAL MINERALS, NO. 122, P. 16-65
South Africa	Strathmore	MANOS, A., NOV., 1977, THE INDUSTRIAL MINERALS OF SOUTH AFRICA, INDUSTRIAL MINERALS, NO. 122, P. 16-65 & CGS METALLOGENIC MAP OF AFRICA
South Africa	Annex Langdon	
South Africa	Bishop	DE VILLIERS, J., 1960, THE MANGANESE DEPOSITS OF THE UNION OF SOUTH AFRICA, GEOL. SURVEY OF S.A., HANDBOOK NO.2, PRETORIA, P. 67.
South Africa	Devon	FRANKEL, J.J., 1958, MANGANESE ORES FROM THE KURUMAN DISTRICT, CAPE PROVINCE, SOUTH AFRICA, ECONOMIC GEOLOGY, V. 53, NO. 5, P. 577-597. & PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON, P. 98.
South Africa	Gloria	
South Africa	Glouchester	DE VILLIERS, J., 1960, THE MANGANESE DEPOSITS OF THE UNION OF SOUTH AFRICA, GEOL. SURVEY OF S.A., HANDBOOK NO.2, PRETORIA, P. 67.
South Africa	Gopane (Gopani)	MANOS, A., NOV., 1977, THE INDUSTRIAL MINERALS OF SOUTH AFRICA, INDUSTRIAL MINERALS, NO. 122, P. 16-65 & CGS METALLOGENIC MAP OF AFRICA
South Africa	Kalahari Field	DEYOUNG, J.H, LEE, M.P., AND LIPIN, B.R., 1984, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT: CHROMIUM, U.S.G.S. CIRULAR 930-B, P. 41. & TALJAARDT, J.J., 1979, MAJOR MANGANESE ORE FIELDS, REPUBLIC OF SOUTH AFRICA, UNPUBLISHED REPORT, SAMAMCOR, JOHANNESBURG
South Africa	Middelplaats	ACP WEBSITE & COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA, P. 61
South Africa	N'Chwaning (Kuruman)	ACP WEBSITE & BOARDMAN, L.G., 1964, FURTHER GEOLOGICAL DATA ON THE POSTMASBURG AND KURUMAN MANGANESE ORE DEPOSITS, NORTHERN CAPE PROVINCE, IN HAUGHTON, S.H., (ED.), THE GEOLOGY OF SOME ORE DEPOSITS IN SOUTHERN AFRICA, V. 2, P. 415-440
South Africa	Paling	DE VILLIERS, J., 1960, THE MANGANESE DEPOSITS OF THE UNION OF SOUTH AFRICA, GEOL. SURVEY OF S.A., HANDBOOK NO.2, PRETORIA, P. 67.
South Africa	Postmasburg Field	TALJAARDT, J.J., 1979, MAJOR MANGANESE ORE FILEDS, REPUBLIC OF SOUTH AFRICA, UNPUBLISHED REPORT: SAMANCOR, JOHANNESBURG.

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	References
South Africa	Santoy	DE VILLIERS, P.R., 1970, THE GEOLOGY AND MINERALOGY OF THE KALAHARI MANGANESE-FIELD NORTH OF SISHEN, CAPE PROVINCE, GEOL. SURV. OF SOUTH AFRICA, MEMOIR 59, & COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA, P.241.
South Africa	Smartt	
South Africa	Wessels (Adams, Mamatwan, Hotazel)	ACP WEBSITE & BOARDMAN, L.G., 1964, FURTHER GEOLOGICAL DATA ON THE POSTMASBURG AND KURUMAN MANGANESE ORE DEPOSITS, NORTHERN CAPE PROVINCE, IN HAUGHTON, S.H., (ED.), THE GEOLOGY OF SOME ORE DEPOSITS IN SOUTHERN AFRICA, V. 2, P. 415-440
South Africa	Western Transvaal Manganese	
South Africa	Black Rock	BOARDMAN, L.G., 1964, FURTHER GEOLOGICAL DATA ON THE POSTMASBURG AND KURUMAN MANGANESE ORE DEPOSITS, NORTHERN CAPE PROVINCE, IN HAUGHTON, S.H., (ED.), THE GEOLOGY OF SOME ORE DEPOSITS IN SOUTHERN AFRICA, V. 2., P. 415-440. & DE VILLIERS, J., 1960, THE MANGANESE DEPOSITS OF THE UNION OF SOUTH AFRICA, GEOL. SURVEY OF S.A., HANDBOOK NO 2 PRETORIA P 67
South Africa	Hotazel	BOARDMAN, L.G., 1964, FURTHER GEOLOGICAL DATA ON THE POSTMASBURG AND KURUMAN MANGANESE ORE DEPOSITS, NORTHERN CAPE PROVINCE, IN HAUGHTON, S.H., (ED.), THE GEOLOGY OF SOME ORE DEPOSITS IN SOUTHERN AFRICA, V. 2., P. 415-440. & DE VILLIERS, J., 1960, THE MANGANESE DEPOSITS OF THE UNION OF SOUTH AFRICA, GEOL. SURVEY OF S.A., HANDBOOK NO 2 PRETORIA P 67
South Africa	Lohathla	BOARDMAN, L.G., 1964, FURTHER GEOLOGICAL DATA ON THE POSTMASBURG AND KURUMAN MANGANESE ORE DEPOSITS, NORTHERN CAPE PROVINCE, IN HAUGHTON, S.H., (ED.), THE GEOLOGY OF SOME ORE DEPOSITS IN SOUTHERN AFRICA, V. 2., P. 415-440. & DE VILLIERS, J., 1960, THE MANGANESE DEPOSITS OF THE UNION OF SOUTH AFRICA, GEOL. SURVEY OF S.A., HANDBOOK NO 2 PRETORIA P 67
South Africa	Mamatwan	BOARDMAN, L.G., 1964, FURTHER GEOLOGICAL DATA ON THE POSTMASBURG AND KURUMAN MANGANESE ORE DEPOSITS, NORTHERN CAPE PROVINCE, IN HAUGHTON, S.H., (ED.), THE GEOLOGY OF SOME ORE DEPOSITS IN SOUTHERN AFRICA, V. 2., P. 415-440. & DE VILLIERS, J., 1960, THE MANGANESE DEPOSITS OF THE UNION OF SOUTH AFRICA, GEOL. SURVEY OF S.A., HANDBOOK NO 2 PRETORIA P 67
South Africa	Mokaning	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA
South Africa	Monarch Kop (Harrington Kop)	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA, P. 173. & PEARTON, T.N., 1986, THE MONARCH CINNABAR MINE: MURCHISON GREENSTONE BELT, IN ANHAEUSSER, C.R., AND MASKE, S., (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, P. 33 448
South Africa	Vlackfontein 902	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48. & PARK, C.E., AND MACDIARMID, R.A., 1970 , ORE DEPOSITS, W.H. FREEMAN AND CO., SAN FRANCISCO, P. 4
South Africa	Nkomati	
South Africa	Insizwa	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48. & THE MINERAL RESOURCES OF THE UNION OF SOUTH AFRICA, 1959, DEPT. OF MINES AND GEOL. SURVEY, THE GOVT. PRINTER, PRETORIA, P. 283 - 284
South Africa	Boschkoppie 104 Jq	WAGNER, P.A., 1929, THE PLATINUM DEPOSITS AND MINES OF SOUTH AFRICA, CAPE TOWN, C. STRUIK, 1973 (3RD ED.), P. 14
South Africa	Crocodile River	ENGINEERING AND MINING JOURNAL, V.13, NO.11, P. 1-3. & MINING JOURNAL, OCT. 20, 1989, P. 35
South Africa	Der Brochen 7 Jt	WAGNER, P.A., 1929, THE PLATINUM DEPOSITS AND MINES OF SOUTH AFRICA, CAPE TOWN, C. STRUIK, 1973 (3RD ED.), P. 16
South Africa	Eastern (Lonmin)	ACP WEBSITE
South Africa	Eland	BUTTERMAN, 1973, PLATINUM-GROUP METALS, IN MINERALS YEARBOOK, VOL. I, U.S. BUREAU OF MINE
South Africa	Elandsfontein 386 Kq	WAGNER, P.A., 1929, THE PLATINUM DEPOSITS AND MINES OF SOUTH AFRICA, CAPE TOWN, C. STRUIK, 1973 (3RD ED.), P. 14
South Africa	Helena 6 Jt	WAGNER, P.A., 1929, THE PLATINUM DEPOSITS AND MINES OF SOUTH AFRICA, CAPE TOWN, C. STRUIK, 1973 (3RD ED.), P. 303, 110. & CAMERON, E.N., AND DESBOROUGH, G.A., 1969, OCCURENCE AND CHARACTERISTICS OF CHROMITE DEPOSITS - EASTERN BUSHVELD COMPLEX, ECONOMIC GEOLOGY MONOGRAPH 4, P. 23-40
South Africa	Karee	ACP WEBSITE
South Africa	Kennedy's Vale	MINING ENGINEERING, 1987, SOUTH AFRICANS PLAN HUGE PLATINUM MINE IN EAST TRANSVAAL, V. 39, NO.1
South Africa	Maandagshoek (Driekop, Onverwacht)	ACP WEBSITE & MINING MAGAZINE, 1977, SOUTH AFRICA PLATINUM, V. 136, NO. 5, P. 38
South Africa	Winterveld 293 Kt	WAGNER, P.A., 1929, THE PLATINUM DEPOSITS AND MINES OF SOUTH AFRICA, CAPE TOWN, C. STRUIK, 1973 (3RD ED.), P. 94 - 9
South Africa	Zeekoegat No. 421 Ks	WAGNER, P.A., 1929, THE PLATINUM DEPOSITS AND MINES OF SOUTH AFRICA, CAPE TOWN, C. STRUIK, 1973 (3RD ED.), P. 302, 9.
South Africa	Driekop	WAGNER, P.A., 1929, THE PLATINUM DEPOSITS AND MINES OF SOUTH AFRICA, CAPE TOWN, C. STRUIK, 1973 (3RD ED.), P. 285, 286, 81-85. & HALL, A.L., 1932, THE BUSHVELD IGNEOUS COMPLEX OF THE CENTRAL TRANSVAAL,MEM. GEOL. SURV. S. AFRICA 28, P. 476.

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	References
South Africa	Rustenburg (Amplats, Union Section, Amandelbult Section, RPM)	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 39-41. & ACP WEBSITE
South Africa	Western Bushveld	VON GRUENEWALDT, G., 1977, THE MINERAL RESOURCES OF THE BUSHVELD COMPLEX, MINERALS, SCIENCE AND ENGINEERING, V. 9, NO. 2, P. 83-95. & EVANS, A.M., 1980, AN INTRODUCTION TO ORE GEOLOGY, NEW YORK, ELSEVIER
South Africa	Drenthe 778	VON GRUENEWALDT, G., 1977, THE MINERAL RESOURCES OF THE BUSHVELD COMPLEX, MINERALS, SCIENCE AND ENGINEERING, V. 9, NO. 2, P. 83-95. & MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630.
South Africa	Mooihoek	WAGNER, P.A., 1929, THE PLATINUM DEPOSITS AND MINES OF SOUTH AFRICA, CAPE TOWN, C. STRUIK, 1973 (3RD ED.), P. 19, 73. & MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 42 - 43.
South Africa	Onverwacht	WAGNER, P.A., 1929, THE PLATINUM DEPOSITS AND MINES OF SOUTH AFRICA, CAPE TOWN, C. STRUIK, 1973 (3RD ED.), P. 285, 284, 65 & CAMERON, E.N., AND DESBOROUGH, G.A., 1964, ORIGIN OF CERTAIN MAGNETITE-BEARING PEGMATITES IN THE EASTERN PART OF THE BUSHVELD COMPLEX, SOUTH AFRICA, ECONOMIC GEOLOGY, V. 59, NO. 2, P. 215-223
South Africa	Bafokeng South	MINING MAGAZINE, JAN., 1987, P. 62. & MINING JOURNAL, 1970, IMPALA, V. 274, P. 24
South Africa	Blaavwbank	WAGNER, P.A., 1929, THE PLATINUM DEPOSITS AND MINES OF SOUTH AFRICA, CAPE TOWN, C. STRUIK, 1973 (3RD ED.), P. 202-20.
South Africa	Pp Rust (Potgietersrus, Pots Plat, Sandsloot Pit, Zwartfontein Pits, Tweefontein Pits, Platreef Pit, Sterkwater, Sandfontein)	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA. & ACP WEBSITE
South Africa	Vaalkop - Zwartfontein Section	WAGNER, P.A., 1929, THE PLATINUM DEPOSITS AND MINES OF SOUTH AFRICA, CAPE TOWN, C. STRUIK, 1973 (3RD ED.), P. 174 - 17.
South Africa	Forest Hill 117 Kt	WAGNER, P.A., 1929, THE PLATINUM DEPOSITS AND MINES OF SOUTH AFRICA, CAPE TOWN, C. STRUIK, 1973 (3RD ED.), P. 94, 11.
South Africa	Impala	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA & MINING JOURNAL, NOV. 19, 1993, P. 34
South Africa	Western Platinum	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA & BRYNARD & OTHERS, 1975, PLATINUM MINE NEAR MARIKANA, SOUTH AFRICA, SOC. OF ECON. GEOL., INTERNATIONAL SYMPOSIUM, DENVER, COLO. PROGRAM, P. 4
South Africa	Amandelbult	BUTTERMAN, 1975, PT-GROUP METALS: US DEPT. INTERIOR, BUR. MINES MINERALS YEARBOOK
South Africa	Atok (Lebowa, Leplats, Middelpunk Hill, Lobewa)	BRABERS, A.J.M., 1971, LIST OF WORKING MINES IN SOUTH AFRICA AND THE KINGDOM OF SWAZILAND AS AT DECEMBER 1968, SOUTH AFRICA GEOL. SURVEY, SPEC. PUB. 18, P. 11. & MINING MAGAZINE, JAN., 1987, P. 6
South Africa	Eastern Bushveld Sector: Merensky Reef	SCHWELLNUS, J.S.I., HIEMSTRA, S.A., AND GASPARRINI, E., 1976, THE MERENSKY REEF AT ATOK PLATINUM MINE AND ITS ENVIRONS, ECONOMIC GEOLOGY, V. 71, NO. 1, P. 249-260
South Africa	Platreef	VON GRUENEWALDT, G., 1977, THE MINERAL RESOURCES OF THE BUSHVELD COMPLEX, MINERALS, SCIENCE AND ENGINEERING, V. 9, NO. 2, P. 86 & VAN DER MERWE, 1976, POTGIETERSRUS LIMB BUSHVELD COMPLEX, ECONOMIC GEOLOGY, V. 71, NO. 7, P. 1337.
South Africa	Merensky Reef	VON GRUENEWALDT, G., 1977, THE MINERAL RESOURCES OF THE BUSHVELD COMPLEX, MINERALS, SCIENCE AND ENGINEERING, V. 9, NO. 2. & VERMAAK, C.F., AND HENDRIKS, L.P., 1976, A REVIEW OF THE MINERALOGY OF THE MERENSKY REEF, WITH SPECIFIC REFERENCE TO NEW DATA ON THE PRECIOUS METAL MINERALOGY, ECONOMIC GEOLOGY, V. 71 , NO. 7, P. 1244-1269.
South Africa	Northam	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
South Africa	Langebaan Area	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA, P. 399-406
South Africa	Phalaborwa (Palabora, Foskor)	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA. & PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON
South Africa	Schiel (Venda)	KRAUSS, U.H., SAAM, H.G., AND SCHMIDT, H.W., 1984, INTERNATIONAL STRATEGIC MINERALS INVENTORY: SUMMARY REPORT--PHOSPHATE, USGS CIRCULAR 930-C
South Africa	Glenover	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA
South Africa	Steenkampskraal	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA, P. 209-210. & CGS METALLOGENIC MAP OF AFRIC
South Africa	Rooiberg (Leeuwpoort, Zanitplaats)	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
South Africa	Union Tin	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA. & CGS METALLOGENIC MAP OF AFRIC
South Africa	Zaaiplaats	LENTHALL, D.H., AND HUNTER, D.R., 1977, THE GEOCHEMISTRY OF THE BUSHVELD GRANITES IN THE POTGIETERSUS TINFIELD, PRECAMBRIAN RESEARCH, VOL. 5, P. 359-400. & CGS METALLOGENIC MAP OF AFRICA

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Country	Deposit Name	References
South Africa	Brand-Se-Baai (Namakwa)	SKILLEN, A., JUNE, 1995, WELCOME TO THE NEW SOUTH AFRICA, INDUSTRIAL MINERALS, P. 25-53. & INUSTRIAL MINERALS, 1997, NO. 356, P. 17.
South Africa	Namaqua Sands	INDUSTRIAL MINERALS, 1993, WORLD OF MINERALS - SOUTH AFRICA, NO. 305, P. 16 & ROBJOHNS, N., 1990, RARE EARTHS, IN SPECIALTY METALS, METALS AND MINERALS ANNUAL REVIEW, P. 78
South Africa	Cape Morgan	ACP WEBSITE & HAMMERBECK, ECI, 1976, TITANIUM MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA, 5TH ED
South Africa	Richards Bay	JACKSON AND CHRISTIANSEN, 1993 & COMPANY REPORTS ON EXPLORATION RESULTS.HAMMERBECK, E.C.I., 1976. TITANIUM: MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA, 5TH EDITION, P.221-226. USBM 1983, 1984, MINERALS YEARBOOK 1983, 1983, VOL. 1, METALS AND MINERALS, US DEPARTMENT & COMPANY REPORTS ON EXPLORATION RESULTS.HAMMERBECK, E.C.I., 1976. TITANIUM: MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA, 5TH EDITION, P.221-226. USBM 1983, 1984, MINERALS YEARBOOK 1983, 1983, VOL. 1, METALS AND MINERALS, US DEPARTMENT & PLATT'S METALS WEEK. OCT. 3, 1994. RICHARDS BAY FACES" | STRIKE. V. 65. NO. 40. P.6." | *AME MINING WEEKLY. JULY 1, 1994. P. 4. AME RESEARCH NOTE" | TITANIUM UPDATE " PRODUCTION" & ACP WEBSITE
South Africa	Umgababa (Umkomaas, Usipingo)	ACP WEBSITE & HAMMERBECK, E.C.I., 1976, TITANIUM, IN COETZEE, C.B. (ED.), MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA, GEOL. SURV. OF SOUTH AFRICA, HANBOOK 7, 5TH ED., P. 221-226
South Africa	Orange River Belt West	STEPHAN, L.A. AND HAMMERBECK, E.C.I., 1978, SCHEELITE DEPOSITS IN THE VIOOLSDRIF AREA, OPEN FILE REPORT 1978-0012, GEOLOGICAL SURVEY OF SOUTH AFRICA. & SÖHNGE, G., 1944, SOME TUNGSTEN DEPOSITS IN THE STEINKOPF RESERVE, NAMAQUALAND, INTERNAL REPORT 1944-0026, GEOLOGICAL SURVEY OF SOUTH AFRICA
South Africa	Wallekraal	ACP WEBSITE & SOUTH AFRICAN COMMITTEE FOR STRATIGRAPHY (SACS), 1980, STRATIGRAPHY OF SOUTH AFRICA, PART 1, COMPILED BY L.E. KENT, SOUTH AFRICA GEOLOGICAL SURVEY, HANDBOOK 8, P. 439-446
South Africa	Wolfram Schist Belt	COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA, P. 227-229
South Africa	Orange River Belt East	SOUTH AFRICAN COMMITTEE FOR STRATIGRAPHY (SACS), 1980, HANDBOOK GEOLOGICAL SURVEY OF SOUTH AFRICA, NO. 8, P. 261-267 & 307-313
South Africa	Afrikander Lease Ltd.	ACP WEBSITE & COETZEE, C.B., (ED.), 1976, MINERAL RESOURCES OF THE REPUBLIC OF SOUTH AFRICA: 5TH EDITION, REPUBLIC OF SOUTH AFRICA, GEOLOGICAL SURVEY HANDBOOK 7, PRETORIA
South Africa	Oryx (Beisa)	ACP WEBSITE & MINING MAGAZINE, JUNE, 1982, BEISA MINE, P. 448-457
South Africa	Brits	ACP WEBSITE
South Africa	Maranda	GALLEY, A.G., HANNINGTON, M.D., AND JONASSON, I.R., 2007, VOLCANOGENIC MASSIVE SULFIDE DEPOSITS, in GOODFELLOW, W.D., ed., MINERAL DEPOSITS OF CANADA, GEOLOGIC ASSOC. OF CANADA, MINERAL DEPOSITS DIVISION, SPECIAL PUBLICATION NO. 5, P. 141-161.
South Africa	Gamsberg (Aggeneys Dsitrict)	ROZENDAAL, A., 1986, THE GAMSBURG ZINCE DEPOSIT, NAMAQUALAND DISTRICT, IN ANHAEUSSER, C.R., AND MASKE, S. (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, GEOL. SOC. OF SOUTH AFRICA, V. 2M P. 1477-1488
South Africa	Pering	WHEATLEY, C.J.V., WHITFIELD, G.G., KENNY, K.J., AND BIRCH, A., THE PERING CARBONATE-HOSTED ZINC-LEAD DEPOSIT, GRIQUALAND WEST, IN ANHAEUSSER, C.R., AND MASKE, S. (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, 1ST ED., GEOLOGICAL SOCIETY OF SOUTH AFRICA, JOHANNESBURG, P. 867-874
South Africa	Bien Venue	GALLEY, A.G., HANNINGTON, M.D., AND JONASSON, I.R., 2007, VOLCANOGENIC MASSIVE SULFIDE DEPOSITS, in GOODFELLOW, W.D., ed., MINERAL DEPOSITS OF CANADA, GEOLOGIC ASSOC. OF CANADA, MINERAL DEPOSITS DIVISION, SPECIAL PUBLICATION NO. 5, P. 141-161.
South Africa	Aggeneys #3	MINING MAGAZINE, JUNE, 1977, P. 43
South Africa	North Natal Coast	TOWNER, R.R., 1992, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - ZIRCONIUM: U.S. GEOLOGICAL SURVEY CIRCULAR 930-L
South Africa	Umbababa	
South Africa	West Cape Coast	TOWNER, R.R., 1992, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - ZIRCONIUM: U.S. GEOLOGICAL SURVEY CIRCULAR 930-L
Sudan	Ingessana Hills (Nile Mining Operation)	DUKE, V.W.A., 1982, CHROMIUM - A MINERAL COMMODITY REVIEW, SOUTH AFRICA MINERALS BUREAU INTERNAL REPORT 86. & VAIL, J.R., 1978, OUTLINE OF THE GEOLOGY AND MINERAL DEPOSITS OF THE DEMOCRATIC REPUBLIC OF THE SUDAN AND ADJACENT AREAS, INSTITUTE OF GEOLOGICAL SCIENCES, OVERSEAS GEOLOGY AND MINERAL RESOURCES NO. 49, LONDON.
Sudan	Kreiter	
Sudan	Hofrat En Nahas	MINING MAGAZINE, AUG., 1976, MINING PROSPECTS FOR THE SUDAN, P. 101. & INTERNATIONAL MINING, JAN., 1990, P. 48-4
Sudan	Aberketieb (Abirkateib)	CGS METALLOGENIC MAP OF AFRICA
Sudan	Gebeit (Gabeit, Gabait)	ACP WEBSITE
Sudan	Hassai (Ariab)	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
Swaziland	Havelock	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & HARBEN, P.W. AND BATES, 1984, ASBESTOS, IN GEOLOGY OF THE NONMETALLICS, METAL BULLETIN INC., NEW YORK, P. 324-335.

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Country	Deposit Name	References
Swaziland	Gege	ACP WEBSITE & UNITED NATIONS, 1970, SURVEY OF WORLD IRON ORE RESOURCES—OCCURRENCE AND APPRAISAL: NEW YORK, NY, UNITED NATIONS, DEPT. OF ECONOMIC AND SOCIAL AFFAIRS, P. 83
Swaziland	Ngwenya (Ngwenye, Bomvu Ridge, Bomwu Ridge)	MINING MAGAZINE, 1972, P. 560-561. & ACP WEBSITE
Swaziland	Dwaleni	DAVIES, D.N., 1964, THE TIN DEPOSITS OF SWAZILAND - IN - HAUGHTON, S.H., (ED.), THE GEOLOGY OF SOME ORE DEPOSITS OF SOUTHERN AFRICA, V. 2, GEOLOGICAL SOCIETY OF SOUTH AFRICA, JOHENNESBURG, P. 535-541
Swaziland	Forbes Reef	DAVIES, D.N., 1964, THE TIN DEPOSITS OF SWAZILAND - IN - HAUGHTON, S.H., (ED.), THE GEOLOGY OF SOME ORE DEPOSITS OF SOUTHERN AFRICA, V. 2, GEOLOGICAL SOCIETY OF SOUTH AFRICA, JOHENNESBURG, P. 535-541
Syria	Eastern A and B (Sawwaneh)	CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA, U.S.G.S. OPEN-FILE REPORT 02-0156A AND 02-0156
Tanzania	Pugu Hills	DE KUN, N., 1987, MINERAL ECONOMICS OF AFRICA, DEVELOPMENTS OF ECONOMIC GEOLOGY, V. 22. & CGS METALLOGENIC MAP OF AFRICA
Tanzania	Panda Hill	
Tanzania	Kabanga	MINING MAGAZINE, APRIL, 1995, PRELIMINARY EVALUATION OF KABANGA, TANZANIA, P. 261. & THE MINING RECORD, MARCH 1, 1995, SUTTON DRILLING ON BULYANHULU GOLD PROPERTY IN TANZANIA, P. 45
Tanzania	Alamasi	ACP WEBSITE & HARRIS, J.F., 1981, SUMMARY OF THE GEOLOGY OF TANGANYIKA, PART IV: ECONOMIC GEOLOGY, GEOLOGICAL SURVEY OF TANGANYIKA MEMOIR 1
Tanzania	Mwadui (Williamson)	RECKLING, K., HOY, R.B., DEREK, S.J.L., AND ROWEL, U.H., 1994, INDUSTRIAL DIAMOND, IN CAR, D.D. (ED.), INDUSTRIAL MINERALS AND ROCKS, 6TH ED., P. 379-395. & ACP WEBSITE
Tanzania	Merelani	HESTER, B., AND BOBERG, W., 1991, OPPORTUNITIES FOR MINERAL RESOURCE DEVELOPMENT [TANZANIA], PREPARED FOR THE GOVERNMENT OF THE UNITED REPUBLIC OF TANZANIA BY THE UNITED NATIONS DEPARTMENT OF TECHNICAL COOPERATION.
Tanzania	Bulyanhulu	THE MINING RECORD, MARCH 1, 1995, SUTTON DRILLING ON BULYANHULU GOLD PROPERTY IN TANZANIA, P. 45. & MINING MAGAZINE, DEC., 1995, SUTTON BOOSTS RESOURCES IN TANZANIA, P. 388
Tanzania	Buck Reef	ACP WEBSITE & HESTER, B., ET AL., 1991, OPPORTUNITIES FOR MINERAL RESOURCE DEVELOPMENT [TANZANIA], PREPARED FOR THE GOVERNMENT OF THE UNITED REPUBLIC OF TANZANIA BY THE UNITED NATIONS DEPARTMENT OF TECHNICAL COOPERATION FOR DEVELOPMENT ACTING AS EXECUTIN & MINING JOURNAL, AUG 11, 1995, P 96 | NORTHERN MINER, JUN 19, 1995 P 10: ACP WEBSITE
Tanzania	Uruwira	TEALE, E.O., AND OATES, F., 1946, THE MINERAL RESOURCES OF TANGANYIKA TERRITORY, 3RD ED., DODOMA, TANGANYIKA TERRITORY, DEPT. OF LANDS AND MINES, GEOLOGICAL DIVISION. & HARRIS, J. F., 1961, SUMMARY OF THE GEOLOGY OF TANGANYIKA; PART IV: ECONOMIC GEOLOGY, GEOLOGICAL SURVEY OF TANGANYIKA MEM. 1, P. 69–73, DAR ES SALAA
Tanzania	Chambogo	ACP WEBSITE & HARRIS, J.F., 1981, SUMMARY OF THE GEOLOGY OF TANGANYIKA, PART IV: ECONOMIC GEOLOGY, GEOLOGICAL SURVEY OF TANGANYIKA MEMOIR 1
Tanzania	Lugalla Hill	HARPUM, J.R., 1970, SUMMARY OF THE GEOLOGY OF TANZANIA, GEOLOGICAL SURVEY OF TANZANIA, MEMOIR, 1, P. 10
Tanzania	Gelai	ACP WEBSITE & GEOL. SURV. OF TANZANIA, 1958, V. 8, P. 67-71
Tanzania	Merkerstein Hill Deposit	CGS METALLOGENIC MAP OF AFRICA
Tanzania	Minjingu	ACP WEBSITE & DE KUN, N., 1987, MINERAL ECONOMICS OF AFRICA, DEVELOPMENTS OF ECONOMIC GEOLOGY, V. 2
Tanzania	Wigu Hill	PELL, J., 1996, MINERAL DEPOSITS ASSOCIATED WITH CARBONATITES AND RELATED ALKALINE IGNEOUS ROCKS, IN R.H. MITCHELL (ED.), UNDERSATURATED ALKALINE ROCKS: MINERALOGY,PETROGENESIS, AND ECONOMIC POTENTIAL, WINNIPEG, MANITOBA, P. 271-310. & CGS METALLOGENIC MAP OF AFRICA
Tanzania	Lake Natron	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC
Tanzania	Kaborishoke (Kwerya, Kyerwa)	ACP WEBSITE & HARRIS, J.F., 1981, SUMMARY OF THE GEOLOGY OF TANGANYIKA, PART IV: ECONOMIC GEOLOGY, GEOLOGICAL SURVEY OF TANGANYIKA MEMOIR 1
Tanzania	Liganga (Ligangu)	ACP WEBSITE & GEOL. SURV. OF TANZANIA, 1958, V. 8, P. 67-71
The Gambia	Sanyang (Batukunku, Kartung	INDUSTRIAL MINERALS, 2003, NO. 425, P. 56 & CGS METALLOGENIC MAP OF AFRIC
Togo	Mt. Ahito	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P. 42
Togo	Hahotoe-Kpogame	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & CGS METALLOGENIC MAP OF AFRICA
Tunisia	Djebel Oust	
Tunisia	Djebel Sta	
Tunisia	Hammam Zriba	INDUSTRIAL MINERALS, APRIL, 1993, NO. 307, P. 42
Tunisia	Zariba	CHERMETTE, A., 1973, SPATH-FLUOR: PERSPECTIVES FRANCAIS ET INTERNATIONALES, METAL SERVICE, PARIS, P. 3
Tunisia	Djerissa	CGS METALLOGENIC MAP OF AFRICA & UNITED NATIONS, 1970, SURVEY OF WORLD IRON ORE RESOURCES—OCCURRENCE AND APPRAISAL: NEW YORK, NY, UNITED NATIONS, DEPT. OF ECONOMIC AND SOCIAL AFFAIRS, P. 66-67
Tunisia	Douaria	UNITED NATIONS, 1970, SURVEY OF WORLD IRON ORE RESOURCES—OCCURRENCE AND APPRAISAL: NEW YORK, NY, UNITED NATIONS, DEPT. OF ECONOMIC AND SOCIAL AFFAIRS, P. 66-67
Tunisia	Tamera	CGS METALLOGENIC MAP OF AFRICA & UNITED NATIONS, 1970, SURVEY OF WORLD IRON ORE RESOURCES—OCCURRENCE AND APPRAISAL: NEW YORK, NY, UNITED NATIONS, DEPT. OF ECONOMIC AND SOCIAL AFFAIRS, P. 66-67
Tunisia	Bechateur	

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Country	Deposit Name	References
Tunisia	Bou Jabeur	INDUSTRIAL MINERALS, JULY, 1996, MAHGREB CEMENT WHERE NEXT?, P.11-14. & WORLD CEMENT DIRECTORY, 1991, CIMEUROP S.A.R.L., P. 40-33.
Tunisia	Bougrine	MINING MAGAZINE, JAN 1994, V. 170, NO. 1, P. 32. & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P. 385-387
Tunisia	Djebel El Adjered	
Tunisia	Djebel Lazered	
Tunisia	El Grefa	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P. 38
Tunisia	Fedj El Adhoum El Krib	
Tunisia	Khanquet Kef Tout	
Tunisia	Megrine	
Tunisia	Usine De Megrine	
Tunisia	Boujabeur	
Tunisia	Djebel Hallouf	SAINFIELD, P., 1950, LES GISEMENTS DE PLOMB ET DE ZINC EN TUNISIE, INT. GEOL. CONG. 18TH, REPORT 7, P. 234-240. & NICOLINI, P., 1968, GISEMENTS PLOMBO ZINCIFERES DE TUNISIE, ANNALES DES MINES ET DE LA GEOLOGIE (TUNIS), NO. 23, P. 208-240.
Tunisia	Fedjel	
Tunisia	Sidi Bou Aouane	
Tunisia	Sidi Driss	
Tunisia	Kef Eddour	DE KUN, N., 1987, MINERAL ECONOMICS OF AFRICA, DEVELOPMENTS OF ECONOMIC GEOLOGY, V. 22. & INTERNATIONAL MINING, JULY 1985, P. 54
Tunisia	Kef Eschfair	KRAUSS, U.H., SAAM, H.G., AND SCHMIDT, H.W., 1984, INTERNATIONAL STRATEGIC MINERALS INVENTORY: SUMMARY REPORT--PHOSPHATE, USGS CIRCULAR 930-C. & MINING MAGAZINE, JANUARY 1989, P. 5
Tunisia	M'Dilla	KRAUSS, U.H., SAAM, H.G., AND SCHMIDT, H.W., 1984, INTERNATIONAL STRATEGIC MINERALS INVENTORY: SUMMARY REPORT--PHOSPHATE, USGS CIRCULAR 930-C & BRITISH SULPHUR CORP. LTD., 1980, WORLD SURVEY OF PHOSPHATE DEPOSITS, 4TH ED., LONDON.
Tunisia	Metlaoui	BRITISH SULPHUR CORP. LTD., 1980, WORLD SURVEY OF PHOSPHATE DEPOSITS, 4TH ED., LONDON. & MINING MAGAZINE, JAN., 1989, P. 50.
Tunisia	Moulares (Moulanes)	BRITISH SULPHUR CORP. LTD., 1980, WORLD SURVEY OF PHOSPHATE DEPOSITS, 4TH ED., LONDON. & MINING MAGAZINE, JAN., 1989, P. 50.
Tunisia	M'Rata	KRAUSS, U.H., SAAM, H.G., AND SCHMIDT, H.W., 1984, INTERNATIONAL STRATEGIC MINERALS INVENTORY: SUMMARY REPORT--PHOSPHATE, USGS CIRCULAR 930-C. & MINING MAGAZINE, JAN., 1979, MINING ACTIVITY IN THE WESTERN WORLD, P. 5
Tunisia	Oum El Khecheb	MINING JOURNAL, APRIL 10, 1989, P. 189. & BRITISH SULPHUR, LTD., 1985, WORLD SURVEY OF SULPHUR RESOURCES, 3RD ED., P. 114.
Tunisia	Redeyef	BRITISH SULPHUR CORP. LTD., 1980, WORLD SURVEY OF PHOSPHATE DEPOSITS, 4TH ED., LONDON. & HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC
Tunisia	Sra Ouertane (Kef)	KRAUSS, U.H., SAAM, H.G., AND SCHMIDT, H.W., 1984, INTERNATIONAL STRATEGIC MINERALS INVENTORY: SUMMARY REPORT--PHOSPHATE, USGS CIRCULAR 930-C. & CGS METALLOGENIC MAP OF AFRICA
Tunisia	Kalaa Khasba	BRITISH SULPHUR CORP. LTD., 1980, WORLD SURVEY OF PHOSPHATE DEPOSITS, 4TH ED., LONDON. & MINING MAGAZINE, JAN., 1989, P. 50. & SAINFELD, P., 1956, THE LEAD-ZINC BEARING DEPOSITS OF TUNISIA, ECONOMIC GEOLOGY, V. 51, NO. 2, P. 150-177.
Tunisia	Sehib	BRITISH SULPHUR CORP. LTD., 1980, WORLD SURVEY OF PHOSPHATE DEPOSITS, 4TH ED., LONDON. & MINING MAGAZINE, JAN., 1989, P. 50. & LUCAS, J., CHAABANI, F. AND PREVOT, L., 1979, PHOSPHORITES ET EVAPORITES: DEUX FORMATIONS DE MILIEUX SEDIMENTAIRES VOISINS, ETUDIES DANS LA COUPE DU PALEOGENE DE FOUM SELJA (METLAOUI, TUNISIE), SCIENCES GEOLOGIQUES BULL V 32 P 7-19
Tunisia	Fedj Assene	SAINFELD, P., 1956, THE LEAD-ZINC BEARING DEPOSITS OF TUNISIA, ECONOMIC GEOLOGY, V. 51, NO. 2, P. 150-17
Turkey	Bigadic District (Acep, Ankara, Begendikler, Salmanli, others)	ORRIS, G.J., 1995, BORATE DEPOSITS, USGS OPEN-FILE REPORT 95-842.
Turkey	Emet (Derekoy, Espey, Goktepe, Hamamkoy, Hisarcik, Killik)	ORRIS, G.J., 1995, BORATE DEPOSITS, USGS OPEN-FILE REPORT 95-842.
Turkey	Kestelek	
Turkey	Kirka	ORRIS, G.J., 1995, BORATE DEPOSITS, USGS OPEN-FILE REPORT 95-842
Turkey	Guleman Mining Area (Bati Kef and Kefdag)	
Turkey	Kopdag Mining Area	
Turkey	Koycegiz	
Turkey	Derekoy	SINGER, D.A., BERGER, V.I., AND MORING, B.C., 2002, PORPHYRY CU DEPOSITS OF THE WORLD: DATABASE,MAPS, AND PRELIMINARY ANALYSIS, USGS OPEN FILES REPORT 02-268

Table 2. Principal mineral deposits of Africa and the Middle East

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Turkey	GŸzelyayla	SINGER, D.A., BERGER, V.I., AND MORING, B.C., 2002, PORPHYRY CU DEPOSITS OF THE WORLD: DATABASE,MAPS, AND PRELIMINARY ANALYSIS, USGS OPEN FILES REPORT 02-268. & LEAMAN, P., AND STAUDE, J., 2002, METALLOGENIC EVOLUTION OF THE WESTERN TETHYS OF TURKEY AND IRAN, MINERAL POTENTIAL OF ASIA, METAL MINING AGENCY OF JAPAN, P. 15-18.
Turkey	Gümüşhane	
Turkey	Murgul	LEAMAN, P., AND STAUDE, J., 2002, METALLOGENIC EVOLUTION OF THE WESTERN TETHYS OF TURKEY AND IRAN MINERAL POTENTIAL OF ASIA, METAL MINING AGENCY OF JAPAN
Turkey	Efemcukuru	LEAMAN, P., AND STAUDE, J., 2002, METALLOGENIC EVOLUTION OF THE WESTERN TETHYS OF TURKEY AND IRAN MINERAL POTENTIAL OF ASIA, METAL MINING AGENCY OF JAPAN
Turkey	Kaymaz	
Turkey	Kisladag	LEAMAN, P., AND STAUDE, J., 2002, METALLOGENIC EVOLUTION OF THE WESTERN TETHYS OF TURKEY AND IRAN MINERAL POTENTIAL OF ASIA, METAL MINING AGENCY OF JAPAN
Turkey	Kucukdere	
Turkey	Ovacik	LEAMAN, P., AND STAUDE, J., 2002, METALLOGENIC EVOLUTION OF THE WESTERN TETHYS OF TURKEY AND IRAN MINERAL POTENTIAL OF ASIA, METAL MINING AGENCY OF JAPAN
Turkey	Bingöl and Bitlis Area	CHERNOFF, C.B., AND ORRIS, G.J., 2002, DATA SET OF WORLD PHOSPHATE MINES, DEPOSITS, AND OCCURRENCES; PART A: GEOLOGIC DATA, PART B: LOCATION AND MINERAL ECONOMIC DATA, U.S.G.S. OPEN-FILE REPORT 02-0156A AND 02-0156
Turkey	Mazidagi	RUSSELL, A., 1987, PHOSPHATE ROCK - TRENDS IN PROCESSING AND PRODUCTION, INDUSTRIAL MINERALS, NO. 240, P. 45-55. & BERKER, E., 1989, THE MARDIN - MAZIDAGI - DERIK PHOSPHATE DEPOSITS, SOUTH-EASTERN TURKEY, IN NOTHOLT, A.J.G., SHELDON, R.P., AND DAVIDSON, D.F., (EDS.), PHOSPHATE DEPOSITS OF THE WORLD, CAMBRIDGE UNIVERSITY PRESS, CAMBRIDGE P. 380-386
Turkey	Beypazari (Baypazari)	HOUSSA, C.E., 1999, TALKING TURKEY - AN UPDATE ON THE TURKISH MINERALS INDUSTRY, INDUSTRIAL MINERALS, NO. 379, APRIL P. 21-27.
Turkey	Cayelli	
Turkey	Cerateppe	
Uganda	Nakiloro	FLEUTY, M.J., 1961, GEOLOGY OF THE NAKILORO CHROMITE AREA, KARAMOJA, GEOLOGICAL SURVEY OF UGANDA, RECORDS FOR 1957-1958. P. 19-36
Uganda	Jinja	
Uganda	Kilembe	ANDREWS, R.W., 1962, COBALT-- OVERSEAS GEOLOGICAL SURVEYS: MINERAL RESOURCES DIVISION, HER MAJESTY'S STATIONERY OFFICE, LONDON. & MINING MAGAZINE, MAY, 1987, P. 36.
Uganda	Gamba Hill Nampeyo	ACP WEBSITE & BARNES, J.W. (ED.), 1961, THE MINERAL RESOURCES OF UGANDA, GEOL. SURV. OF UGANDA, BULL. NO. 4, P. 9,10,24,27.
Uganda	Sukulu Hills	BRITISH SULPHUR CORP. LTD., 1987, WORLD SURVEY OF PHOSPHATE DEPOSITS, 5TH ED., LONDON. & PELL, J., 1996, MINERAL DEPOSITS ASSOCIATED WITH CARBONATITES AND RELATED ALKALINE IGNEOUS ROCKS, IN MITCHELL, R.H. (ED.), UNDERSATURATED ALKALINE ROCKS: MINERALOGY, PETROGENESIS, AND ECONOMIC POTENTIAL, WINNIPEG, MANITOBA, P. 271-310
Uganda	Bukusu	NOTHOLT, A.J.G., 1994, PHOSPHATE ROCK IN DEVELOPING COUNTRIES: A REVIEW OF GEOLOGY, RESOURCES AND DEVELOPMENT, IN MATHERS, S.J., AND NOTHOLT, A.J.G. (EDS.), INDUSTRIAL MINERALS IN DEVELOPING COUNTRIES, AGID REPORT SERIES, GEOSCINECES IN INTL. DEVELOPMENT 18. & DE KUN, N., 1987, MINERAL ECONOMICS OF AFRICA, DEVELOPMENTS OF ECONOMIC GEOLOGY, V. 22
Uganda	Nyamalilo (Nyamulilo, Mpororo, Ruhiza, Rushunga, Nyamuliro, Bjordal)	REEDMAN, A.J., 1973, PARTLY REMOBILIZED SYNGENETIC TUNGSTEN DEPOSIT AT NYAMALILO MINE, OVERSEAS GEOLOGY AND MINERAL RESOURCES, NO. 41, LONDON, INSTITUTE OF GEOLOGICAL SCIENCES, H.M.S.O., P. 101-106. & PALLISTER, J.W., THE GEOLOGY OF SOUTHERN MENGO. GEOLOGICAL SURVEY OF UGANDA. BULL. NO. 1
Western Sahara	Bou Craa	BRITISH SULPHUR CORP. LTD., 1980, WORLD SURVEY OF PHOSPHATE DEPOSITS, 4TH ED., LONDON. & HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC
Yemen	Jabali	MCCOMBE, D.A., FERNETTE, G.L., AALAWI A.J., 1994, THE GEOLOGICAL AND MINERAL RESOURCES OF YEMEN, MINISTRY OF OIL AND MINERAL RESOURCES, GEOLOGICAL SURVEY OF YEMEN, SANA'A, YEMEN
Zambia	Bwana Mkubwa	PELLETIER, R.A., 1964, MINERAL RESOURCES OF SOUTH-CENTRAL AFRICA, OXFORD UNIV. PRESS, LONDON. & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM
Zambia	Chambishi	TER BRUGGEN J.W., 1972, INTRODUCTION INTO MINING AND METALLURGY ON THE ZAMBIAN COPPERBELT, GEOLOGIE EN MIJNBOUW, V. 51, P. 361-370. & MINING MAGAZINE, JAN., 1989, P. 50
Zambia	Chimiwungo	BENHAM, D. G., GREIG, D. D., AND VINK, B. W., 1976, COPPER OCCURRENCES OF THE MOMBEZHI DOME AREA, NORTHWESTERN ZAMBIA, ECONOMIC GEOLOGY, V. 71, 1976, P433-442. & MINING JOURNAL, NOV. 14, 1975, FEASIBILITY STUDY AT LUMWANA, P. 372.
Zambia	Hippo	MINING ANNUAL REVIEW, 1972, P. 345
Zambia	Kalengwa	WORLD MINING, KALENGWA CU MINE IS ZAMBIA'S MIGHTY MIDGET, JUNE, 1972, P.32. & MINING MAGAZINE, 1971, MAY, V. 124, P. 347-349.
Zambia	Kansanshi	MINING MAGAZINE, JAN., 1989, P. 50

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Zambia	Konkola	SUTTON, S.J., AND MAYNARD, J.B., 2004, A FLUID MIXING MODEL FOR COPPER MINERALIZATION AT KONKOLA NORTH, ZAMBIAN COPPERBELT, JOURNAL OF AFRICAN EARTH SCIENCES, V. 42, ISSUES 1-5, P. 95-118
Zambia	Luanshya	MINING MAGAZINE, JAN., 1989, P. 50
Zambia	Malundwe	BENHAM, D. G., GREIG, D. D., AND VINK, B. W., 1976, COPPER OCCURRENCES OF THE MOMBEZHI DOME AREA, NORTHWESTERN ZAMBIA, ECONOMIC GEOLOGY, V. 71, 1976, P433-442. & MINING JOURNAL, NOV. 14, 1975, FEASIBILITY STUDY AT LUMWANA, P. 372.
Zambia	Baluba	ANDREWS, R.W., 1962, COBALT-- OVERSEAS GEOLOGICAL SURVEYS: MINERAL RESOURCES DIVISION, HER MAJESTY'S STATIONERY OFFICE, LONDON, P. 71. & TER BRUGGEN J.W., 1972, INTRODUCTION INTO MINING AND METALLURGY ON THE ZAMBIAN COPPERBELT, GEOLOGIE EN MIJNBOUW, V. 51, P. 361-370
Zambia	Bancroft	ANDREWS, R.W., 1962, COBALT-- OVERSEAS GEOLOGICAL SURVEYS: MINERAL RESOURCES DIVISION, HER MAJESTY'S STATIONERY OFFICE, LONDON
Zambia	Chibuluma	TER BRUGGEN J.W., 1972, INTRODUCTION INTO MINING AND METALLURGY ON THE ZAMBIAN COPPERBELT, GEOLOGIE EN MIJNBOUW, V. 51, P. 361-370. & ANDREWS, R.W., 1962, COBALT-- OVERSEAS GEOLOGICAL SURVEYS: MINERAL RESOURCES DIVISION, HER MAJESTY'S STATIONERY OFFICE, LONDON
Zambia	Nchanga	JACKSON, G.C.A., 1932, THE ORES OF THE NCHANGA MINE AND EXTENSIONS, NORTHERN RHODESIA, ECONOMIC GEOLOGY, V. 27, P. 247-280. & TER BRUGGEN J.W., 1972, INTRODUCTION INTO MINING AND METALLURGY ON THE ZAMBIAN COPPERBELT, GEOLOGIC EN MIJNBOUW, V. 51, P. 361-370
Zambia	Nkana (Mindola)	MCMAHON, A.D., 1965, COPPER, A MATERIALS SURVEY, US BUREAU OF MINES, INFORMATION CIRCULAR 8225, P. 71. & ANDREWS, R.W., 1962, COBALT - OVERSEAS GEOLOGICAL SURVEYS: MINERAL RESOURCES DIVISION, HER MAJESTY'S STATIONERY OFFICE, LONDON, P. 71.
Zambia	Mkushi	MINING ANNUAL REVIEW, 1974, P. 361 & DE VLETTER, D.R., 1972, SPECIAL ISSUE GEOLOGIE EN MIJNBOUW, V. 51, NO. 3., P. 251-263.
Zambia	Mtuga (Coloquo, Kolokwo, Munshiwemba)	REEVE, W.H., THE GEOLOGY AND MINERAL RESOURCES OF NORTHERN RHODESIA, BULLETIN OF THE GEOLOGICAL SURVEY NO. 3 LUSAKA, P. 69-70. & CGS METALLOGENIC MAP OF AFRICA
Zambia	Allies (Allies 2, Sisengo, Changwe)	REEVE, W.H., THE GEOLOGY AND MINERAL RESOURCES OF NORTHERN RHODESIA, BULLETIN OF THE GEOLOGICAL SURVEY NO. 3 LUSAKA, P. 63. & ACP WEBSITE
Zambia	Chongwe	REEVE, W.H., THE GEOLOGY AND MINERAL RESOURCES OF NORTHERN RHODESIA, BULLETIN OF THE GEOLOGICAL SURVEY NO. 3 LUSAKA, P. 134-135. & CGS METALLOGENIC MAP OF AFRICA
Zambia	Mufulira	VAN EDEN, J.G., 1974, DEPOSITIONAL AND DIAGENETIC ENVIRONMENT RELATED TO SULFIDE MINERALIZATION, MUFULIRA, ZAMBIA: ECONOMIC GEOLOGY, V. 69, P. 59-79. & DEKUN, NICOLAS, 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER, AMSTERDAM, P. 740.
Zambia	Aries	REEVE, W.H., THE GEOLOGY AND MINERAL RESOURCES OF NORTHERN RHODESIA, BULLETIN OF THE GEOLOGICAL SURVEY NO. 3 LUSAKA, P. 143. & CGS METALLOGENIC MAP OF AFRICA
Zambia	Miku	REEVE, W.H., THE GEOLOGY AND MINERAL RESOURCES OF NORTHERN RHODESIA, BULLETIN OF THE GEOLOGICAL SURVEY NO. 3 LUSAKA, P. 142. & ACP WEBSITE
Zambia	Dunrobin	ACP WEBSITE
Zambia	Matala	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
Zambia	Chongwe East	CGS METALLOGENIC MAP OF AFRICA & REEVE, W.H., 1963, THE GEOLOGY AND MINERAL RESOURCES OF NORTHERN RHODESIA, BULLETIN OF THE GEOLOGICAL SURVEY #3, NORTHERN RHODESIA MINISTRY OF LABOUR AND MINES
Zambia	Pamba	CGS METALLOGENIC MAP OF AFRICA & REEVE, W.H., 1963, THE GEOLOGY AND MINERAL RESOURCES OF NORTHERN RHODESIA, BULLETIN OF THE GEOLOGICAL SURVEY #3, NORTHERN RHODESIA MINISTRY OF LABOUR AND MINES, P. 128-13
Zambia	Shimyoka (Shimwyoka)	REEVE, W.H., THE GEOLOGY AND MINERAL RESOURCES OF NORTHERN RHODESIA, BULLETIN OF THE GEOLOGICAL SURVEY NO. 3 LUSAKA, P. 135-137
Zambia	Kampumba	ACP WEBSITE & FOCKEMA, R.A.F., 1957, A BRIEF DESCRIPTION OF THE IRON-MANGANESE DEPOSITS AT KAMPUMBA, NORTHERN RHODESIA, TRANSACTIONS OF THE GEOLOGICAL SOCIETY OF SOUTH AFRICA, V. 60, P81-86
Zambia	Kabwe	AME MINERAL ECONOMICS QUARTERLY MINE ANALYSIS, JUNE, 1993, P. 39, 49. & MINING MAGAZINE, JAN., 1989, P. 5
Zambia	Broken Hill	WHYTE, W.J., 1968, GEOLOGY OF THE BROKEN HILL MINE, ZAMBIA, IN NICOLINI, P. (ED.), LEAD-ZINC DEPOSITS IN AFRICA, ANNALES DES MINES ET DE LA GEOLOGIE, NO. 23, P. 393
Zambia	Chiwefwe	REEVE, W.H., THE GEOLOGY AND MINERAL RESOURCES OF NORTHERN RHODESIA, BULLETIN OF THE GEOLOGICAL SURVEY NO. 3 LUSAKA, P. 87. & ACP WEBSITE
Zambia	Nampundwe	REEVE, W.H., THE GEOLOGY AND MINERAL RESOURCES OF NORTHERN RHODESIA, BULLETIN OF THE GEOLOGICAL SURVEY NO. 3 LUSAKA, P. 125-126. & MINING MAGAZINE, JANUARY 1989, P. 50
Zimbabwe	Boss	MINING MAGAZINE ANNUAL REVIEW, JUNE, 1975, P. 423
Zimbabwe	Gaths	MINING MAGAZINE ANNUAL REVIEW, JUNE, 1975, P. 423. & MINING MAGAZINE, JANUARY, 1989, P. 5
Zimbabwe	King	MINING MAGAZINE, APRIL 11, 1972. & MINING MAGAZINE ANNUAL REVIEW, JUNE, 1975, P. 42
Zimbabwe	Kudu	MINING MAGAZINE, MARCH, 1978, MINING ACTIVITY IN THE WESTERN WORLD, P. 235
Zimbabwe	Mashaba	MANOS, ANTHONY, 1978, INDUSTRIAL MINERALS OF RHODESIA, IN INDUSTRIAL MINERALS, NO. 126, P. 93-10

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Zimbabwe	Shabanie (Nil Desperandum)	HARBEN, P.W., AND KUZVART, M., 1996, INDUSTRIAL MINERALS - A GLOBAL GEOLOGY, LONDON, METAL BULLETIN PLC. & CGS METALLOGENIC MAP OF AFRICA
Zimbabwe	Temeraire	MINING MAGAZINE ANNUAL REVIEW, JUNE, 1975, P. 423
Zimbabwe	Bat Claims (Ngezi Cooperative)	
Zimbabwe	Bee	WORST, B.W., 1960, THE GREAT DYKE OF SOUTHERN RHODESIA, SOUTHERN RHODESIA GEOLOGICAL SURVEY BULLETIN, 47, SALISBURY.
Zimbabwe	Caesar	DAVIES, R.D., ALLSOPP, H.L., ERLANK, A.J., AND MANTON, W.I., 1970, SR - ISOTOPIC STUDIES ON VARIOUS LAYERED INTRUSIONS IN SOUTHERN AFRICA, GEOLOGICAL SOCIETY OF SOUTH AFRICA, SPECIAL PUBLICATION 1, P. 576-59
Zimbabwe	Cambrai	WORST, B.W., 1960, THE GREAT DYKE OF SOUTHERN RHODESIA, SOUTHERN RHODESIA GEOLOGICAL SURVEY BULLETIN, 47, SALISBURY.
Zimbabwe	Central Midlands	
Zimbabwe	Crown Divide North	
Zimbabwe	Divide (Francis)	WORST, B.W., 1960, THE GREAT DYKE OF SOUTHERN RHODESIA, SOUTHERN RHODESIA GEOLOGICAL SURVEY BULLETIN, 47, SALISBURY.
Zimbabwe	Glenapp	WORST, B.W., 1960, THE GREAT DYKE OF SOUTHERN RHODESIA, SOUTHERN RHODESIA GEOLOGICAL SURVEY BULLETIN, 47, SALISBURY & ALREY, N.M., 1975, A REVIEW OF CHROMITE MINING IN THE GREAT DYKE, CHAMBER OF MINES JOURNAL, JUNE, P. 35-43.
Zimbabwe	Great Dyke	DEYOUNG, J.H, LEE, M.P., AND LIPIN, B.R., 1984, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT: CHROMIUM, U.S.G.S. CIRULAR 930-B, P. 41
Zimbabwe	Greenvale	
Zimbabwe	Impinge	WORST, B.W., 1960, THE GREAT DYKE OF SOUTHERN RHODESIA, SOUTHERN RHODESIA GEOLOGICAL SURVEY BULLETIN, 47, SALISBURY.
Zimbabwe	Inyala	
Zimbabwe	Iron Sides	ALREY, N.M., 1975, A REVIEW OF CHROMITE MINING IN THE GREAT DYKE, CHAMBER OF MINES JOURNAL, JUNE 1975. P.35-43. & COTTERILL, P., 1969, THE CHROMITE DEPOSITS OF SELUKWE, RHODESIA, ECONOMIC GEOLOGY MONOGRAPH NO.4. P. 154-186.
Zimbabwe	Iron Ton	ALREY, N.M., 1975, A REVIEW OF CHROMITE MINING IN THE GREAT DYKE, CHAMBER OF MINES JOURNAL, JUNE 1975. P.35-43. & COTTERILL, P., 1969, THE CHROMITE DEPOSITS OF SELUKWE, RHODESIA, ECONOMIC GEOLOGY MONOGRAPH NO.4. P. 154-186.
Zimbabwe	Lalapanzi	WORST, B.W., 1960, THE GREAT DYKE OF SOUTHERN RHODESIA, SOUTHERN RHODESIA GEOLOGICAL SURVEY BULLETIN, 47, P. 32-36, 82-84, AND 196-231
Zimbabwe	Magazine Hill	ALREY, N.M., 1975, A REVIEW OF CHROMITE MINING IN THE GREAT DYKE, CHAMBER OF MINES JOURNAL, JUNE 1975. P.35-43. & COTTERILL, P., 1969, THE CHROMITE DEPOSITS OF SELUKWE, RHODESIA, ECONOMIC GEOLOGY MONOGRAPH NO.4. P. 154-186.
Zimbabwe	Magundi	
Zimbabwe	Maryland	
Zimbabwe	Mcgowan	
Zimbabwe	Mdindi (Mapanzuri, Chrome Hill)	
Zimbabwe	Netherburn	WORST, B.W., 1960, THE GREAT DYKE OF SOUTHERN RHODESIA, SOUTHERN RHODESIA GEOLOGICAL SURVEY BULLETIN, 47, SALISBURY. & ACP WEBSITE
Zimbabwe	Noro (Hay)	WORST, B.W., 1960, THE GREAT DYKE OF SOUTHERN RHODESIA, SOUTHERN RHODESIA GEOLOGICAL SURVEY BULLETIN, 47, SALISBURY. & ACP WEBSITE
Zimbabwe	Ore Recovery Tribute	ALREY, N.M., 1975, A REVIEW OF CHROMITE MINING IN THE GREAT DYKE, CHAMBER OF MINES JOURNAL, JUNE 1975. P.35-43. & COTTERILL, P., 1969, THE CHROMITE DEPOSITS OF SELUKWE, RHODESIA, ECONOMIC GEOLOGY MONOGRAPH NO.4. P. 154-186.
Zimbabwe	Pons	
Zimbabwe	Railway Block	COTTERILL, P., 1979, THE SELUKWE SCHIST BELT AND ITS CHROMITITE DEPOSITS, IN ANHAEUSSER, C.R., FOSTER, R.P., AND STRATTEN, T. (EDS.), A SYMPOSIUM ON MINERAL DEPOSITS AND THE TRANSPORTATION AND DEPOSITION OF METALS, GEOLOGICAL SOCIETY OF SOUTH AFRICA, SPECIAL PUBLICATION 5, P. 229-246. & CGS METALLOGENIC MAP OF AFRICA
Zimbabwe	Rhodesia	
Zimbabwe	Rose (Seymore, Makamisa)	
Zimbabwe	Rutala	WORST, B.W., 1960, THE GREAT DYKE OF SOUTHERN RHODESIA, SOUTHERN RHODESIA GEOLOGICAL SURVEY BULLETIN, 47, SALISBURY. & ACP WEBSITE
Zimbabwe	Selukwe Peak	COTTERILL, P., 1979, THE SELUKWE SCHIST BELT AND ITS CHROMITITE DEPOSITS, IN ANHAEUSSER, C.R., FOSTER, R.P., AND STRATTEN, T. (EDS.), A SYMPOSIUM ON MINERAL DEPOSITS AND THE TRANSPORTATION AND DEPOSITION OF METALS, GEOLOGICAL SOCIETY OF SOUTH AFRICA, SPECIAL PUBLICATION 5, P. 229-246. & CGS METALLOGENIC MAP OF AFRICA
Zimbabwe	Shurugwi Peak	
Zimbabwe	Spot	

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Zimbabwe	Sutton (Rodcamp)	ALREY, N.M., 1975, A REVIEW OF CHROMITE MINING IN THE GREAT DYKE, CHAMBER OF MINES JOURNAL, JUNE 1975. P.35-43. & COTTERILL, P., 1969, THE CHROMITE DEPOSITS OF SELUKWE, RHODESIA, ECONOMIC GEOLOGY MONOGRAPH NO.4. P. 154-186.
Zimbabwe	Umsweswe (Bee)	WORST, B.W., 1960, THE GREAT DYKE OF SOUTHERN RHODESIA, SOUTHERN RHODESIA GEOLOGICAL SURVEY BULLETIN, 47, SALISBURY. & ACP WEBSITE
Zimbabwe	Umvukwes Section	ACP WEBSITE
Zimbabwe	Valley Chrome	ALREY, N.M., 1975, A REVIEW OF CHROMITE MINING IN THE GREAT DYKE, CHAMBER OF MINES JOURNAL, JUNE 1975. P.35-43. & COTTERILL, P., 1969, THE CHROMITE DEPOSITS OF SELUKWE, RHODESIA, ECONOMIC GEOLOGY MONOGRAPH NO.4. P. 154-186.
Zimbabwe	Vanad (Rhod African Chrom)	BICHAN, R., 1969, ORIGIN OF CHROMITE SEAMS IN THE HARTLEY COMPLEX OF THE GREAT DYKE OF RHODESIA, IN WILSON, H.B.D. (ED.), MAGMATIC ORE DEPOSITS, A SYMPOSIUM, ECONOMIC GEOLOGY MONOGRAPH 4, P. 95-113. & WORST, B.W., 1960, THE GREA DYKE OF SOUTHERN RHODESIA, SOUTHERN RHODESIA GEOLOGICAL SURVEY BULLETIN, 47, SALISBURY
Zimbabwe	Windsor	WORST, B.W., 1960, THE GREAT DYKE OF SOUTHERN RHODESIA, SOUTHERN RHODESIA GEOLOGICAL SURVEY BULLETIN, 47, SALISBURY. & ACP WEBSITE
Zimbabwe	York	WORST, B.W., 1960, THE GREAT DYKE OF SOUTHERN RHODESIA, SOUTHERN RHODESIA GEOLOGICAL SURVEY BULLETIN, 47, SALISBURY. & ACP WEBSITE
Zimbabwe	Ngezi (Bee)	ACP WEBSITE
Zimbabwe	Alaska	JACOBSEN, J.B.E., 1964, THE GEOLOGY OF THE ALASKA MINE, IN THE GEOLOGY OF SOME ORE DEPOSITS OF SOUTHERN AFRICA, VOL. II, GEOLOGICAL SOCIETY OF SOUTH AFRICA, P. 353-366 & TOOMBS, R.B., 1962, A SURVEY OF THE MINERAL INDUSTRY OF SOUTHERN AFRICA, MINERAL INFORMATION BULLETIN MR 58, DEPARTMENT OF MINES AND TECHNICAL SURVEY, OTTAWA.
Zimbabwe	Inyati	MINING MAGAZINE ANNUAL REVIEW, JUNE, 1972, P. 340. & MINING JOURNAL, MAR., 1972, P. 20
Zimbabwe	Norah	ACP WEBSITE
Zimbabwe	Sanyati	METALS WEEK, JAN. 30, 1995, V. 66, NO. 5, P. 6. & BAHNEMANN K.P., 1961, THE ORES OF THE J'LINES, SANYATI COPPER MINE, SOUTHERN RHODESIA, TRANSACTION OF THE GEOLOGICAL SOCIETY OF SOUT AFRICA, VOL. 64
Zimbabwe	Shackelton (Avondale, Angwa (Cu), Alaska)	ACP WEBSITE & CGS METALLOGENIC MAP OF AFRICA
Zimbabwe	Mangula	MINING JOURNAL, DEC. 8, 1989, MHANGURA COPPER REVIEW, P. 462
Zimbabwe	River Ranch	INDUSTRIAL MINERALS, SEPT., 1993, AURIDIAM DEVELOPS DIAMOND MINE, NO. 312, P. 23 & CGS METALLOGENIC MAP OF AFRICA
Zimbabwe	Bell, (Riverlea)	ACP WEBSITE & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBL.CO., AMSTERDAM
Zimbabwe	Blanket	ACP WEBSITE & FOSTER, R.P., MANN, A.G., STOWE, C.W., AND WILSON, J.F., 1986, ARCHEAN GOLD MINERALISATION IN ZIMBABWE, IN ANHAEUSSER, C.R., AND MASKE, S. (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, GEOLOGICAL SOCIETY OF SOUTH AFRICA, P. 43-112.
Zimbabwe	Commoner (Welcome Back, Colombina)	ACP WEBSITE
Zimbabwe	Dalny (Colne, Pixie)	ACP WEBSITE & BOYLE, R.W., 1979, THE GEOCHEMISTRY OF GOLD AND ITS DEPOSITS, GEOL. SURV. OF CANADA, BULLETIN 280.
Zimbabwe	Dawn (Queens Group, Barberton, Czarina, Queen's Mine)	ACP WEBSITE & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBL.CO., AMSTERDAM.
Zimbabwe	Eiffel Flats (Eiffel Blue)	ACP WEBSITE
Zimbabwe	Elvington (Lone Star)	ACP WEBSITE
Zimbabwe	Felixburg Gold Belt	WORLD MINING, RHODESIAN MINING TODAY: THE FAILURE OF SANCTIONS, DEC., 1967, P. 20-23. & MINING MAGAZINE, ANNUAL REVIEW, JUNE, 1966, P. 219
Zimbabwe	Freda Rebecca	ACP WEBSITE & ENGINEERING AND MINING JOURNAL, MAY, 1993, P. 31
Zimbabwe	Gaika (Robin Hood)	ACP WEBSITE & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBL.CO., AMSTERDAM
Zimbabwe	Globe and Phoenix	ACP WEBSITE & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBL.CO., AMSTERDAM
Zimbabwe	Indarama (Futi, Broomstock)	ACP WEBSITE & INTERNATIONAL DIRECTORY OF MINING AND MINERAL PROCESSING OPERATIONS,1978 MCGRAW HILL, N.Y., P. 334.
Zimbabwe	Isabella (Calcite 1)	ACP WEBSITE
Zimbabwe	Kanyemba (Electra)	ACP WEBSITE & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBL.CO., AMSTERDAM
Zimbabwe	Long John	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P.160 AND 32
Zimbabwe	Marvel	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P. 32
Zimbabwe	Old Nic	ACP WEBSITE
Zimbabwe	Patchway (Brompto)	ACP WEBSITE & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBL.CO., AMSTERDAM
Zimbabwe	Pickstone (Pitchstone, Peerless, Concession Hill (doublon), Duchess Hill, St Kilda)	ACP WEBSITE
Zimbabwe	Rezende (Rezende Group, Elgin, Perthshire, Umtali)	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P.329. & CGS METALLOGENIC MAP OF AFRICA
Zimbabwe	Sabi	ACP WEBSITE

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	References
Zimbabwe	Sebakwe	WORLD MINING, RHODESIAN MINING TODAY: THE FAILURE OF SANCTIONS, DEC., 1973, P. 20-23
Zimbabwe	Venice	ACP WEBSITE
Zimbabwe	Vubachikwe	CGS METALLOGENIC MAP OF AFRICA
Zimbabwe	Cam and Motor	CGS METALLOGENIC MAP OF AFRICA & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM, P. 325
Zimbabwe	Renco	FOSTER, R.P., MANN, A.G., STOWE, C.W., AND WILSON, J.F., 1986, ARCHEAN GOLD MINERALISATION IN ZIMBABWE, IN ANHAEUSSER, C.R., AND MASKE, S. (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, GEOLOGICAL SOCIETY OF SOUTH AFRICA, P. 23-33. & MINING MAGAZINE, JAN., 1989, P. 50
Zimbabwe	Athens	TAYLOR, G.H., 1977, GEOLOGY OF THE ATHENS AU-CU MINE, INST. MIN. RESEARCH, 8TH ANNUAL REPORT, P. 4 & FOSTER, R.P., MANN, A.G., STOWE, C.W., AND WILSON, J.F., 1986, ARCHEAN GOLD MINERALISATION IN ZIMBABWE, IN ANHAEUSSER, C.R., AND MASKE, S. (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, GEOLOGICAL SOCIETY OF SOUTH AFRICA, P. 43-11
Zimbabwe	Golden Kopje (Union Jack)	ACP WEBSITE
Zimbabwe	Arcturus	ACP WEBSITE & FOSTER, R.P., MANN, A.G., STOWE, C.W., AND WILSON, J.F., 1986, ARCHEAN GOLD MINERALISATION IN ZIMBABWE, IN ANHAEUSSER, C.R., AND MASKE, S. (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, GEOLOGICAL SOCIETY OF SOUTH AFRICA, P. 43-112.
Zimbabwe	How	ACP WEBSITE & FOSTER, R.P., MANN, A.G., STOWE, C.W., AND WILSON, J.F., 1986, ARCHEAN GOLD MINERALISATION IN ZIMBABWE, IN ANHAEUSSER, C.R., AND MASKE, S. (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, GEOLOGICAL SOCIETY OF SOUTH AFRICA, P. 43-112.
Zimbabwe	Mazoe (Mazowe, Carn Brae, Birthday 3, Nucleus, Jumbo 1, Connaught, Bojum, Bucks 2, Flowing Bowl, Commonwealth)	ACP WEBSITE & FOSTER, R.P., MANN, A.G., STOWE, C.W., AND WILSON, J.F., 1986, ARCHEAN GOLD MINERALISATION IN ZIMBABWE, IN ANHAEUSSER, C.R., AND MASKE, S. (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, GEOLOGICAL SOCIETY OF SOUTH AFRICA, P. 43-112.
Zimbabwe	Redwing and Oldwest	ACP WEBSITE & BOWEN, D.J., 1980, GOLD MINES OF RHODESIA, 1890-1980, THOMSON NEWSPAPERS (ZIMBABWE) LTD., HARARE, P. 78-82.
Zimbabwe	Shamva (Ashkirk, Cymric)	ACP WEBSITE & FOSTER, R.P., MANN, A.G., STOWE, C.W., AND WILSON, J.F., 1986, ARCHEAN GOLD MINERALISATION IN ZIMBABWE, IN ANHAEUSSER, C.R., AND MASKE, S. (EDS.), MINERAL DEPOSITS OF SOUTHERN AFRICA, GEOLOGICAL SOCIETY OF SOUTH AFRICA, P. 43-112.
Zimbabwe	Bulawayo District	ACP WEBSITE
Zimbabwe	Golden Valley	ACP WEBSITE & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBL.CO., AMSTERDAM
Zimbabwe	Bindura	ACP WEBSITE
Zimbabwe	Lynx	KRAUSS, U.H., SCHMITT, H.W., TAYLOR, H.A., JR. AND SUTHPHIN, D.M., 1988, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - NATURAL GRAPHITE, USGS, CIRC. 930-H. & STAGMAN, J.G., 1978, AN OUTLINE OF THE GEOLOGY OF RHODESIA, RHODESIA GEOL. SURV., BULLETIN NO. 80
Zimbabwe	Buchwa (Buhwa, Doughnut, Fulano, Garrat-Diesel, Grandeux, Ironic, Norie, Vent, Whikwi)	ACP WEBSITE & AME MINERAL ECONOMICS QUARTERLY MINE ANALYSIS, JUNE, 1993, P. 36.
Zimbabwe	Mwanesi	ACP WEBSITE
Zimbabwe	Que Que Iron (Kwekwe District)	ACP WEBSITE & UNITED NATIONS SURVEY OF WORLD IRON ORE RESOURCES, DEPT. OF ECONOMIC AND SOCIAL AFFAIRS, NEW YORK, 1970, P. 83
Zimbabwe	Ripple Creek	MINING MAGAZINE, JAN., 1989, P. 50. & CGS METALLOGENIC MAP OF AFRIC
Zimbabwe	Bikita (Mdara)	PARRY, 1980 ; THOMAS, G.W.W., AND BUCKLEY, S.A., 1987, INTRODUCTION OF HEAVY MEDIA SEPARATION AT BIKITA MINERALS, AFRICAN MINING, HARARE, ZIMBABWE, P. 375-383
Zimbabwe	Richmond	ACP WEBSITE
Zimbabwe	Epoch	DEYOUNG, J.H., SUTPHIN, D.M., WERNER, A.B.T., AND FOOSE, M.P., 1985, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - NICKEL, USGS CIRCULAR 930-D. & CLUTTEN, J.M., OSTER, R.P., AND MARTIN, A., 1981, NICKEL MINERALIZATION IN ZIMBABWE, EPISODES, V. 1981, NO. 2, P. 10-15
Zimbabwe	Hunters Road	ACP WEBSITE
Zimbabwe	Perseverence	CGS METALLOGENIC MAP OF AFRICA
Zimbabwe	Empress	SHARPE J.W.N, 1975, THE EMPRESS NICKEL-COPPER DEPOSIT, SOUTHERN RHODESIA, ENGINEERING AND MINING JOURNAL, P. 263. & EALES, H.V., 1964, MINEROLOGY AND PETROLOGYOF THE EMPRESS NICKEL - COPPER DEPOSIT, SOUTHERN RHODESIA, TRANSACTIONS OF THE GEOLOGICAL SOCIETY OF SOUTH AFRICA, V. 67, P. 173-201
Zimbabwe	Madziwa	CLUTTEN, J.M., FOSTER, R.P., AND MARTIN, A., 1981, NICKEL MINERALIZATION IN ZIMBABWE: EPISODES, V. 2, P. 10-15
Zimbabwe	Trojan	DEYOUNG, J.H., SUTPHIN, D.M., WERNER, A.B.T., AND FOOSE, M.P., 1985, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - NICKEL, USGS CIRCULAR 930-D. & CGS METALLOGENIC MAP OF AFRIC
Zimbabwe	Shangani	DEYOUNG, J.H., SUTPHIN, D.M., WERNER, A.B.T., AND FOOSE, M.P., 1985, INTERNATIONAL STRATEGIC MINERALS INVENTORY SUMMARY REPORT - NICKEL, USGS CIRCULAR 930-D. & VILJOEN, M.J., BERNASCONI, A., VAN COLLER, N., KINLOCK, E., AND VILJOEN, R.P., 1976, THE GEOLOGY OF THE SHANGANI NICKEL DEPOSIT, RHODESIA, ECONOMIC GEOLOGY, V. 71, NO. 1, P. 76-95.
Zimbabwe	Hartley	

Table 2. Principal mineral deposits of Africa and the Middle East

Country	Deposit Name	References
Zimbabwe	Makwiro Platinum Field	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 45-48 & WORST, B.G., 1960, THE GREAT DYKE OF SOUTHERN RHODESIA, SOUTHERN RHODESIA GEOLOGICAL SURVEY BULL. NO. 47, P. 125.
Zimbabwe	Wedza (Mimosa)	MERTIE, J.B., 1969, ECONOMIC GEOLOGY OF THE PLATINUM GROUP METALS, USGS PROFESSIONAL PAPER 630, P. 49. & ACP WEBSITE
Zimbabwe	Dorowa	CGS METALLOGENIC MAP OF AFRICA & BRITISH SULPHUR CORP. LTD., 1980, WORLD SURVEY OF PHOSPHATE DEPOSITS, 4TH ED., LONDON.
Zimbabwe	Shawa	CGS METALLOGENIC MAP OF AFRICA
Zimbabwe	Benson Pegmatites	DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM
Zimbabwe	Kamativi	ACP WEBSITE & DE KUN, N., 1965, THE MINERAL RESOURCES OF AFRICA, ELSEVIER PUBLISHING COMPANY, AMSTERDAM.
Zimbabwe	Sunyati	GALLEY, A.G., HANNINGTON, M.D., AND JONASSON, I.R., 2007, VOLCANOGENIC MASSIVE SULFIDE DEPOSITS, in GOODFELLOW, W.D., ed., MINERAL DEPOSITS OF CANADA, GEOLOGIC ASSOC. OF CANADA, MINERAL DEPOSITS DIVISION, SPECIAL PUBLICATION NO. 5, P. 141-161.

Table 3.—Mineral deposit types and examples

Mineral Deposit Type	Deposit Types and Process of Formation	Examples
Surficial deposits	Deposits that form at the Earth's surface by residual effects of weathering or by the mechanical concentration of minerals by flowing water.	Deposits enriched in residual aluminum, nickel, and clay. Placer deposits of gold, platinum, and titanium.
Sedimentary deposits	Deposits that form from surface waters that chemically precipitated the minerals. Includes evaporite deposits.	Sedimentary layers of salts such as halite and potash, phosphate, most iron deposits, and limestone.
Hydrothermal deposits	Deposits that form mostly from fluids in veins at moderate temperatures.	Some gold and silver deposits and lead-zinc-copper polymetallic veins; hot spring deposits. Porphyry copper deposits.
Igneous deposits	Deposits that form from the crystallization of molten rock.	Nickel deposits, gemstones in pegmatite deposits, Rare earth element deposits.
Metamorphic deposits	Deposits that form when rocks are metamorphosed by heat and pressure.	Graphite, magnesite, talc, and wollastonite deposits.

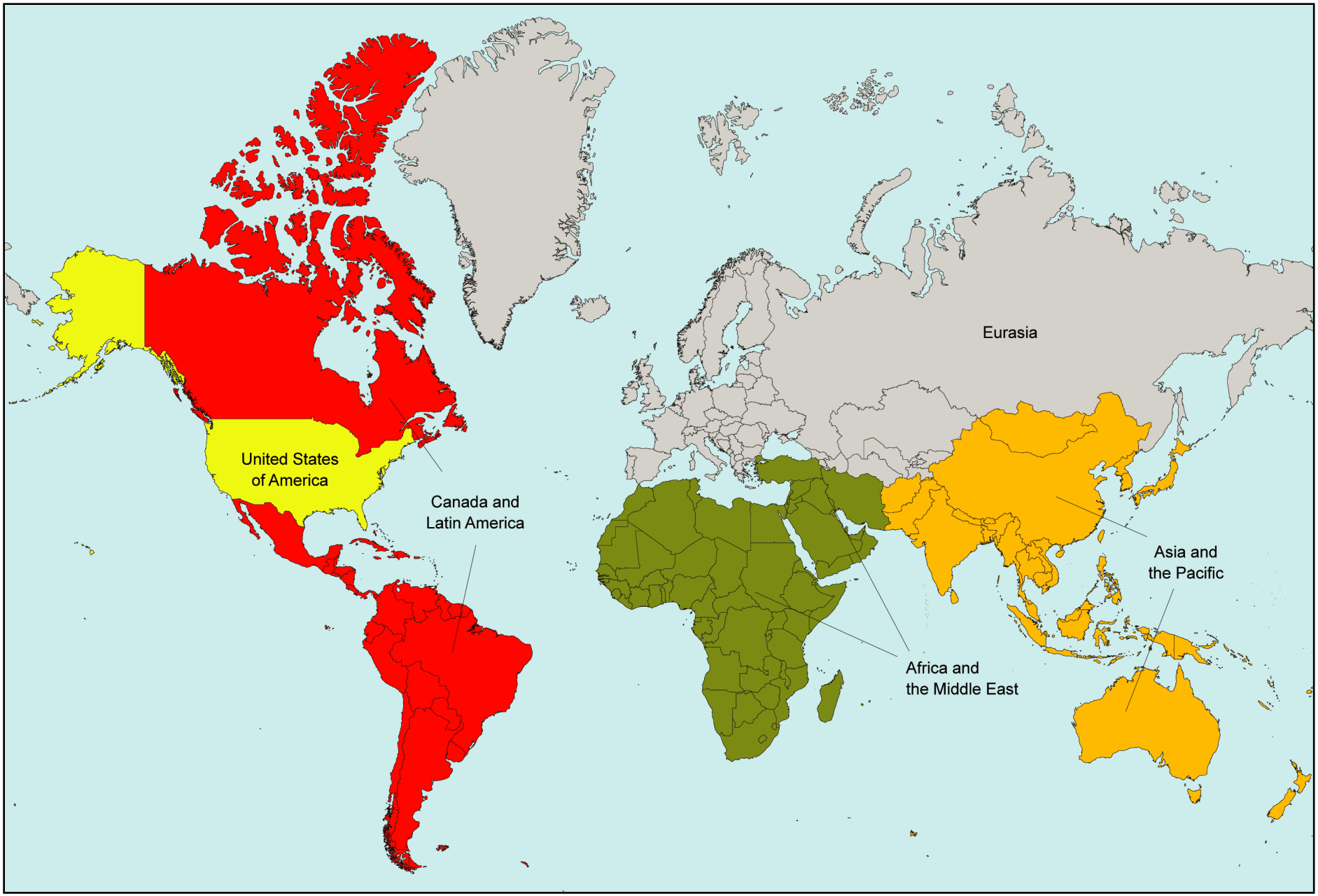


Figure 1. Map showing areas of the regional reports. The area of this report is in green.



Figure 2. Digital elevation image of Africa, the Middle East, and the surrounding ocean basins. Major aspects of the geology of the world are evident in the differences in elevation (topography). Examples include folded mountain ranges (orogens) such as the Atlas Mountains, volcanic mountain ranges that encircle the globe beneath the sea (mid-ocean ridges), linear depressions formed where continental crust is being stretched (East African rift system), and topographic highs formed where geologically old, stable rocks that are the nuclei of continents (shields) are present (Arabian shield).



Figure 3. Map showing location and names of countries covered in this report.

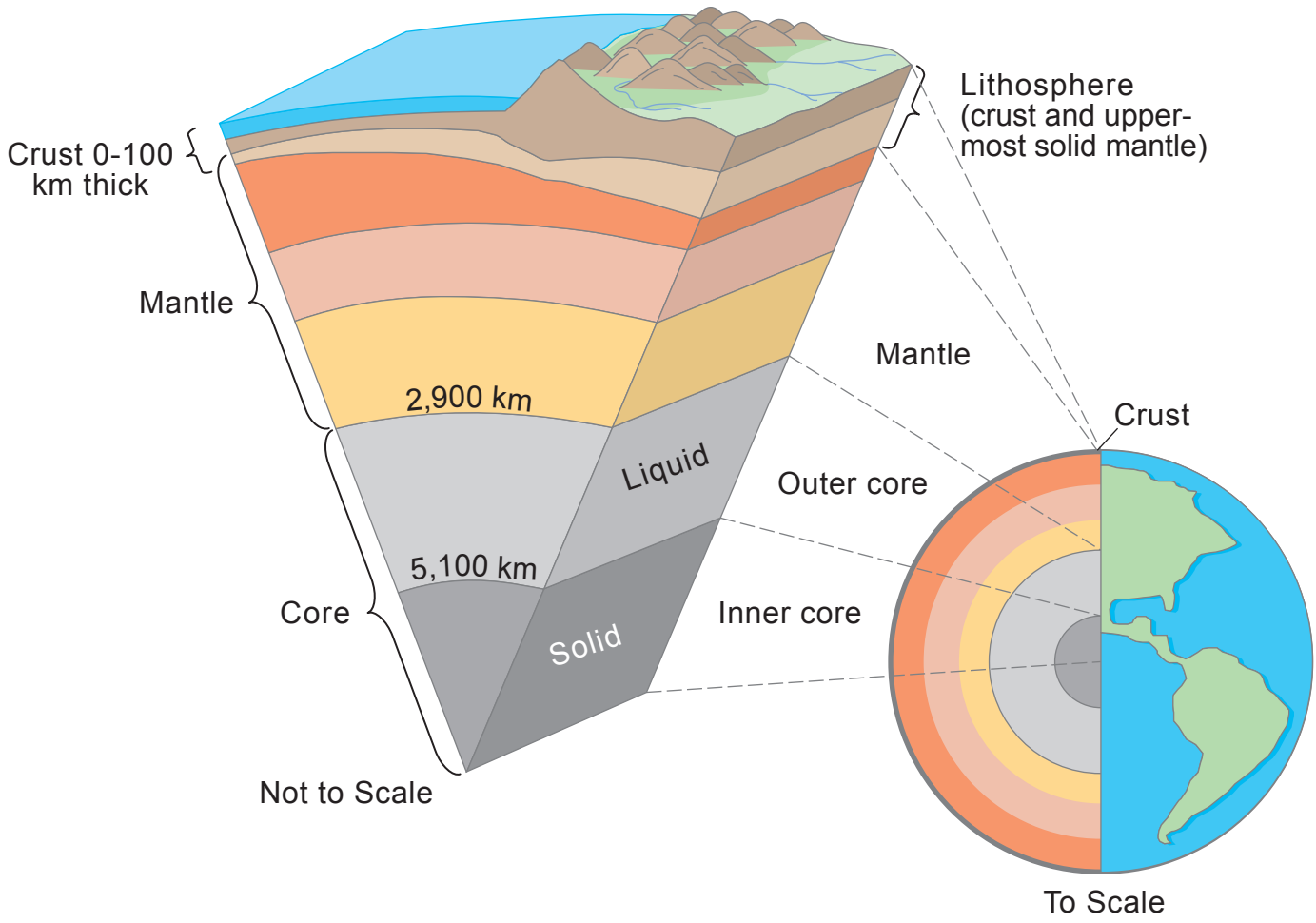


Figure 4. Sketch showing principal layers of the Earth. The surface is composed of a relatively thin, brittle crust (lithosphere) that is broken into plates. These plates move slowly over the surface of the Earth. The underlying mantle is a thick, hot, rock layer that deforms like plastic. The core has a liquid outer part and a a solid inner part composed of iron and nickel. The Earth's magnetic field is related to the spinning of the core. After Kious and Tilling (1996).

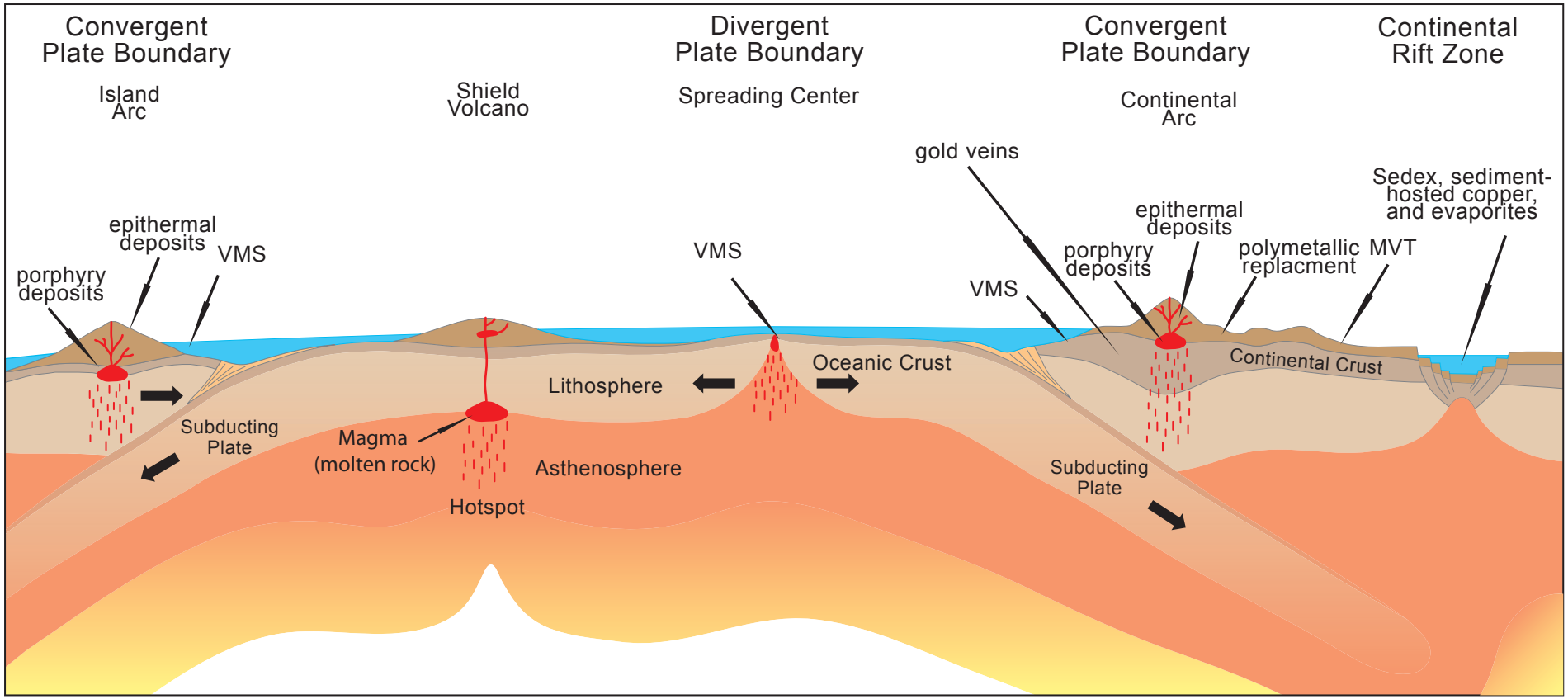


Figure 5. Diagram illustrating the plate tectonic setting in which several major types of mineral deposits are formed. The diagram shows a divergent plate boundary (spreading center) where tectonic plates are moving apart from each other and lava flows are extruded on the ocean floor forming a line of undersea mountains that encircle the Earth. Iceland, in the north Atlantic, is the tip of one part of this mountain range. Volcanogenic massive sulfide (VMS) deposits (described in the text) are an example of mineral deposits that form on the sea floor. Also shown are convergent plate boundaries where an oceanic plate is being subducted beneath a continental tectonic plate forming folded and faulted mountains (orogen) and volcanoes. The subduction of oceanic tectonic plates is accompanied by strong earthquakes and the generation and movement of tmagma (molten rock) and hydrothermal fluids that form a variety of mineral deposits, including porphyry copper deposits and associated gold and silver veins and polymetallic replacement deposits and associated gold and silver veins and polymetallic replacement deposits described in this report. Continental rift zones are areas where the crust is stretched (extended) forming linear depressions characterized by faults, volcanoes, sedimentary basins, and a variety of mineral deposit types including sediment-hosted (sedex) lead-sinc, sediment-hosted copper, and evaporite deposits. See text for further discussion. Modified from Kious and Tilling (1996).

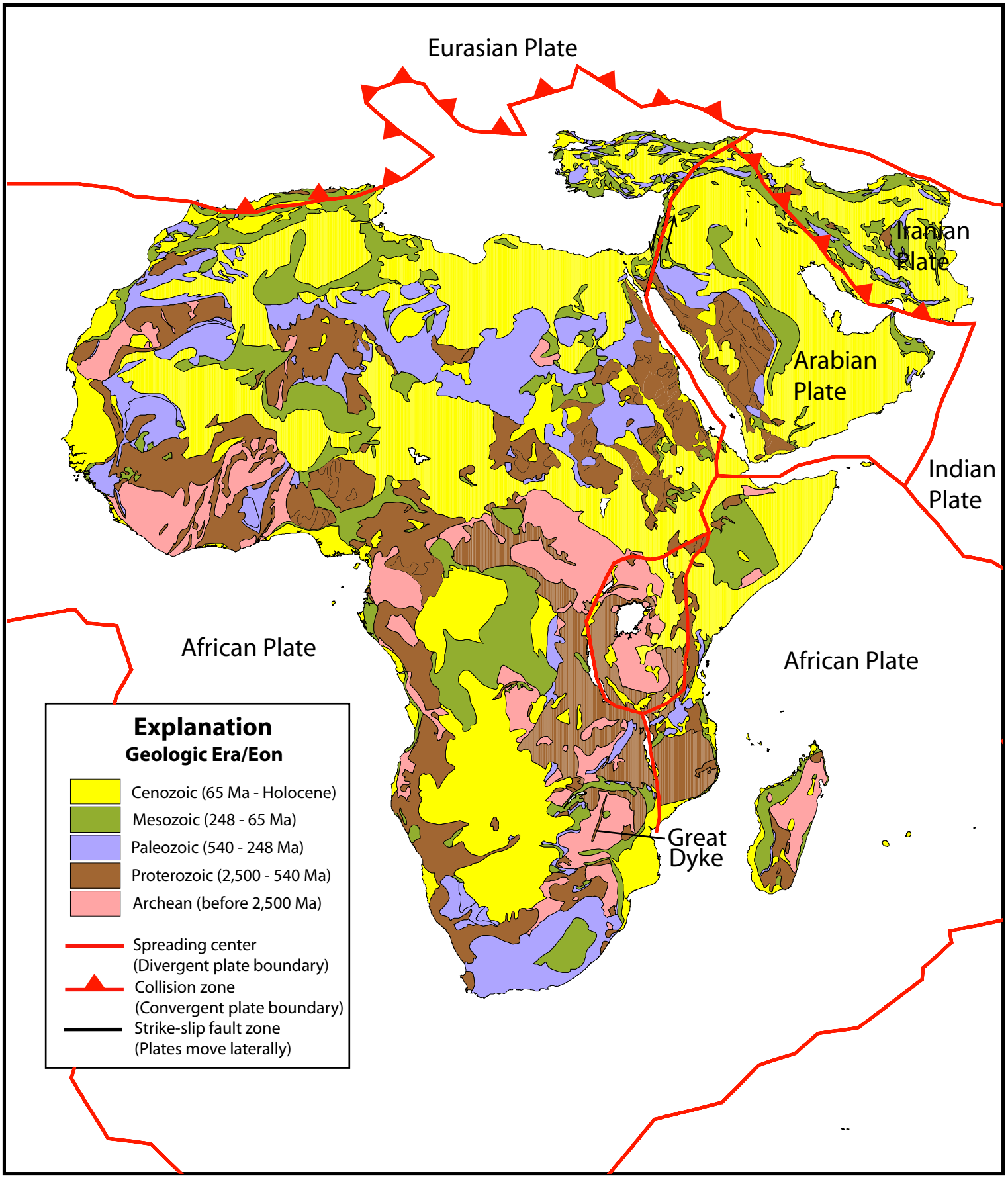


Figure 6. Geologic map of Africa and the Middle East showing the ages of principal rock units and the location of tectonic plate and plate boundaries. Modified from Kirkham and others (1995).

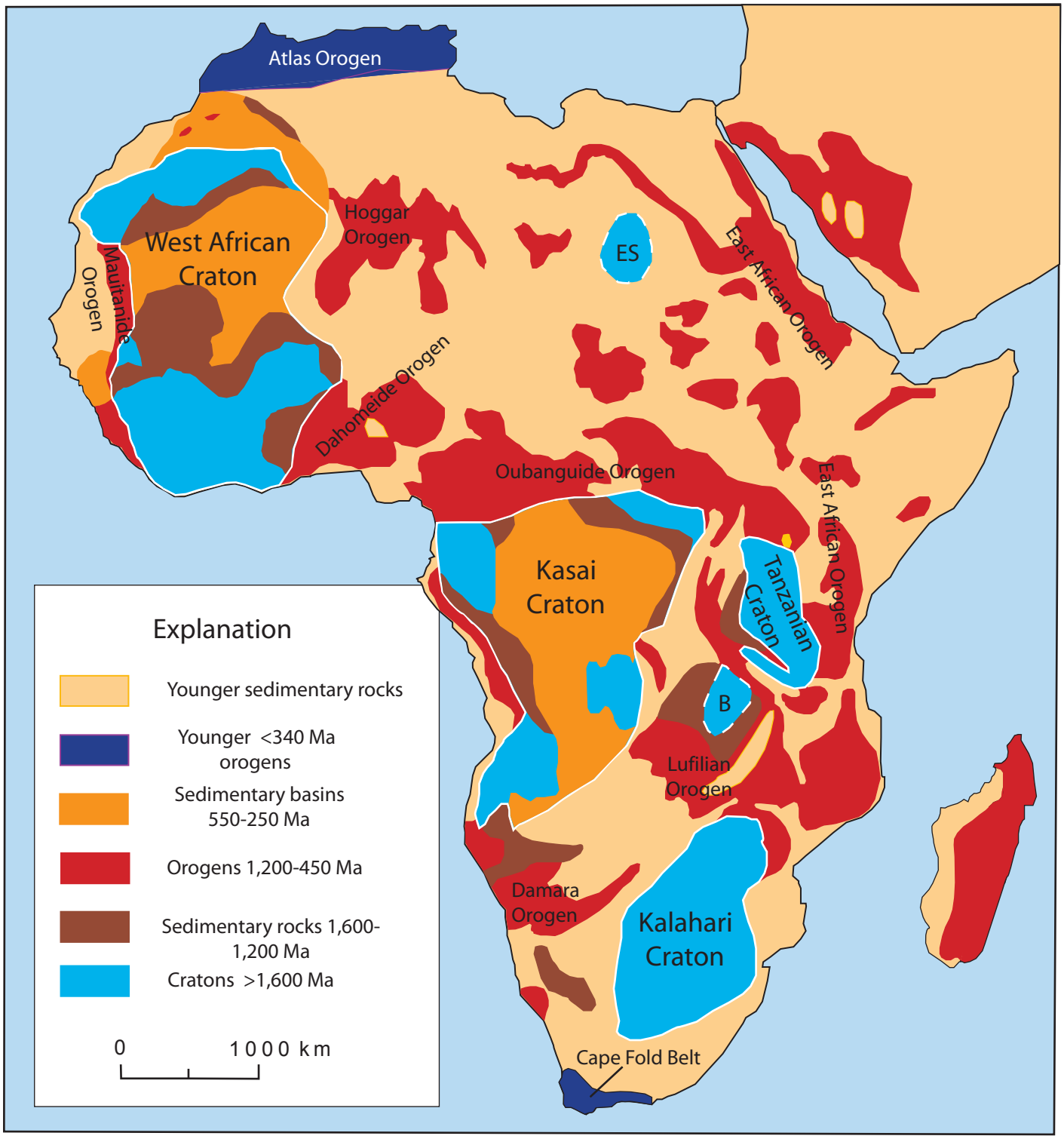


Figure 7A. Map showing selected geologic and tectonic features of Africa. The small cratonic nuclei of the Bangweulu craton is depicted with a "B" and the East Saharan craton with "ES". Modified from Dallmeyer and Lecorche (1991).

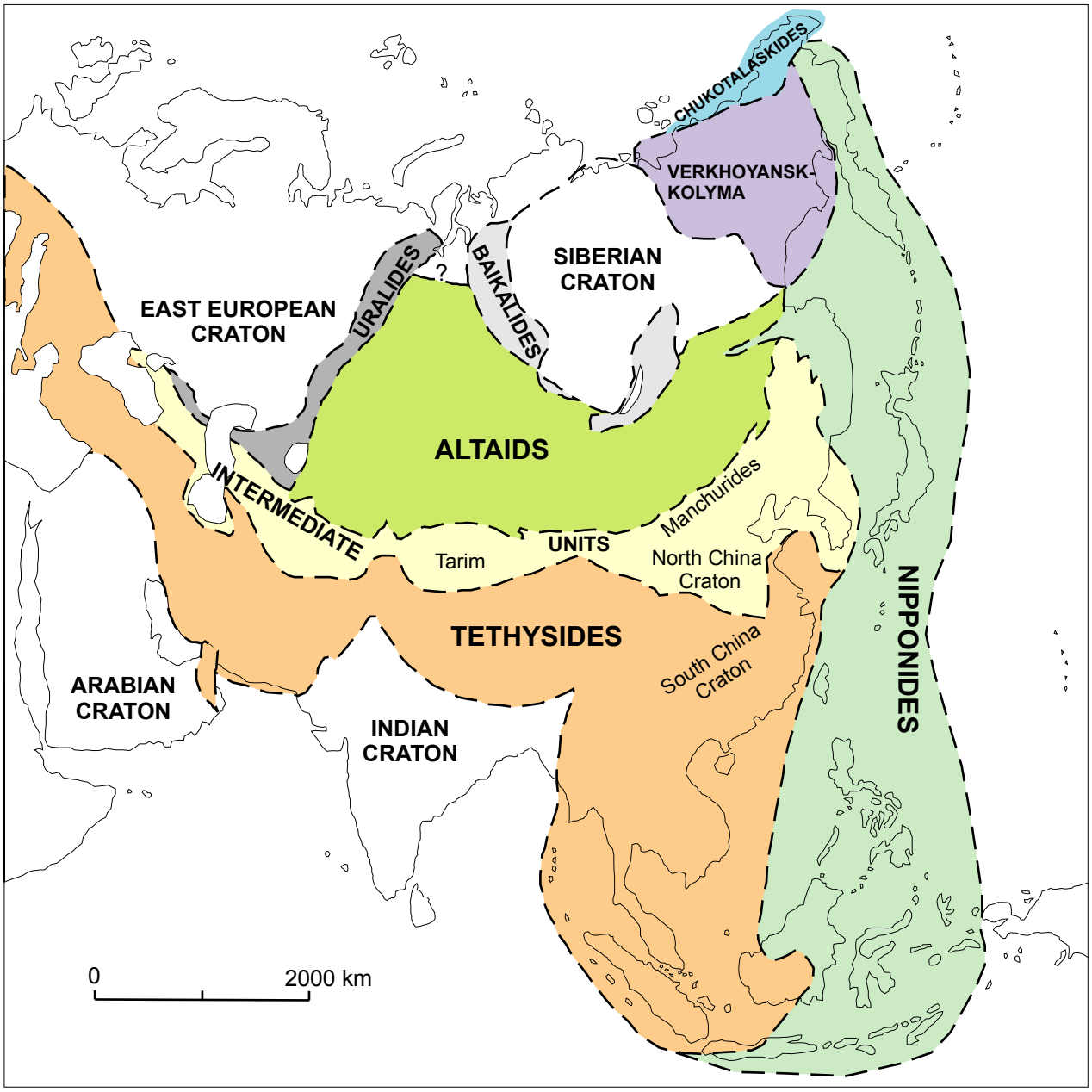


Figure 7B. Map showing selected geologic and tectonic features of the Middle East and Asia. Modified from Sengör and Natal' (1996a).

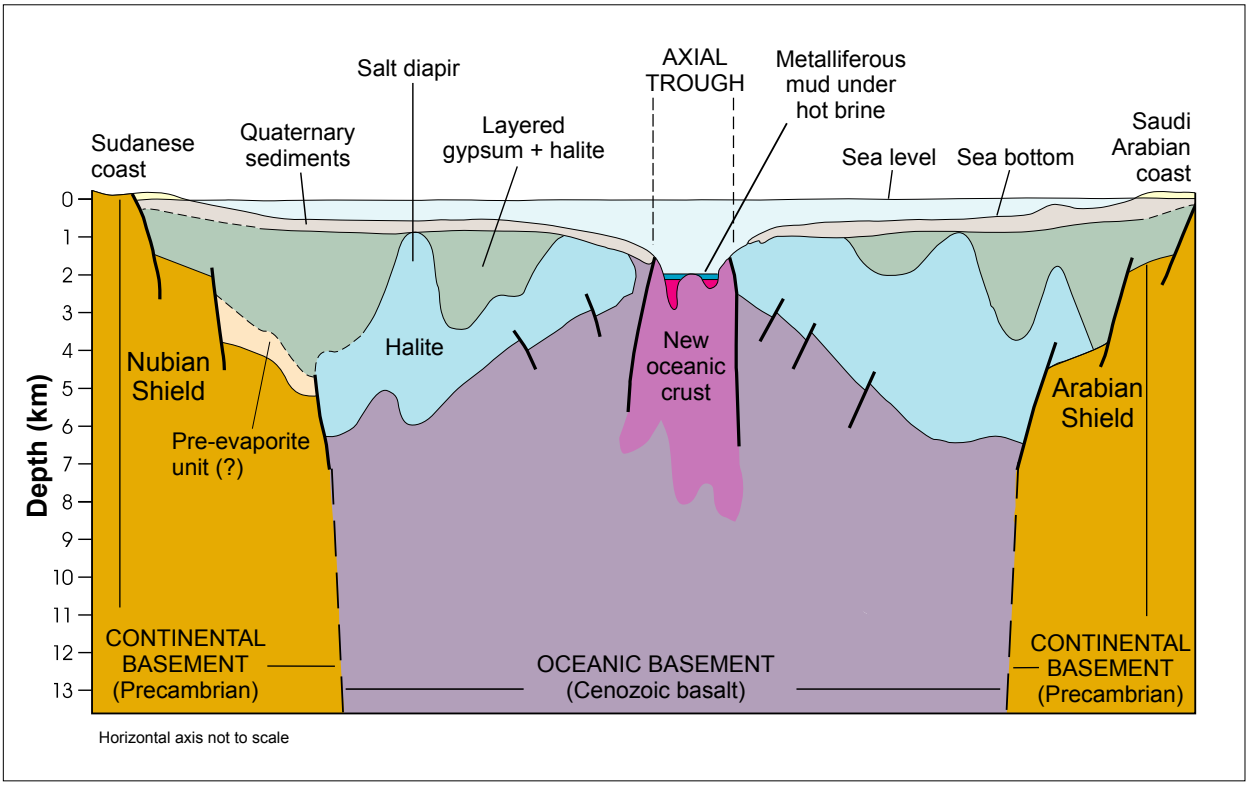


Figure 8. Schematic cross section of the Red Sea Basin. Modified from Collenette and Grainger, (1994).

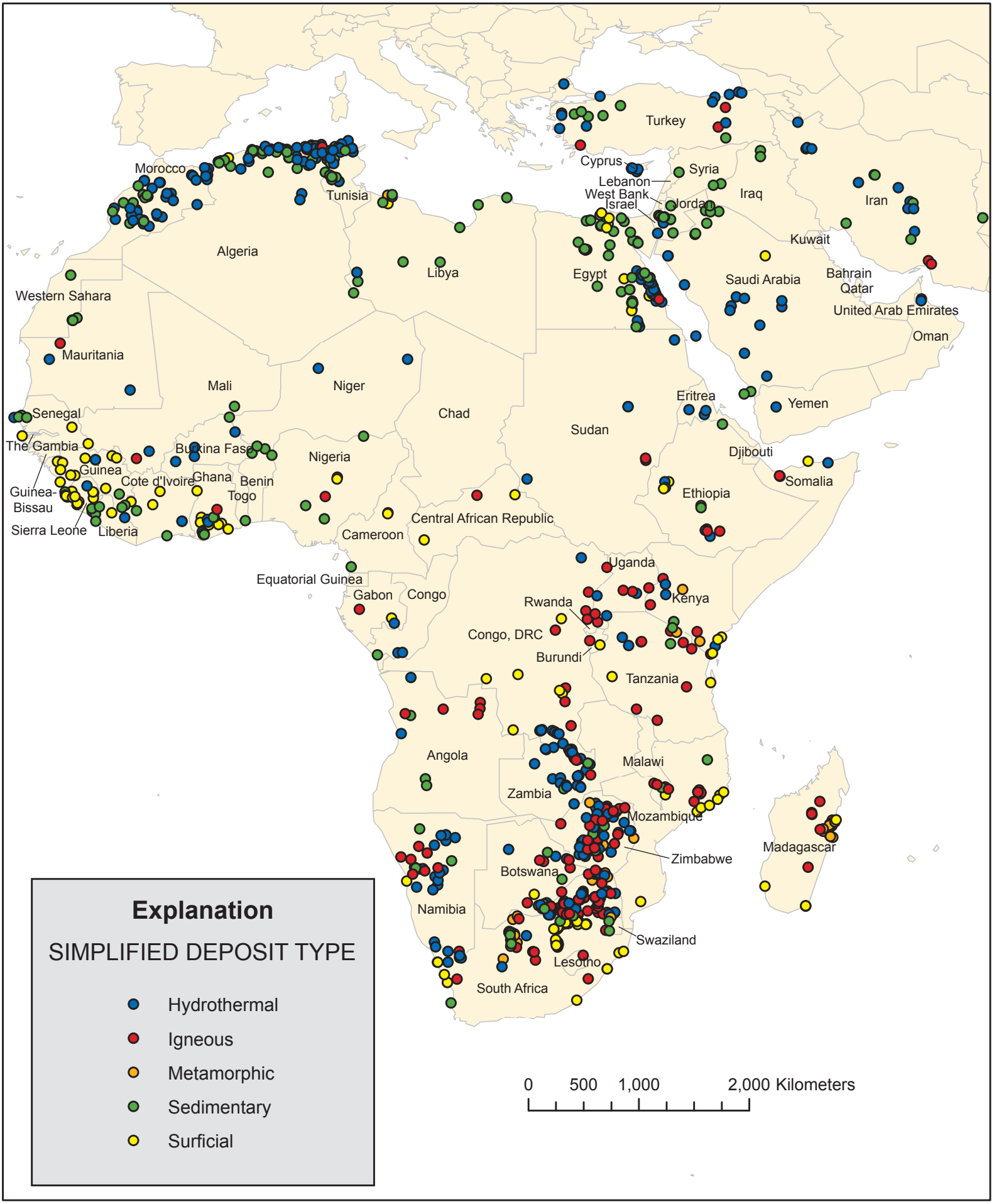


Figure 9A. Map showing distribution of principal nonfuel mineral deposits in Africa and the Middle East by simplified deposit type. There is a tendency for surficial laterite deposites to form in tropical settings near the equator; surficial placer deposits form in fluvial, lacustrine, and coastal marine environment. Hydrothermal deposits tend to form in mountain ranges and in basins affected by orogenic activity and igneous deposits to be localized in island arcs, continental margin arces, and to a lesser extent in stable shields.

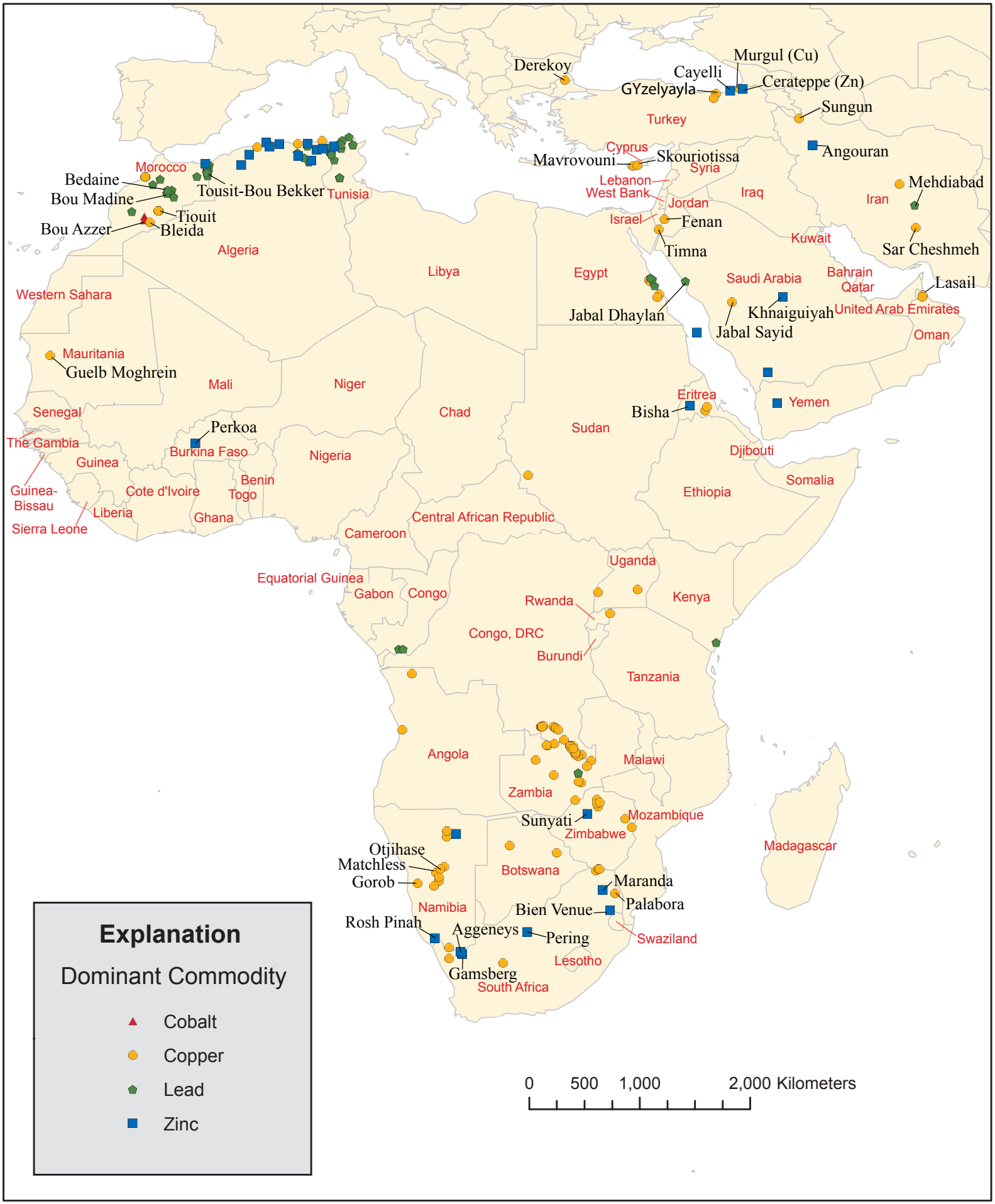


Figure 9B. Map showing location of major deposits of zinc, lead, cobalt, and copper.

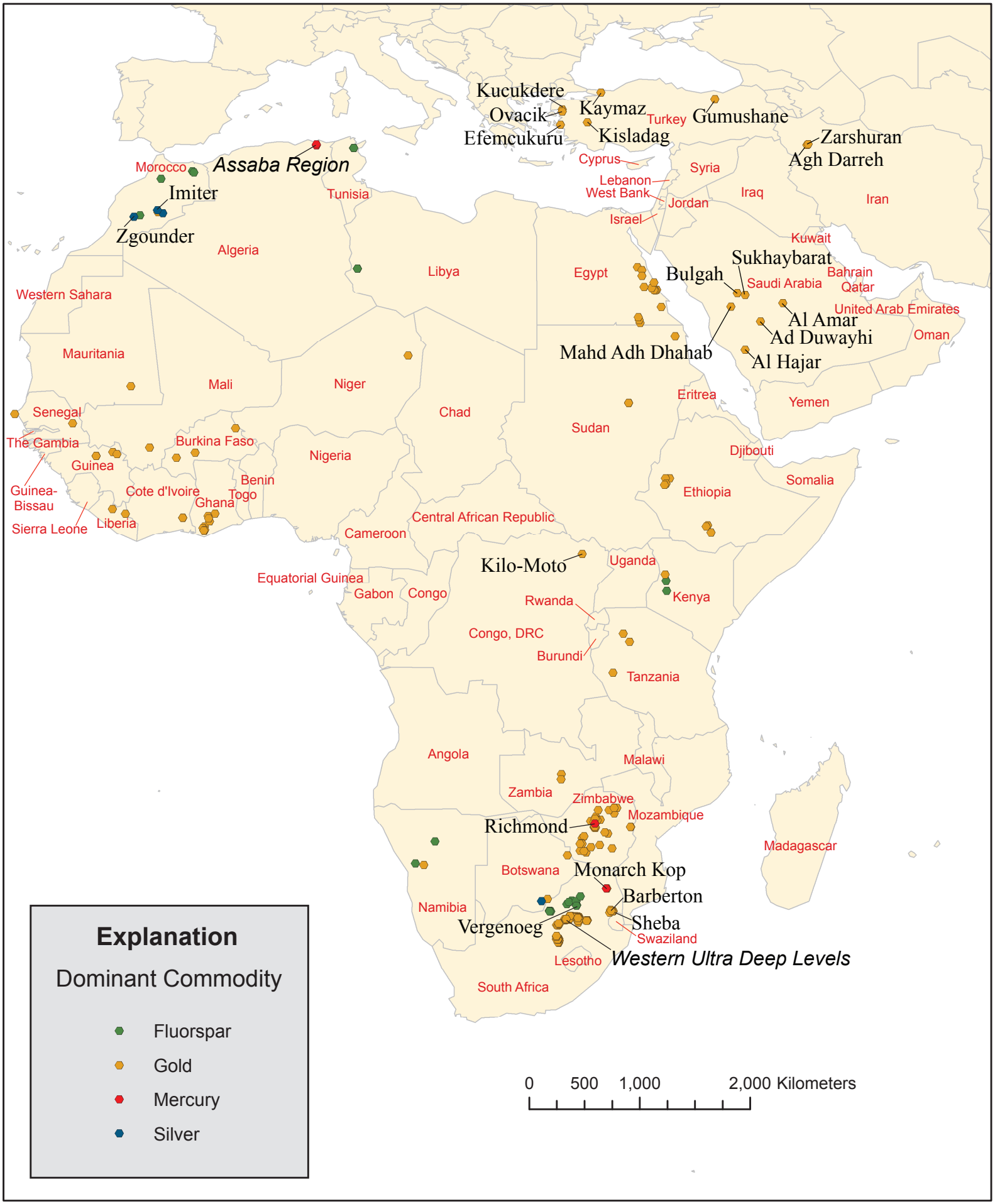


Figure 9C. Map showing location of major deposits of silver, gold, mercury, and fluorspar (fluorite).

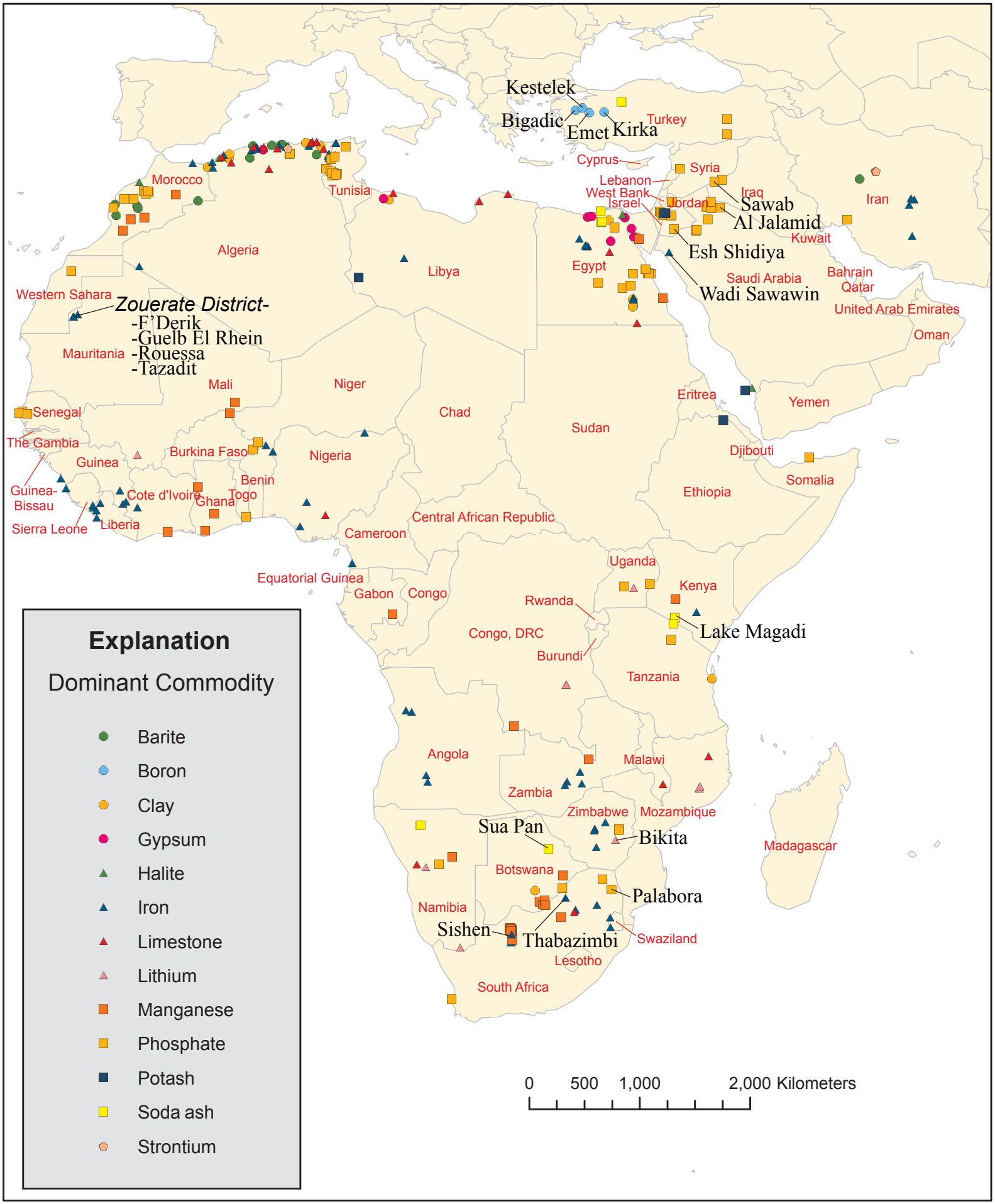


Figure 9D. Map showing location of major deposits of strontium, sodium carbonate, potash, phosphate, managanese, lithium, limestone, clay (bentonite and kaolin), iron, halite (salt), gypsum, boron, and barite.

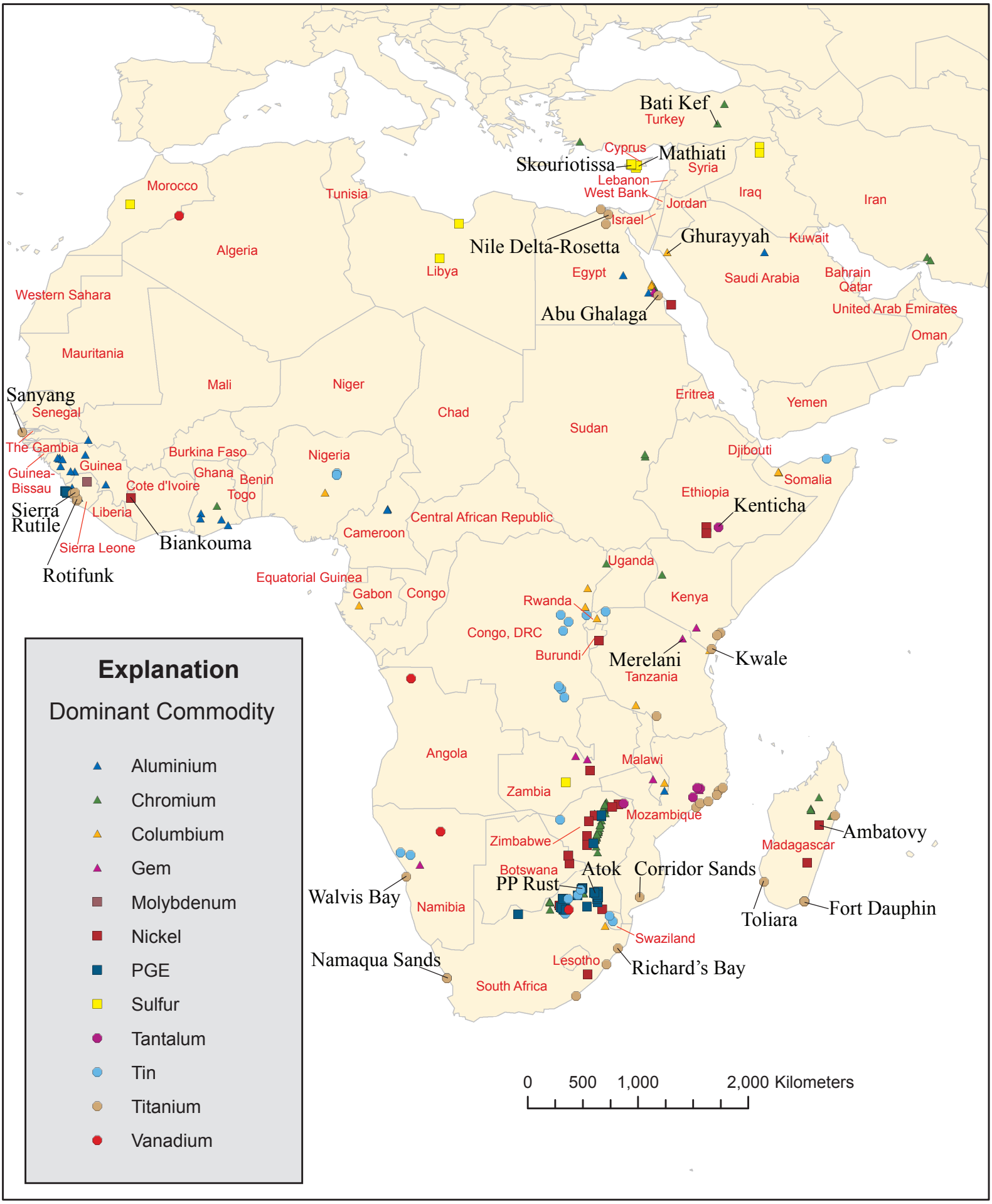


Figure 9E. Map showing location of major deposits of titanium, tin, tantalum, vanadium, sulfur, chromium, platinum-group elements (PGE), nickel, molybdenum, gemstones, columbium, and aluminum.

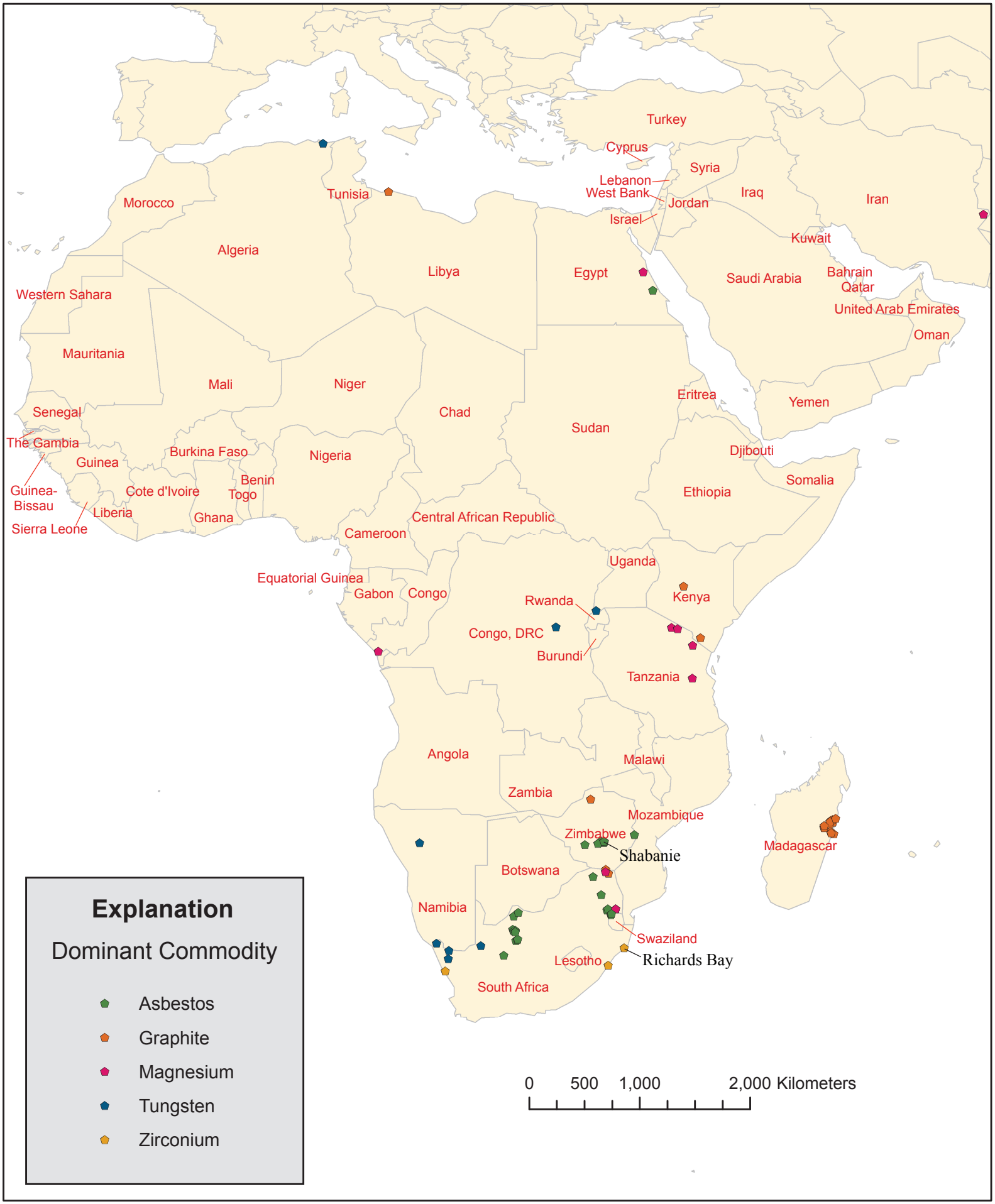


Figure 9F. Map showing location of major deposits of tungsten, magnesium, graphite, zirconium, and asbestos.

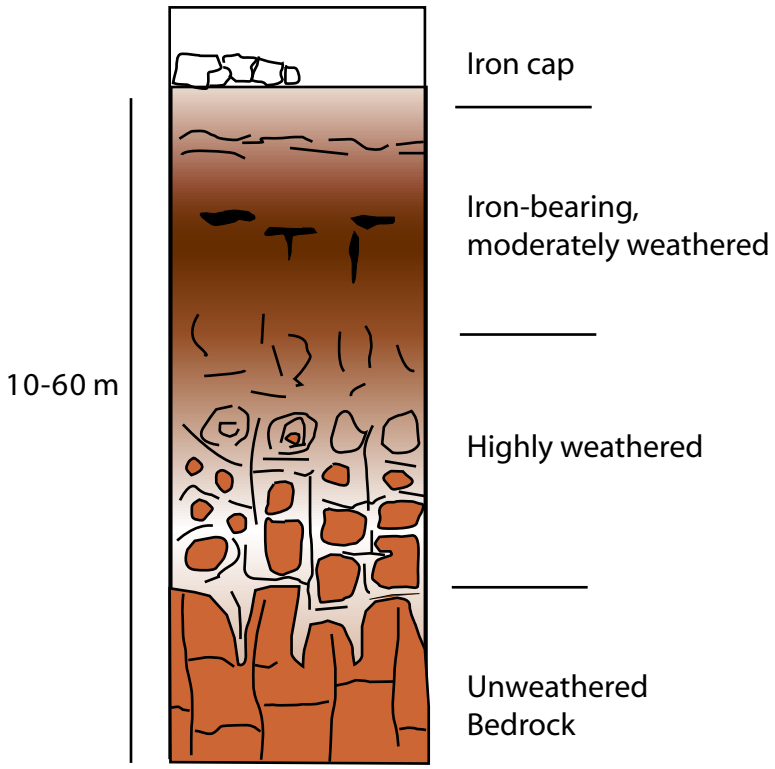


Figure 10A. Schematic soil profile in a laterite showing the progression of weathering effects on rock. Some commodities, such as aluminum and nickel, are enriched by weathering. Modified slightly from Elias (2002).

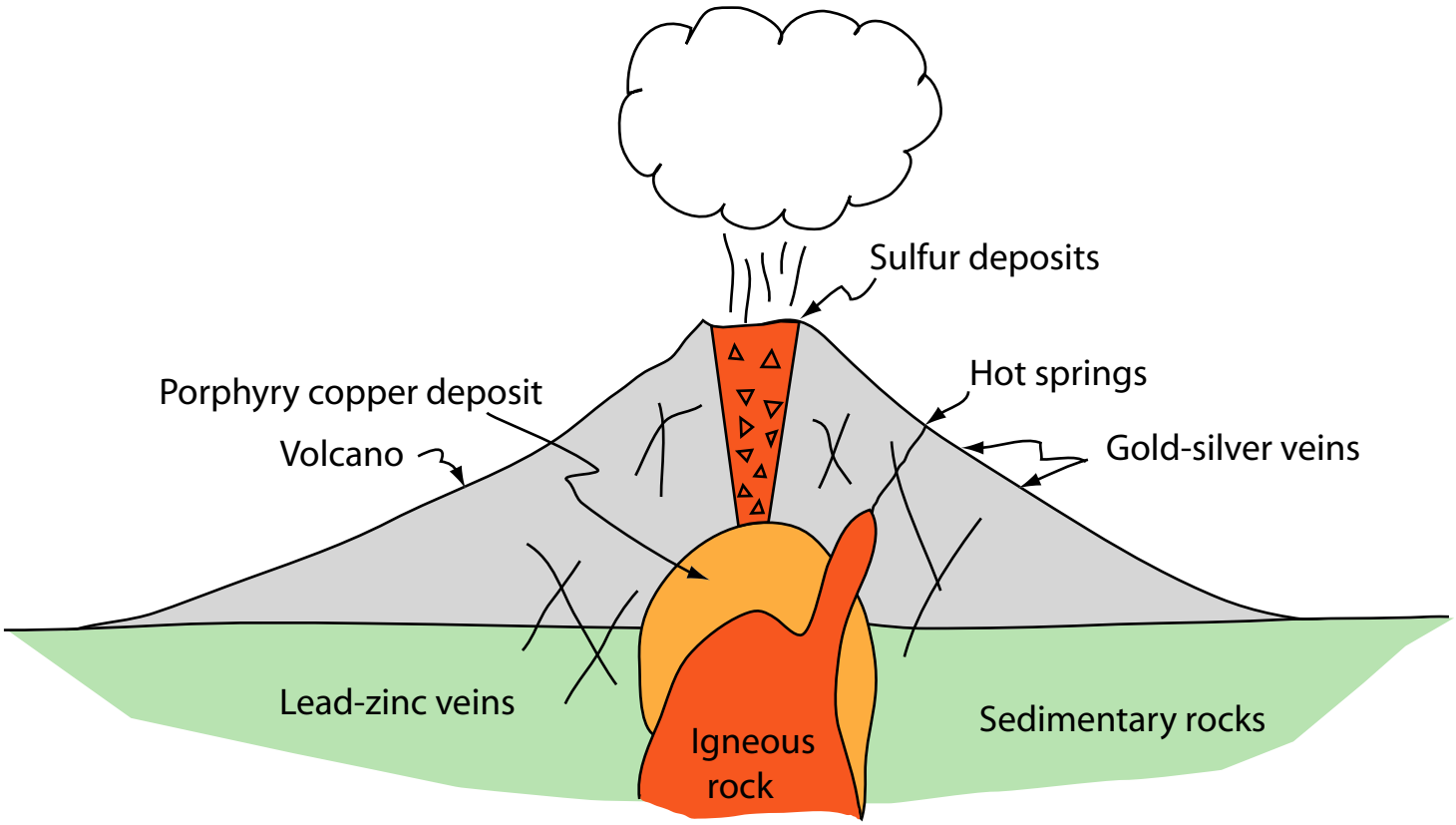


Figure 10B. Cross section of a stratovolcano showing the relative locations of porphyry copper deposits, lead-zinc veins, gold-silver veins, and sulfur deposits.

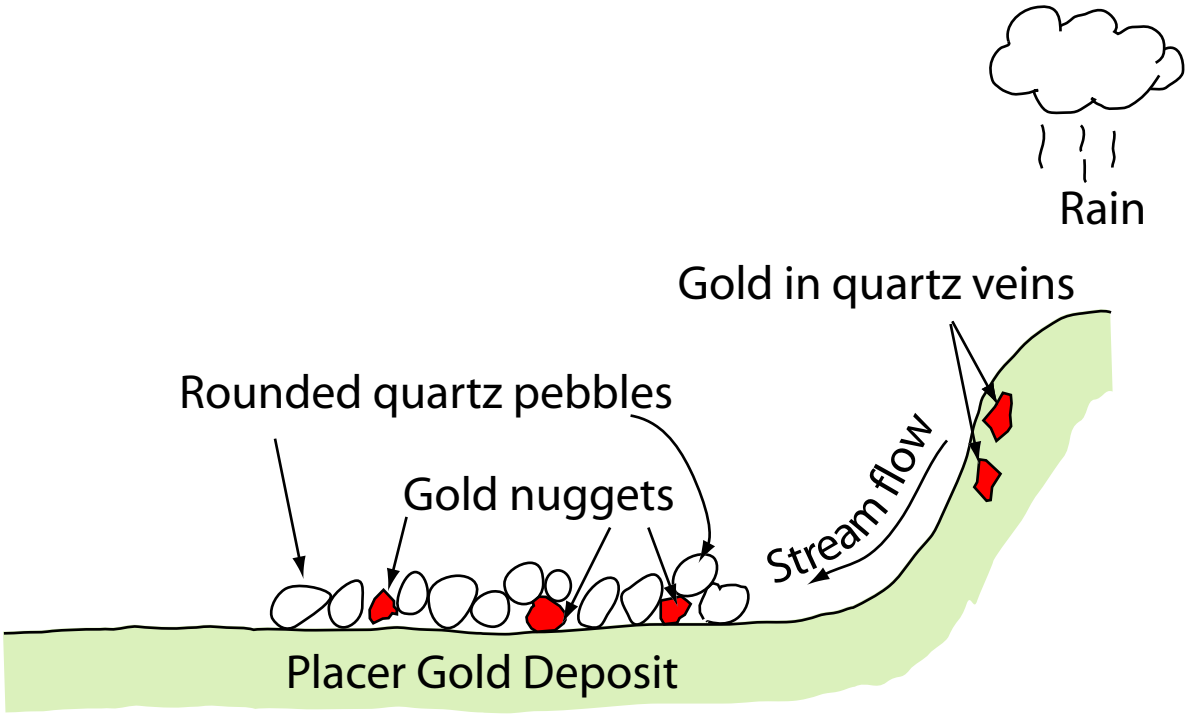


Figure 10C. Sketch illustrating formation of placer gold deposits. Most gold is transported in hydrothermal fluids that travel through cracks in the earth. Veins are cracks filled by gold and the other chemical elements carried in by the hydrothermal fluids. Eventually, the veins may be exposed at the surface of the Earth by weathering and erosion where running water can concentrate the heavy gold nuggets in placer (alluvial) deposits. These deposits form because of gold's high weight and can be prospected with a gold pan or mined on a commercial basis with a dredge.

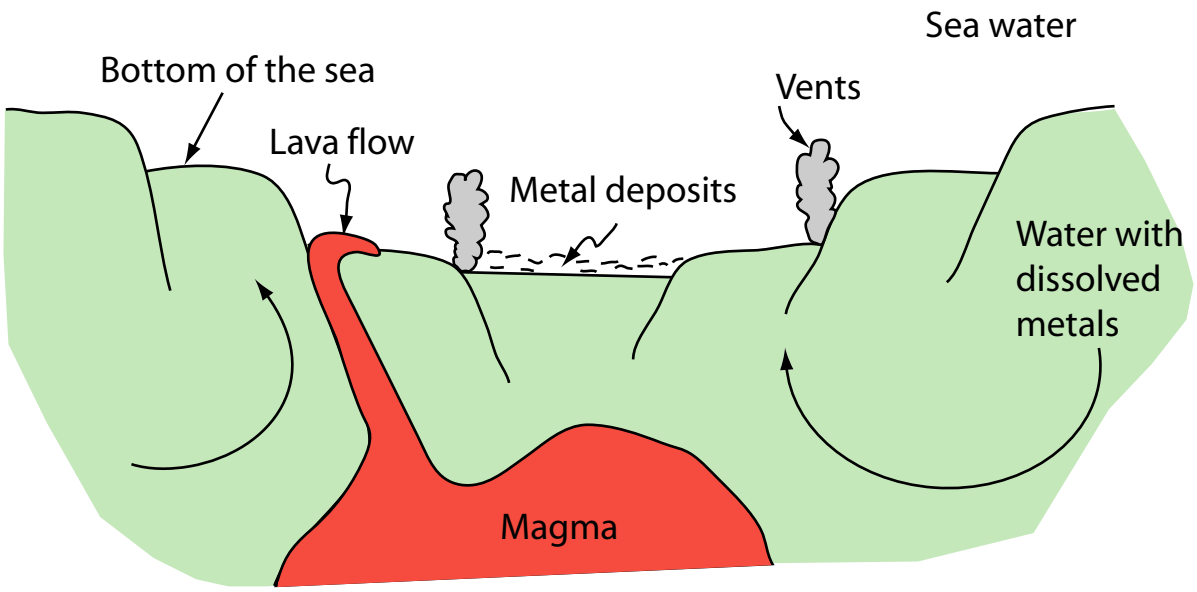


Figure 10D. Cross section showing extensional tectonic setting where plates are moving away from each other under the ocean. Magma (molten rock) comes up the cracks and sometimes is erupted as submarine lava flows on the sea floor. The heat from the magma causes hydrothermal fluids (hot, salty water containing dissolved metals) to circulate in fractures in the rocks. The metal-bearing hydrothermal fluids react with the sea water and depost metals to form mineral deposits.

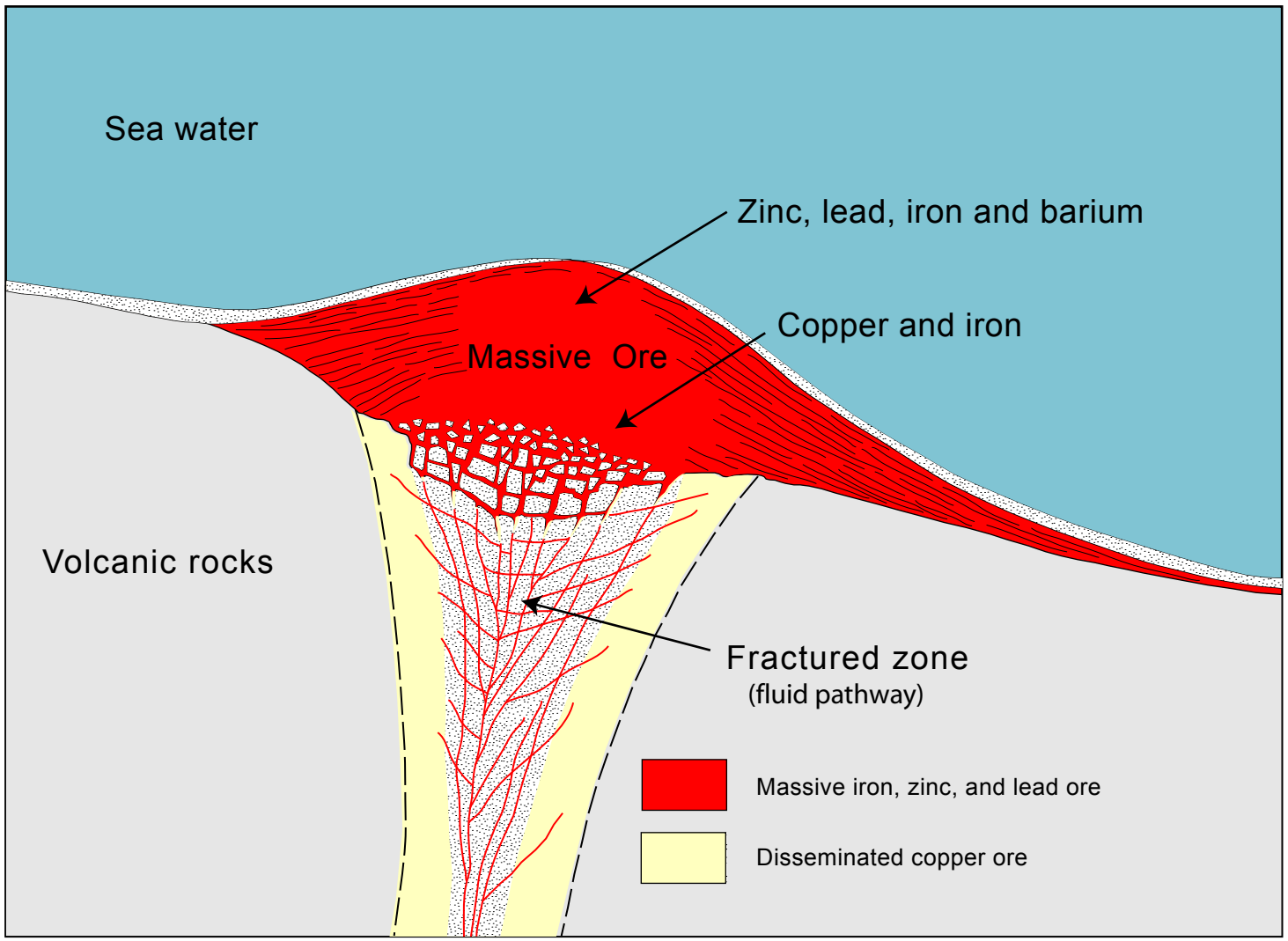


Figure 10E. Cross section schematically illustrating the characteristic features of volcanogenic massive sulfide (VMS) deposits. Hydrothermal fluids move upwards along fractures in volcanic rocks towards the sea floor. When the hot hydrothermal fluids vent and mix with cold ocean water, iron, copper, lead, and zinc sulfide minerals can form and collect as a mound on the sea floor. Ore minerals also can form in the fractures underlying the mound of sulfide materals. Modified from Lydon (1988).

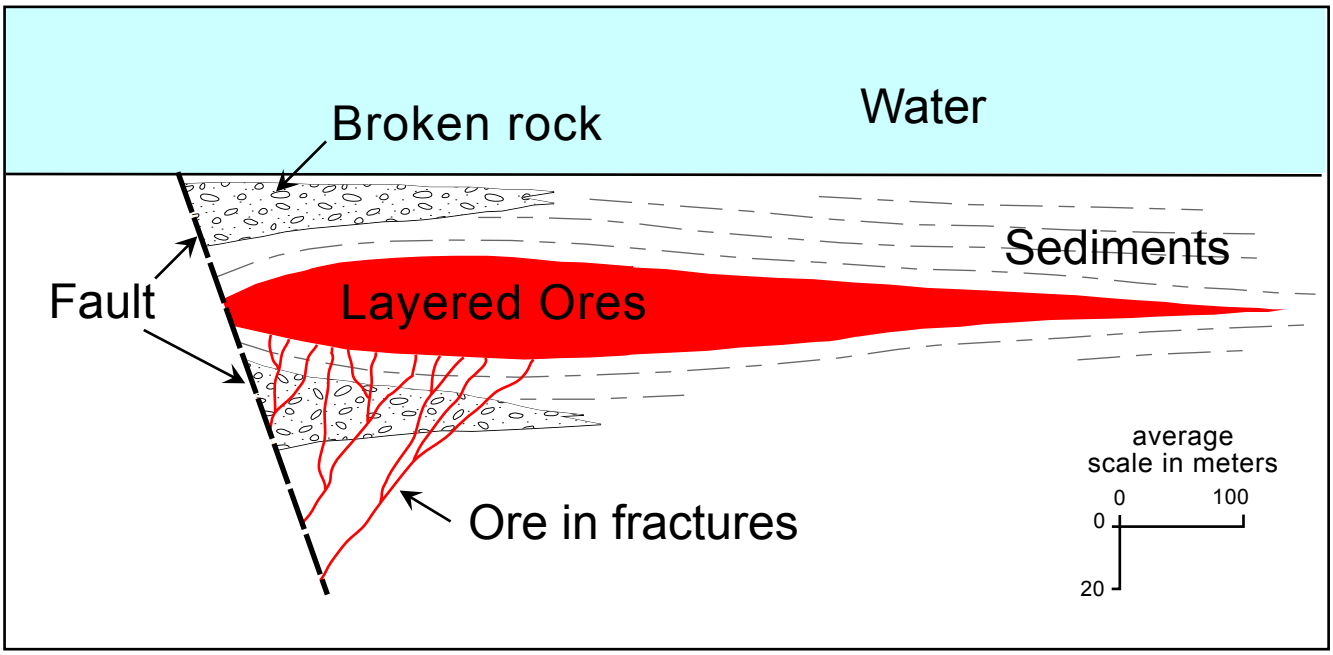


Figure 10F. Cross section schematically illustrating the characteristic features of sediment-hosted (sedex) lead and zinc deposits. The fault is active during accumulation of the sediments and the ore minerals. Hydrothermal fluids move upwards along the fault and other fractures towards the sea floor. Beds of broken rock form near the active fault by erosion of fault scarps or by explosions related to the venting of hydrothermal fluids into open water. Bedded ores consist of iron, lead, and zinc sulfide minerals that formed at or near the bottom of the sea from hydrothermal fluids that vented into open water from faults and fractures. Ores in fractures consist of iron, lead, and zinc minerals that were deposited by hydrothermal fluids moving through sediments. Modified from Lydon (1996).

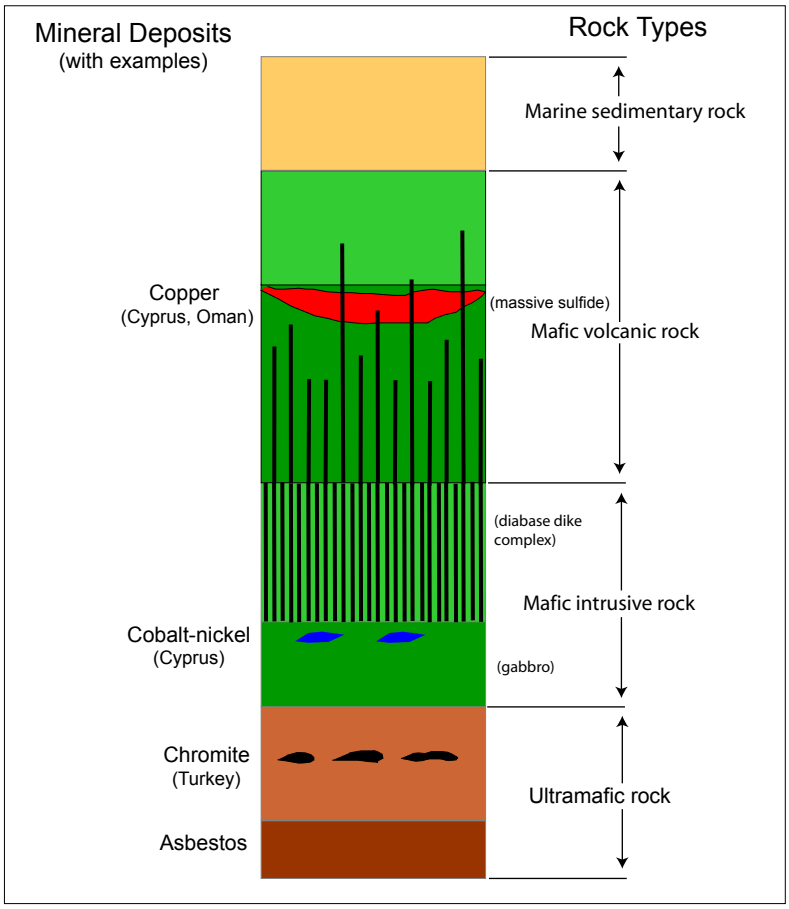


Figure 10G. Schematic diagram of a typical sequence of rock types and mineral depostis in oceanic crust generated at a mid-ocean ridge spreading center. Fragments of ocean crust found in mountain belts are called ophiolites. Ophiolites and their associated mineral deposits are emplaced in mountain belts when ocean crust is subducted and continents collide. Modified from Constantinou (1980).

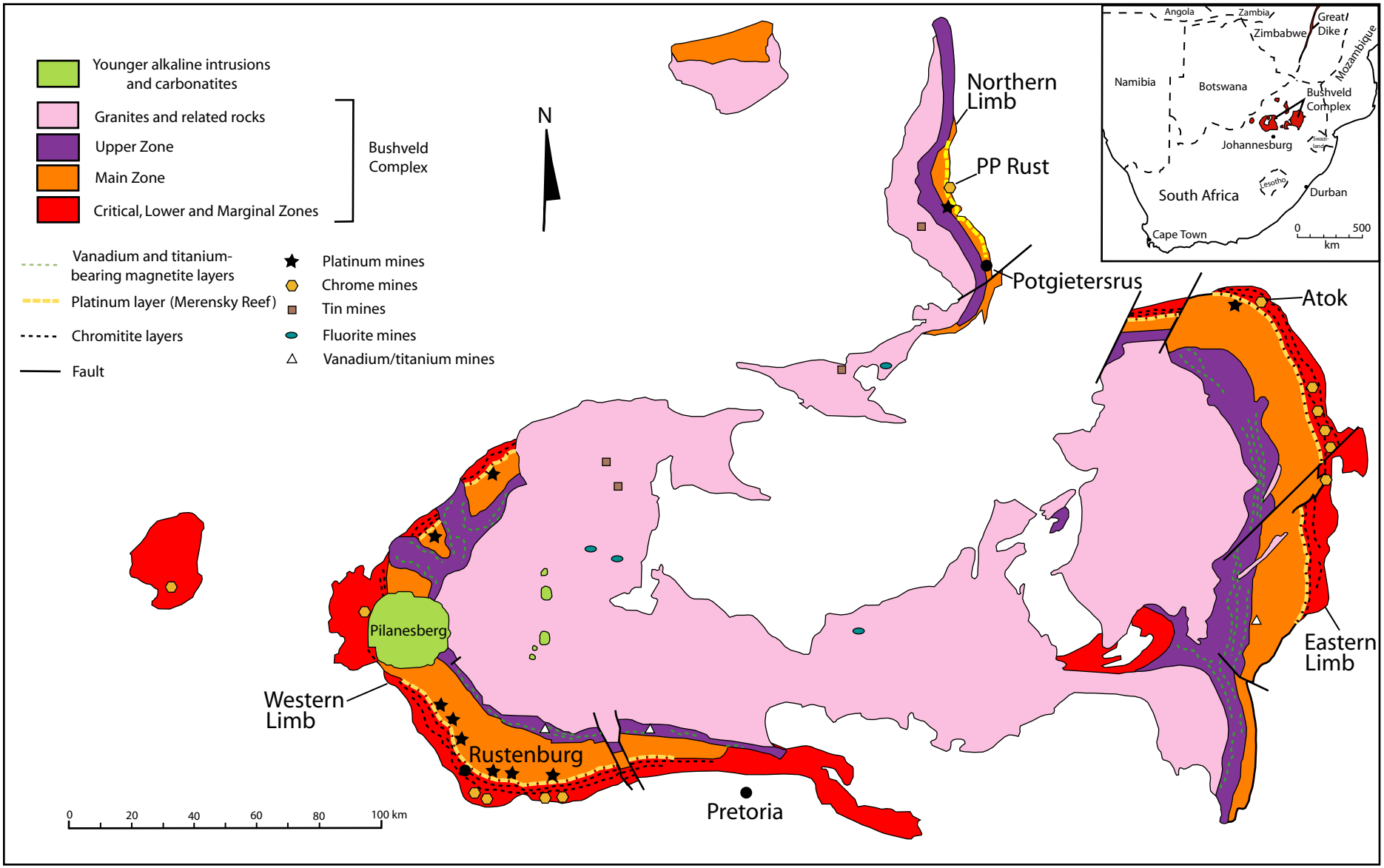


Figure 10H. Simplified geologic map of the Bushveld Igneous Complex, showing locations of some of the more important chromium and PGM mines. Modified from Viljoen and Schurmann (1998).

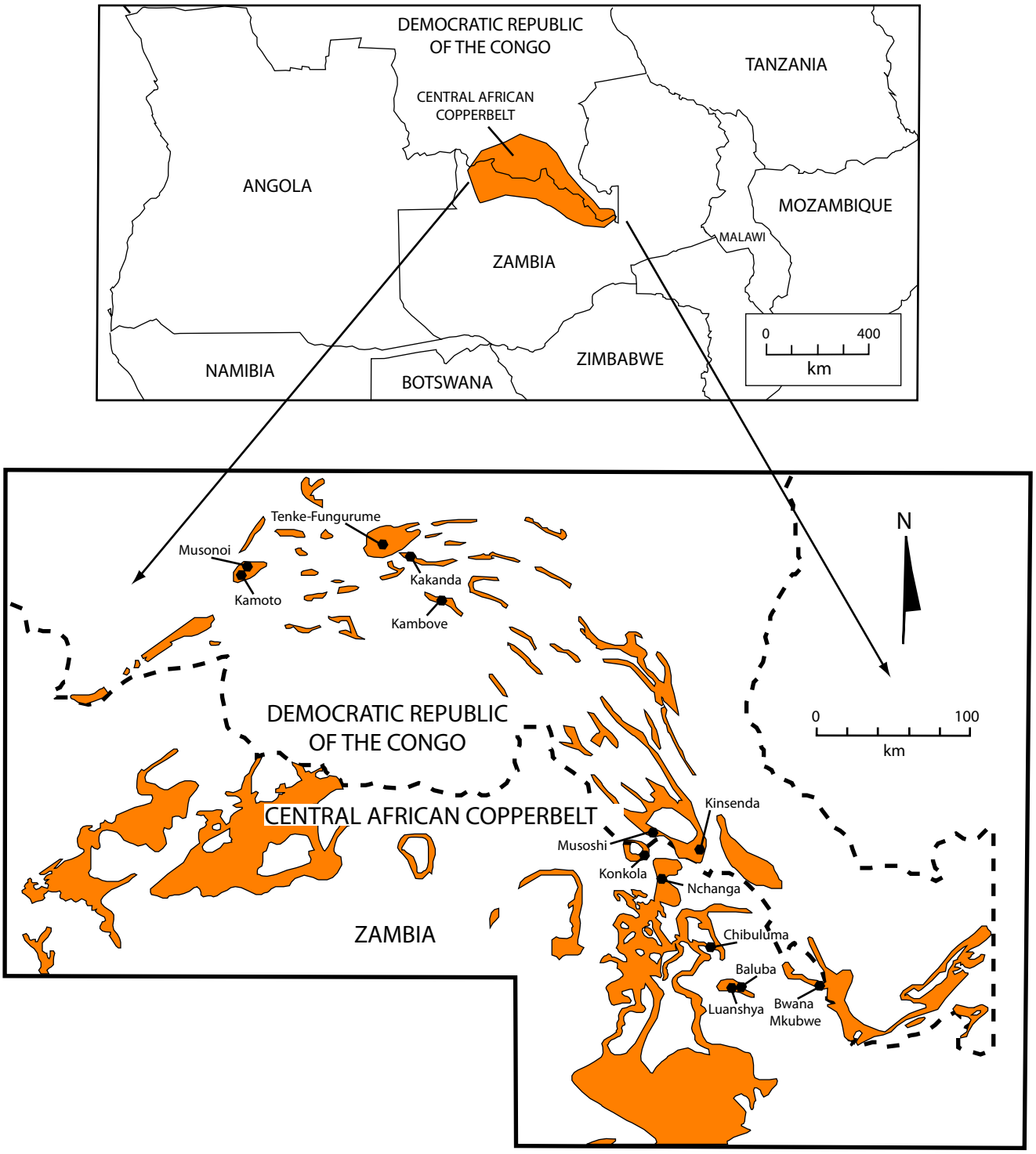


Figure 10I. Simplified geologic map of the Central African Copperbelt showing the distribution of the Katanga Supergroup and some of the regions major mines. Modified from Francois, (1974) and Cailteux and others, (2005).

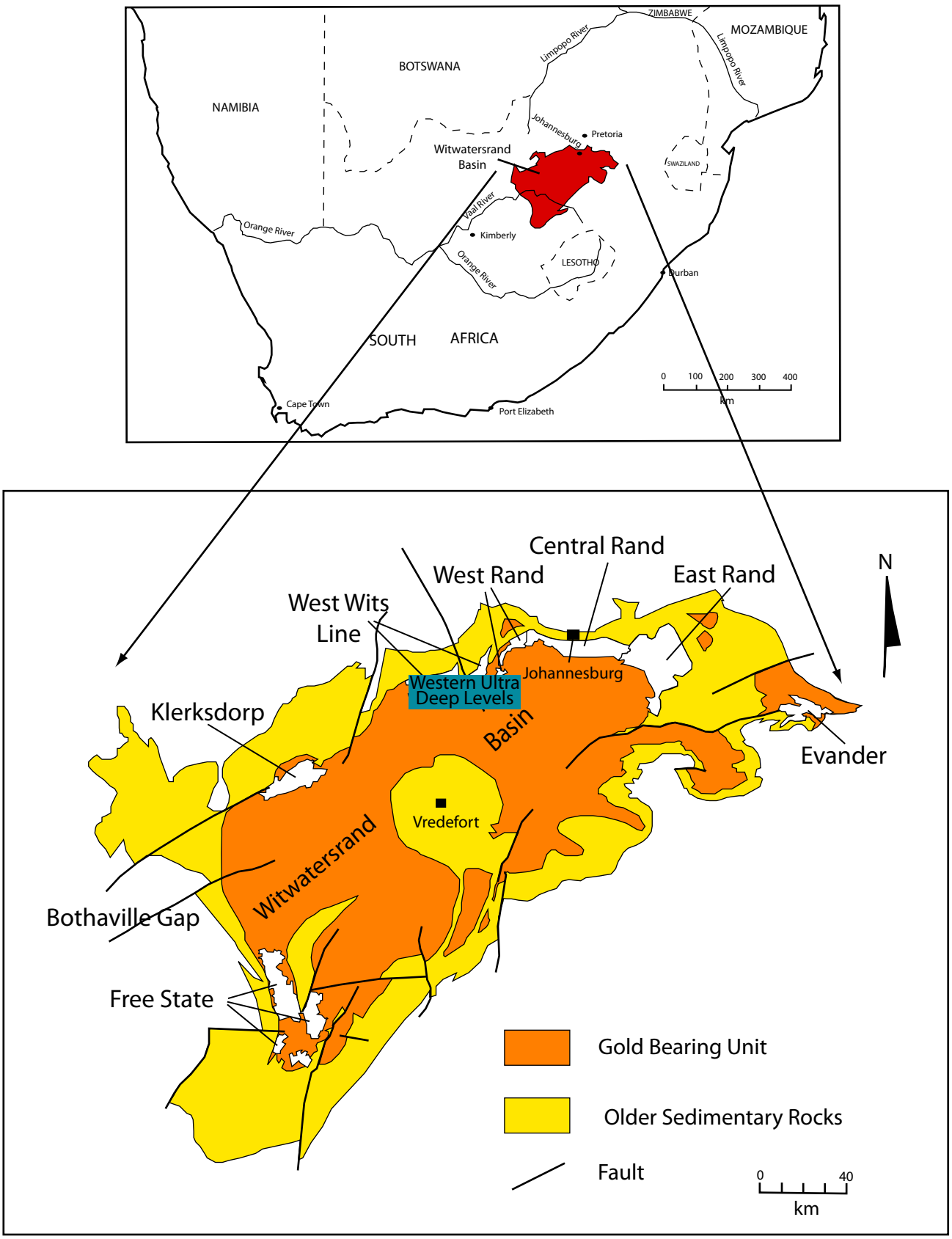


Figure 10J. Location map of the Witwatersrand Basin and its major goldfields. Modified from Robb and Robb (1998).

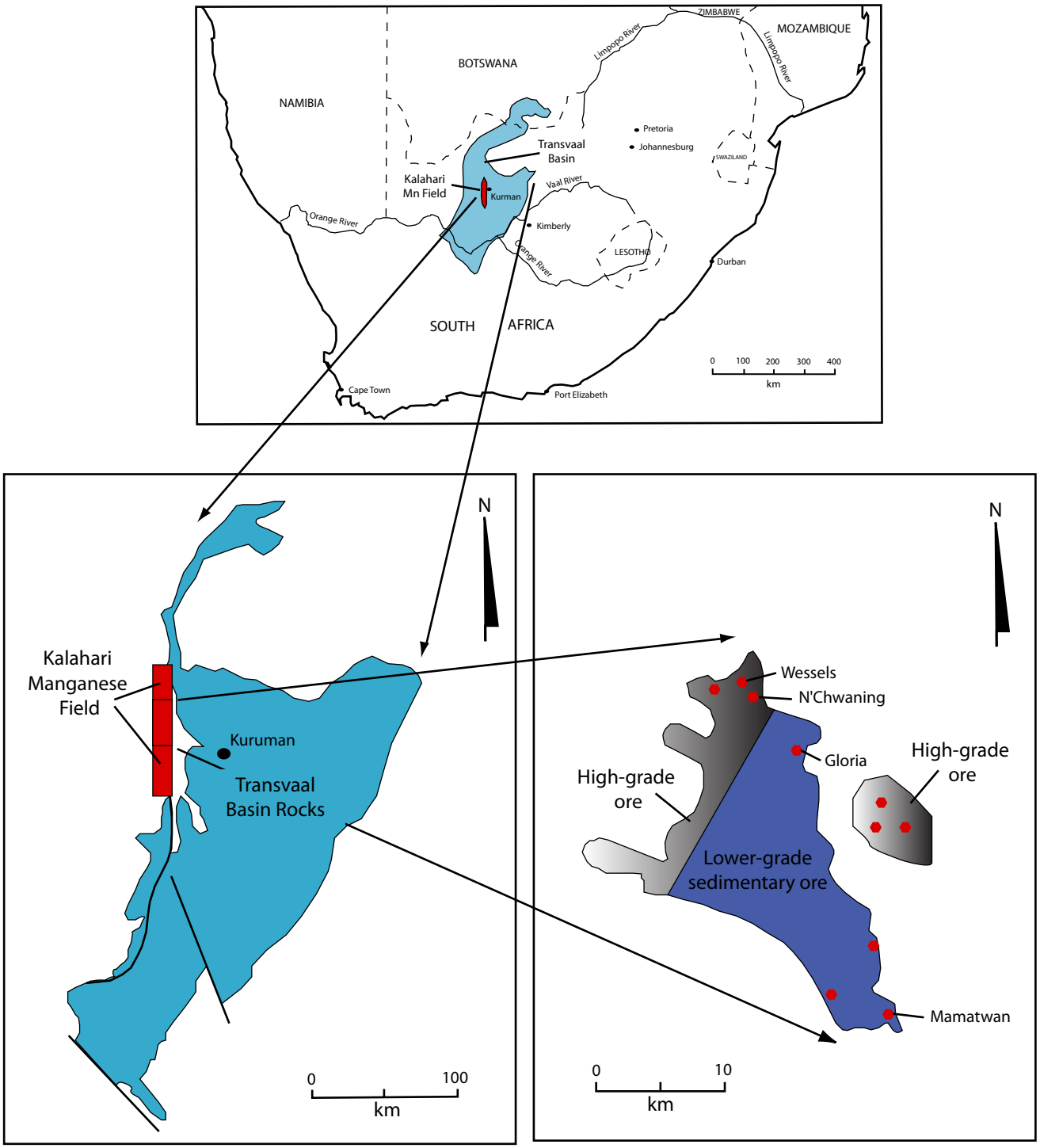


Figure 10K. Location map of the Trasvaal Basin, the Kalahari manganese field, and current producers. Modified from Tiskos and Moore (1998).

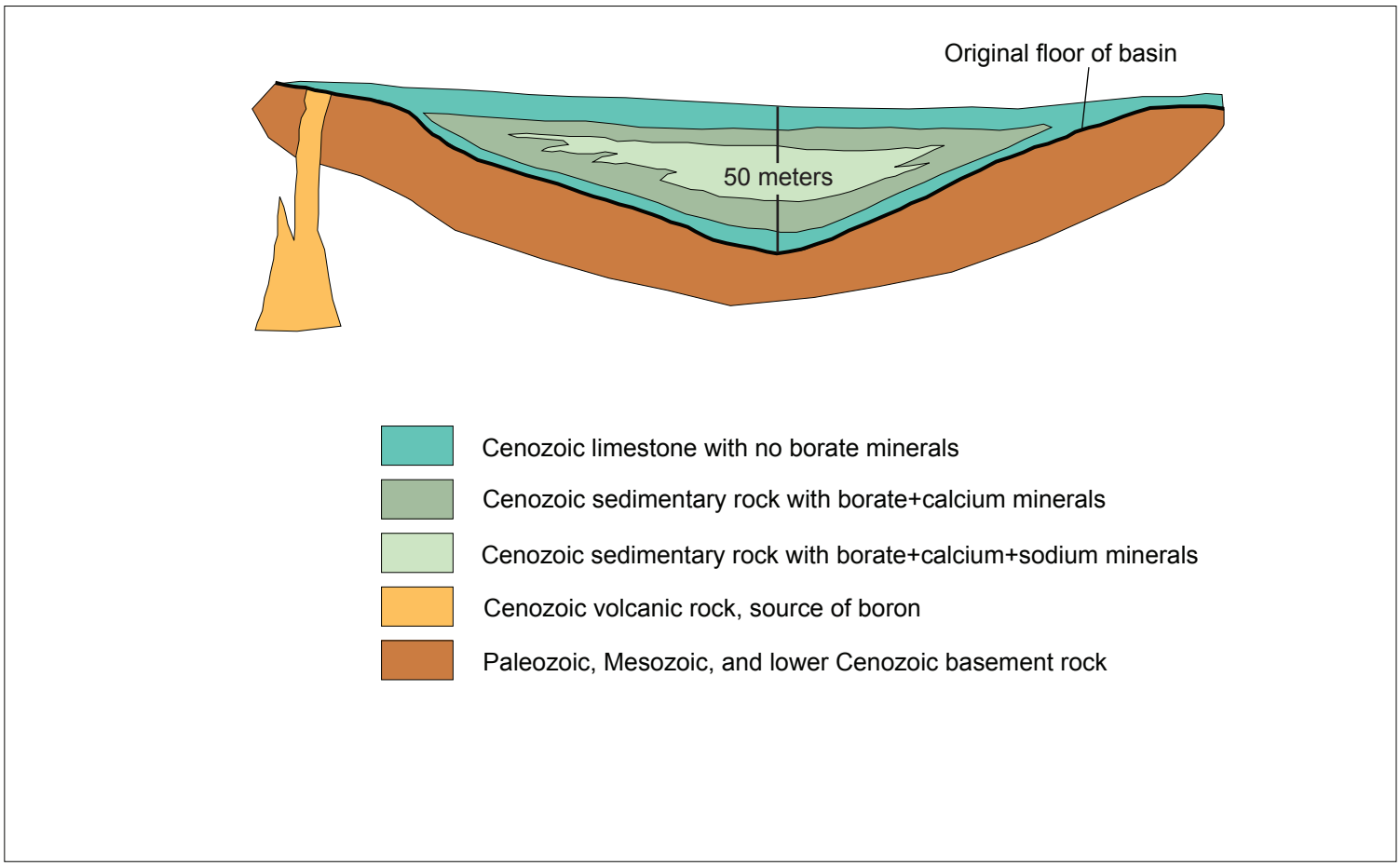


Figure 10L. Schematic section of a borate deposit from the Bigadic district, western Turkey. Modified from Helvaci (1995).

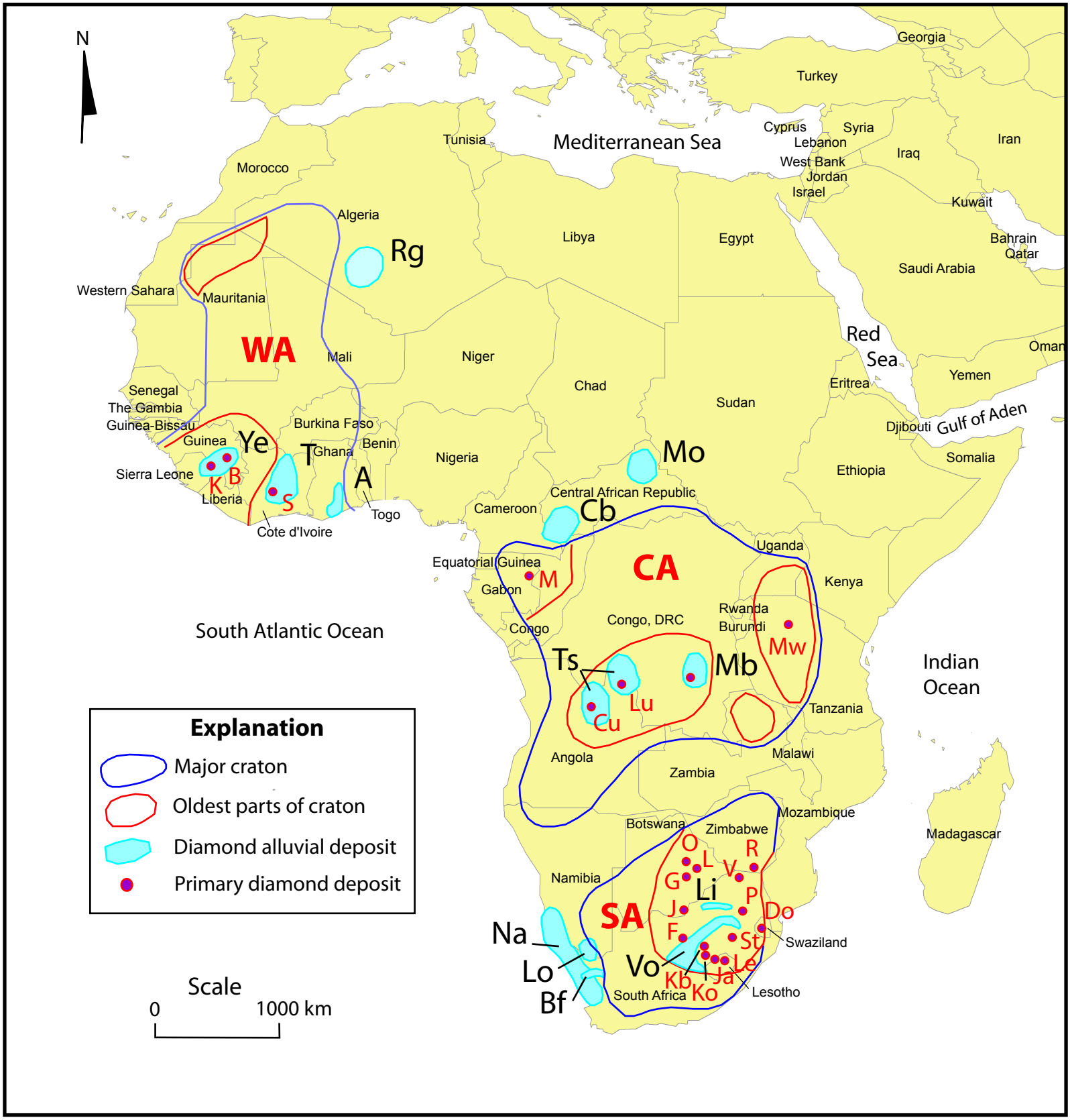


Figure 10M. Map of Africa showing the distribution of diamond deposits with repect to cratons (outlined in blue) and their most ancient rock units (outlined in red). Note that economic kimberlites are found only on those ancient parts of cratons. Red dots and red letters are kimberlite bodies, and light blue areas with black letters are alluvial deposits (note that some areas contain both kimberlite bodies and alluvial deposits). Key to large red letters: CA--Central African (Kasai) cration; SA--South African (Kalahari) craton; WA--West African craton. Key to solid red and black letter: A--Akwatia/Birim alluvials; B--Banankoro alluvials and bodies; Bf--Buffels River alluvials; Cb--Carnot/Berberati alluvials; Cu--Cuango Valley alluvials and bodies; Do--Dokolwayo body; F--Finsch body; G--Gope body; J--Kwaneng body; Ja--Jagersfontein body;K--Koidu body; Kb--Kimberley bodies (5); Ko--Koffiefontein body; L--Letlhakane body; Le--Letseng body; Li--Lichtenburg alluvials; Lo--Lower Orange River alluvials; Lu--Lunda bodies and alluvials: M--Mitzic bodies; Mb--Mbuji-Mayi bodies and alluvials; Mo--Mouka Ouadda alluvials; Mw--Mwadui body; Na--beach and offshore alluvials along Namibia and Namaqualand coast; O--Orapa body; P--Primier body; R--River Ranch body; T--Tortiya alluvials; Ts--Tshikapa alluvials; V--Venetia body; Vo--Vaal/Orange Rivers alluvials; Ye--Yengema alluvials. Map from Janse, (1996).

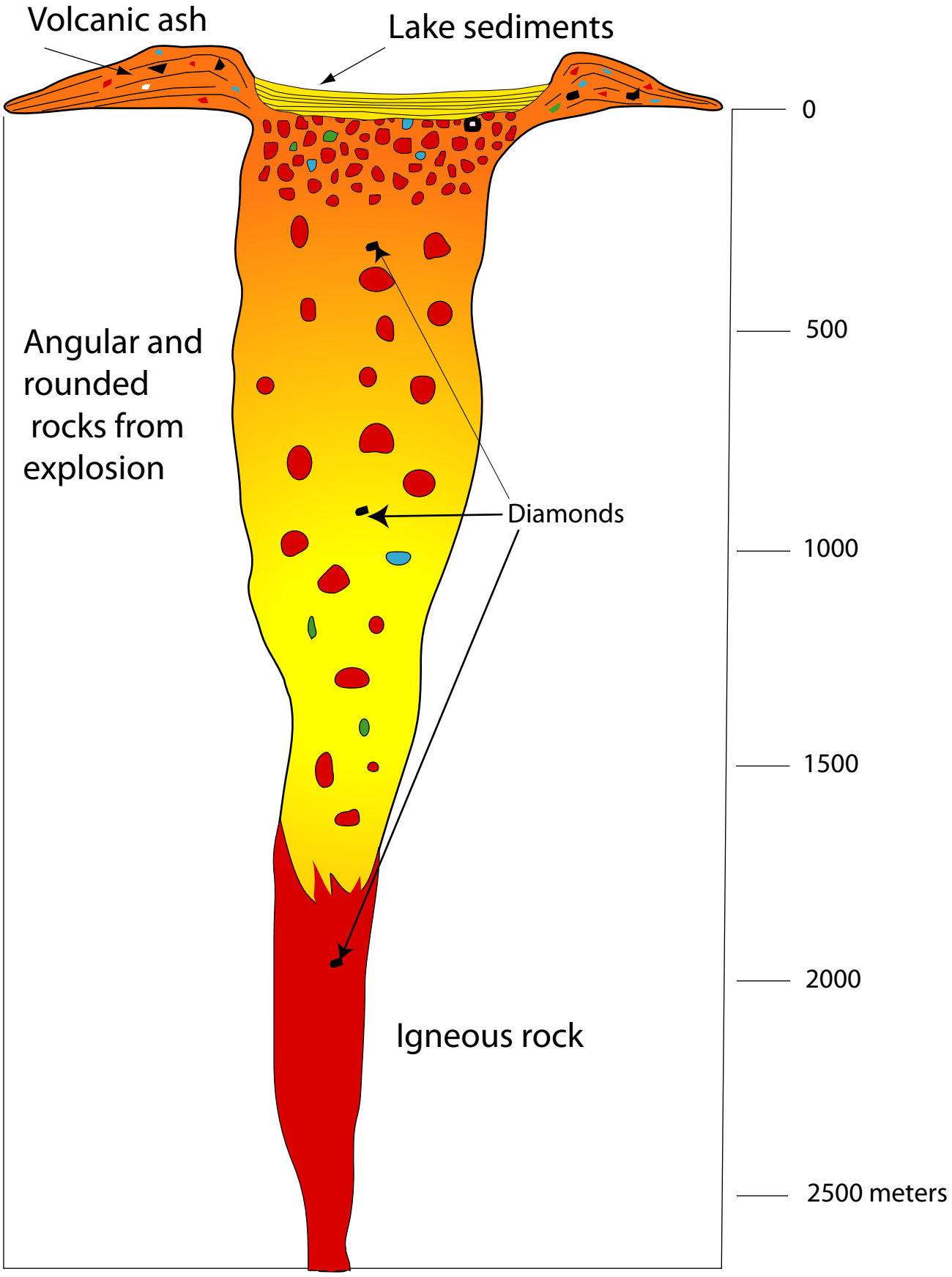


Figure 10N. Diagrammatic section of a diamond kimberlite pipe. These igneous intrusions are pipe-like bodies that form by explosive processes and consist of a distinctive type of dark rock called kimberlite. The magma that forms kimberlites originates in the Earth's mantle where pressures and temperatures are high enough to form diamonds. Adopted from Cunningham and others (this volume).

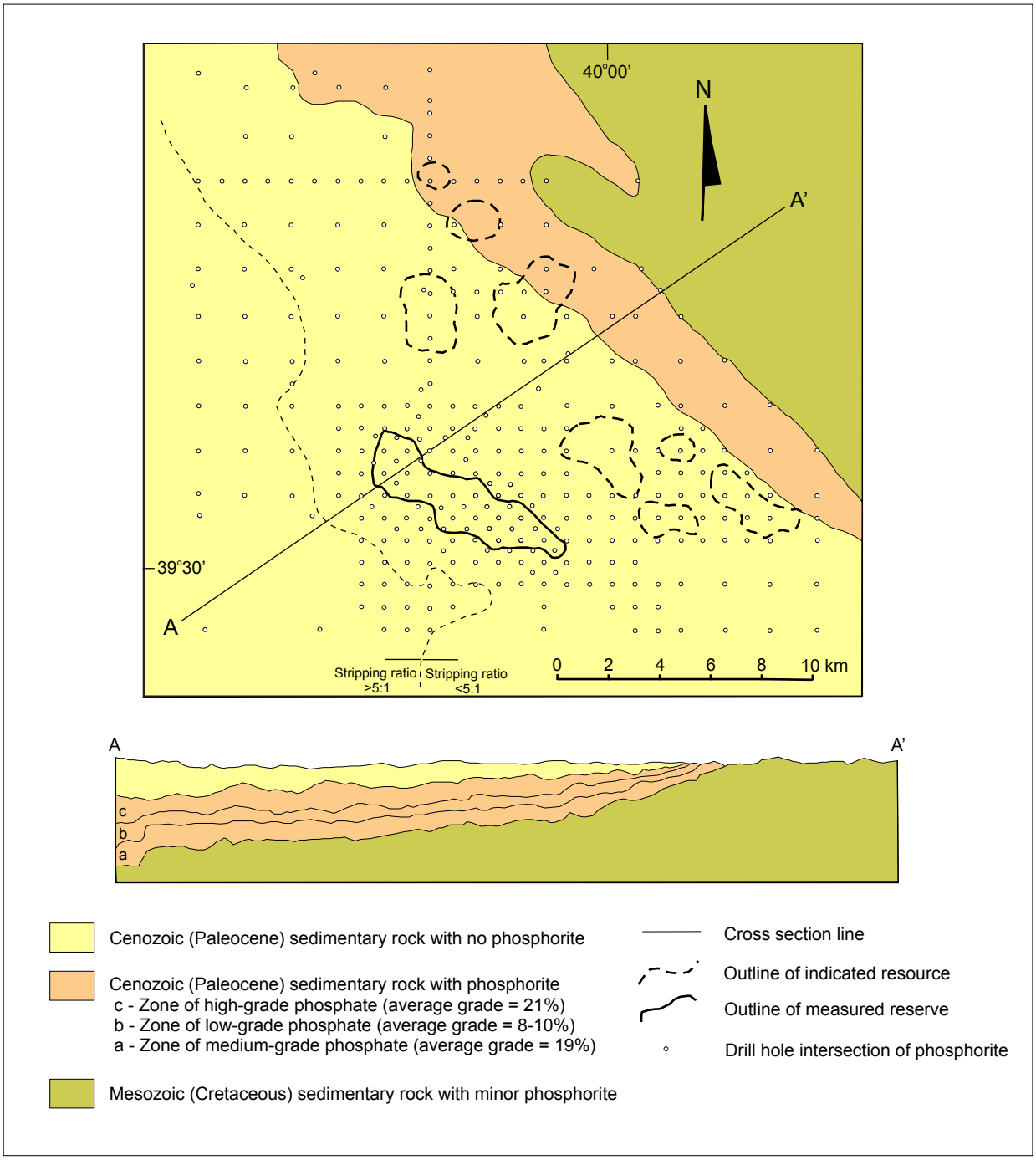


Figure 10O. Generalized geologic map of the Al Jalamid phosphate deposit, Saudi Arabia, showing the lateral distribution of phosphate resources and reserves. The schematic cross section shows the vertical distribution of phosphate resources (modified from Collenette and Grainger, 1994).

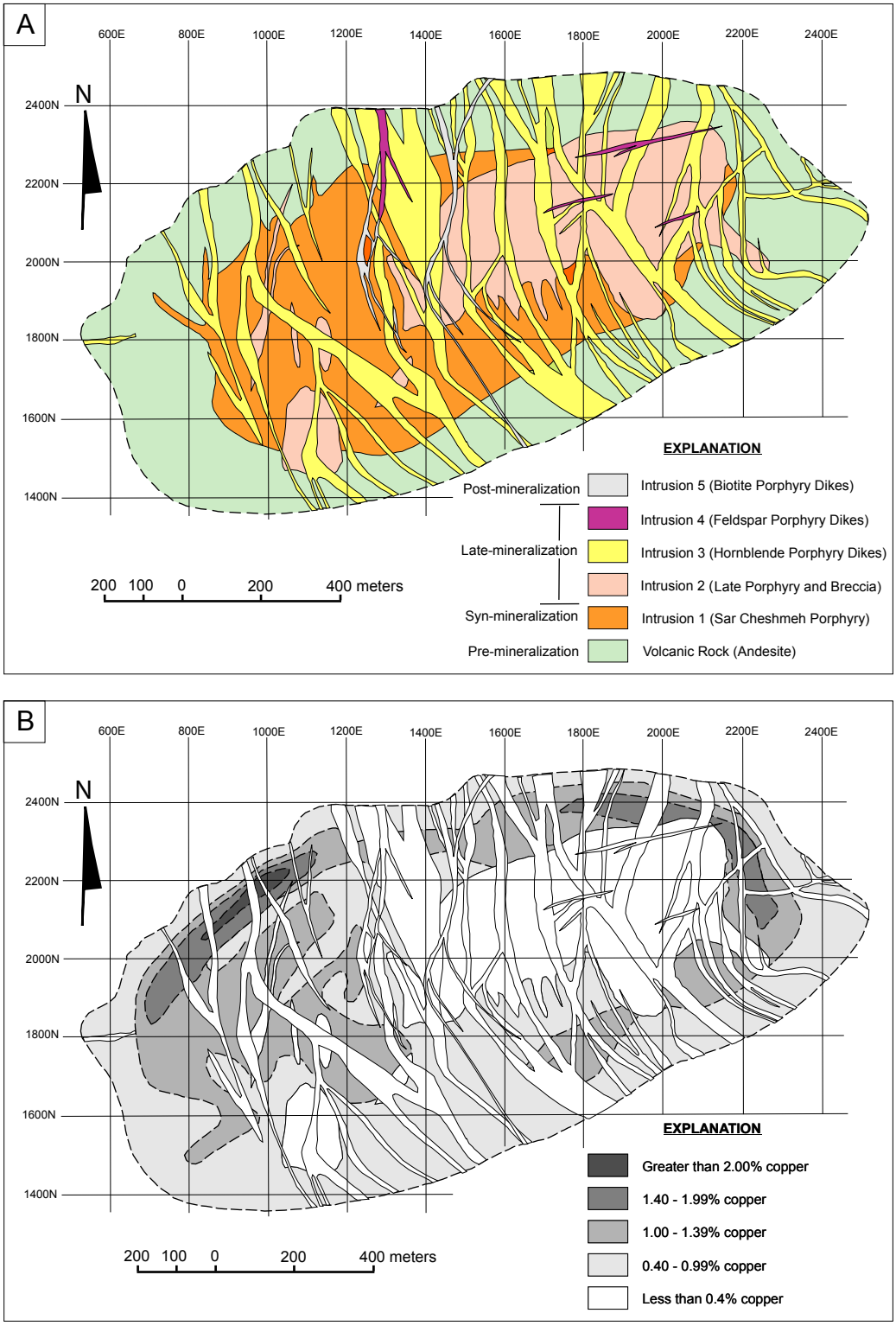


Figure 10P. The Sar Cheshmeh copper deposit, Iran (modified from Waterman and Hamilton, 1975). *A*. Distribution of rock types within the zone of greater than 0.4 percent copper, at the 2,400-meter. elevation level. *B*. Distribution of copper grades at the 2,400-meter elevation level.

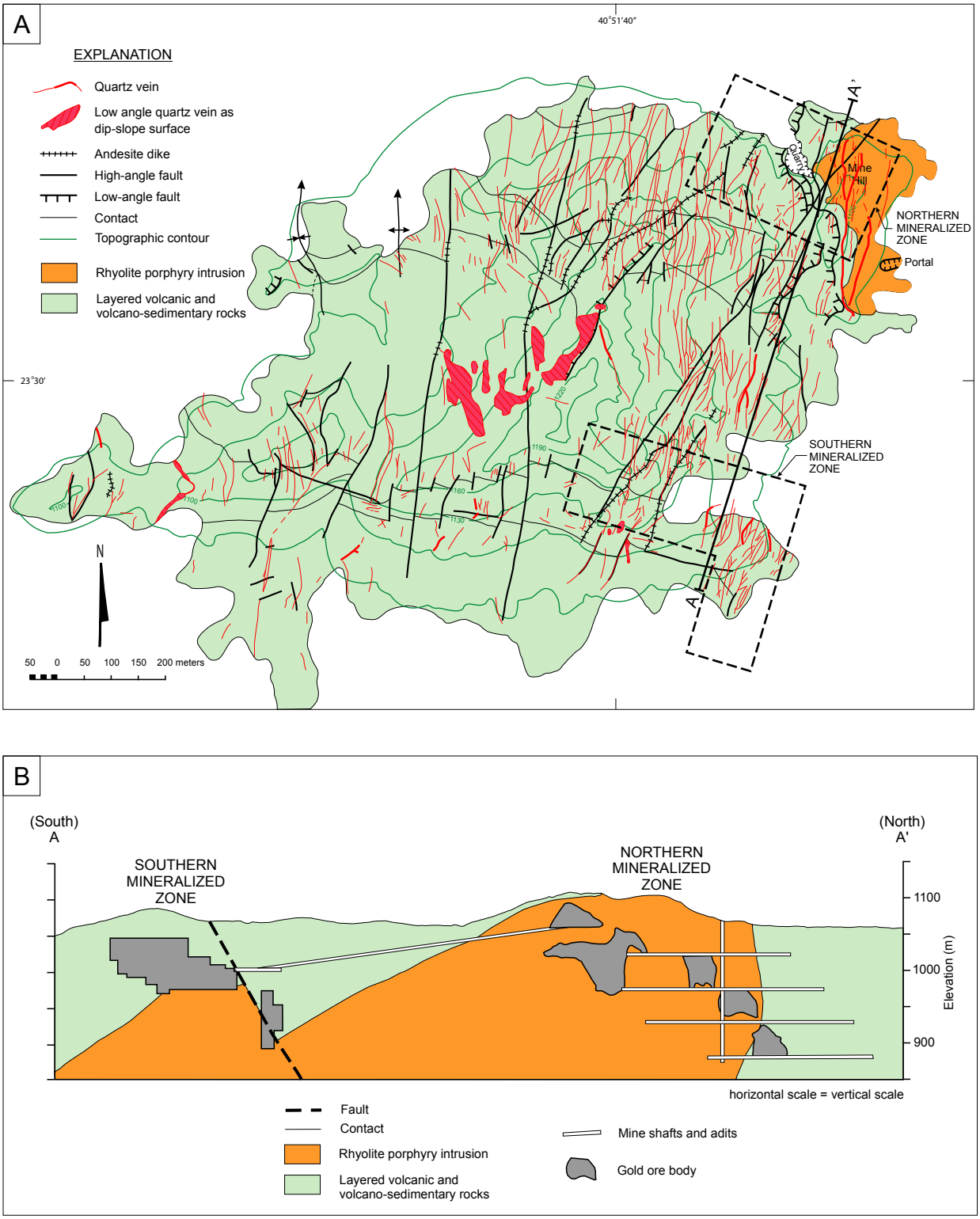


Figure 10Q. The Mahd adh Dhahab gold deposit, Saudi Arabia (modified from Doebrich, 1999). *A*. Generalized geologic map showing geologic units, faults, and the distribution of quartz veins. *B*. North-south cross section A-A' through the Northern and Southern Mineralized Zones.