

## 40 Common Minerals and Their Uses



### Aluminum

The most abundant metal element in Earth's crust. Aluminum originates as an oxide called alumina. Bauxite ore is the main source of aluminum and must be imported from Jamaica, Guinea, Brazil, Guyana, etc. Used in transportation (automobiles), packaging, building/construction, electrical, machinery and other uses. The U.S. was 100 percent import reliant for its aluminum in 2012.



### Antimony

A native element; antimony metal is extracted from stibnite ore and other minerals. Used as a hardening alloy for lead, especially storage batteries and cable sheaths; also used in bearing metal, type metal, solder, collapsible tubes and foil, sheet and pipes and semiconductor technology. Antimony is used as a flame retardant, in fireworks, and in antimony salts are used in the rubber, chemical and textile industries, as well as medicine and glassmaking. The U.S. was 87 percent import reliant in 2012.



### Barium

A heavy metal contained in barite. Used as a heavy additive in oil well drilling; in the paper and rubber industries; as a filler or extender in cloth, ink and plastics products; in radiography ("barium milkshake"); as a deoxidizer for copper; a sparkplug in alloys; and in making expensive white pigments.

### Bauxite

Rock composed of hydrated aluminum oxides. In the U.S., it is primarily converted to alumina. See "aluminum." The U.S. was 100 percent import reliant in 2012.



### Beryllium

Used in the nuclear industry and to make light, very strong alloys used in the aircraft industry. Beryllium salts are used in fluorescent lamps, in X-ray tubes and as a deoxidizer in bronze metallurgy. Beryl is the gem stones emerald and aquamarine. It is used in computers, telecommunication products, aerospace and defense applications, appliances and automotive and consumer electronics. Also used in medical equipment. The U.S. was 10 percent import reliant in 2012.

### Chromite

The U.S. consumes about 6 percent of world chromite ore production in various forms of imported materials, such as chromite ore, chromite chemicals, chromium ferroalloys, chromium metal and stainless steel. Used as an alloy and in stainless and heat resisting steel products. Used in chemical and metallurgical industries (chrome fixtures, etc.) Superalloys require chromium. It is produced in South Africa, Kazakhstan and India. The U.S. was 70 percent import reliant for chromium in 2012.

### Clays

Used in floor and wall tile as an absorbent, in sanitation, mud drilling, foundry sand bond, iron pelletizing, brick, light weight aggregate and cement. It is produced in 40 states. Ball clay is used in floor and wall tile. Bentonite is used for drilling mud, pet waste absorbent, iron ore pelletizing and foundry sand bond. Kaolin is used for paper coating and filling, refractory products, fiberglass, paint, rubber and catalyst manufacture. Common clay is used in brick, light aggregate and cement. The U.S. was not import reliant in 2012.



### **Cobalt**

Used primarily in superalloys for aircraft gas turbine engines, in cemented carbides for cutting tools and wear-resistant applications, chemicals (paint dryers, catalysts, magnetic coatings) and permanent magnets. The United States has cobalt resources in Minnesota, Alaska, California, Idaho, Missouri, Montana and Oregon. Cobalt production comes principally from Congo, China, Canada, Russia, Australia and Zambia. The U.S. was 78 percent import reliant in 2012.



### **Copper**

Used in building construction, electric and electronic products (cables and wires, switches, plumbing, heating); transportation equipment; roofing; chemical and pharmaceutical machinery; and alloys (brass, bronze and beryllium alloyed with copper are particularly vibration resistant); alloy castings; electroplated protective coatings and undercoats for nickel, chromium, zinc, etc. More recently copper is being used in medical equipment due to its anti-microbial properties. The United States has mines in Arizona, Utah, New Mexico, Nevada and Montana. Leading producers are Chile, Peru, China, United States and Australia. The U.S. was 35 percent import reliant in 2012.

### **Feldspar**

A rock-forming mineral; industrially important in glass and ceramic industries; patten and enamelware; soaps; bond for abrasive wheels; cements; insulating compositions; fertilizer; tarred roofing materials; and as a sizing, or filler, in textiles and paper. In pottery and glass, feldspar functions as a flux. End-uses for feldspar in the U.S. include glass (70 percent) and pottery and other uses (30 percent). The U.S. was not import reliant in 2012.

### **Fluorite (fluorspar)**

Used in production of hydrofluoric acid, which is used in the pottery, ceramics, optical, electroplating and plastics industries; in the metallurgical treatment of bauxite; as a flux in open hearth steel furnaces and in metal smelting; in carbon electrodes; emery wheels; electric arc welders; toothpaste; and paint pigment. It is a key ingredient in the processing of aluminum and uranium. The U.S. was 100 percent import reliant in 2012.



### **Gallium**

Gallium is used in integrated circuits, light-emitting diodes (LEDs), photodetectors and solar cells. It has a new use in chemotherapy for some types of cancer. Integrated circuits are used in defense applications, high performance computers and telecommunications. Optoelectronic devices were used in areas such as aerospace, consumer goods, industrial equipment, medical equipment and telecommunications. Leading sources are Germany, UK, China and Canada. The U.S. was 99 percent import reliant in 2012.



### **Gold**

Used in jewelry and arts; dentistry and medicine; in medallions and coins; in ingots as a store of value; for scientific and electronic instruments; as an electrolyte in the electroplating industry. Mined in Alaska and several western states. Leading producers are China, Australia, United States, Russia and Canada. The U.S. was not import reliant in 2012.

### **Gypsum**

Processed and used as prefabricated wallboard or an industrial or building plaster; used in cement manufacturing; agriculture and other uses. The U.S. was 12 percent import reliant in 2012.

### **Halite (sodium chloride–salt)**

Used in human and animal diet, food seasoning and food preservation; used to prepare sodium hydroxide, soda ash, caustic soda, hydrochloric acid, chlorine, metallic sodium; used in ceramic glazes; metallurgy, curing of hides; mineral waters; soap manufacturing; home water softeners; highway de-icing; photography; in scientific equipment for optical parts. Single crystals used for spectroscopy, ultraviolet and infrared transmission. The U.S. was 19 percent import reliant for salt in 2012.



### **Indium**

Indium tin oxide is used for electrical conductivity purposes in flat panel devices - most commonly in liquid crystal displays (LCDs). It is also used in solders, alloys, compounds, electrical components, semiconductors and research. Indium ore is not recovered from ores in the U.S. China is the leading producer. It is also produced in Canada, Japan and Belgium. The U.S. was 100 percent import reliant in 2012.

### **Iron Ore**

Used to manufacture steels of various types. Powdered iron: used in metallurgy products; magnets; high-frequency cores; auto parts; catalyst. Radioactive iron (iron 59): in medicine; tracer element in biochemical and metallurgical research. Iron blue: in paints, printing inks, plastics, cosmetics, paper dyeing. Black iron oxide: as pigment; in polishing compounds; metallurgy; medicine; magnetic inks. Most U.S. production is from Michigan and Minnesota. China, Australia, Brazil and Russia are the major producers. The U.S. was not import reliant in 2012.



### **Lead**

Used in lead-acid batteries, gasoline additives (now being eliminated) and tanks, and solders, seals or bearing; used in electrical and electronic applications; TV tubes and glass, construction, communications and protective coatings; in ballast or weights;



### **Lithium**

Compounds are used in ceramics and glass; batteries; lubricating greases; air treatment; in primary aluminum production; in the manufacture of lubricants and greases; rocket propellants; vitamin A synthesis; silver solder; batteries; medicine. Lithium ion batteries have become a substitute for nickel-cadmium batteries in hand held/portable electronic devices. There is one brine operation in Nevada. Australia, Chile and China are major producers. The U.S. was more than 70 percent reliant for lithium in 2012.



### **Manganese**

Ore is essential to iron and steel production. Also used in the making of manganese ferroalloys. Construction, machinery and transportation end uses account for most U.S. consumption of manganese. Manganese ore has not been produced in the U.S. since 1970. Major producers are South Africa, Australia, China, Gabon and Brazil. The U.S. was 100 percent import reliant in 2012.

### **Mica**

Micas commonly occur as flakes, scales or shreds. Ground mica is used in paints, as joint cement, as a dusting agent, in oil well-drilling muds; and in plastics, roofing, rubber and welding rods. Sheet mica is fabricated into parts for electronic and electronic equipment. China and Russia are leading producers. The U.S. was 100 percent import reliant in 2012.



### **Molybdenum**

Used in alloy steels to make automotive parts, construction equipment, gas transmission pipes; stainless steels; tool steels; cast irons; super alloys; and chemicals and lubricants. As a pure metal, molybdenum is used because of its high melting temperatures (4,730 F) as filament supports in light bulbs, metalworking dies and furnace parts. Major producers are China, the United States, Chile and Peru. The U.S. was not import reliant in 2012.



### **Nickel**

Vital as an alloy to stainless steel; plays key role in the chemical and aerospace industries. End uses were transportation, fabricated metal products, electrical equipment, petroleum and chemical industries, household appliances and industrial machinery. Major producers are the Philippines, Indonesia, Russia, Australia and Canada. The U.S. was 49 percent import reliant in 2012.

### **Perlite**

Expanded perlite is used in building construction products like roof insulation boards; as fillers, for horticulture aggregate and filter aids. It is produced in New Mexico and other western states and is processed in over 20 states. Leading producers are the U.S., Greece and Turkey. The U.S. was 24 percent import reliant in 2012.



### **Platinum Group Metals (PGM)**

Includes platinum, palladium, rhodium, iridium, osmium and ruthenium. Commonly occur together in nature and are among the scarcest of the metallic elements. Platinum is used principally in catalysts for the control of automobile and industrial plant emissions; in jewelry; in catalysts to produce acids, organic chemicals and pharmaceuticals. PGMs used in bushings for making glass fibers used in fiber-reinforced plastic and other advanced materials, in electrical contacts, in capacitors, in conductive and resistive films

used in electronic circuits; in dental alloys used for making crowns and bridge. South Africa, Russia, the U.S. and Canada are major producers. The U.S. was over 50 percent import reliant for most PGMs in 2012.

### **Phosphate rock**

Used to produce phosphoric acid for ammoniated phosphate fertilizers, feed additives for livestock, elemental phosphorus, and a variety of phosphate chemicals for industrial and home consumers. U.S. production occurs in Florida, North Carolina, Idaho and Utah. The U.S. is a major producer. It was not import reliant in 2012.

### **Potash**

A carbonate of potassium; used as a fertilizer, in medicine, in the chemical industry and to produce decorative color effects on brass, bronze and nickel. The leading producers are Canada, Russia and Belarus. The U.S. was 81 percent import reliant in 2012.

### **Pyrite**

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

### **Quartz (silica)**

As a crystal, quartz is used as a semiprecious gem stone. Crystalline varieties include amethyst, citrine, rose quartz, smoky quartz, etc. Cryptocrystalline forms include agate, jasper, onyx, etc. Because of its piezoelectric properties quartz is used for pressure gauges, oscillators, resonators and wave stabilizes; because of its ability to rotate the plane of polarization of light and its transparency in ultraviolet rays, it is used in heat-ray lamps, prism and spectrographic lenses. Also used in manufacturing glass, paints, abrasives, refractory materials and precision instruments.



**Rare Earth Elements** (lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium and lutetium) Used mainly in petroleum fluid cracking catalysts, metallurgical additives and alloys, glass polishing and ceramics, permanent magnets and phosphors. It is estimated that 40 pounds of rare earths are used in a hybrid car for rechargeable battery, permanent magnet motor and the regenerative braking system. The U.S. now has one rare earth (bastnasite) mine in California. More than 85 percent of global production is in China. The U.S. was import reliant for most of its rare earth metals in 2012.

### Silica

Aluminum and aluminum alloy producers and the chemical industry are major users of silicon metal. Silica is also used in manufacture of computer chips, glass and refractory materials; ceramics; abrasives; water filtration; component of hydraulic cements; filler in cosmetics, pharmaceutical, paper, insecticides; anti-caking agent in foods; flattening agent in paints; thermal insulator; and photovoltaic cells. China is the leading producer. The U.S. was 36 percent reliant on metallurgical grade silicon metal in 2012.



### Silver

Used in coins and medals, electrical and electronic devices, industrial applications, jewelry, silverware and photography. The physical properties of silver include ductility, electronics conductivity, malleability and reflectivity. Used in lining vats and other equipment for chemical reaction vessels, water distillation, etc.; a catalyst in manufacture of ethylene; mirrors; silver plating; table cutlery; dental, medical and scientific equipment; bearing metal; magnet windings; brazing alloys, solder. Also used in catalytic converters, cell phone covers, electronics, circuit boards, bandages for wound care and batteries. Silver is produced in the U.S. at over 30 base and precious

metal mines primarily in Alaska and Nevada. The leading global producers include Mexico, China, Peru, Chile, Australia, Bolivia and the U.S. The U.S. was 57 percent reliant in 2012.

### Sodium Carbonate

(soda ash or trona)

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



### Sulfur

Used in the manufacture of sulfuric acid, fertilizers, petroleum refining; and metal mining. Elemental sulphur and byproduct sulfuric acid were produced in over 100 operations in 26 state and the Virgin Islands. The U.S., Canada, China and Germany are major producers.



### Tantalum

A refractory metal with unique electrical, chemical and physical properties used to produce electronic components, tantalum capacitors (in auto electronics, pagers, personal computers and portable telephones) ; for high-purity tantalum metals in products ranging from weapon systems to superconductors; high-speed tools; catalyst; sutures and body implants; electronic circuitry; thin-film components. Used in optical glass and electroplating devices. Leading producers are Mozambique, Brazil and Congo. The U.S. was 100 percent reliant in 2012.



### Titanium

Titanium mineral concentrates are used primarily by titanium dioxide pigment producers. A small amount is used in welding rod coatings and for manufacturing carbides, chemicals and metals. It is produced in Florida and Virginia. Leading producing countries are South Africa, Australia, Canada and China. The U.S. was 77 percent reliant in 2012.

Titanium and titanium dioxide are used in aerospace applications (in jet engines, airframes and space and missile applications). It is also used in armor, chemical processing, marine, medical, power generation, sporting goods and other non-aerospace applications. Titanium sponge metal was produced in three operations in Nevada and Utah. The leading global producers are China, Japan, Russia and Kazakhstan.



### **Tungsten**

More than half of the tungsten consumed in the United States was used in cemented carbide parts for cutting and wear-resistant materials, primarily in the construction, metalworking, mining, and oil- and gas-drilling industries. The remaining tungsten was consumed to make tungsten heavy alloys for applications requiring high density; electrodes, filaments, wires, and other components for electrical, electronic, heating, lighting, and welding applications; steels, superalloys, and wear-resistant alloys; and chemicals for various applications. China is by far the leading producer. Russia, Canada, Austria and Bolivia also produce tungsten. The U.S. produces very little. It was 42 percent import reliant in 2012.



### **Uranium**

Nearly 20 percent of America's electricity is produced using uranium in nuclear generation. It is also used for nuclear medicine, atomic dating, powering nuclear submarines and other uses in the U.S. defense system. The U.S. received 83 percent of its uranium from other countries in 2012.



### **Vanadium**

Metallurgical use, primarily as an alloying agent for iron and steel, accounted for about 93 percent of the domestic vanadium consumption. Of the other uses for vanadium, the major non-metallurgical use was in catalysts for the production of maleic anhydride and sulfuric acid. China, South Africa and Russia are largest producers. The U.S. was 96 percent reliant in 2012.

### **Zeolites**

Used in animal feed, cat litter, cement, aquaculture (fish hatcheries for removing ammonia from the water); water softener and purification; in catalysts; odor control; and for removing radioactive ions from nuclear plant effluent. The U.S. was not import reliant in 2012.



### **Zinc**

Of the total zinc consumed in the U.S., about 55 percent was used in galvanizing, 21 percent in zinc-based alloys, 16 percent in brass and bronze, and 8 percent in other uses. Zinc compounds and dust were used principally by the agriculture, chemical, paint, and rubber industries.

Major co-products of zinc mining and smelting, in order of decreasing tonnage, were lead, sulfuric acid, cadmium, silver, gold and germanium. Zinc is used as protective coating on steel, as die casting, as an alloying metal with copper to make brass and as chemical compounds in rubber and paints; used as sheet zinc and for galvanizing iron; electroplating; metal spraying; automotive parts; electrical fuses; anodes; dry cell batteries; nutrition; chemicals; roof gutter; engravers' plates; cable wrappings; organ pipes and pennies. Zinc oxide used in medicine, paints, in vulcanizing rubber, sun block. Zinc dust used for primers, paints, precipitation of noble metals; removal of impurities from solution in zinc electrowinning. U.S. production is in three states and 13 mines. Leading producers are China, Australia, Peru and the U.S. The U.S. was 72 percent import reliant in 2012.

*Sources: The U.S. Geological Survey, Facts About Minerals (National Mining Association); Mineral Information Institute; the Energy Information Administration*