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Mineral Resources and Exploration

Have you ever asked yourself, "where does *that* come from," or "how do they *make* that?" As an example, consider the ingredients necessary to build the typical home: gravels for driveways and landscaping, cement and concrete for the foundation, glass for windows, metal for nails, screws, hinges, and wiring, glass for lightbulbs, drywall or sheetrock for interior walls, and paper, rubber, and plastic for various other components. All of these materials, and most of the materials we use on a daily basis, come from the ground in one way shape or form.

Minerals

Any economically valuable resource which is removed from the ground is referred to by the mining industry as a *mineral*. An approximation of the contribution of nonfuel minerals to the economy of the United States in the year 2002 was around $10.4 trillion.[1] Mineral resources obviously play an important role in our economy, and based on the home-building example above, they are also very important to industry and society in general. Minerals are the materials manipulated to build or make everything. Cement and concrete are made by mixing together lime (hardening agent produced by heating limestone), clay or shale, sand or gravel, and water. Glass is made by melting feldspar and quartz sand. Steel is produced by mixing iron with other metals. Tungsten, because it has the highest melting point of any known element (at 3422° C), is used for filaments in incandescent lightbulbs. The drywall used for interior walls is made primarily of the mineral gypsum. The mineral talc is used in the manufacture of everything from paper to plastic to baby powder. Other minerals, like rubies, diamonds, sapphires, gold, and silver, are garnished for purely aesthetic reasons.

Iron Ore

Gypsum

Quartz

Potash

Even the synthetic materials made in laboratories must unclude mineral ingredients; plastic and rubber, for example, are ultimately produced from oil.

Some materials, like clay, gravel, and stone, often go unrecognized as economically significant resources. Because of their capacity for being molded into shapes when wet, and hardened into impermeable structures when baked, clays have marketable properties which allow them to be used in pottery, bricks, cements, heat-resistant kilns, paper, porcelain, and as a "glue" for sticking iron ore pellets together.[2] Gravels, in addition to all of their landscaping uses, are included in the production of concrete and asphalt. Granite, sandstone, and marble slabs are used as both decorative and durable building materials. The collective group of minerals known as potash are mined for fertilizer, certain medicines, and to make explosives.[2] Soda ash (trona) is one of the most widely used and important commodities in the United States, being used in the manufacture of fiberglass and specialty glass, liquid detergents, and for photographic processes. In fact, because of its use in so many industries,

Open Pit Mine

monthly soda ash production information is one of the pieces evaluated in determining the condition of the U.S. economy.[2]

Exploration and Recovery

The journey from raw material (from the ground) to commercial or industrial product (refined) involves many steps. Starting at the very beginning, before the raw material can be extracted, it must first be located. This usually requires geological reconnaissance of rocks and soils in the field or examination of geologic maps. By looking at soil, water, and vegetation types, geologists can determine the minerals present in the local rock types. Additionally, seismic methods, gravity irregularities (indicative of large concentrations of heavy metals, such as iron), and Geiger counters (for detecting radioactive materials) can be used to isolate other sites of probable mineral concentration.

Mineral exploration requires different methods for different materials. Gravels, for example, are amply found in the moraines and outwash deposits of glaciated regions. Nickel, used in the manufacture of stainless steel, corrosion-resistant coatings, coins, and batteries, can be found concentrated in what are called *laterite deposits* just below the ground surface in areas of high-percentage nickel-bearing rocks.[2] The mineral graphite, composed exclusively of carbon, is used as a dry lubricant and for brake linings and pencil lead, and forms when organic-rich beds interspersed within large masses of limestone are compressed and reoriented by heat and pressure. In order to locate deposits of graphite, a geologist would look in regions of metamorphic rock where ancient seas once existed.

Once a suitably large mineral deposit has been identified, the building of a *mine* ensues. The purpose of a mine is to extract a marketable material at the lowest possible cost, and with the least possible disturbance to the natural environment. Upon depletion of the resource, the mine is closed and the surrounding area is returned to its pre-mining condition as closely as possible. Mining is an expensive operation, and this is why large concentrations of minerals must be present before mining can be profitable.

Mining Truck

Underground Mine

Many different types of mining exist: open pit mining, surface strip mining, hard and soft rock mining, and solution mining. *Underground* mining requires the construction of a shaft large enough to allow miners and their equipment to enter. From this shaft, a series of tunnels can be excavated horizontally into layers of valuable mineral, such as coal or potash. The ore is then transported via conveyor belt to the shaft where it is hoisted to the surface. *Surface* mining is reserved for mineral deposits that are found near the earth's surface. In this process, overlaying material is removed until the valuable resource is encountered and subsequently continues progressively deeper until the material of value runs out. *Solution* mining is used to mine minerals (sodium chloride and sodium sulfate – salts) which dissolve in water. In this method, a number of wells are drilled through which hot water is pumped down into layers of profitable salt content. The salt-bearing solution is then pumped to the surface and placed into evaporators which remove the water, allowing the minerals to crystallize out into a marketable form.

Potash Mine

Geologists are present in every aspect of mining: from predicting the locations of likely mineral concentrations to cost effectively and safely removing them from the ground. More than simply filling the role of a scientist, the geologist is often an integral part of the management team that operates a mine. His or her knowledge of minerals and the earth is an invaluable national resource that not only makes American industry possible, but successful too.

References

1. USGS, Mineral Commodity Summaries 2003, http://minerals.usgs.gov/minerals/pubs/mcs/2003/mcs2003.pdf
2. Mineral Information Institute, www.mii.org/commonminerals.php

Of Interest

http://webmineral.com/

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