“Mining Magnetite for your future.”

What is Magnetite?

Magnetite is a valuable source of iron ore and is mainly used in making steel.

Magnetite is a ferrimagnetic mineral with definite north and south poles and a chemical formula Fe_3O_4, one of several iron oxides and a member of the spinel group. **Magnetite** is the most magnetic of all the naturally occurring minerals on Earth, and these magnetic properties led to lodestone being used as an early form of magnetic compass. Magnetite typically carries the dominant magnetic signature in rocks, and so it has been a critical tool in paleomagnetism, a science important in discovering and understanding plate tectonics. The relationships between **magnetite** and other iron-rich oxide minerals such as ilmenite, hematite, and ulvospinel have been much studied, as the complicated reactions between these minerals and oxygen influence how and when **magnetite** preserves records of the Earth's magnetic field.

Magnetite has been very important in understanding the conditions under which rocks form and evolve. **Magnetite** reacts with oxygen to produce hematite. Small grains of **magnetite** occur in almost all igneous rocks and metamorphic rocks. **Magnetite** also occurs in many sedimentary rocks, including banded iron formations. In many igneous rocks, **magnetite**-rich and ilmenite-rich grains occur that precipitated together from magma. **Magnetite** also is produced from peridotites and dunites by serpentinization.

The chemical IUPAC name is iron(II,III) oxide and the common chemical name ferrous-ferric oxide. The formula for **magnetite** may also be written as $FeO{\cdot}Fe_2O_3$, which is one part wüstite (FeO) and one part hematite (Fe_2O_3). This refers to the different oxidation states of the iron in one structure, not a solid solution.

Mineral Properties

Color	**Black, greyish**
Crystal habit	**Octahedral, fine granular to massive**
Crystal system	**Isometric**
Cleavage	**Indistinct**
Fracture	**Uneven**
Mohs Scale hardness	**5.5–6.5**
Lustre	**Metallic**
Refractive index	**Opaque**
Streak	**Black**
Specific gravity	**5.17–5.18**
Unusual Feature	**Magnetic**

Little Known Facts!

A piece of intensely magnetic **magnetite**, called “lodestone” was used as an early form of magnetic compass.

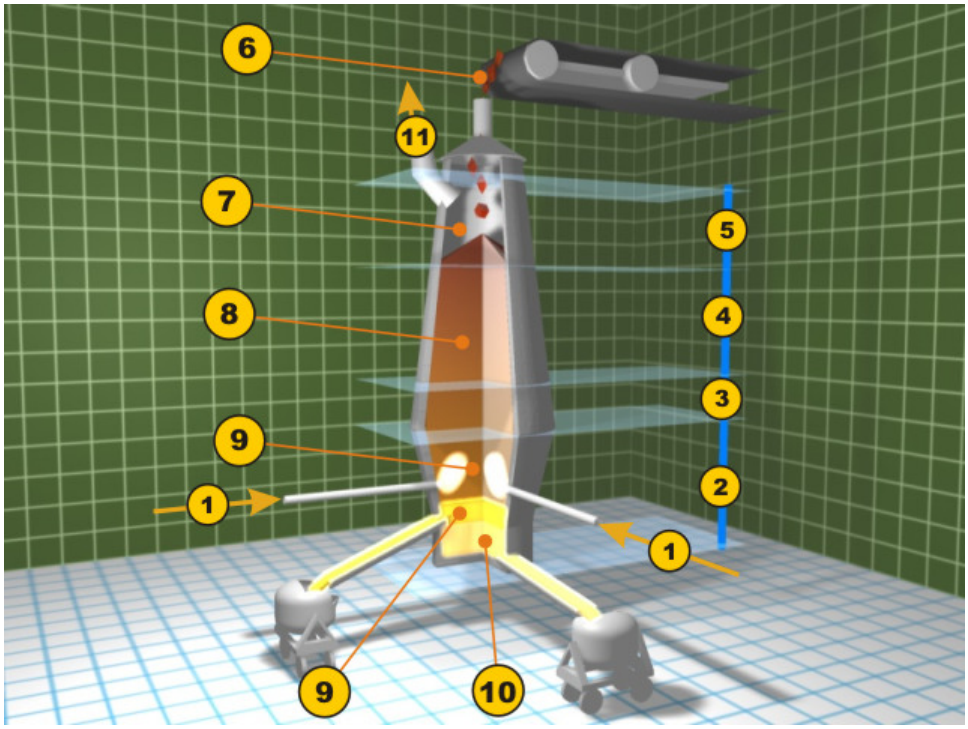
Iron, steel and ordinary **magnetite** is attracted to a magnetic field, including the Earth's magnetic field. Only **magnetite** in a relatively pure form called a lodestone can act as a natural magnet and attract and magnetize iron. The name "magnet" comes from lodestones found in a place called Magnesia.

In China, the earliest literary reference to magnetism lies in a 4th century BC book called *Book of the Devil Valley Master* (鬼谷子): "The lodestone makes iron come or it attracts it." The earliest mention of the attraction of a needle appears in a work composed between 20 and 100 AD (*Louen-heng*): "A lodestone attracts a needle." By the 12th century the Chinese were known to use the lodestone compass for navigation.

Crystals of **magnetite** have been found in some bacteria (e.g., Magnetospirillum magnetotacticum) and in the brains of bees, of termites, of some birds (e.g., the pigeon), and of humans. These crystals are thought to be involved in magnetoreception, the ability to sense the polarity or the inclination of the Earth's magnetic field, and to be involved in navigation. Also, chitons have teeth made of **magnetite** on their radula making them unique among animals. This means they have an exceptionally abrasive tongue with which to scrape food from rocks.

Iron Making with Magnetite

Industrially, iron is produced starting from iron ores, principally haematite (nominally Fe_2O_3) and **magnetite** (Fe_3O_4) by a carbothermic reaction (reduction with carbon) in a blast furnace at temperatures of about 2000 °C. In a blast furnace, iron ore, carbon in the form of coke, and a *flux* such as limestone (which is used to remove impurities in the ore which would otherwise clog the furnace with solid material) are fed into the top of the furnace, while a blast of heated air is forced into the furnace at the bottom. In the furnace, the coke reacts with oxygen in the air blast to produce carbon monoxide. The carbon monoxide reduces the iron ore to molten iron, becoming carbon dioxide in the process. The flux is present to melt impurities in the ore, principally silicon dioxide sand and other silicates. Common fluxes include limestone (principally calcium carbonate) and dolomite (calcium-magnesium carbonate). Other fluxes may be used depending on the impurities that need to be removed from the ore. In the heat of the furnace the limestone flux decomposes to calcium oxide (quicklime). Then calcium oxide combines with silicon dioxide to form a *slag*.



Blast furnace diagram
1. Hot blast from Cowper stoves
2. Melting zone (*bosh*)
3. Reduction zone of ferrous oxide (*barrel*)
4. Reduction zone of ferric oxide (*stack*)
5. Pre-heating zone (*throat*)
6. Feed of ore, limestone, and coke
7. Exhaust gases
8. Column of ore, coke and limestone
9. Removal of slag
10. Tapping of molten pig iron
11. Collection of waste gases

The slag melts in the heat of the furnace. In the bottom of the furnace, the molten slag floats on top of the more dense molten iron, and apertures in the side of the furnace are opened to run off the iron and the slag separately. The iron once cooled, is called pig iron, while the slag can be used as a material in road construction or to improve mineral-poor soils for agriculture. Pig iron is not pure iron, but has 4-5% carbon dissolved in it with small amounts of other impurities like sulfur, magnesium, phosphorus and manganese. As the carbon is the major impurity, the iron (pig iron) becomes brittle and hard. This form of iron is used to cast articles in foundries such as stoves, pipes, radiators, lamp-posts and rails.

Alternatively pig iron may be made into steel (with up to about 2% carbon) or wrought iron (commercially pure iron). Various processes have been used for this, including finery forges, puddling furnaces, Bessemer converters, open hearth furnaces, basic oxygen furnaces, electric arc furnaces. In all cases, the objective is to oxidise some or all of the carbon, together with other impurities. On the other hand, other metals may be added to make alloy steels.

The hardness of the steel depends upon their carbon content. As high the proportion of carbon greater is the hardness. It becomes less ductile. The property of the steel can also be changed by tempering it. To harden the steel, it is heated to red hot and then cooled by putting in the water (quenching) when it becomes harder and brittle. If steel is heated to a required temperature and allowed to cool it becomes softer or more malleable.

In 2005, approximately 1,544 Mt (million tonnes) of iron ore was produced worldwide.

What is Iron?

Iron is believed to be the sixth most abundant element in the universe, formed as the final act of nucleosynthesis by carbon burning in massive stars. While it makes up only about 5% of the Earth's crust, the earth's core is believed to consist largely of an iron-nickel alloy constituting 35% of the mass of the Earth as a whole. Iron is consequently the most abundant element on Earth, but only the fourth most abundant element in the Earth's crust. Most of the iron in the crust is found combined with oxygen as iron oxide minerals such as hematite and **magnetite**. About 1 in 20 meteorites consist of the unique iron-nickel minerals taenite (35-80% iron) and kamacite (90-95% iron). Although rare, meteorites are the major form of natural metallic iron on the earth's surface.

The reason for Mars' red colour is thought to be an iron-oxide-rich soil.

Iron (as Fe^{2+}, ferrous ion) is a necessary trace element used by almost all living organisms. The only exceptions are several organisms that live in iron-poor environments and have evolved to use different elements in their metabolic processes, such as manganese instead of iron for catalysis, or hemocyanin instead of hemoglobin. Iron-containing enzymes, usually containing heme prosthetic groups, participate in catalysis of oxidation reactions in biology, and in transport of a number of soluble gases.

Iron is the most widely used of all the metals, accounting for 95% of worldwide metal production. Its low cost and high strength make it indispensable in engineering applications such as the construction of machinery and machine tools, automobiles, the hulls of large ships, and structural components for buildings. Since pure iron is quite soft, it is most commonly used in the form of steel.

Source From Wikipedia, the free encyclopedia

http://en.wikipedia.org/wiki/Magnetite