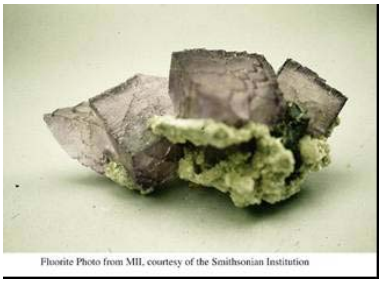
FLUORSPAR



INTRODUCTION

When found in nature, fluorspar is known by the mineral name *fluorite*. Fluorspar (fluorite) is calcium fluoride (CaF_2). It is found in a variety of geologic environments. Fluorspar is found in granite (igneous rock), it fills cracks and holes in sandstone, and it is found in large deposits in limestone (sedimentary rock). The term fluorspar, when used as a commodity name, also refers to calcium fluoride formed as a by-product of industrial processes.

Fluorspar is relatively soft, number 4 on Moh's scale of hardness. Pure fluorspar is colorless, but a variety of impurities give fluorite a rainbow of different colors, including green, purple, blue, yellow, pink, brown, and black. It has a pronounced cleavage, which means it breaks on flat planes. Fluorite crystals can be well formed, beautiful and highly prized by collectors.

Despite its beauty and physical properties, fluorspar is primarily valuable for its fluorine content.

Name

Even though fluorite contains the element fluorine, its name is not derived from its chemical composition. The name was given by Georg Agricola in 1546 and was derived from the Latin verb *fluere* which means *to flow* because it melts easily.

Spar is a generic name used by mineralogists to refer to any non-metallic mineral that breaks easily to produce flat surfaces and which has a glassy luster.

A miner's name used long ago for fluorite was *Blue John*.

Sources

The United States once produced large quantities of mineral fluorspar. However, the great fluorspar mines of the Illinois-Kentucky fluorite district are now closed. Today, the United States imports fluorspar from China, South Africa, Mexico, and other countries.

A small percentage of the fluorspar consumed in the United States is derived as a by-product of industrial processes. For instance, an estimated 5,000 to 8,000 tons of synthetic fluorspar is produced each year in the uranium enrichment process, the refining of

petroleum, and in treating stainless steel. Hydrofluoric acid (HF) and other fluorides are recovered during the production of aluminum.

Uses

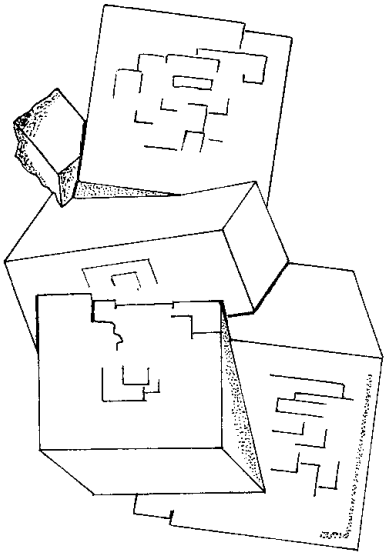
Fluorite (fluorspar): used in production of hydrofluoric acid, which is used in the electroplating, stainless steel, refrigerant, and plastics industries; in production of aluminum fluoride, which is used in aluminum smelting; as a flux in ceramics and glass, and in steel furnaces; and in emery wheels, optics, and welding rods.

The majority of the United States' annual consumption of fluorspar is for the production of hydrofluoric acid (HF) and aluminum fluoride (AlF_3). HF is a key ingredient for the production of all organic and non-organic chemicals that contain the element fluorine. It is also used in the manufacture of uranium. AlF_3 is used in the production of aluminum.

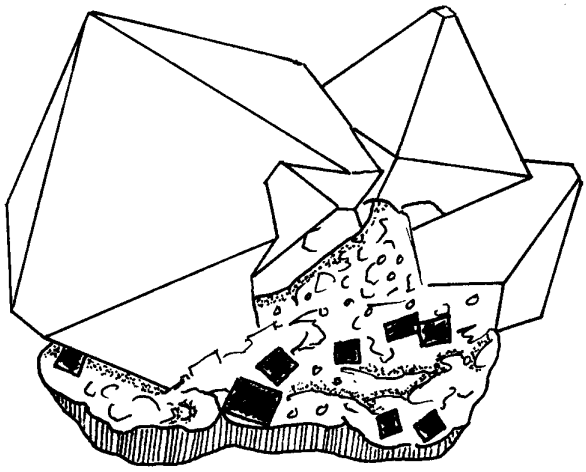
The remainder of fluorspar consumption is as a flux in making steel, glass, enamel, and other products. A flux is a substance that lowers the melting temperature of a material.

Substitutes and Alternative Sources

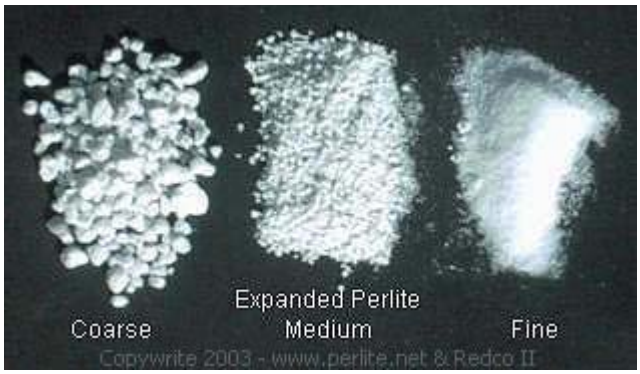
Phosphoric acid plants, which process phosphate rock into phosphoric acid, produce a by-product chemical called fluorosilicic acid. This is used to fluoridate public water supplies or to produce AlF3. Phosphate-rich rocks are a minor alternative source for elemental fluorine.



Yellow fluorite from Illinois



Pink fluorite from Peru



Fluorite crystal drawings by Darryl Powell

1999 Darryl Powell

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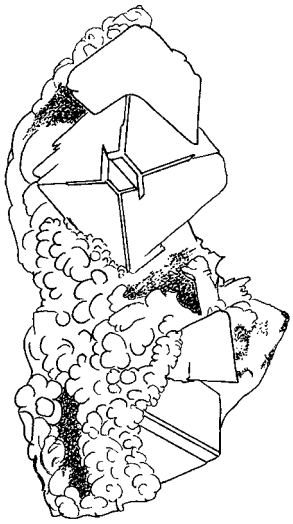

Green fluorite from Colorado

Perlite is not a trade name but a generic term for naturally occurring siliceous rock. The distinguishing feature which sets perlite apart from other volcanic glasses is that when heated to a suitable point in its softening range, it expands from four to twenty times its original volume.

This expansion is due to the presence of two to six percent combined water in the crude perlite rock. When quickly heated to above 1600 degrees F (871 degrees C), the crude rock pops in a manner similar to popcorn as the combined water vaporizes and creates countless tiny bubbles which account for the amazing light weight and other exceptional physical properties of expanded perlite.

This expansion process also creates one of perlite's most distinguishing characteristics: its white color. While the crude rock may range from transparent light gray to glossy black, the color of expanded perlite ranges from snowy white to grayish white.

Expanded perlite can be manufactured to weigh as little as 2 pounds per cubic foot making it adaptable for numerous applications.

Since perlite is a form of natural glass, it is classified as chemically inert and has a pH of approximately 7.

Perlite is mined and expanded all over the world. The United States is estimated to be the largest consumer and producer of crude and expanded perlite. However, there is very

strong world wide production and consumption of perlite. Other leading countries producing perlite include China, Greece, Japan, Hungary, Armenia, Italy, Mexico, Philippines, and Turkey.

Typical Elemental Analysis	
Silicon	33.8
Aluminum	7.2
Potassium	3.5
Sodium	3.4
Iron	0.6
Calcium	0.6
Magnesium	0.2
Trace	0.2
Oxygen (by difference)	47.5
Net Total	97.0
Bound Water	3.0
Total	100.0
* All analyses are shown in elemental form even though the actual forms present are mixed glassy silicates. Free silica may be present in small amounts, characteristic of the particular ore body. More specific information may be obtained from the ore supplier involved.	

Typical Physical Properties	
Color	White
Refractive Index	1.5
Free Moisture, Maximum	0.5%
pH (of water slurry)	6.5 - 8.0
Specific Gravity	2.2 - 2.4
Bulk Density (loose weight)	As desired but usually in the 2-25 lb/ft^3 range (32-400 kg/m^3)
Mesh Size Available	As desired, 4-8 mesh and finer
Softening Point	1600-2000°F (871-1093°C)
Fusion Point	2300-2450°F (1260-1343°C)
Specific Heat	0.2 Btu/lb·°F (387 J/kg·K)
Thermal Conductivity at 75°F (24°C)	.27-.41 $Btu·in/h·ft^2·°F$(.04-.06 W/m·K)
Solubility .....Soluble in hot concentrated alkali and HF Moderately soluble (<10%) in 1N NaOH Slightly soluble (<3%) in mineral acids (1N) Very slightly soluble (<1%) in water or weak acids	

Uses for Perlite...

There are many uses for perlite. These uses can be broken down into three general categories: construction applications, horticultural applications, and industrial applications.

Construction Applications

Because of perlite's outstanding insulating characteristics and light weight, it is widely used as a loose-fill insulation in masonry construction. In this application, free-flowing perlite loose-fill masonry insulation is poured into the cavities of concrete block where it completely fills all cores, crevices, mortar areas and ear holes. In addition to providing thermal insulation, perlite enhances fire ratings, reduces noise transmission and it is rot, vermin and

termite resistant. Perlite is also ideal for insulating low temperature and cryogenic vessels. When perlite is used as an aggregate in concrete, a lightweight, fire resistant, insulating concrete is produced that is ideal for roof decks and other applications. Perlite can also be used as an aggregate in Portland cement and gypsum plasters for exterior applications and for the fire protection of beams and columns. Other construction applications include under-floor insulation, chimney linings, paint texturing, gypsum boards, ceiling tiles, and roof insulation boards.

Horticultural Applications

In horticultural applications, perlite is used throughout the world as a component of soilless growing mixes where it provides aeration and optimum moisture retention for superior plant growth. For rooting cuttings, 100% perlite is used. Studies have shown that outstanding yields are achieved with perlite hydroponic systems. Other benefits of horticultural perlite are its neutral pH and the fact that it is sterile and weed-free. In addition, its light weight makes it ideal for use in container growing. Other horticultural applications for perlite are as a carrier for fertilizer, herbicides and pesticides and for pelletizing seed. Horticultural perlite is as useful to the home gardener as it is to the commercial grower. It is used with equal success in greenhouse growing, landscaping applications and in the home in house plants.

Industrial Applications

Industrial applications for perlite are the most diverse, ranging from high performance fillers for plastics to cements for petroleum, water and geothermal wells. Other applications include its use as a filter media for pharmaceuticals, food products, chemicals and water for municipal systems and swimming pools.

Additional applications include its use as an abrasive in soaps, cleaners, and polishes; and a variety of foundry applications utilizing perlite's insulating properties and high heat resistance. This same heat reistant property is taken advantage of when perlite is used in the manufacture of refractory bricks, mortars, and pipe insulation.

What is diatomaceous earth and why is it an effective natural pesticide?

Diatomaceous earth (DE) contains the **fossil remains of diatoms, a type of algae** which produces skeletons made amorphous (non-crystalline) silica.

Almost universally, the diatoms obtain silica from volcanic ash which falls into the water in which the diatoms grow. Over eons, these lakes dried out, exposing volumes of these fossil remains many feet deep. This material is now called diatomaceous earth, or in the case of **White Mountain Natural Products, Inc.**, it is called **DI-ATOMATE"! to identify it as the only diatomaceous earth selected specifically for its insect killing power.**

HOW DOES IT WORK?

The small, superior, and more effective type of diatomaceous earth such as DI-ATOMATE™ uses its sharp edges to cut the waxy coating of the insect allowing the DI-ATOMATE™ to absorb the body fluids released, dehydrating the insect and causing it to die.

The insect doesn't die instantly, as when you use a chemical insecticide, rather it dies slowly as it dehydrates, in one or two days. Naturally, a bug that dies in a day or two is just as dead as a bug that dies in a shorter time.

Also, the insect doesn't need to come in direct contact with DE for it to be effective. The fine particles are attacted to the waxy exoskeleton of the insect by static electricity if it's even in the ***relative vicinity*** of the DE. Try ***that*** with chemical pesticides!

The best part of this system is that the **insects cannot and will not build up resistance in succeeding generations, which happens when using chemicals**. The main reason is that the bug is killed mechanically (physically) instead of chemically, **making it the obvious choice for insect control**.