Boron

U.S. Geological Survey Boron Commodity Specialist Phyllis A. Lyday has prepared the following information on boron.

What does boron have to do with baseball, apple pie, motherhood and Chevrolet? Boron minerals and chemicals are used in the tanning of leather baseballs and gloves; in micro-fertilizer to grow apples and in the glass and enamels of bakewares to cook apple pie; in boron detergents for soaking baby clothes and diapers; and in fiberglass parts for the Chevrolet Corvette.

Boron minerals and compounds have been used commercially for 2,000 years. In nature, boron is present in the form of borate, combined with oxygen and other elements. Borates are salts or esters of boric acid, and are widely present in oceans, sedimentary rocks, coal, shale and soils. The modern borate industry began in the 13th century when Marco Polo brought borax, an ore of boron, to Europe to be used in glass and as a flux (a substance used to promote fusion) in metallurgy.

The borate component of importance is boron oxide. The glass-forming properties of boron oxide account for three-quarters of the total U.S. consumption of boron minerals and chemicals (by weight). These applications include manufacture of borosilicate glass, ceramics, frits and insulation-grade and textile-grade glass fibers. The most commonly refined borate, borax pentahydrate, is used in glass and agriculture and is a derivative of anhydrous borax. Borate's other uses include preservatives in makeup and antiseptics in eyewash and first-aid creams.

Boric acid is produced by adding an acid to boron minerals or borax; the anhydrous boric acid is produced by heating borax to evaporate water. Uses for boric acid include glass and cellulosic insulation. Anhydrous boric acid can react to produce elemental boron, which is used in car airbags.

Other boron compounds also have varied uses. Boron nitride forms cubic crystals that rival the hardness of diamond. Boron carbide, a highly refractory material and one of the hardest substances known, is used as an abrasive and in nuclear shielding.

There are more than 200 known boron-bearing minerals, and they are obtained by several methods: by pumping brines with high boron concentrations from wells to a processing plant to separate the borax by carbonation or solvent extraction; by pumping chemicals underground and processing the dissolved boron solution; and by surface and underground mining.

World production of all boron minerals and compounds in 2004 was about 4.4 million metric tons gross weight of ore. Major producers of boron minerals, in order of importance are Turkey, the United States, Russia and Argentina.

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Borax crystals from Kramer, California. Image from Aram Dulyan.