Zeolite Encyclopedia Article

Zeolite

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Contents

Zeolite Encyclopedia Article.....1

Contents.....2

Zeolite.....3

Zeolite

The zeolites are a group of more than 35 soft, white **minerals** comprised mostly of **aluminum, silicon**, and **oxygen** and having a crystal structure featuring spacious pores or rings. Zeolites often form as **crystals** in small cavities in basaltic rocks or as volcanic tuffs altered by **water**. They are also synthesized industrially.

The pores of a natural zeolite crystal are filled with water that can be driven off by heating. The result is a honeycomb-like structure penetrated by openings on the order of a few atoms in width (2–8 angstroms). This structure can act as a hyperfine filter or molecular sieve. For example, nitrogen binds to some zeolites, so forcing ordinary air (which consists mostly of nitrogen) through such crystals yields an output of up to 95% oxygen. Equally useful is the ability of zeolites to capture large positively-charged ions from aqueous solution. This capture process is reversible; that is, an ion adsorbed by a zeolite can generally be driven off again by heat. This property allows many zeolite-based molecular sieves to be reused indefinitely. Such sieves—often consisting of tanks filled with tons of crushed zeolitic tuff—have been used to filter radioactive cesium and strontium from nuclear waste, to remove ammonia from sewage, to scrub sulfur dioxide (SO_2) from coal-fired electric power station emissions, to purify landfill gas for household utility use, to filter mercury and other heavy **metals** from industrial wastewater, to remove calcium from water in water-softening systems, and for many other purposes.

Zeolites were first identified in 1756, but their molecular sieve properties were not observed until the mid 1920s. Even then they remained a mere curiosity for some time, as geologists still argued that natural zeolites were too rare to be commercially useful. Attention turned instead to zeolite synthesis. It was not until the 1950s that geologists discovered that million-ton deposits of volcanic **tuff** consisting mostly of zeolite are not, in fact, uncommon.

See Also

Crystals and Crystallography; Minerology