

Vermiculite

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Vermiculite is a natural mineral that expands with the application of heat. The expansion process is called exfoliation and it is routinely accomplished in purpose-designed commercial furnaces. Vermiculite is formed by weathering or hydrothermal alteration of biotite or phlogopite.^[1] Large commercial vermiculite mines currently exist in South Africa, China, and Brazil.

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Occurrence

Vermiculite was first described in 1824 for an occurrence in Millbury, Worcester County, Massachusetts, USA. Its name is from Latin *vermiculare*, *to breed worms*, for the manner in which it exfoliates when heated.^[1]

It typically occurs as an alteration product at the contact between felsic and mafic or ultramafic rocks such as pyroxenites and dunites. It also occurs in carbonatites and metamorphosed magnesium rich limestone. Associated mineral phases include: corundum, apatite, serpentine and talc. It occurs interlayered with chlorite, biotite and phlogopite.^[2]

Vermiculite



General

Category	Phyllosilicate
Chemical formula	$(\text{MgFe,Al})_3(\text{Al,Si})_4\text{O}_{10}(\text{OH})_2 \cdot 4\text{H}_2\text{O}$

Identification

Color	Colorless, white, yellow, green, brown
Crystal habit	Clay, scaly, aggregate, rarely as pseudo-hexagonal crystal plates
Crystal system	Monoclinic Prismatic H-M Symbol (2/m) Space Group: C 2/m
Cleavage	Perfect {001}
Fracture	Uneven
Tenacity	Pliable
Mohs scale hardness	1.5-2
Luster	Dull to pearly, bronzy
Streak	Greenish white
Diaphaneity	Translucent
Specific gravity	2.2-2.6

Structure

Vermiculite is a 2:1 clay, meaning it has 2 tetrahedral sheets for every one octahedral sheet. It is a limited expansion clay with a medium shrink-swell capacity. Vermiculite has a high cation exchange capacity at 100-150 meq/100 g. Vermiculite clays are weathered micas in which the potassium ions between the molecular sheets are replaced by magnesium and iron ions.

Optical properties	Biaxial (-)
Refractive index	$n_{\alpha} = 1.525 - 1.561$ $n_{\beta} = 1.545 - 1.581$ $n_{\gamma} = 1.545 - 1.581$
Birefringence	$\delta = 0.020$
Pleochroism	X in paler shades than Y and Z
References	[1][2][3]

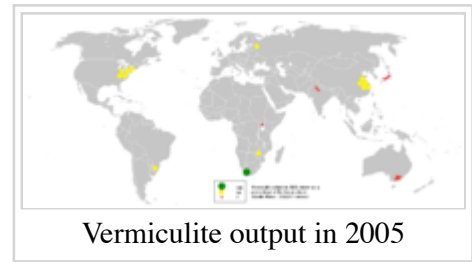
Commercial uses

- molded shapes bonded with sodium silicate for use in:
 - high-temperature insulation
 - refractory insulation
 - fireproofing of structural steel and pipes
- soil conditioner
- as loose-fill insulation
- packing material, valued for its high absorbency
- suitable as a substrate for various animals and/or incubation of eggs
- lightweight aggregate for plaster, proprietary concrete compounds, firestop mortar and cementitious spray fireproofing
- as an additive to fireproof wallboard
- component of the interior fill for firestop pillows, along with graphite
- carrier for dry handling and slow release of agricultural chemicals
- soil additive for plants, together with perlite for potted plants
- growing medium for hydroponics.
- means to permit slow cooling of hot pieces in glassblowing, lampwork, steelwork, and glass beadmaking
- used in in-ground swimming pools to provide a smooth pool base
- used in commercial hand warmers
- used as a sterile medium for the incubation of reptile eggs
- light-weight insulative concrete [1] (<http://sugarmtfarm.com/blog/2007/09/float-my-concrete-boat.html>)
- used in AGA cookers as insulation
- used in explosives storage as a blast mitigant
- used to absorb hazardous liquids for solid disposal
- used in gas fireplaces to simulate embers
- used as a coating/impregnation on fiberglass sleeve, tape, rope and fabric to increase the useful temperature range and to add abrasion resistance. (<http://www.vermiculitecoated.com>)
- used as a growing substrate in the PF Tek method of mushroom cultivation.

Commercial manufacture of exfoliated vermiculite

In 2005, South Africa was the top producer of vermiculite with about 40% world share followed by the USA and China, reports the British Geological Survey.

While some exfoliators focus on only a few of the possible applications, others can provide vermiculite products for all its applications. It is common for vermiculite exfoliators to exfoliate perlite also, as both are often sold together. For those who want to set up a new exfoliation process, it is possible to find expert consultants to advise in the design and construction of the desired facilities. Vermiculite exfoliators have an international trade association called *The Vermiculite Association* to represent the industry's interests and to exchange information.^[4] Many of its members also maintain memberships in *The Perlite Institute*.^[5]



Fireproofing

For many years, since the advent of the asbestos removal business, before which nearly everyone sold asbestos-based spray fireproofing, vendors could be cleanly categorized into users of MMMF (man-made-mineral-fibers), which included both rockwool and ceramic fibres, and cementitious sprays, whereby the binder was typically Portland cement and the lightweight aggregate inside the plaster was vermiculite. For many years, makers of the cementitious products would point out the ill health effects that are possible from overexposure and lack of proper industrial hygiene procedures when working with MMMF.^[citation needed] Vendors of the MMMF products would point out the possibility of asbestos contamination, particularly with US mined vermiculite ore.^[citation needed] Ironically, both sides were defending against lawsuits in the asbestos litigation and eventually stopped pointing out these particular weak spots about one another. Most affected manufacturers are still in receivership as a means of dealing with the results of the asbestos litigation.^[citation needed] One large British manufacturer of asbestos products even had to discontinue selling anything to North America directly, having to rely now on surrogate trading companies for sales to that continent.^[citation needed]

Asbestos contamination

Although not all vermiculite contains asbestos, some products were made with vermiculite that contained asbestos until the early 1990s. Vermiculite mines throughout the world are now regularly tested for it and are supposed to sell products that contain no asbestos. The former vermiculite mine in Libby, Montana, did have tremolite asbestos as well as winchite and richterite (both fibrous amphiboles) — in fact, it was formed underground through essentially the same geologic processes as the contaminants. A vermiculite mine in Virginia has also been found to be contaminated by asbestos.^[6]

Pure vermiculite does not contain asbestos and is non-toxic, but it can become contaminated over long periods if there is a presence of a secondary mineral called diopside. After millions of years of weatherization, the biotite turns into vermiculite and the diopside turns into asbestos.

Controversy over health risks

The largest and oldest vermiculite mine in the United States was started in the 1920s, at Libby,

Montana, and the vermiculite was sold under the commercial name Zonolite. The Zonolite brand and the mine was acquired by the W.R. Grace Company in 1963. Mining operations at the Libby site stopped in 1990 in response to asbestos contamination. While in operation, the Libby mine may have produced 80% of the world's supply of vermiculite.^[7]

The United States government estimates that vermiculite was used in more than 35 million homes, but does not recommend its removal. Nevertheless, homes or structures containing vermiculite or vermiculite insulation dating from before the mid 1990s—and especially those known to contain the "Zonolite" brand—may contain asbestos, and therefore may be a health concern.

An article published in the *Salt Lake Tribune* on December 3, 2006, reported that vermiculite and Zonolite had been found to contain asbestos, which had led to cancers such as those found in asbestos-related cases. The article stated that there had been a "cover-up" by W.R. Grace Company and others regarding the health risks associated with vermiculite and that several sites in the Salt Lake Valley had been remediated by the EPA when they were shown to be contaminated with asbestos. W.R. Grace Company has vigorously denied these charges.

The vermiculite deposit at the mine in Libby, Montana, was (and is) heavily contaminated with asbestos.^[8] Numerous people were knowingly^[9] exposed to the harmful dust of vermiculite that contained asbestos. Unfortunately, the mine had been operating since the 1920s, and environmental and industrial controls were virtually non-existent until the mine was purchased by the W.R. Grace Company in 1963. Yet, knowing the human health risks, the mining company still continued to operate there until 1990. Consequently, many of the former miners and residents of Libby have been affected and continue to suffer health problems. Over 200 people in the town have died from asbestos-related disease due to contamination from vermiculite mining from nearby Zonolite Mountain, where soil samples were found to be loaded with fibrous tremolite (known to be a very toxic form of asbestos), and countless others there who insulated their homes with Zonolite have succumbed to asbestos-related diseases, most of whom never were employed in environments where asbestos was an issue.^[10]

After a 1999 Seattle Post-Intelligencer story claimed that asbestos-related disease was common in the town, the EPA, in response to political pressure, made cleanup of the site a priority and called Libby the worst case of community-wide exposure to a toxic substance in U.S. history.^{[11][12]} The EPA has spent \$120 million in Superfund money on cleanup.^[12] In October 2006, W. R. Grace Company tried to appeal the fines levied on them from the EPA, but the Supreme Court rejected the appeal.^[13] The United States government is also pursuing criminal charges against several former executives and managers of the mine for allegedly disregarding and covering up health risks to employees.^[13] They are also accused of obstructing the government's cleanup efforts and wire fraud. To date, according to the indictment, approximately 1,200 residents of the Libby area have been identified as suffering from some kind of asbestos-related abnormality.^[14] Jury selection was to have been completed in February, 2009.^{[15][16]} The case ended in acquittals on May 8, 2009.^[17] On June 17, 2009, the EPA issued a public health emergency in and near Libby, thereby allowing Federal agencies to provide funding for health care, and for removal of contaminated insulation from affected homes.^[18]

See also

- Passive fire protection
- Fireproofing
- Firestop
- Asbestos
- Perlite
- Sodium silicate
- Plaster
- List of minerals
- Square foot gardening

References

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2. [^] ^{*a b*} <http://rruff.geo.arizona.edu/doclib/hom/vermiculite.pdf> Handbook of Mineralogy
3. [^] <http://webmineral.com/data/Vermiculite.shtml> Webmineral data
4. [^] "The Vermiculite Association" (<http://www.vermiculite.org/>) . <http://www.vermiculite.org/>.
5. [^] "The Perlite Institute" (<http://www.perlite.org/>) . <http://www.perlite.org/>.
6. [^] <http://www.seattlepi.com/uncivilaction/asb04.shtml>
7. [^] "Libby Site Background" (<http://www.epa.gov/region8/superfund/libby/background.html>) . United States Environmental Protection Agency. <http://www.epa.gov/region8/superfund/libby/background.html>.
8. [^] AP Feature on Libby, MT: "For asbestos-ravaged town, questions persist." Accessed May 24, 2010. (http://news.yahoo.com/s/ap/20100524/ap_on_he_me/us_asbestos_town_2)
9. [^] Dean, Cornelia. <http://www.hereandnow.org/shows/2009/02/rundown-219/> The "Here and Now" radio show played a recording of testimony from a 1989 court case. The person testifying was a mine supervisor in mid-1950s. He testified unambiguously that the mine management knew that there was asbestos present, that it was toxic, and that the miners were being exposed to it.
10. [^] "Deadly dust" (http://www.cbc.ca/national/news/deadly_dust/) . *CBC News*. 2003-02-07. http://www.cbc.ca/national/news/deadly_dust/.
11. [^] "A town left to die: hundreds of miners and family members killed and sickened" (<http://seattlepi.nwsource.com/uncivilaction/>) . *Seattle PI*. 1999-11-18. <http://seattlepi.nwsource.com/uncivilaction/>.
12. [^] ^{*a b*} "Libby Asbestos" (<http://www.epa.gov/region8/superfund/libby/>) . United States Environmental Protection Agency. <http://www.epa.gov/region8/superfund/libby/>.
13. [^] ^{*a b*} Verhovek, Sam Howe (2006-10-11). "Firm Must Pay Asbestos Costs" (<http://www.latimes.com/news/nationworld/nation/la-na-grace11oct11,1,3194269.story?coll=la-headlines-nation>) . *LA Times*. <http://www.latimes.com/news/nationworld/nation/la-na-grace11oct11,1,3194269.story?coll=la-headlines-nation>.
14. [^] "W.R. Grace and executives charged with fraud, obstruction of justice, and endangering Libby, Montana community" (http://www.usdoj.gov/opa/pr/2005/February/05_enrd_048.htm) . 2005-02-07. http://www.usdoj.gov/opa/pr/2005/February/05_enrd_048.htm.
15. [^] Johnson, Carrie (2007-07-13). "Asbestos Evidentiary Ruling Goes Against Grace" (<http://www.washingtonpost.com/wp-dyn/content/article/2007/07/12/AR2007071201799.html>) . *The Washington Post*. pp. D05. <http://www.washingtonpost.com/wp-dyn/content/article/2007/07/12/AR2007071201799.html>.
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17. [^] <http://abcnews.go.com/US/wireStory?id=7539715>
18. [^] Dean, Cornelia. U.S. Cites Emergency in Asbestos-Poisoned Town (<http://www.nytimes.com/2009/06/18/science/earth/18libby.html>) *New York Times*, June 18, 2009.

External links

- United States Senator Patty Murray (<http://murray.senate.gov/asbestos/asbestos-links.cfm>)

- Environmental Working Group (<http://www.ewg.org/issues/siteindex/issues.php?issueid=5002>)
- United States Environmental Protection Agency (<http://www.epa.gov/asbestos/>)
- The Vermiculite Association [2] (<http://www.vermiculite.org/>)
- The Perlite Association [3] (<http://www.perlite.org/>)
- Petition for writ of certiorari to U.S. Supreme Court (April 27, 2006) (<http://www.scotusblog.com/movabletype/archives/W.R.GracePetition%28Apr.27%2C2006%29.pdf>)

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