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ASBESTOS AND SERPENTINE IN WYOMING

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Introduction

Asbestos is a general term for most fibrous minerals, and it doesn't specify the mineralogy of the material. The principal asbestos mineral is chrysotile, $3MgO{\cdot}2SiO_2{\cdot}2H_2O$ (Thrush, 1968). The chemical formula for chrysotile is more commonly reported as $Mg_3\{Si_2O_5\](OH)_4$ (Deer and Others, 1966). Chrysotile is a variety of the serpentine mineral group. Chrysotile comprises about 95 percent of all commercial asbestos (Mann, 1983). Chrysotile is sometimes confused with chrysolite, a variety of olivine. Other asbestos minerals include amosite-montasite, fibrous varieties of the minerals grunerite-cummingtonite, $(Fe,Mg)_7[Si_8O_{22}](OH)_2$, crocidolite, and the fibrous variety of riebeckite, $Na_2Fe_3^{+2}Fe_2^{+3}$ $[Si_8O_{22}](OH)_2$ .. * tremolite, $Ca_2Mg_5[Si_8O_{22}](OH)$, and anthophyllite, $(Mg,Fe)_7[Si_8O_{22}](OH)2$. Asbestos is infrequently called earth flax, mountain cork, or amianthus (Thrush, 1968, Deer and others, 1966). The commercial value of asbestos is due to its fibrous nature, heat resistance, and heat conductivity. Serpentine is a group of minerals that includes chrysotile, the principal asbestos mineral. Other minerals of the serpentine group are lizardite and antigorite. These minerals are nonfibrous varieties. All have the same chemical formula, $3MgO{\cdot}2SiO_2{\cdot}2H_2O$ (Thrush, 1968) or $Mg_3\{Si_2O_5\](OH)_4$ (Deer and Others, 1966). Because of the relationship, between asbestos and serpentine, both of these industrial materials are considered together in this report. Serpentine is usually green in color, and its chief value is for decorative stone.

Chrysotile, and other members of the serpentine group occur in highly metamorphosed ultrabasic rocks. Some chrysotile, and actinolite-tremolite minerals are found in metamorphosed dolomites. Nonfibrous members of this group are found in such localities, but are not considered in this report.

Production and Economic uses of asbestos and serpentine

In recent years, the consumption of asbestos has decreased dramatically due to the classification of fibrous silicates, mostly asbestos, as carcinogens. Fibrous

minerals of specific length-diameter ratios (Campbell and others, 1980) have been shown to increase the risk of certain kinds of cancer when ingested (Mine

Safety and Health Administration 1991, Occupational Health and Safety Administration, 1992). There is no detrimental chemical property of these minerals, they do not pose a hazard unless the fibers themselves are breathed or enter the digestive system through the mouth or nose. Because of these reported health risks, the use of asbestos for insulation, formerly the primary use, has decreased to zero, especially following the passage of the Asbestos Workers Recovery Act in 1985 (Murphy, 1985). The year 1976 saw the most asbestos mined in the United States. Production declined following that year due to recessionary economic conditions after the Viet Nam War ended, and later due to the health problems.

In 1989, the U. S. Environmental Protection Agency (EPA) decreed that all uses of asbestos shall end by 1997. In 1991, there was a ruling by a U. S. Court of Appeals that the EPA did not adequately evaluate the health risks of asbestos substitutes, and it didn't adequately asses the costs and benefits of alternatives, so this ruling was overturned. At present, the only asbestos products banned by the EPA are those that were not manufactured before July 12, 1989 (Virta, 1992) (*i.e.*, the only products now banned are those that were developed to avoid the air- and waterborne fiber problem).

In 1991, the International Fibre (*sic*) Safety Group issued a recommendation that the arbitrary removal of asbestos from public buildings is unwarranted and that other pollutants pose a greater lifetime risk (Asbestos Information Association, 1991). These findings were considered by the American Medical Association, which issued a paper recommending management, containment, and better disposal methods, rather than removal, to prevent asbestos-related injury and disease (Engineering News Record, 1991)

Around 5,500 short tons of asbestos are mined in the United States in California. The United States uses much more asbestos than it mines. In 2001, 65 percent of all asbestos used in the United States was imported, 96 percent of which came from Canada (Virta, 2002).

Asbestos is useful primarily for its fibrous nature. The tensile strength of the fibers is the most important physical property when the material is considered for commercial use. Of the asbestos minerals, crocidolite has the greatest tensile strength, followed by chrysotile, amosite, anthophyllite, tremolite and actinolite (Mann, 1983). Asbestos also has high heat conductivity, making it useful in applications where the generation of heat does not change the physical properties of the material, as in friction products such as brake linings and in fireproof insulating materials. The principal uses of asbestos in 2002 were roofing products (pressed fire-resistant shingles, etc.) (62 percent), gaskets, (22 percent), and friction products (brake linings, etc.) (12 percent), and other uses, (4 percent). Future production is predicted to remain constant. (Virta, 2002). The United States is the only nation in the world with extensive restrictions on the use of asbestos. Given the uncertain nature of the market, there is not likely to be a great interest in Wyoming asbestos in the near future, unless a deposit is located producible at such a low cost to compete with foreign asbestos, even considering transportation costs from Wyoming.

Serpentine is used locally as a decorative stone. Small amounts of green serpentine are mined in Wyoming for decorative aggregate used for landscape rock or rough stone facing and other ornamental uses.

Wyoming Asbestos and serpentine occurrences

There are several occurrences of serpentine and asbestos in Precambrian age rocks in Wyoming. Asbestos was mined from at least six deposits in Wyoming. Three asbestos mills were constructed in Wyoming before 1920. The only substantial production came from the Casper Mountain deposit (see occurrence #9). Serpentine has been mined intermittently throughout the 1900's. In the 1950's and early 1960's, and again in 1968 - 1970, Basins Engineering of Wheatland quarried several serpentine bodies south of Glenrock (occurrence #5) and sold the material for decorative stone facing. Several buildings in Wheatland and other towns the area are faced with this green stone, notably a

farm equipment dealership on 16th street in Wheatland, and the Catholic Church in Guernsey. Serpentine is currently mined south of Glenrock, the site of Basins' operations, for use as decorative aggregate.

The following is a description of known asbestos and serpentine occurrences in Wyoming. The numbers preceding each occurrence refer to the numbers on the location map (**Figure 1)**. The list is alphabetical by county.

Albany County

1) Halleck Canyon Sec. 18, T. 22N., R. 71W.
Green and light green serpentine occurs in lenses in a high-grade metamorphic terrain consisting of amphibolite schists, amphibolite-biotite schists, quartzofeldspathic gneisses and calc-silicate gneiss. Fields (1963) describes two of these bodies and notes that the serpentine contains chrysotile veins up to two inches in width, and notes that the fibers are not "excessively brittle".

Carbon County

2) Sunday Morning Creek area, Secs. 21 and 22, T. 26N., R. 85 W.
Two veins of anthophyllite asbestos are present in this area. These veins are up to 1.6 feet in width and are contained in chlorite-amphibolite schist and amphibolite schist (Bishop, 1964.) The author visited these prospects in 1968 during a uranium exploration program, and noted that the fibers are light gray to very light greenish in color, brittle, and contain parallel flexures. The veins dip vertically and their extent at depth is unknown.

3) Encampment River area
Osterwald and others (1966) note "A deposit of amphibole asbestos is reported to be located about 1 1/2 mi. southwest of Encampment", according to field notes in the Geological Survey of Wyoming files.

Converse County

4) Deer Creek area, Sec. 15, T. 31 N., R. 77W.
A lens of serpentine measuring 1500 by 500 feet is found on the north side of the west fork of Deer Creek. Smaller lenses of green serpentine are also present in the area. These bodies contain small amphibole asbestos veinlets, and one veinlet of chrysotile asbestos is noted (Berckwith, 1939). A tunnel was driven into the serpentine. It had reached a length of 300 feet in 1942, and was not at that time long enough to intersect the asbestos zone in the subsurface. A surface pit 10 feet depth had encountered "good quality" asbestos (Hagner, 1942a). Granite and vermiculite were encountered in the tunnel.

5. Head of Dry Creek area, Secs. 17, 18, 19, and 20, T. 32 N., R. 75 W.
Several large lenses of serpentine are present in this area. Most are elongated N. 60° E. The serpentine is light green at the surface and grades into dark green to bright green and bright yellowish green a few inches below the surface. Basins, Inc., of Wheatland, mined several of these bodies in the 1950's and early 1960's for decorative stone. Basins, Inc., mined about 500 tons of serpentine in 1968, 1969, and 1970, according to Wyoming Ad Valorem Tax Division annual reports for these years. The serpentine came from this locality. The serpentine is massive and contains a few veinlets up to 1/4 inch thick of chrysotile asbestos. Polished specimens also show metallic magnetite and small grains of chromite. The lenses in Sec. 15 are currently being quarried for decorative aggregate, primarily sized between 1/2 inch and 2 inches, and used for landscape rock. Jenkins (1938) reported that a small amount of chrysotile asbestos is found associated with a vermiculite deposit in sec. 20.

Fremont County

6) Western Owl Creek Mountains Sec. 5, T. 7 N., R. 5W.,and sec. 32, T. 8 N., R. 5 W, W.R.M. and Sec. 7, T. 42N., R. 104 W, 6th P.M.
Love (1934) reports on numerous veins of amphibole asbestos deposited along fracture and cleavage lines in a thick diabase dike. The fibers are as long as

three inches but they are "weedy and brittle". Serpentine is also often found between and surrounding the asbestos.

7) Fire King deposit Sec. 26, T. 30 N., R. 100 W.
Two bodies of serpentine crop out in this area. The largest body measures 700 feet by 2500 feet, and the smaller measures 80 feet by 350 feet. The larger body is not exposed south of Rock Creek. The serpentine is dark green to black in color, and massive. Chrysotile asbestos occurs in the small body and in the northern part of the larger serpentine body. The asbestos is light greenish-yellow, and fibers are as long as 1 1/2 inches. The prospect was developed by a 440-foot long tunnel and smaller surface workings (Geological Survey of Wyoming, undated). Small amounts of asbestos were mined at this locality in 1918 and 1919, and processed at a mill constructed on the site (Beckwith, 1939). There has been no further production of asbestos from this prospect. The serpentine may be a useful decorative stone, both for small polished pieces and as aggregate.

Natrona County

8) Beaver Creek (Abernathy) asbestos deposit NW 1/4 SE 1/4 Sec. 19, T. 30 N., R. 96 W.
Four serpentine bodies are exposed in this locality.. The largest measures 600 feet by 250 feet. Chrysotile asbestos is found in the serpentine. Beckwith (1939) reports that the longest fibers he found measured 1/4 of an inch in length. Hagner (1942b) also reports that chrysotile fibers up to 1/4 inch in length are found in serpentine, and that there was a 70 foot long tunnel developed into the asbestos-bearing portion of the serpentine. There is no record of any production or shipments of minerals from this property. Hagner (1942b) also reports the presence of tremolite, actinolite, vermiculite and talc in the area. The serpentine may be useful as a decorative stone.

9) Casper Mountain asbestos deposits Secs. 9, 16, 17, 18, 19, and 20, T.32 N., R. 79W.
Several square miles are underlain by black to very dark greenish serpentine. The serpentine is cut by quartz veins and pegmatites. One of the pegmatites is

currently being mined for feldspar, used primarily for decorative aggregate. Asbestos bearing serpentine is found in sections 16 and the east half of 17. A lens of chrysotile asbestos 1400 feet in length and 500 feet wide is present in this area. Fibers up to one inch in length are present (Beckwith, 1939). Fisher (1929) estimated that over 963,000 tons of recoverable asbestos fiber was present. The first hand-cobbed asbestos fiber was shipped from this deposit in 1893 by the McConnell Asbestos Company (The Engineering and Mining Journal, 1893). By 1907, the U. S. Asbestos Mining and Fiberizing Company had opened about 35 small pits and adits on its property, and had shipped ore (Hall, 1907). Hall (1907) recommended the construction of a mill on the U. S. Asbestos Mining and Fiberizing Company's site. A mill capable of processing 250 tons of ore per day (Fisher, 1929) was constructed near this lens between 1907 and 1911 (Beckwith, 1939). Production apparently stopped before 1920. This locality produced the most asbestos mined from Wyoming, although the amount mined or shipped is unknown. No production records were kept by the state before 1920. In 1935, several tons of serpentine were quarried for concrete aggregate from the SE 1/4 of section 17 (Beckwith, 1939).

10) Smith Creek deposit, SW 1/4 SE 1/4 Sec. 19, and the common corner of Secs. 19, 20, 29, and 30, T. 31N., R. 78 W.
Three bodies of yellowish green to black serpentine crop out as low hills in this area. The bodies measure 900 feet by 350 feet, 650 feet by 300 feet and 550 feet by 200 feet. The largest body contains no asbestos. The central, middle-sized body contains bands of chrysotile asbestos up to six inches wide. The western, and smallest body contains small amounts of chrysotile asbestos in a zone measuring 150 feet by 75 feet (Beckwith, 1939). In 1909,.a mill was constructed near the central serpentine body by the Wyoming Consolidated Company (Peterson, 1909), but production has been minor, as evidenced by the small size of the pits in the area. The serpentine may be useful as decorative aggregate.

11) Green Hill deposit, NW 1/4 SE 1/4 sec. 23, T. 31N., R.78W
This occurrence of serpentine and asbestos is three miles east of the Smith Creek occurrences (#10, above). One lens of green serpentine, giving its name to the hill, is found in this locality. The exposure measures 1700 feet by 500

feet, and is covered by Tertiary rocks at its southern end (Beckwith, 1939). Beckwith (1939) also reports that there was no asbestos found in the exposure of the serpentine body, but small amounts of chrysotile asbestos were found in the dump adjacent to a caved adit. The asbestos also contained trace amounts of talc.

Teton County

12) Brown Bear (Berry Creek) deposit, unsurveyed Sec 19 and 20, T. 47 N., R. 116 W.
Osterwald and others (1966) report on two asbestos occurrences in Teton County, but both of these reported occurrences are actually the same one. A black chloritic altered dike is exposed in the south wall of the canyon of Berry Creek. The dike extends for 400 feet, and is as much as 50 feet wide. Talc schist bounds the chloritic rock to the west. Greenish yellow chrysotile asbestos is found in the chloritic body. Small amounts of asbestos were produced from this dike prior to 1921 (Beckwith, 1939). The deposit now lies within Grand Teton National Park, and is closed to mineral location and development.

Washakie County

13). Grey Goose - Canyon Creek Cow Camp - Canyon Creek Talc Deposit, SE 1/4, SW 1/4, Sec. 25, N. !/2 Sec. 36, T. 48N., R. 86W.
Dark gray steatite, fibrous talc and a small amount of brittle amphibole asbestos are exposed in several small pits and a partially filled in shaft on the ridge above the Canyon Creek Cow Camp. The talc and asbestos are present in a sequence of greenstones, hornblende schists and olivine metadiabases that strike N. 15° E. In the summer of 1934, the Wyoming Asbestos Mining Company sank a shaft into the talc, looking primarily for asbestos. Rocks exposed in the shaft were talc schist and fibrous talc (Beckwith, 1939). This shaft was sunk to approximately 25 feet, but is now almost filled in. See also Harris (1994).

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