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Reported Historic Asbestos Prospects and Natural Asbestos Occurrences in the Central United States

By

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Introduction

This map and the accompanying dataset (***asbestos_sites.xls***) provide information for 26 natural asbestos occurrences in the Central United States (U.S.) using descriptions found in the geologic literature. Data on location, mineralogy, geology, and relevant literature for each asbestos site are provided in the aforementioned digital file. Using the map and digital data in this report, the user can examine the distribution of previously reported asbestos occurrences and their geological characteristics in the Central U.S. This report is part of an ongoing study by the U.S. Geological Survey to identify and map reported natural asbestos occurrences in the U.S., which began with U.S. Geological Survey Open-File Report 2005-1189 (Van Gosen, 2005). These reports are intended to provide State and local government agencies and other stakeholders with geologic information on natural occurrences of asbestos.

The file ***asbestos_sites.xls*** was compiled through a systematic State-by-State search of the geologic literature. Although this asbestos dataset represents a thorough study of the published literature, it can not be construed as a complete list. An asbestos site was included only when the literature source specifically mentioned asbestos and (or) described the commonly recognized asbestos minerals as occurring in the asbestiform crystal morphology. No attempt was made to interpret the presence of asbestos from the context of the geology-mineralogy description if asbestos was not explicitly described. The user should refer to the references cited with each asbestos site entry for descriptions of these occurrences. These asbestos occurrences were reported to exist in outcrop exposures or rock exposed by mining operations. Note that these site descriptions apply to the time of each report's publication. No field verification of the sites was performed, nor were evaluations of potential exposure made at these sites. Many of the sites are likely to have been subsequently modified by human activities since their description, sometimes substantially. For example, since the time that the source literature was published there may have been remediation of the site or it may have been either exposed or covered by more recent development.

What is Asbestos?

The history of asbestos discovery and usage is at least 5,000 years old, extending back to the ancient civilizations in Greece and what is now Italy (see Ross and Nolan, 2003). Historically, asbestos is a generic commercial-industrial term used to describe a group of specific silicate minerals that form as long, very thin mineral fibers, which combine to form bundles. When handled or crushed, asbestos bundles readily separate into individual mineral fibers. The special properties of commercial-grade asbestos—long, thin, durable mineral fibers and fiber bundles with high tensile strength, flexibility, and resistance to heat, chemicals, and electricity—have made it well suited for a number of commercial applications (Ross, 1981; Zoltai, 1981; Cossette, 1984; Ross and others, 1984; Skinner and others, 1988). Asbestos has been especially used for its insulating and fire-resistant properties in many types of products (see Virta and Mann, 1994; Ross and Virta, 2001).

Currently, commercial and regulatory definitions of asbestos most commonly include chrysotile, the asbestiform member of the serpentine group, and several members of the amphibole mineral group, including the asbestiform varieties of (1) riebeckite (commercially called crocidolite), (2) cummingtonite-grunerite (commercially called amosite), (3) anthophyllite (anthophyllite asbestos), (4) actinolite (actinolite asbestos), and (5) tremolite (tremolite asbestos). Other amphiboles are known to occur in the fibrous or asbestiform habit (Skinner and others, 1988), such as winchite, richterite (Meeker and others, 2003), and fluoro-edenite (Gianfagna and Oberti, 2001; Gianfagna and others, 2003), but to date they have not been specifically listed in the asbestos regulations. The many different ways that asbestos and asbestiform and other related terms have been described are summarized in Lowers and Meeker (2002).

Historically, chrysotile has accounted for more than 90 percent of the world's asbestos production, and it presently accounts for over 99 percent of the world production (Ross and Virta, 2001; Virta, 2002). Mining of crocidolite (asbestiform riebeckite) and amosite (asbestiform cummingtonite-grunerite) deposits accounts for most of the other asbestos production, and small amounts of anthopyllite asbestos have been mined in Finland and the U.S. in the past (Ross and Virta, 2001; Van Gosen, 2005). Asbestos is no longer mined in the U.S. The last U.S. asbestos operation mined chrysotile deposits in California; this mine closed in 2002.

Naturally Occurring Asbestos

Mounting evidence throughout the 20th century indicated that inhalation of asbestos fibers caused respiratory diseases that have seriously affected many workers in certain asbestos-related occupations (Tweedale and McCulloch, 2004; Dodson and Hammar, 2006). Airborne exposures to asbestos have been linked to a number of serious health problems and diseases, including asbestosis, lung cancer, and mesothelioma. Additional asbestos information is available online at http://www.epa.gov/asbestos/ and http://www.atsdr.cdc.gov/asbestos/.

Asbestos-bearing materials (some pipe wrappings and insulation, as examples) are frequently uncovered in older buildings and structures, causing health concerns for those individuals exposed to dusts liberated from these materials. As older structures are continually torn down or remodeled, contact with asbestos-bearing materials will likely be of concern for decades to come. The proper handling and disposal of these man-made asbestos materials is addressed by a number of federal regulations. Less straightforward is the regulation and management of "naturally occurring asbestos" (NOA), which has recently gained the attention of regulatory agencies, health agencies, and citizen groups. NOA is asbestos found in-place in its natural state; that is, asbestos minerals in bedrock exposed by man's excavations or by natural weathering. The geology of asbestos is summarized in Van Gosen (2006).

NOA is of concern due to potential exposures to microscopic fibers that can become airborne if asbestos-bearing rocks are disturbed by natural erosion or human activities (road building, urban excavations, agriculture, mining, crushing, and milling, as just a few examples). Examples of occupational and environmental exposures to asbestos are described in Nolan and others (2001) and Ross and Nolan (2003).

Recent attention towards NOA was spurred by the recognition of high incidences of asbestos-related mortality and respiratory disease in vermiculite miners and residents of Libby, Montana. This disease cluster has been attributed to fibrous and asbestiform amphibole particles within the vermiculite ore body once mined and milled near the town from 1923 to 1990 (Peipins and others, 2003). Meeker and others (2003) described in detail the fibrous and asbestiform amphibole minerals intergrown with the Libby vermiculite deposit.

Large areas of exposed ultramafic bedrock in northern California, some now densely populated by housing and infrastructure, have become the focus of recent attention because they contain chrysotile and possibly tremolite-actinolite asbestos (Churchill and Hill, 2000; Clinkenbeard and others, 2002; Ross and Nolan, 2003; Swayze and others, 2004).

The history and study of naturally occurring asbestos and the multiple, complex issues that surround asbestos are discussed in Campbell and others (1977), Ross (1981), Stanton and others (1981), Zoltai (1981), Levadie (1984), Skinner and others (1988), Mossman and others (1990), Occupational Safety and Health Administration (1992), Guthrie and Mossman (1993), van Oss and others (1999), Nolan and others (2001), Virta (2002), Plumlee and Ziegler (2003), and Dodson and Hammar (2006). Current federal regulations are provided in the Code of Federal Regulations (available online at http://www.gpoaccess.gov/cfr/). However, these asbestos regulations do not specifically address exposures to natural occurrences of asbestos.

Asbestos in the Central United States

Based on this study, natural asbestos appears to be relatively sparse in the Central U.S., especially when compared with other regions of the country (Van Gosen, 2005). The asbestos occurrences in the Central U.S. are found in a diverse variety of geologic settings (see ***asbestos_sites.xls***), including altered ultramafic rocks, mafic alkaline igneous intrusions, dolomitic marbles, metamorphosed iron-formations, iron-rich skarns, and talc deposits that replace dolostones. The majority of the sites on the map represent asbestos that occurs as a minor accessory mineral within bedrock or a larger mineral deposit. Only five sites in this region were once prospected for asbestos (evaluated for commercial use), and apparently none of these deposits were further developed. No records were found to indicate that asbestos was ever mined from this region of the U.S.

Fibrous Amphiboles in the Central United States

During this study, several examples were noted in the geologic literature that mentioned the presence of fibrous amphiboles in outcrops or within a metallic ore body (copper, gold, iron). These examples are shown on the map and described in a separate dataset (***fibrous_amphiboles.xls***). Amphibole asbestos was not specifically mentioned in the descriptions of these deposits. However, these sites indicate geologic settings with the *potential* to host asbestos. This is because the geologic settings of these examples are similar to those that elsewhere form and host the reported asbestos, including metamorphosed and metasomatized mafic rock, skarn, marble, and metamorphosed banded iron-formation. Thus, a discovery of asbestos in these areas would not be unusual from a geologic standpoint. Also, the distinction between "fibrous" amphibole and "regulatory" amphibole asbestos is often not clear-cut in natural amphibole-bearing deposits. This regulatory dilemma—clear distinction between "fibrous" particle and "regulatory fiber" (Occupational Safety and Health Administration, 1992)—is well illustrated by the descriptions provided in this dataset (***fibrous_amphiboles.xls***). For example, elongate amphibole particles, mostly grunerite and cummingtonite, in metamorphosed banded iron-formation of the eastern Mesabi iron range, Minnesota, have been variously described as tabular or fibrous (French, 1968), or asbestiform (Great Lakes Advisory Board, 1975), depending on the author (see Lowers and Meeker, 2002, for published definitions of these terms). Grunerite and cummingtonite are widespread rock-forming minerals in the Biwabik iron-formation in this area, but do not everywhere occur in fibrous form. Concentrations of grunerite or cummingtonite occur widely within contact-metamorphosed banded iron-formation elsewhere in northern Minnesota. They also occur widely in other iron ranges of the Lake Superior region, particularly the western part of the Marquette iron range in Michigan and the western part of the Gogebic iron range in Wisconsin. However, descriptions of these amphibole deposits are not sufficiently detailed to define areas where the amphiboles occur in fibrous form, and thus specific sites could not be shown on this map. These amphiboles may or may not meet the regulatory criteria of asbestos, which requires site-specific detailed microscopic analyses.

Digital Databases

The enclosed asbestos database (***asbestos_sites.xls***) summarizes information found in geologic references examined by the author. Each asbestos site entry in the database includes the following data fields:

Site number

Number used to identify the dataset entries with their corresponding locations on the map.

State

The State in which in the asbestos deposit occurs, using the two-letter U.S. Postal Service abbreviation.

Historic site name as reported

The name of the asbestos prospect or occurrence, matching the nomenclature used in the source literature.

Development

This field indicates whether the asbestos site represents a past prospect or occurrence. "Former prospect" indicates that the asbestos deposit was once prospected (evaluated) for possible commercial use, typically by trenching and (or) drilling, but the deposit was not further developed. "Occurrence" indicates that asbestos was reported at this site. The occurrence category includes (1) sites where asbestos-bearing rock is described in a geologic map or report; and (2) asbestos noted as an accessory mineral or vein deposit within another type of mineral deposit.

Latitude

The latitude of the site's location in decimal degrees, measured using the North American Datum of 1927. The number of significant figures following the decimal point indicates the believed accuracy of the location: (1) three significant figures (for example, 45.132) indicates a fairly accurate location based on a detailed description or location shown on a small-scale map (1:50,000 scale or smaller); and (2) four significant figures (for example, 45.1327) indicates a precise location based on a detailed description or a location shown on a large-scale map (1:24,000 scale or larger).

Longitude

Longitude was calculated in the same manner as latitude.

Asbestiform mineral(s) reported

This field identifies the type of asbestos present as described in the source literature.

Associated minerals reported

Minerals mentioned in association with the asbestos, as they were described in the source literature. The order in which each mineral is listed does not necessarily indicate their relative abundance in the deposit, but rather their order of mention in the source report.

Host rock(s) reported

The host rock type(s) for the asbestos is (are) listed when available as described in the source literature.

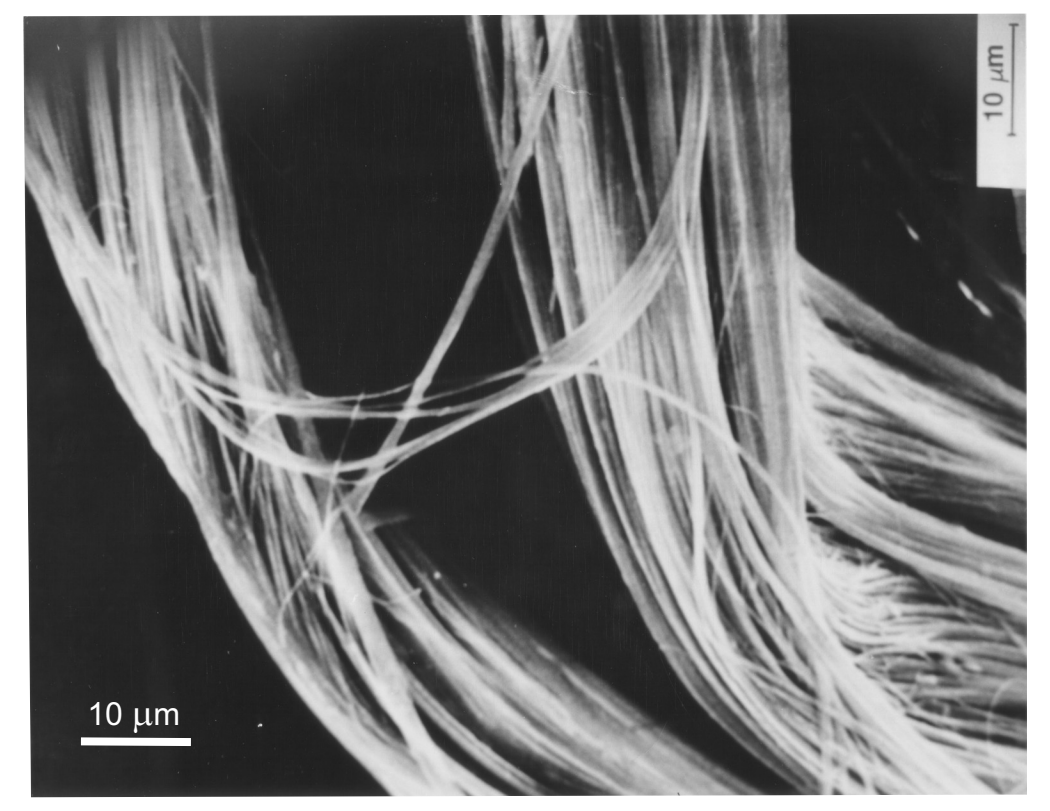
References

The references used to compile the site information are listed in this field. The full reference citations are provided in the accompanying digital files ***References.pdf*** and ***References.xls.***

Another attached database, ***fibrous_amphiboles.xls,*** lists 10 localities where fibrous amphiboles are described in the geologic literature. This database is organized in a manner similar to ***asbestos_sites.xls*** with the exception of two data fields:

1) The data field "Site type" replaces the data field "Development."

2) The data field "Fibrous amphibole(s) description" replaces the data field "Asbestiform mineral(s) reported." This field contains short excerpts of amphibole description, quoted directly from the geologic literature.



Scanning electron-micrograph of asbestiform potassian winchite from the Diablo prospect, Allamoore talc district, Texas. Photograph reprinted from Wylie and Huggins (1980) with the permission of the authors and *Canadian Mineralogist.*

Reported Natural Asbestos and Fibrous Amphibole(s) Occurrences in the Central United States

EXPLANATION

[Not all sites are shown individually due to scale. Site number corresponds to a specific entry in the dataset]

● Former asbestos prospect

○ Reported asbestos occurrence

▪ Reported fibrous amphibole(s)

▨ Urban area

Number and Type of Asbestos Sites Reported in the Central United States

State	Former asbestos prospect	Asbestos occurrence
Arkansas	--	2
Kansas	--	3
Michigan	--	5
Minnesota	--	1
Missouri	1	1
South Dakota	1	2
Texas	2	6
Wisconsin	1	1
	5	21

0 50 100 200 Miles

0 50 100 200 Kilometers

Projection: Lambert Conformal Conic
False Easting: 0.00000
False Northing: 0.000000
Central Meridian: -93.000000
Standard Parallel 1: 33.000000
Standard Parallel 2: 45.000000
Latitude of Origin: 0.000000
Datum: North American 1927

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