FILE NAME: Talc (TALC)

DATE: 0000

DOC#: TALC054

DOCUMENT DESCRIPTION: Unpublished Conference Presentation - NTP Talc Definition Issue

Robert Virta of USGS

NTP Talc Definition Issue

From a geological and mineralogical viewpoint, some of the difficulties encountered with the inclusion of talc in the previous Report on Carcinogens were due to a lack of knowledge of exactly what constituted the talcose materials that were tested. Talc can be used as both a specific mineralogical term and as a generally applied industrial term. A mineralogical term, such as talc, strictly defines a crystalline chemical compound with distinct chemical and physical characteristics. In contrast, in commercial or industrial terminology, the term "talc" is more loosely applied to talc-bearing or talc-rich materials. To a mineralogist, briefly, talc is a hydrous magnesium silicate with an ideal formula of $Mg_3Si_4O_{10}(OH)_2$ and a composition of 63.36 weight % SiO_2, 31.89 weight % MgO, and 4.75 weight % H_2O. Talc may contain minor amounts of aluminum and titanium replacing silicon; minor amounts of fluorine replacing hydroxyl groups, and minor to trace amounts of iron, calcium, chromium, manganese, nickel, potassium, sodium and titanium replacing magnesium. Talc is a sheet silicate. The bonds between the sheets are very weak, causing talc to be an extremely soft mineral. Talc is used to represent a hardness of 1 (softest) on the Mohs scale. Its color can vary from apple-green to brown to gray to white. Additional properties, such as cleavage, crystal structure, optical properties, and specific gravity also are used to further identify talc and minerals in general (American Chemical Society, 1996; Clifton, 1984; Deer, Howie, and Zussman, 1976; Evans and Guggenheim, 1988, Hurlbut, 1971).

As a commercial term, talc refers to rocks and mineral products that may be composed almost entirely of the mineral talc or, rather, may be talc-rich but contain other minerals in significant quantities. For example, soapstone is a form of talc-rich rock that contains 50 to 80% of the mineral talc (Hughes, 1932). Associated minerals include members of the amphibole, carbonate, chlorite, clay, and serpentine mineral groups, and such minerals as magnetite, muscovite, phlogopite, and quartz (Cosmetics, Fragrance, and Toiletries Association, Inc., 1976; Piniazkiewicz, McCarthy, and Genco, 1994; Van Gosen et al., 2004). Amphibole and serpentine minerals may occur in the asbestiform crystal habit in some talc deposits. Depending on the particular application, the many useful properties of commercial talc are taken into consideration, such as its chemical inertness, electrical conductivity, fragrance retention, grease and oil adsorption, luster, moisture content, purity, softness, thermal conductivity, and whiteness; these properties can vary considerably amongst mined deposits (Clifton, 1985).

Talc (both the mineral and rock) is formed during the hydrothermal alteration of magnesium-rich rocks, such as some sedimentary rocks (typically dolomite-rich rock) and ultramafic and mafic igneous or metamorphic rocks, such as gabbro, dunite, and periodotite (Chidester, Engel, and Wright, 1964; Piniazkiewicz, McCarthy, and Genco, 1994). The hydrothermal alteration (heated silica-rich fluids) that caused talc formation may be due to regional or contact metamorphism or a buried magma body nearby. When dolomite-rich rock is altered, the reaction to form talc is:

3 dolomite + 4 quartz + water = talc +3 calcite + 3 CO_2

With the alteration of mafic and ultramafic rocks, the usual precursor to talc formation is serpentinite. The reaction to form talc from serpentine is:

2 serpentine + 3 CO_2 = talc + 3 magnesite + 3 H_2O (Deer, Howie, and Zussman, 1976).

In many cases, there is a deficiency in one of the reacting components on the left side of the equation that can result in incomplete reaction. Additionally, many of the accessory minerals in the parent rock also will react during the alteration process, resulting in a mixture of minerals in the deposit (and any mineral products made by milling this rock) after the mineralizing process has completed. These considerations have given rise to the questions about the mineralogy of the talc samples evaluated in the previous National Toxicology Program (NTP) review process.

As a result of our telephone conversation on Monday, August 9, it appears that the issue for NTP is not specifically the mineral talc, but rather commercial talc products. Consequently, I have to reverse my original thinking and recommend that the NTP panel use a definition for commercial talc rock or products. The definition could be along the lines of:

Talc is defined for the purpose of the NTP review as a talc-rich rock or mineral product used in the manufacture of products classified mainly as ceramics, cosmetics, paint, paper, plastic, roofing, and rubber. There are other applications, such as adhesives, flow control agent, and insecticide carriers that do not fall into the above broad categories. The rock or mineral product contains the mineral talc, typically in quantities exceeding 50% but not excluding lesser amounts. These rocks and products also may contain numerous associated minerals, including amphiboles (such as anthophyllite and tremolite), carbonates (calcite, dolomite, and magnesite), chlorites, clays (kaolin), serpentines (antigorite and lizardite), and magnetite, muscovite, quartz, sericite, and vermiculite. Asbestiform amphiboles and chrysotile are present in some talc deposits but not necessarily those mined at present. Asbestiform amphiboles also generally are excluded from most commercial talc products.

This definition will avoid having to classify rocks and products as "industrial" versus "cosmetic" as it would apply to both. Whether it is a "cosmetic" or "industrial" probably is irrelevant because the issue appears to be whether or not exposure to talc products results in a site specific form of cancer, namely ovarian cancer.

For your summary of information—Talc page, you might think about the following:

Summary of Information—Talc

Primary uses or exposures: Talc occurs in various geological settings around the world. Exposure to general population (excluding occupational exposure) occurs primarily through use of products such as cosmetics, particularly in loose powder form.
Nominated by: National Institute for Environmental Health Science
Basis for Nomination: The NTP deferred consideration of listing talc in the 10th Report on Carcinogens because its 2000 review of talc found that most of the scientific literature did not specify the mineralogy of the talc products that were the subject of the medical studies. Given the available evidence on health effects of all exposure routes, the NTP only will focus its investigation on the relationship between talc and a site specific cancer, namely ovarian cancer.

I will point out that by using talc as defined above, if a causal relationship is discovered, the NTP panel still will not know: (1) which component of the talc product is the carcinogen, (2) if another additive in the talcum powder was the problem, or (3) if an accessory mineral has an effect (I doubt if many talcum powders are 100% talc).

References

American Chemical Society, 1996, Talc: Washington, DC, Chemical Abstract Service Registry Number 14807-96-6, 2 p.

Chidester, A.H., Engel, A.E.J., and Wright, L.A., 1964, Talc resources of the United States: U.S. Geological survey Bulletin 1167, 61 p.

Clifton, R.A., 1984, What is talc, *in* Definition for asbestos and other health-related silicates: Philadelphia, American Society for Testing and Materials Special Technical Publication 834, p. 158-174.

Clifton, R.A., 1985, Talc and pyrophyllite, *In* Mineral Facts and Problems: Washington, DC, U.S. Bureau of Mines Bulletin 675, pp. 799-810.

Cosmetics, Fragrance, and Toiletries Association, Inc., 1976, Cosmetic talc: Washington, DC, Cosmetics, Fragrance, and Toiletries Association, Inc. Standard, 1 p.

Deer, W.A., Howie, R.A., and Zussman, J., 1976, An introduction to the rock-forming minerals: Longman Group Ltd., London, 528 p.

Evans, B.W., and Guggenheim, S.J., 1988 Talc, pyrophyllite, and related minerals, chap 8 *of* Bailey, S.W., ed., Hydrous phyllosilicates (exclusive of micas): Washington, D.C, Mineralogical Society of America Reviews in Mineralogy 19, p. 225-294.

Hughes, H. Herbert, 1932, Soapstone: U.S. Bureau of Mines Information Circular 6563, 17 p.

Hurlbut, C.S., 1971, Dana's manual of mineralogy, 18th ed.: John Wiley & Sons, Inc., New York, 579 p.

Piniazkiewicz, R.J., McCarthy, E.F., and Genco, N.A., 1994, Talc: in Carr, D.D., ed., Industrial Minerals and Rocks, 6th Edition: Society for Mining, Metallurgy, and Explorations, Inc., Littleton, CO, p. 1049-1069.

Van Gosen, B.S., Lowers, H.A., Sutley, S.J., and Gent, C.A., 2004, Using the gologic setting of talc deposits as an indicator of amphibole asbestos content: Environmental Geology, v. 45, no. 7, May, p. 920-939.