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R. Skerrett

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CYPRUS ORE RESERVES - ARSENIC & TREMOLITE*Excerpts from Cyprus Talc Reserve Report by R.C. Munro*Geology & Environment

There are some important environmental issues related to the geology and mineralogy of the Cyprus talc deposits, particularly in Vermont.

Arsenic

Arsenic iron sulphides (arsenopyrite) are, with their alteration products, present in many of the talc-carbonate schist ore zones in the Vermont area. Total arsenic, as analyzed in the Ludlow Rainbow deposit, averages generally less than 100 ppm but with some small zones in excess of 1000 ppm. No apparent major effort is underway to regularly monitor or completely assess the total arsenic content of ores, tailing solids and wastes although the distribution of sulphides and arsenates in the talc ore system is generally understood.

In near surface weathering zones, crushed rock, stock piles and mine working areas, the arsenic sulphides (above) convert in part to the more soluble arsenates, for example, the hydrous nickel arsenate, annabergite (38% As_2O_5). Soluble arsenic is measured in cores, ore samples, mill feed, product and tailings. Soluble arsenic content is monitored and governed under EPA/OSHA regulations.

High (e.g. +6 ppm As) soluble arsenic contents of mill feed at the West Windsor mill contribute to reduced recoveries and milling rates. At West Windsor, part of the mill recovery problem at least is being ascribed to a high fines content in the feed and to low pH of the process water, both of which contribute to increased soluble As. The problem has been under study at West Windsor since 1987 by Mill Manager, Jeff Scott, who indicated that if the arsenic content is above +6 ppm soluble As and the talc content falls below 62% talc production rates and recoveries can fall by 50%. The product specs are -3 ppm As or less at West Windsor and current material in the silos is measured at 0.73 ppm to 2.33 ppm soluble As.

To me, there also seems to be the overall risk of continuing conversion of As in sulphide to more soluble arsenates in some stockpiles, waste, and solid tailings as acid, water, air and time work on them.

Tremolite

The other serious mineralogical contaminant in the talc ores of Vermont is the fibrous variety of the amphibole minerals, tremolite and actinolite (hydrous calcium iron-magnesium silicates) which have been classified as asbestiform minerals by OSHA and EPA. OSHA was expected to de-classify non-fibrous (blocky) tremolite on February 29, but has not as yet announced their decision.

As a result, all tremolite, the fibrous varieties of all amphiboles and chrysotile asbestos in talc ores are a source of great concern to all talc producers and especially to marketers of cosmetic products.

Cyprus claims that there are no fibres in their cosmetic talc products and they work rigorously to ensure this. However, a recent paper published by Rutgers University worker, Alice Blount, suggests the presence of fibre in several cosmetic talcs, some of which might have been from Cyprus West Windsor material, which is a source of great concern to Cyprus management and potentially to their principal customer, Johnson & Johnson. Talc de Luzenac personnel are well aware of the situation and Phillippe Moreau is currently quietly working to identify the reality and the magnitude of the problem.

Vermont talcs are derived from altered serpentine - a natural host for asbestiform minerals. There is certainly visible tremolite and actinolite in specific zones of the Vermont deposits - fibrous tremolite was identified by the writer in exposures and cores at the East Argonaut and Black Bear mines. Cyprus staff report past tremolite from the Hammondsville and Clifton deposits.

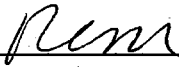
Tremolite in these deposits is encountered in the contact zones between the talc and the surrounding schist; in "grey talcs" in the vicinity of the contacts; and associated with the chlorite/amphibole waste zones within the talc ores that are locally termed "cinders". Cyprus maintains a selective mining program in Vermont that is directed toward exclusion of all of these potentially fibre-bearing zones from the ores sent to the mills, and those suspect tonnages, including the associated talc, are left in the pit walls or sent to waste piles.

Minor occurrences of amphiboles and asbestiform minerals are also attributed to confined areas of the Montana deposits. Tremolite (blocky) was encountered in a dike zone at Antler. A chlorite zone at intersecting faults at Yellowstone S40 contained some minor tremolite, and stockpiles of Beaverhead open pit fines, slated

for burial, have been measured at 0.33% to 0.70% tremolite by Three Forks and Alpine Mill Labs.

No fibrous material showed up in samples taken by the writer at the Western Source Red Hill mine in California, but minor tremolite is possibly present in the contact zone where it should be avoidable by selective mining.

Arsenic content (total and soluble) and the presence of fibrous minerals in exposed stockpiles and waste need to be checked at Alpine, Alabama and the now closed California properties operated by Cyprus in the past.



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R. J. Kerstetter
G. L. Toll
G. B. Lawson - BCL
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