Using imaging spectroscopy to map ultramafic rocks, serpentinites, and tremolite-actinolite-bearing rocks in California

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Airborne Visible/InfraRed Imaging Spectrometer (AVIRIS) data were collected in approximately 3-kilometer-wide swaths over selected areas in El Dorado and Plumas Counties, California, USA, that contain serpentinite and ultramafic rocks as part of an experiment to determine if potentially asbestos-bearing rocks could be identified spectrally. Mineral maps created from the data were successfully used to delineate exposures of serpentine and tremolite-actinolite/talc in areas with up to 70 percent vegetation cover. In some cases, the vegetation density is so high that it prevented spectral identification of minerals by AVIRIS in those areas. Thus, there may be more serpentine and tremolite-actinolite/talc present than is shown on the mineral maps. Importantly, not all tremolite-actinolite is fibrous; just because tremolite-actinolite was mapped, does not necessarily mean it is tremolite- or actinolite-asbestos. It is difficult to spectrally distinguish tremolite-actinolite from talc using AVIRIS data. Serpentine has been detected outside of known serpentinite outcrop areas, mostly as aggregate that covers dirt roads. Four flight lines of AVIRIS data were analyzed over areas selected to show trends in degree of surface exposure as a function of elevation and vegetation cover. Field checking has verified the accuracy of the mineral maps at 25 accessible locations. Eleven additional flight lines remain to be analyzed and field checked pending future funding. AVIRIS mineral mapping has shown promise as a complement to field mapping but cannot replace it. Because AVIRIS is a remote-sensing technology, the presence of serpentine or tremolite-actinolite would have to be verified in the field by direct observation and by appropriate sampling and laboratory analysis, if needed. At this time, no conclusion regarding the presence or absence of asbestos minerals in the identified areas is possible from the AVIRIS data alone. Identification of asbestos minerals in the identified areas would require appropriate sampling and laboratory analysis of the materials in those areas.

Surface coatings on quartz grains in bentonites and their relevance to human health

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In 1997, the International Agency for Research on Cancer recognized that the carcinogenic properties of silica dusts may be dependent on the physical and chemical characteristics of external grain surfaces. Surface coatings on respirable quartz grains are of particular interest as they have been implicated in modifications to cytotoxic reactivity in lung tissue (Fubini, 1998). Our investigations utilize XRD, SEM, ESEM, EPMA, LA-ICPMS, and XPS analyses to characterize the mineralogy, habit, and composition of surface coatings on quartz grains from US deposits of southern (Alabama) and western (South Dakota) bentonites.

Quartz contents of bentonites are less than 7.5 wt%, with the <10μm size fraction comprising 6-45% of this total. Surface coatings are pervasive on all quartz grains in the observed bentonites and resist removal by repeated vigorous washings and reaction with HCl. Textural attributes and XPS and EDS analyses of these coatings are consistent with most being either montmorillonite or opaline silica, or a mixture of both. Montmorillonite coatings may be so thin that underlying pre-existing conchoidal fractures are clearly visible, but may also be more than 10 microns thick. Plagioclase and K-feldspar rarely show well-developed montmorillonite surface coatings, but both have been observed with opaline silica coatings that have a morphology similar to that of opal-CT. Biotite and muscovite grains never have surface coatings. Trace element contents (Fe-Ti-Al) of quartz grains from any given bentonite are very similar, indicating a single origin for the quartz, presumed to be magmatic, with little if any contamination from other sources.

Accordingly, detailed surface characterizations of silica dusts are essential precursors to future *in vitro* and *in vivo* investigations of silica dust toxicity.

Reference

Fubini, B. (1998) *Ann. Occup. Hyg.* **42**, 521-530.