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3-4: Mineralogy of the Coalinga Asbestos Deposit

by

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Since 1960 the asbestos production of the United States has more than doubled, a phenomenon in large part due to the development of the Coalinga Asbestos deposit in western California. Despite the fact that this deposit is of enormous size and contains over 50% recoverable fiber, it remained unrecognized for over 100 years, since its physical appearance is totally unlike that of almost every other asbestos deposit in the world. The Coalinga deposit occupies the southeastern third of the New Idria serpentinite, an elongated dome-shaped body about 4 miles wide and 12 miles long, which has been intruded into greywackes and shales of Jurassic and Cretaceous age. Whereas most asbestos ores consist of cross-fiber veinlets of chrysotile within massive serpentinite, no such veinlets have been found in the Coalinga deposit. This body has been extensively sheared and pulverized into a gigantic pile of powdery asbestos. The great bulk of the deposit consists of soft, powdery, pellet-like agglomerates of matter, friable chrysotile, surrounding blocks and fragments of hard, dense, competent serpentinite. The very nature of this ore has led directly to its exploitation, since mining can be accomplished with ease, by low-cost, open pit methods, and the fiber content can be easily separated from the coarse, hard rock. At the present time three companies are processing Coalinga ore with an annual production of about 50,000 tons.

Four main types of serpentine materials are distinguishable in the ore: (1) fragments and blocks of hard, dense serpentinite, ranging in size from fractions of an inch to boxcar dimensions; (2) large, tough, leathery sheets of matted chrysotile, up to several square feet in size; (3) brittle, bladed fragments of green serpentine, up to several square inches in size; and (4) soft, friable, greenish-white agglomerates of flaky asbestos, 1/4" to 1" in diameter, which also contain appreciable amounts of both the green, bladed material and the hard, gritty serpentinite. The bulk ore consists predominantly of members of the serpentine group, with chrysotile making up about 75% of the total. Chrysotile is almost the sole constituent of both the green bladed material and the leathery sheets. Serpentinite fragments consist primarily of lizardite and antigorite, with smaller amounts of short-fiber chrysotile, brucite, and magnetite. Minor quantities of calcite and traces of chromite and uvarovite are also present. Talc has not been observed.

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Coalinga chrysotile has an unusually large surface area, about 70-80M^2/g, most likely due to the absence of inter-fiber material, compared with most other chrysotiles. Although long-fiber, per se, is not present, fiber lengths up to several microns have been noted in the leathery sheets. Most of the chrysotile in the ore, however, is much shorter and is arranged in a swirling mesh of disoriented, tangled fibers, much like cellulose in paper. Serpentinite gangue is scattered throughout the soft ore, and contains the bulk of the platy serpentines present. Petrographically it is not unlike most other serpentinites; however, brucite is a common constituent and is often found intimately intergrown with serpentine. The results of chemical, electron probe, and X-ray analyses confirm that the brucite of this ore is iron-rich, having an approximate fomula of $(Mg_{10}Fe_2)(OH)_{24}$. The high iron content of the brucite is a critical factor in the susceptibility of the ore to weathering, and brucite-rich ore invariably discolours rapidly when exposed to surface oxidation conditions. Within the 20-30' thick surface weathering zone, blocks and fragments of brucite-rich serpentinite transform into dark brown, soft, crumbly masses. The weathered serpentinite 'boulders' are enriched in pyroaurite, the new mineral, coalingite, and amorphous iron oxides, while brucite is almost absent. Laboratory experiments have confirmed that in the surface weathering zone, iron-rich brucite either dissolves, leaving behind a residue of brown, amorphous iron oxides, or transforms in situ into pyroaurite or coalingite by oxidation and carbonation. The dissolved magnesium later precipitates as hydromagnesite which is abundant immediately above the water table throughout the deposit.

The presence of about 8% brucite in the New Idria serpentinite suggests that the parent igneous rock was a dunite, which was injected into the surrounding sediments during the serpentinization process. Its location, a few miles east of the famous San Andreas fault zone, probably accounts for its extremely sheared and fractured nature. The material present in the mass today may be the result of intensive crushing and pulverization during or after serpentinization, much as a thick paste is ground and smeared in a wet ball mill or mix-muller. The abundance of chrysotile, especially in the friable portions of the ore, may be the result of lizardite and antigorite of the original serpentinite transforming into the 'stable' phase, chrysotile, during this extensive reworking process.

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