Cana Brava asbestos chrysotile deposit (Goiás, Brasil): The geology and geochemistry of the serpentinization

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The Cana Brava mineralized zone consists of four bodies composed of green, black, red and brown serpentinite, chaotic, densely fractured, and mineralized, with fractures filled with cross chrysotile that, together, form a mineralized region with a NS orientation, about 4.5 km in length and 0.2 to 1.0 km wide. Chrysotile veins occur mostly in green serpentinite, within a stratiform zone, limited above and below by low-angle to subhorizontal shear zones.

The green serpentinite consists of chrysotile or clinochryisotile, lizardite (1T polytype), and magnetite. It contains the highest chrysotile concentration in its matrix and veinlets. The cross chrysotile veinlets are filled with cross clinochysotile, and rarely, orthochrystotile. The red serpentinite is composed mainly of lizardita (1T polytype) mixed with antigorite, chrysotile, and/or clinochrysotile and brucite. The black serpentinite is a rock with a mixing of lizardita 3T (polytype 1\ITT\RG), antigorite (polytype 8.0\ITM\RG and common antigorite), chrysotile or clinochrysotile ±brucite, and magnetite. In the brown serpentinite the predominant mineral here is lizardite, either in the polytype 1T, or 3T, mixed with common or 8.0\ITM\RG antigorite polytype, clinochrysotile, brucite, magnetite and chromite.

The serpentinization trends for ultramafic rocks of the Cana Brava deposits (Brazil), Burro Mountain (USA), Munro Sill (Canada), and Cassiar (Canada) are displayed in an RO' - Mol H_2O - Mol SiO_2 diagram. The serpentinization trends for Burro Mountain, Cassiar, and Munro Sill occurred for values of RO'/SiO_2 that were practically constant, with values from 2.0 to 1.7 for the Burro Mountain dunites and harzburgites, between 1.7 and 1.9 for Munro Sill, and between 1.9 and 1.5 for Cassiar. In contrast with these other complexes, in Cana Brava the serpentinization trend showed nearly constant RO' values. The process that generated the Cana Brava red, brown, and black serpentinites occurred with a decrease in volume of approximately 5%. The SiO_2 losses were around 8 to 13 wt%, the losses of CaO were of the order of

1-3.5 wt%, and the losses of total Fe ranged between 1 and 4 wt%. The gain in water, considered as a LOI, was approximately 3 wt%.

The crystallization of the green serpentinite occurred with an increase in volume that was between 6 and 10% higher than that associated with the red and brown serpentinites, and 6% lower than that associated with black serpentinite. When green serpentinite was transformed into cross chrysotile, this occurred with changing concentrations of SiO_2 (-4 to 5 wt%), Fe_2O_3 (-0.5 to 1.0 wt%), MgO (-13 wt%), and H_2O (–2.0 to 3.0 wt%). In places far from the green serpentinite nuclei, veinlets with cross chrysotile usually have two reaction fringes, namely a green and a red fringe. In general green fringe crystallization occurred with losses of 1-5 wt% SiO_2, 5-6 wt% MgO, and 1-3 wt% H_2O, and gains of 1-3 wt% Fe_2O_3, while the red fringe formed with gains of approximately 1 wt% SiO_2, 1-4 wt% CaO, and a loss of 1 wt% H_2O in red and brown serpentinite, and a gain of 3 wt% in black.