

The occurrence and speciation of arsenic in serpentinites in northern Vermont, USA

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High concentrations of As are reported in ground waters and bedrocks in many parts of New England [1]. Ryan et al. [2] reported that hydrated ultramafic rocks contain high concentrations of As (up to 449 ppm in serpentinites and 1,100 ppm in talc-magnesite rocks) in northern Vermont. Altered ultramafic rocks are common in the Appalachians in New England. We investigated the occurrence of As in representative serpentinites from northern Vermont (103-450 ppm As in bulk rocks). The study includes the examination of polished-thin sections, electron microprobe analysis of minerals, mechanical separation of mineral fractions (ferrihydrite films, antigorite-rich fraction, magnetite-rich fraction), acid leaching and digestion of these fractions, and X-ray absorption spectroscopic study of As. Magnetite-rich fractions yielded high concentrations of As in hot HNO₃ digestion at 90 °C. Brown films of ferrihydrite along cracks and on surfaces contain very low concentrations of As. Antigorite-rich fractions contain minor As (<50 ppm). X-ray absorption spectra of these fractions show that the As is predominantly +3 in magnetite- and antigorite- fractions.

Magnetite commonly forms a fine dusting in serpentine since the hydration of olivine releases Fe(II). Magnetite also forms rims of chromite grains during serpentinization. Our data suggest that As(III) in water was fixed in magnetite and minor amounts in serpentine during the hydration of ultramafic rocks. Our earlier study of serpentinites in northwestern Himalayas show that As(V) is fixed in serpentinites by replacing Si(IV) in antigorite [3]. The results of these studies suggest that hydrating ultramafic rocks are capable of fixing both As(III) and As(V) and that the speciation of As in serpentinites is controlled by the oxidation state of As in the hydrating fluids.

[1] Ayotte, J.D. et al. (2003) *Environ. Sci. Technol.*, **37**, 2075-2083. [2] Ryan, P.C. et al. (2009) *Abst. GSA Mtg.*, **77-3**. [3] Hattori, K. et al. (2005) *Geochim. Cosmochim. Ac.*, **69**, 5585-5596.