The thermodynamics of asbestos mineral dissolution and conversion in the human lung

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Amphibole asbestos is now considered to be the most harmful type of asbestos. Its dissolution in low-temperature environments is poorly known, especially under simulated lung conditions. Because of its dominance in asbestos mines, chrysotile (serpentine) asbestos is by far the most widely studied asbestos mineral in relation to its dissolution kinetics. Chrysotile mines are commonly contaminated with amphibole asbestos. In a study by J.C. Wagner (1987; see also Case, 1991), in which no evidence of tremolite asbestos was found in initial and "respirable" chrysotile asbestos fibers, tremolite asbestos was "clearly evident in the lungs of the rats after three months of exposure." This study is the impetus for our hypothesis that less harmful chrysotile asbestos may convert to more harmful tremolite asbestos or some other mineral in the lung.

To begin our investigation of the above hypothesis, the equilibrium constants of the dissolution of both chrysotile and tremolite and conversion of chrysotile to tremolite in the lung were calculated using SUPCRT92 software package (Johnson et al., 1992). The ion activity products (IAP) and saturation indices (SI) for each of these reactions were calculated. Both chrysotile and tremolite are undersaturated with respect to lung fluid at pH 4 to 7.5 (for chrysotile, see also Hume and Rimstidt, 1992 and Parry, 1985). The SI for the conversion reaction also indicates that the conversion reaction should proceed to the right under lung conditions. However, conversion of chrysotile to tremolite would only occur if tremolite dissolution were much slower than the conversion reaction, or if rapid chrysotile dissolution locally supersaturated the lung fluid in dissolved silica and Mg. Thus, the kinetics of tremolite dissolution under lung conditions is currently being investigated in order to determine of the reaction rate is measurable on a human timescale.

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Small scale geochemical variability in the basalts from the Lucky Strike Hydrothermal Field

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Abstract

The Azores Platform is associated with a regional-scale enrichement in incompatible elements and radiogenic isotopes (Schiling, 1975; Dosso et al., 1999). However, studies of dredged and grabbed samples collected from the Lucky Strike segment, and focused on the hydrothermal field at 37.30ºN, reveal local-scale heterogeneties (over 100s of meters) that are not related by fractional crystallisation or differences in mantle melting.

Based on analytical data obtained by XRF and ICP-MS on fresh whole rock samples, three groups of basalts, having different distinct geochemical signatures, are identified. Average contents in REE, LILE and HFSE for each group are represented in Figure 1 as a ratio to typical N-MORB compositions (normalising factors from Sun & McDonough, 1989). The two most enriched groups have very high concentrations in the more incompatible elements.

Possible explanations for these local-scale variations are explored and either mantle metasomatism or assimilation of hydrothermally alterated crust are candidates.

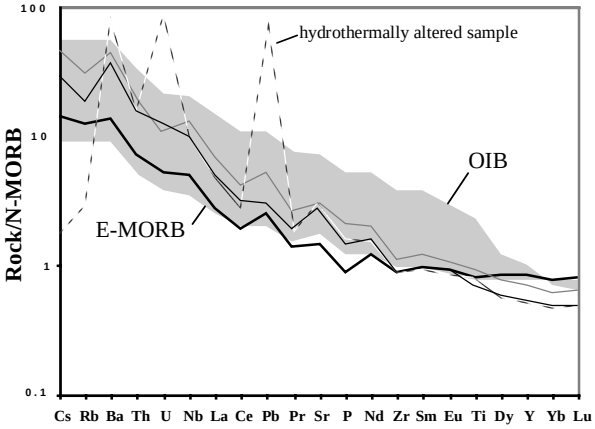

Figure 1.

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