Role of Manganese in the Oxidation of Arsenite by Freshwater Lake Sediments[1]

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Abstract: The importance of various sediment components in the oxidation of As(III) (arsenite) to As(V) (arsenate) by freshwater lake sediments in southern Saskatchewan was examined. Treating the sediments with hydroxylamine hydrochloride or sodium acetate to remove Mn greatly decreased the oxidation of As(III). Furthermore, synthetic Mn(IV) oxide was a very effective oxidant with respect to As(III): 216 μg As(V)/ml was formed in solution when 1000 μg As(III)/ml was added to suspensions of 0.1 g of the oxide. These results indicate that Mn in the sediment was probably the primary electron acceptor in the oxidation of As(III). The conversion of As(III) to As(V) by naturally occurring carbonate and silicate minerals common in sediments was not evident in the system studied. Sediment particles >20 μm in size are the least effective in oxidizing As(III); the oxidizing ability of the 5 – 20-, 2 – 5-, and <2-μm particle size fractions varies depending on the sediment. The concentration of As(V) in equilibrated solutions after adding increasing amounts of As(III) (as much as 100 μg/ml) to 1 g of the three sediments ranged from approximately 3.5 to 19 μg/ml. Because As(III) is more toxic and soluble than As(V), Mn-bearing components of both the colloidal and non-colloidal fractions of the sediments may potentially detoxify any As(III) that may enter aquatic environments by converting it to As(V). This is very important in reducing the As contamination and in maintaining the ecological balance in aquatic environments.

Key Words: Arsenic • Lake sediments • Manganese • Oxidation

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