

BEDROCK AND OVERBURDEN SOURCES OF ARSENIC IN LEACHATE PLUMES FROM A LANDFILL IN SACO, MAINE

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Concentrations of arsenic in leachate-plume water at the municipal landfill, Saco, Maine, varied with the character of geologic materials that underlie separate landfill piles. Comparisons were made of arsenic concentrations and arsenic-to-iron ratios in ground water, whole rock, and hydroxylamine-hydrochloride leaches of aquifer solid materials between leachate plumes that pass through (1) glaciomarine fine sands not in contact with bedrock, and (2) gravel and till deposits, consisting of an upper and a lower unit, over a fine-grained hornfels bedrock. Low arsenic concentrations and ratios were measured in plume water associated with the fine-sand deposits (average As = 0.033 mg/L, As:Fe = 0.031 w/w percent). High concentrations and ratios were associated with the upper gravel and diamict deposits (average As = 0.326 mg/L, As:Fe = 0.64 w/w percent). These corresponded with differences in arsenic concentration and arsenic-to-iron ratio measured between the solid materials associated with the plumes. The results were compatible with a hypothesized source of arsenic in the iron- and manganese-hydroxide minerals coating the aquifer solid materials. These minerals could be dissolved under reducing conditions in anaerobic leachate plumes. In the ground-water samples from the lower gravel and diamict aquifer and bedrock wells, an additional bedrock source was required to explain high arsenic concentrations and arsenic-to-iron ratios measured in water samples. Speciation analysis of arsenic in the leachate plumes indicated that high-level concentrations were primarily inorganic arsenic(III) associated with anaerobic conditions and with high concentrations of organic carbon and dissolved iron and manganese (0.1-micron filter). Equilibrium-speciation modeling indicated that no saturation indices were approached for arsenic-containing minerals; sorption reactions of arsenic onto iron-hydroxide minerals coating aquifer sediments, however, could control concentrations of arsenic in ground water.