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Ecological Interactions Between Metals and Microbes That Impact Bioremediation

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RESULTS TO DATE: Samples have been obtained from (a) soil highly contaminated with Cr (tannery site) and (b) soils contaminated with petroleum, Cr, and Pb (Seymour, IN). Microcosm experiments with the tannery site soil indicated that microbial biomass (assayed as phospholipid-phosphate) and activity (assayed as carbon dioxide evolution) were primarily determined by organic carbon availability, but not total Cr concentration. The toxicity of metals to the indigenous microbial populations of the Seymour soils was determined by measuring microbial activity (incorporation of tritiated leucine into protein) of cells extracted from soil particles in solutions of increasing metal concentration. Although total Cr concentration varied 100-fold in these soils, the inhibition constant for Cr toxicity varied < 3-fold. Of additional interest in one soil was the dose-response function; the response suggests the soil contains a complex mixture of microbes with different Cr resistance levels. Cr and Pb resistant bacteria have been isolated from these soil samples. In Arthrobacter sp. Cr15, Cr resistance was spontaneously lost at a frequency of ca. 0.5% after growth for 20 generations in non-selective medium. The wild-type contained a 60 kb plasmid. In two Cr sensitive strains, restriction fragment analysis has shown that 15 kb of the plasmid have been lost. Matings between the wild type and cured strains result in transfer of the Cr resistance phenotype at a frequency of 1%.