CHROMATE GENERATION BY CHROMATE DEPLETED SUBSURFACE MATERIALS

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Abstract. Soluble chromate concentrations as high as 200 μg Cr L^{-1} have been reported in water samples from monitoring wells tapping alluvial deposits allegedly contaminated by laboratory waste as well as control wells off site and upgradient (shallow aquifer) near Davis California, U.S.A. In this report we present evidence that these Cr(VI) levels could have been generated by geogenic processes rather than by anthropogenic inputs. We tested the hypothesis that native Cr(III) has been and can be oxidized to chromate by native manganese oxides. Twenty-three drill core samples (all unsaturated) were retrieved from depths varying from 1.5 to 22.5 m in 6 different wells. Visible nodules of MnO_2 were dispersed throughout many of the samples and carbonates were also present. Sample pH values averaged about 8.0 and organic C was mostly less than 1.0 g kg^{-1}. Total Mn and Cr averaged 835 and 191 mg kg^{-1} respectively. All samples had the capability to oxidize added Cr(III) to Cr(VI). To determine the inherent capability of the samples to produce Cr(VI) from native Cr(III), subsamples were extracted with 5 mM $CaSO_4$ plus 5 mM $MgSO_4$ until Cr(VI) was no longer detected. After freeze-drying, deionized-distilled water was added to the leached samples to approximately field capacity (0.03 MPa). Freeze drying did not generate Cr(VI). These samples were incubated in polyethylene film bags at room temperature in the dark. After 1 week incubation, water in the samples was extracted by centrifugation and the extracts were analyzed for Cr(VI). All of the samples generated Cr(VI), and the concentrations in the extracts ranged from 20 to 100 μg Cr L^{-1}. Total chromium, endemic chromium VI and chromium VI generated in leached samples were not statistically different between samples from onsite and control samples taken offsite and upgradient in respect to the shallowest aquifer.

Keywords: chromate, chromium VI, manganese oxide, vadose zone

1. Introduction

Trace element concentrations in ground water systems at levels above established water quality standards are problematic. These elevated levels are often associated with anthropogenic inputs. The Criterion Maximum Concentration (CMC) for Cr(VI) in freshwater is 16 μg Cr L^{-1} (National Recommended Water Quality Criteria, 1998). Chromate levels approaching 200 μg Cr L^{-1} have been reported in monitoring well water samples from alluvial deposits beneath a United States Department of Energy research laboratory as well as in water samples from control

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