Desorption of contaminant Cs and Sr from clay systems after weathering in caustic waste solutions

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Disssolution behavior and contaminant (Cs and Sr) release from solid phase products of kaolinite weathering were studied by wet chemistry, X-ray diffraction (XRD), scanning electron microscopy coupled with energy dispersive X-ray spectroscopy (SEM/EDS), diffuse reflectance infrared Fourier transform (DRIFT) and Extended X-ray absorption fine structure (EXAFS). Kaolinite weathering took place in suspensions characteristic of leaking tank waste at the Hanford Site in WA (0.05 M Al_t, 2M Na^+, 1 M NO_3^-, pH ~ 14, Cs^+ and Sr^{2+} presents as co-contaminants at concentrations from 10^{-5} to 10^{-3} M) for 10 months at room temperature. We have previously reported that kaolinite weathers to form Cs and Sr containing zeolites under these conditions. In the present work, desorption experiments were then conducted up to 324 h in 5 mM $CaCl_2$ using a fill and draw technique.

Chemistry data showed 96 % and 98 % of Cs that was sorbed initially remained in the solid phase after 324 d for initial concentrations of 10^{-5} and 10^{-3} M, respectively. Also, 79 % and 88 % of Sr remained sorbed at the end of the desorption period for initial concentrations of 10^{-5} and 10^{-3} M, respectively. SEM/EDS clearly revealed the spheroidal secondary phase chabazite as containing the majority of Cs and Sr after desorption. EDS spectra indicated that Ca effectively displaced Na in the chabazite cation exchange sites, but evidently this was not the case for Sr and Cs. Microfocused EXAFS of individual zeolite particles was used to elucidate the effects of the desorption/dissolution reaction on Sr coordination.

Trace metals in the water column and sediments from Zeekoevlei, South Africa

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Zeekoevlei is the largest fresh water lake in South Africa. Physical and chemical processes contributing towards the distribution of metals in water and surface sediments were investigated in this hyper-eutrophic polymictic shallow lake. Sediment cores and surface water samples were collected in summer and winter of 2004. Dissolved trace metal concentrations in Zeekoevlei were high in comparison to other natural water systems. Concentration of Ni in surface water was high in summer, whereas a noticeable increase in concentrations of Cr, Fe, Cu, Cd, Zn, and Pb occured during winter. Only Mn did not show any change (Table 1). The high concentrations of these metals were found in the surface lake sediment. This could be explained by the increased precipitation of metals in highly alkaline (pH 9) lake water. Furthermore, the well oxygenated (11.14 mg/l in summer and 14.39 mg/l in winter) lake water could keep the surface lake sediments oxidised throughout the year enhancing trace metal accumulation through adsorption onto oxyhydroxides. Concentrations of total (dissolved + particulate) Cr, Mn, Ni, Cu, Zn, Cd, and Pb in the bottom water were high, and close to the concentrations observed in the surface lake sediment. We propose that wind induced resuspension possibly enhances the exchange between the sediment and the water column and could result in high particulate metal concentrations in bottom waters. The distribution of metals in the Zeekoevlei sediment and water column was probably controlled by pH, dissolved oxygen, physical forces like wind and seasonal variation in water supply.

Table 1. Metal concentrations (µg/l) in summer (s) and winter (w) lake surface water

	Ni	Cr	Fe	Cu	Cd	Zn	Pb	Mn
s	3.15	0.97	18.9	1.30	0.02	9.31	0.87	1.9
w	2.54	4.90	321	89.2	0.22	12.4	1.59	1.9