Use of TGA/DSC-IR to assess the effect of Cr on struvite stability

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A TGA/DSC-IR hyphenated technique was used to evaluate the effect of sorbed Cr on the thermal properties of struvite ($NH_4MgPO_4 \cdot 6H_2O$, MAP). MAP occurs in guano deposits, peat, and lake sediments [1, 2]. It is also found in agroecosystems as a fertilizer decomposition product, and as a component of animal manure and poultry litter [3]. These systems can have high metal content, including Cr, which may substitute for P in MAP. Simultaneous thermal analysis has been used to determine the effect of Cr on the thermodynamic properties and stability of phosphate minerals [3, 4]. Addition of IR spectroscopy allows direct identification and quantification of decomposition products. Cr-MAP solids were generated from solutions with 0-100 μM Cr (III) and Cr (VI). DSC indicated an endothermic peak for all solids at 127 ± 0.5 °C, accompanied by >50% sample weight loss based on TGA, due to evolution of H_2O (g) and NH_3 (g) as identified by IR. The enthalpy, weight loss, and moles of evolved gases varied with initial Cr oxidation state and concentration. This was suggestive of diverse sorption complexes and mechanisms, further investigated using FT-IR and XAFS. The overall effect of sorbed Cr was to increase the structural H_2O content of MAP and to reduce the enthalpy of the endothermic transition. This indicates that Cr reduces the stability of MAP, increasing susceptibility to decomposition and thus release of the metalloid. This has implications for cycling of Cr, P and N in MAP-bearing natural and agricultural systems.

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Identification of geochemical processes in groundwater at the Chernobyl Pilot Site and preliminary contamination characterization with $^{36}Cl/Cl$ ratios

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After the accident at the Chernobyl Nuclear Power Plant in april 1986, 12.10^{18} Bq of radionuclides (RN) were released in the atmosphere and most of them were redeposited around the facility. To prevent atmospheric resuspension, about 800 trenches were dug on site to dispose contaminated material (debris, organic matter, topsoil containing reactor fuel particles). Since 1999, the EPIC (Experimental Platform In Chernobyl) project has been set to study migration of radionuclides from one of these trenches, the trench T22, through the unsaturated and saturated zone. A plume of ^{90}Sr was identified downstream from the trench. The aim of this study is to contribute to the understanding of the migration of ^{90}Sr and other RN in groundwater. Water stable isotopes indicate winter recharge and groundwater stratification. Major elements show an increase in concentration with depth, linked to mixing and/or water-rock interaction processes. Preliminary results in $^{36}Cl/Cl$ show ratios in the order of those observed in concrete of proton-accelerator facilities [1] and 2 to 3 orders of magnitude higher than the theoretical ratio in precipitation. The source of this contamination may be contaminated particles released during the explosion and/or background activity and/or waste buried in the trench. Characterization of transport processes will be further investigated based on $^{235}U/^{238}U$, $^{86}Sr/^{88}Sr$ and $^{87}Sr/^{86}Sr$ ratios and additional $^{36}Cl/Cl$ measurments.

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