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## Study of Np(V) complexation with propionate and lactate at room temperature

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Np-237 is one of the important contributors to the radiation inventory of nuclear waste repositories over a very long time period, because of its long half-life (2.14•10<sup>6</sup> y). Natural clay rocks are considered as potential host rocks for deep geological disposal of nuclear waste, because of their low permeability and high retention properties for radionuclides via sorption processes. However, small organic molecules, such as lactate and propionate exist in clay rock pore water and they might enhance Np mobility. The understanding of the complexation of Np with these ligands and reliable complex formation data are required in the frame of safety assessment of a nuclear waste repository.

Two methods were applied and compared for the determination of Np(V) (NpO<sub>2</sub><sup>+</sup>) complexation with propionate ([Prop] = 0-0.30 mol/L) and lactate ([Lact] = 0-0.33 mol/L), namely UV-Vis/NIR spectroscopy and liquid-liquid extraction (LLE) technique with isoamyl alcohol solution containing 10<sup>-3</sup> M TTA and 5•10<sup>-4</sup> M 1,10-phenanthroline [1]. All measurements were performed at 0.5 M ionic strength of NaCl solution at room temperature (22±1 °C). The concentration of <sup>237</sup>Np(V) in LLE experiments was 1•10<sup>-6</sup> - 3•10<sup>-6</sup> M at pH 7. Liquid scintillation counting was used for the determination of the neptunium concentration in aqueous and organic phases after the extraction. UV-Vis/NIR spectroscopy measurements in the wavelength range of 950-1030 nm were carried out at pH 4, 5 and 7 with <sup>237</sup>Np(V) concentrations of 2•10<sup>-5</sup> - 6•10<sup>-5</sup> M. The maximum of the absorption band of the neptunyl aqua ion (NpO<sub>2</sub><sup>+</sup>) at 980 nm shifts with increasing ligand concentration to 983 nm (NpO<sub>2</sub>Prop) and 986 nm (NpO<sub>2</sub>Lact) while its absorption intensity decreases. Slope analysis of the results yields a 1:1 Np(V) complex formation for propionate and lactate at the given pH values. In the extraction experiment, the distribution ratio of [Np-org]/[Np-aq] decreases with increasing ligand concentration. Both methods provided similar conditional complexation constants at ionic strength of 0.5 M NaCl: log K<sub>c</sub> (spec) = 1.09±0.1 and log K<sub>c</sub> (LLE) = 1.04±0.02 for NpO<sub>2</sub>Prop; log K<sub>c</sub> (spec) = 1.75±0.1 and log K<sub>c</sub> (LLE) = 1.85±0.01 for NpO<sub>2</sub>Lact. The value for the lactate complex is comparable with a value from literature: log K<sub>c</sub> (spec) = 1.78±0.03 for NpO<sub>2</sub>Lact I = 0.3 M [2]. The complexation strength of propionate is similar to the acetate complexation expressed in a similar complex formation constant of log K<sub>c</sub> (spec) = 1.05±0.04 for NpO<sub>2</sub>Acet at I = 0.3 M [2].

The work will be extended to different ionic strengths and elevated temperatures in the near future.

References:

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