Sorption of Np on magnetite in solutions of different ionic strengths

V.G. PETROV*, A.A. ZADORIN AND S.N. KALMYKOV

119991, Leninskie gory, 1/3, Chemistry Department, MSU, Moscow, Russia
(*correspondence: vladimir.g.petrov@gmail.com)

Neptunium is an element of interest due its high content in spent nuclear fuel and its physico-chemical properties, such as long half-life ($T_{1/2}$ (^{237}Np) = $2.14 \cdot 10^6$ years) and high potential mobility of Np (V) which is the most stable valent state under the environment conditions. Among numerous geochemical reactions controlling the migration behavior of actinides, sorption processes are of main importance. Magnetite is one of the possible iron oxide phases forming as a result of steel containers corrosion. There are number of research works dealing with sorption of neptunium onto different iron oxides in solutions with low ionic strengths in literature. However in near-field conditions due to dissolving of cementitious materials and host rocks formation of brine solutions is possible.

The objective of this work is to investigate sorption of pentavalent neptunium on magnetite in sodium chloride solutions of different concentrations both in aerobic and anaerobic conditions.

Experiments in aerobic conditions were done in contact with atmospheric air in the pHc (pHc = -log [H^+]) range 2.0 – 8.0. Experiments in anaerobic conditions were done in N_2 glove box in the pHc range 2.0 – 10.0. All solutions were prepared using deionized water and NaOH/NaCl, HCl/NaCl for adjusting pHc. The initial neptunium concentration was $1 \cdot 10^{-9}$ M. For activity measurements short-lived gamma-emitting isotope ^{239}Np ($T_{1/2}$ = 2.36 days) was used. Solid/solution ratio was 1 g/L.

The shift of the sorption edge to higher values of pHc (6.5 – 7.5) and decreasing of maximum sorption with increasing ionic strength was observed in both aerobic and anaerobic conditions (from 98% in 0.1 M NaCl solution to 67% in 5 M NaCl solution). In the 0.1 M NaCl solutions typical for cation sorption curve was observed with pHc_{50} (50 % sorption) 6.5. Unusual sorption behavior was observed for 1-5 M NaCl solutions in aerobic conditions with additional maximum in the pHc range 4.5-5.5, that could be explained by reduction of pentavalent neptunium in the presence of iron (II). This maximum has the highest value of 70% for 1 M NaCl and decreases to 20% with increasing of the ionic strength to 5 M NaCl. Further thermodynamic calculations are required for accurate description of obtained results.

Modeling reconciles observations for Traps in East and West Siberia

A.G. PETRUNIN AND S.V. SOBOLEV

GFZ, German Research Centre for Geosciences, 14473 Potsdam, Germany
(*correspondence: stephan@gfz-potsdam.de)

The Permo-Triassic Siberian Traps – the type example and the largest continental Large Igneous Province, is located on both thick cratonic lithosphere of Precambrian Siberian Craton in the East Siberia and on much thinner lithosphere of the Mesozoic West Siberian Basin. Based on largest volumes of the exposed basalts and on highest source temperatures of basalts in the East Siberia, it is believed that the head of a hot mantle plume, which was probably the source of basalts, arrived in the East Siberia. However, there is no evidence of the expected pre-magmatic uplift nor of a large lithospheric stretching of the basaltic sequence in the East Siberia, while these features are reported for the West Siberian Basin [1]. Based on these observations it was suggested [1] that mantle plume head arrived to the base of the lithosphere of the West Siberian Basin and only later leaked below the East Siberian Craton.

Here we test scenarios with different locations of the mantle plume, using thermomechanical modeling technique. The model employs petrological constraints for the source composition and temperature [2, 3], non-linear temperature- and stress-dependent elasto-visco-plastic rheology [4] and pressure- and temperature-dependent melting of a heterogeneous mantle. We show that observations for the West and East Siberian Traps can be reconciled for the large (more than 400 km in radius) and hot (potential temperature up to 1600°C) plume head containing large amount (up to 15 Wt%) of the recycled oceanic crust, that arrived to the thick lithosphere of the East Siberia and was then deflected towards the thin lithosphere of the West Siberia. In this case no uplift and stretching is generated in the East Siberia and major basaltic eruptions may occur first in the West Siberia.

[1] Saunders, A.D. *et al*. (2005) *Earth Planet. Sci. Lett*. **79**, 407–424. [2] Sobolev, A.V. *et al*. (2009) *Petrology* **17**, 253–286. [3] Sobolev, A.V. *et al*. (2009) *Russian Geology & Geophysics* (2009) **50**, 999–1033. [4] Sobolev, S.V. & Babeyko, A.Y. (2005) *Geology* **33**, 617–620.