# Reaction of aqueous U(VI) with nano-crystalline magnetite

E.S. ILTON[1]*, J-F BOILY[1] AND J. BARGAR[3]

[1]Pacific Northwest National Laboratory, Richland, WA, 99352, USA (*correspondence: Eugene.Ilton@pnl.gov)
[2]Stanford Synchrotron Radiation Laboratory, Menlo Park, CA, 94025, USA (Bargar@slac.stanford.edu)

U(VI)aq was reacted with nano-crystalline magnetite for 1-9 weeks at pH 5-5.4. Solid run products were analyzed with high resolution X-ray photoelectron spectroscopy (XPS) and extended X-ray absorption spectroscopy (EXAFS). XPS indicated the presence of both U(VI) and U(V) on the near surface of magnetite. This contrasts strongly with the interaction of U(VI)aq with green rust, where XPS analyses were consistent with near-stoichiometric $UO_2$ on the surface. EXAFS indicated the presence of a uranyl species with axial bond lengths around 1.8 A and a species with U-O bond lengths at 2.05 A, which we shall call the uranate species. An analysis of second nearest neighbours EXAFS indicated the presence of relatively large multiple Fe shells at distances between about 3.5 and 4.3 A. Second neighbour U were inconsistent with the EXAFS data. We initially conclude that at least two U species are present, including surface-bound U(VI) and uranium incorporated into a Fe-oxide phase, possibly a surface alteration product. The putative incorporation site is not compatible with the Fe1 or Fe2 sites of magnetite. The uranate phase is consistent with either U(VI) or U(V), but certainly not U(IV). These results suggest that the uranate phase reflects a reductive environment and could in fact be the U(V) species identified by XPS. If this is the case, then the experiments provide the first evidence that U(V) can be stabilized on or near a mineral surface at low sorption densities during heterogeneous reduction of U(VI)aq.

# Coal-based subseafloor seep microbial ecosystem

FUMIO INAGAKI, YUKI MORONO, AND "*CHIKYU*" SHAKEDOWN EXPEDITION CK06-06 SCIENTIFIC PARTY

Geomicrobiology Group, Kochi Institute for Core Sample Research, Japan Agency for Marine-Earth Science and Technology (JAMSTEC) (inagaki@jamstec.go.jp)

Recent studies of the deep subseafloor biosphere have suggested that microbial population and activities in sediments are controlled by nutrient and energy flux(s) transported via the overlying seawater and/or the secondary seawater circulation through the basaltic aquifer [1]. The microbial populations in marine sediments generally decrease with increasing depth [2], except for sedimentological and geochemical interfaces, and the metabolic activities and turn over rates are extremely low. The available nutrient and energy sources are subsequently limited in deeper sediments with burial, hence the adaptation of long-term survival as well as the dynamics of population and activities corresponding to the energy and nutrient fluxes in the deep subseafloor biosphere remain largely unknown.

From August to October in 2006, the newly constructed deep-sea drilling research vessel "*Chikyu*" went down on the shake down cruise CK06-06 offshore the Shimokita Penninsula, Japan. During the expedition, a 365 m-sediment core was recovered from a methane hydrate field, where the presence of thick coal layers (TOC 40-60%, 30-125 m in thickness) was expected at around 2,000 mbsf by the preliminary multiple seismic profiles [3] and the previous drilling survey of natural gas production [4]. The thick coal layers produce large amount of hydrocarbon gases via physical and/or biological degradation processes *in situ*, from which derived carbon components, as well as some other nutrient and energy substrates such as nitrogen sources, are transported upward through the sediment column via fluids and gas flows, which may support active and abundant microbial habitat in the deep marine subsurface. We will show microbiological and biogeochemical characteristics of the sediment core off Shimokita, and will discuss about the nature of subseafloor life in the coal-based subseafloor seep ecosystem.

[1] D'Hondt, S. *et al.* (2004) *Science* **306**, 2216-2221. [2] Parkes, R. J. *et al.* (2000) *Hydrogeol. J.* **8**, 11-28. [3] Taira, A. & Curewits, D. (2005) *CDEX Tech. Rep.* **2**, 1-155. [4] Osawa, M. *et al.* (2002) *J. Jap. Assn. Petrol. Tech.* **67**, 37-51.