Remobilisation of uranium from contaminated sediments: effect of the bioturbation

MIKAEL MOTELICA-HEINO [1]*, F.LE MOING[2], SANDRA LAGAUZERE [2], JEAN-MARC BONZOM[2], LAURENINE FEVRIER[2] AND VIRGINIE CHAPON[3]

[1]ISTO, University of Orléans, Orléans, France, mikael.motelica@univ-orleans.fr
[2]IRSN, Cadarache, France, jean-marc.bonzom@irsn.fr
[3]CEA,Cadarache, France, virginie.chapon@cea.fr

Introduction

The main thrust of this work is to bring some answers to the following question: what either distinct or combined role do the different physico-chemical and biological (benthic macro-organisms) play on the reactivity, the transfer and the biotic impact of metallic contaminants in sediments? To achieve this goal, experimentations wre carried out in microcosmes with different forcing parameters (oxia, anoxia, with and without macro-benthic organisms).

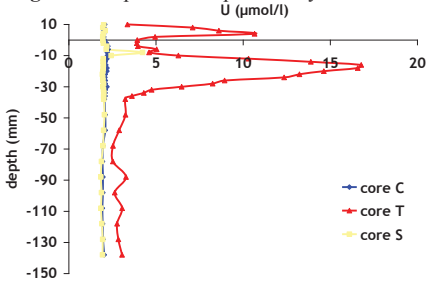
Material and methods

15 sediment cores were samples in the Pontabrier lake within the village of Compreignac north of Limoges (Haute-Vienne, France). These sediments are heavily contaminated in uranium (34 317 Bq/Kg m.s.). Cores were untouched and were used as the characterisation cores (cores « C »). 6 other cores were then depleted in benthic macro-organisms by addition of niyrogen gas for 24 h. Half of the cores depleted in macro-organisms were populated with 1060 Tubifex tubifex by core with a mean density of 60 000 individualss /m² close to what observed in some environments (cores « T »). The three remaining cores were submitted to gamma irradiation (delivered dose: 40 Kgy) during 6 days t sterilise them (cores « S »). At day 0 and after a month, peepers-gels DET probes (diffusive equilibrium in thin-films) were inserted for 24 h in all probes to determine the concentration profiles of the dissolved species.

Results and conclusion

Results suggested the enhanced release of uranium from the sediment by bioturbation (figure 1). The present study provides further evidence of the enhanced release of uranium from the sediment by bioturbation, possibly from the dissolutive reduction of iron oxyhydroxydes coated with uranium. The bioturbation is in fact likely to shift the redox processes with the further addition of dissolved oxygen by the Tubifex activity.

Figure 1: U pore-water profiles by DET



In situ high pressure changes to the O *K*-edge electronic structure of $CaMgSi_2O_6$: An x-ray Raman approach

B.J.A. MOULTON[1*], M. KANZAKI[2], H. FUKUI[3], N. HIRAOKA[4] AND G.S. HENDERSON[1]

[1]University of Toronto, Toronto, Canada, bja.moulton@utoronto.ca*; henders@geology.utoronto.ca
[2]Institute for Study of the Earth's Interior, Okayama University, Misasa, Japan, mkanzaki@misasa.okayama-u.ac.jp
[3]University of Hyogo, Hyogo, Japan, fukuih@sci.u-hyogo.ac.jp
[4] National Synchrotron Radiation Research Center, SPring-8, Hyogo, Japan, hiraoka@spring8.or.jp

Abstract

X-ray Raman spectroscopy (XRS) is a rapidly developing technique for in situ observation of the near edge structures in the soft x-ray regime. This region includes the K- and L-edges of most common silicate melt forming elements including Si, Al, Mg and O. This is the only technique that provides direct in-situ observation of the near edge features of these elements at high pressure. This study uses a panoramic diamond anvil cell and beryllium (Be) gasket in the through gasket geometry to investigate the oxygen (O) K-edge within $CaMgSi_2O_6$ glass, an important high pressure phase. Experiments were performed on the Taiwanese inelastic x-ray scattering beamline BL12XU at SPring 8, Japan.

Preliminary results show a prominent edge feature at 533 eV. With increasing pressure the edge first shifts to slightly lower values (~0.1 eV/GPa) until 17.5 GPa whereupon the edge shift becomes positive. At 8 GPa, the O K-edge changes from being a single asymmetric peak (537 eV) at ambient pressure to a distinct double peak (537 and 541 eV). Above 8 GPa, the main peak retains these features though the resolution becomes degraded. The changes in the O K-edge are related to the changes in Si-O-Si glass network.

In comparison to XRS studies on the O K-edge of SiO_2[1], and its polymorphs, the edge features for $CaMgSi_2O_6$ glass are substantially more broad, indicating more complex bonding interactions of local structures. Additionally, the development of an intense peak at 544 eV in SiO_2 glass, thought to represent the presence of $Si^{[6]}$ found in stishovite, is lacking. Although the absense of the 544 eV feature does not preclude the presence of higher coordinated Si species within the glass structure, it does suggest that a more in-depth understanding of the O K-edge under pressure is essential to directly observing, interpreting and understanding the structural role of O within silicate melts at high pressure.

[1] Lin, Fukui, Prendergast, Okuchi, Cai, Hiraoka, Yoo, Trave, Eng, Hu and Chow (2007) *Physical Reviews B* **75**, 012201:1-4.