Migration of bentonite colloids in a granite fracture.

T.MISSANA, M.GARCÍA GUTIÉRREZ, U.ALONSO, J.QUIÑONES

CIEMAT, Avenida Complutense, 22 - 28040 MADRID (SPAIN). (e-mail: tiziana.missana@ciemat.es)

Clay colloids might be generated from the backfill material at the bentonite / granite interface of a deep geological radioactive waste repository and they have been shown to be stable in low saline and neutral - alkaline waters [i]. It is therefore important to study their migration behaviour in order to assess their potential relevance on radionuclides transport. Laboratory experiments are very important to identify the possible processes occurring in natural systems as filtration and colloids/rock interactions.

A fractured granite core was obtained by drilling from the Grimsel Test Site (Grimsel, Switzerland). A column of 10 cm diameter and 22.8 cm length with a longitudinal fracture was obtained for the experimental tests.

The bentonite colloids transport experiments in this fractured core were performed with Grimsel water (ionic strength $1 \cdot 10^{-3}$ M, pH=9.5 and Eh=-250 mV) and under anoxic conditions (N_2 atmosphere). Experiments were carried out with low water flows (5.56 ml/h few ml per hour). The hydrodynamic characterisation of the column was made using HTO as a conservative tracer and the HTO breakthrough curves were modelled with an analytical solution of the equation for the transport in a fractured medium with appropriate boundary and initial conditions [ii].

Bentonite colloids at different concentrations were therefore injected in the fracture and their transport behaviour compared with that of HTO.

The breakthrough curve of the bentonite colloids was obtained using different techniques. Photon Correlation Spectrometry (PCS) and chemical analysis of significant elements like Al, Fe, Zn, Ti, were used to identify the presence of clay particles in the water. Both techniques gave consistent results.

The breakthrough curve of bentonite colloids always showed a peak in a position very similar to that of the conservative tracer indicating that at least a fraction of bentonite colloids is able to move no retarded. Nevertheless, the percentage of colloid mass recovery was dependent on the initial experimental conditions, for example on the colloid concentration, the increase in colloid concentration favouring the filtration process. The effect of the water flow rate on the colloid recovery is under investigation.

Timing and Mechanism of Lacustrine Organogenic Dolomitization, Bahama Islands

S. W. MITCHELL AND D. BARON

Department of Geology, California State University, Bakersfield, CA 93311 (smitchell@csub.edu ; dbaron@csub.edu)

Background

Microbially-,mediated dolomitization is widespread in the near-surface organic-rich sediments of the Bahama Islands [1]. The nature and timing of this <10µm organogenic dolomitization is poorly understood [2]. The <4Ø size fraction of shallow Bahamian lake cores has been analyzed using ICP-MS to determine the vertical distribution of potentially relevant trace elements.

Timing of Dolomitization

Elevated (X2-5) ^{90}Sr in the upper 2-3 cm can be related to atmospheric nuclear testing over the past 50 years; also, levels of Ba, Cr, Cu, Hg, Mn, Mo Pb, Sn, Ti, U and V increase X2-5 above background levels in the upper 0-15 cm of cores. The enhanced flux is attributed to the atmospheric deposition of anthropogenic metals post-1840 [3]. Preliminary ^{206}Pb/^{207}Pb isotope ratios do not match the mid-Atlantic/Bermuda Pb isotope signal records [4]. The highest levels of dolomitization usually occur within the upper 20-30 cm of lake sediments [1]. The inferred depositional rate of 10 cm = ~100 years is in agreement with archaeological evidence [5].

Organodiagenesis

As organogenic dolomitization proceeds, high-Mg calcite is converted to dolomite; aragonite levels are unaffected [1]. Zones of dolomitization contain elevated levels of Al (X2-4 background) and Si (X2-10 background). The soluble Si is attributed to the diatom component (<10% of biomass) of the associated cyanobacterial-bacterial mat community [6] (aerosol,, non-soluble SiO_2 contributes up to 1% of <4Ø size fraction). Total Sr levels vary considerably, but are usually enhanced (X2) or reduced (X1/2) in zones of dolomitization.

Conclusions

Most organogenic dolomitization in the near-surface sediments of Bahamian lakes has formed during the past 200 years—since deforestation and increased aridity of island environments. Trace element variations reflect increasing biomass production and high concentrations of Al during dolomitization.

References

[1] Mitchell, S. W. and Horton, R. A., (1995), *Geol. Soc. Am. Sp. Pap.* 300, 201-221.
[2] Mazzullo, S. J., (2000), *J. Sed. Pet.* 70, 10-23.
[3] Shotyk, W., et al., (1998), Science 281, 1635-1640.
[4] Marcantonio, F., et al., (2002), Mar. Chem. 77, 123-132.
[5] Mitchell, S. W. and Keegan, W. F., (1987), Am. Arch. 6, 88-96.
[6] Paerl, H. W., et al., (2001), Env. Microbiol. 3, 123-130.