High-MgO glass (melt) inclusions in the 200 million year old Palisades Sill, New Jersey, USA

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The much-studied Palisades sill, New Jersey, is part of 200 Ma Central Atlantic Magmatic Province that was emplaced during the separation of North Aemerica from Europe, Africa, and South America and opening of the Central Atlantic Ocean. We discovered some unusually primitive (17 to 21 wt% MgO) glass (melt) inclusions in olivine phenocrysts in what appears to be a feeder dike of the Palisades sill. Although the sill is clearly tholeiitic, these melts are alkaline picrite and are also unlike the most primitive tholeiitic glasses that were found in submarine landslide deposits off the coast of Hawaii, the site of an important modern plume. Chemical composition of the melt inclusions yielded a well-correlated pressure and temperature of 2.5-3.5 GPa (75-100 km) and 1460 -1600°C. The temperatures are about 100° (and not 250-400° excess temperature required by thermal plume models) hotter than the solidus of a dry lherzolite. We suggest that the source rock for such melts was a metasomatized cpx-poor lherzolite. The implications of our findings for the splitting North America from others and the opening of the Central Atlantic Ocean will be discussed.

Modelling microbially mediated redox processes in lake sediments

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In aquatic systems, microbial respiration oxidizes organic carbon whilst reduces inorganic components such as O_2, NO_3^-, Fe^{3+}, SO_4^{2-} and C(4) which, in turn, triggers changes in key geochemical parameters such as pH and pe (Lovley *et al*., 1991, among others).

Performance assessment of a deep geological repository for high level radioactive waste includes predictions for its long-term geochemical evolution. In this context, a jar-fermentor experiment with lake water and sediment samples was developed to assess the role of microbial respiration in aquatic systems (Nakajima *et al*., 2008). During the experiment, the main geochemical parameters were measured.

A numerical model has been developed in order to quantify the role of each microbial group that is believed to influence the geochemical evolution of the jar-fermentor experiment. Monod kinetic equations have been implemented to simulate microbially mediated reactions. Abiotic, kinetic and equilibrium, geochemical reactions have also been considered. Reduction of O_2, NO_3^-, Fe^{3+} and SO_4^{2-}, lactate fermentation, pH, pe and production of CO_2(g) and CH_4(g) are very well reproduced by the model.

Model results show that the initial concentration of the microbial groups considered which is usually an unknown of the experiments plays an important role in numerical results. This study was performed as a part of "Project for Assessment Methodology Development of Chemical Effects on Geological Disposal System" funded by Ministry of Economy, Trade and Industry, Japan.

[1] Lovley *et al*. (1991). *Env. Sci. & Tec.* **25**(6), 1062-1067.
[2] Nakajima *et al*. (2008) ISSM2008, SP-P8.