Colloidal green rust behaviour: Adhesion, transformation and mobility

E. B. HANSSON AND S. L. S. STIPP

NanoGeoScience, Department of Chemistry, University of Copenhagen,Universitetsparken 5, 2100 Copenhagen Ø, Denmark (ehansson@geol.ku.dk; stipp@geol.ku.dk)

One of the more poorly understood processes in nature is the transport mechanisms of solutes and particles. In order to predict the behavior of unwanted compounds in nature, we need to establish these processes. Colloidal transport is believed to be one of the major pathways for distributing contaminants. These contaminants might come from general pollution or from leaking radioactive waste repositories. One very interesting compound that forms colloids and which is believed to exist in such environments is green rust.

Green rust is a layered double hydroxide (LDH) of high reactivity. It consists of ordered layers of Fe(II) and Fe(III), alternating with hydroxide layers and intercalating anions, cations (see poster by Christansen *et al.*) and water. It can form from partial oxidation of ferrous iron in the groundwater or directly from corrosion of metallic iron, which we use in reactive barriers and for reinforcement of underground radioactive waste repositories. Green rust reacts readily with redox sensitive contaminants due to the Fe in the layered structure and allows for a high degree of adsorption due to a large external and internal surface area.

Immobilisation of contaminants in or on a solid is desirable, but if the solid is transported as a colloid, the contaminant is mobilised anyway. Therefore, we investigated the attachment ability of green rust using atomic force microscopy (AFM). To survey general colloid behaviour, we examined adhesion on 11 substrates chosen to represent common natural solids. Green rust colloids adhered well to all these substrates regardless of their surface charge.

The mobility of the particles formed from aerial oxidation of green rust was also examined. Upon oxidation, the green rust crystals showed dissolution along the edges. On hydrophilic substrates, elongated goethite crystals typically formed on and near original green rust particles. The stickiness of green rust suggests that it also serves as a substrate for other colloids which might have contaminants adsorbed.

From our experiments we interpret that the presence of green rust will generally limit contaminant transport in the groundwater system.

Mantle magma chambers beneath Gran Canaria

T.H. HANSTEEN

IFM-GEOMAR, Kiel, Germany (thansteen@ifm-geomar.de)

A suite of basanite-hosted mantle xenoliths from the Quaternary Bandama volcanic center, Gran Canaria, comprises spinel harzburgites, spinel dunites and wehrlites, where Mg# of olivine range from 81 to 91, and clinopyroxenes encompass both igneous (Ti-augite to aegirine-augite) and upper mantle (Cr-diopside) types. They contain abundant silicate melt and CO_2-dominated fluid inclusions. Clinopyroxene rim-melt thermobarometry of the host basanites indicates significant crystallization at pressures between 0.9 and 1.2 GPa. Barometry of primary magmatic CO_2-inclusions in basanite olivines similarly yields minimum formation pressures between 0.7 and 1.0 GPa indicating cotectic olivine-clinopyroxene-Ti-magnetite crystallization at such pressures.

In the xenoliths, texturally late fluid inclusions coexist with melt inclusions thus indicating higher formation temperatures than the early fluid inclusions, which do not coexist with melt inclusions. The observed densitiy differences of fluid inclusions is interpreted as *in situ* isobaric heating of the xenoliths in the upper mantle at 0.75 ±0.1 GPa (26 ±3 km depth), from about 750°C to near host-magma temperatures. This depth coincides with a change in the upper mantle P-wave velocity structure from anomalously low velocities of 7.5 -7.8 kms^{-1} between the Moho and 26 km depth, to normal values of 8.3 kms^{-1} below [1]. This low-velocity zone is interpreted as a clinopyroxene-enriched underplating zone in upper mantle, i.e. a region containing a complex mixture of harzburgite, wehrlite, and partly crystallized melt pockets. The xenoliths represent fragments of wall-rocks from a magma chamber within this region. A genetic link between magma chamber formation in the uppermost mantle, metasomatic overprinting and magmatic underplating is proposed for Gran Canaria, where a localized underplating zone has developed possibly from the late Pliocene to the Holocene through repeated metasomatic interaction between mantle rocks and ascending magmas.

References

[1] Ye *et al*. (1999) *J Geodyn* **28**: 3-26