

Mineral variation induced by CO₂ injection in saline aquifer

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Conceptual modelling

A reactive transport model with TOUGHREACT^[1] for the carbon dioxide sequestration into appropriate deep saline aquifer with a depth of 1200m has been involved in this study. Considering storage conditions, a 1D homogeneous conceptual storage formation with a thickness of 50m is constructed, the salt is 1 mol/L, and T is 50°C, carbon dioxide was injected with a speed of 100kg/s through the central injection well, which lasted for 10a, and the complex geochemical reaction occurs between carbon dioxide and minerals afterward could be known with the model.

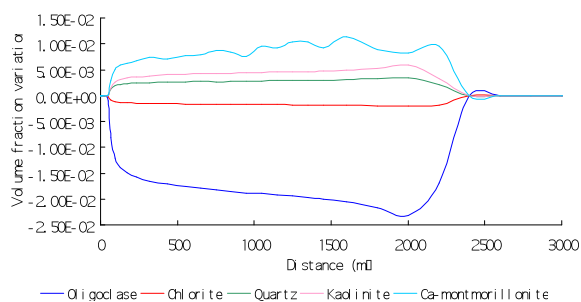


Figure 1: Mineral variation at 1000a after CO₂ injection

Considering the long term of mineral reaction, the minerals fractions variation at 1000a after the CO₂ injection have been detected from the reaction transport model, and the results represented as Figure 1. From the figure we can see that, the injected CO₂ influencing area has reached 2500m. Dissolution and precipitation occur with different extent ascribe to the distances and minerals. According to the simulation model, there are obvious volume variations of oligoclase, chlorite and illite because of mineral precipitation, and there are obvious volume variations of Calcite, Ca-montmorillonite, quartz, kaolinite, siderite and albite because of mineral dissolution, these are similar with the study results of other studies [2].

[1] Xu T. *et al* (2006), *Computer & Geosciences*, **32**, 145-165.

[2] Zhang W. *et al* (2009), *International Journal of Greenhouse Gas Control*, **3**, 161-180.

Translocation and fractionation of Rare Earth Elements in intensely weathered lateritic profiles in Western Australia

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Three intensely weathered lateritic profiles (GE, MQ I, II) developed on granite with dolerite dykes in Western Australia were studied to investigate the translocation, fractionation and geochemical pathways of rare earth elements (REE) during intense weathering and lateritization. The study has relevance for geochemistry, pedogenesis and environmental chemistry research, and mineral exploration of REE which is one of the most important strategic resources in the world. Geochemical mass balances were calculated based on bulk geochemical compositions. REE-bearing minerals in parent rocks and regolith samples were identified by synchrotron X-ray powder diffraction (SXRD) and scanning electron microscopy with energy dispersive spectroscopy (SEM-EDS).

In all three profiles, chondrite normalized REE distributions confirmed that the regolith was developed from granite. High deficiency of REE in the weathered residue indicated strong depletion, except in soils of horizon A in MQ profiles. In MQ profiles, the REE patterns normalized to parent rock represented two layers: accumulation in the upper part of profiles and depletion at the lower part, indicating the regolith below 0.6m depth in MQ I and 1.1m depth in MQ II were weathered *in-situ*. The source of REE accumulation in surface soil in MQ profiles was unclear, possibly representing biogeochemical recycling. In the GE profile, regolith samples showed great loss of total REE, up to 95 % in the mottled clay (10m deep), followed by ferricrete (83%loss, 3.5m deep).

Depletion of LREE is greater than HREE in all three profiles, except saprolite. In GE profile, a strong linear relationship of (LREE)/(HREE) ratio normalized by parent granite with pH suggested the fractionation of REE in GE profile was controlled by pH. In MQ profile II, main REE-bearing accessory minerals of the parent granite included allanite, fluocerite and epidote. In the weathered regolith, the small grain size of phosphate phases (<20 μm) were surrounded by clay matrix. The geochemical composition and mineralogy of the regolith indicated REE fractionation intensified during advanced weathering.