

Reactive transport models at the iron/bentonite interface at laboratory and in situ scales and long-term predictions

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Non-isothermal reactive transport models are presented to study the interactions of iron-bentonite under repository conditions at: (1) Laboratory corrosion experiments (FB4, FB5 and FeMo tests with 7, 13 and 15 years in operation) in which Fe-powder is in contact with bentonite; (2) The Febex in situ test in a section where the steel liner is in contact with bentonite during 18 years; and (3) The long-term (50.000 years) geochemical evolution of a HLW disposal cell in granite with a carbon-steel canister in contact with saturated bentonite. Models were computed with INVERSE-FADES-CORE and CORE.

The reactive transport model of the corrosion tests considers an anaerobic constant steel corrosion rate. Magnetite, siderite, and goethite are the main CP. FB4 and FB5 model results indicate that magnetite precipitates in the whole Fe-powder but only in a small amount (2 mm) into the bentonite (Figure 1). FeMo model results show that magnetite precipitates in the whole Fe powder but only in a small amount (0.1 mm) into the bentonite.

The model of the Febex in situ test considers a transition phase between the aerobic and anaerobic conditions and the anaerobic phase. Goethite, hematite, magnetite and siderite are the main CP. The anaerobic steel-liner corrosion rate is larger (15 $\mu\text{m}/\text{y}$) at the first years and then it decreases to 2 $\mu\text{m}/\text{y}$. Computed results of total iron and goethite and hematite precipitated are compared with the observations at the bentonite block BM-B-41-1.

Model predictions of the long-term geochemical evolution of a HLW disposal cell in granite are performed for a canister corrosion period which last 25.000 years (Period II) and for a glass dissolution period from 25.000 to 50.000 years (Period III). An anaerobic constant steel corrosion is assumed (1.41 mm/y). At Period II the thickness of magnetite precipitation band in the bentonite is 1 cm while siderite precipitates at both sides of the canister/bentonite interface (Figure 2). At Period III greenalite precipitates at the glass/canister and canister/bentonite interfaces while magnetite precipitates in the canister (Figure 2) while there is carbon steel to corrode. Once the canister is fully corroded, magnetite redissolves near the glass/canister interface.

