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Modelling of carbon steel and Ca-Mg bentonite boundary development

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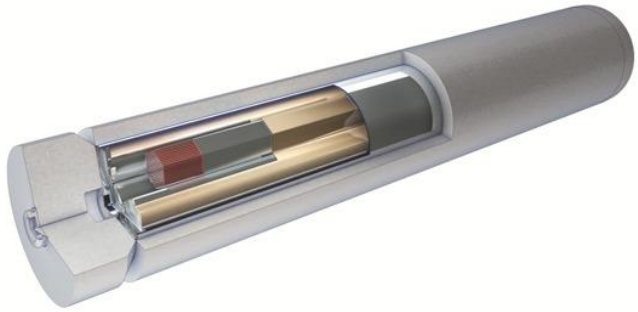
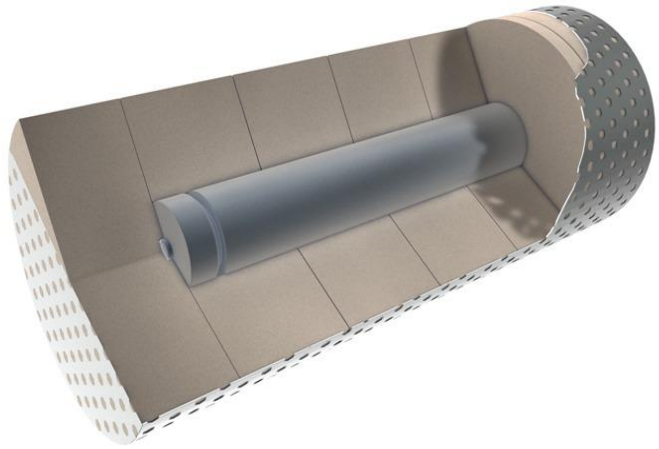
Introduction

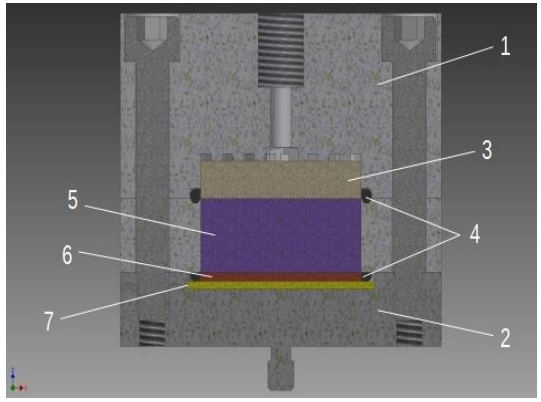
Involvement in EJP EURAD WP ACED is aimed to develop, characterize and model experiments on interactions between **compacted bentonite** (**Ca-Mg bentonite, MX 80**) and **carbon steel** under increased temperature

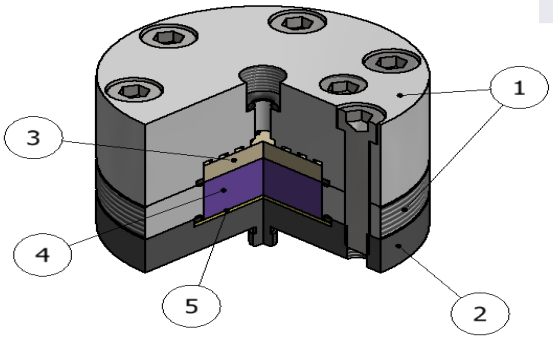


1. Evaluation of results of laboratory and in situ corrosion tests under increased temperature
2. Modelling of **carbon steel/Ca-Mg bentonite interaction**, concerning long term anaerobic saturated conditions (ekvilibrium and kinetic)
3. Development of **1D reactive transport model in PHREEQC**, looking namely in chemical evaluation of the interface, altogether with time dependent evolution of corrosion products and bentonite



Corrosion experiments to be studied





Project	Bentonite	GW	T (°C)	Conditions
Corrosion products (CoPr)	BAM	SGW	25, 40, 70	Lab, anaerobic
MACOTE	BAM	GGW	25, 70	In situ
	MX80	GGW	25, 70	In situ
Canister development (ÚOS)	BAM	SGW	25, 70	Lab, Anaerobic

Work flow

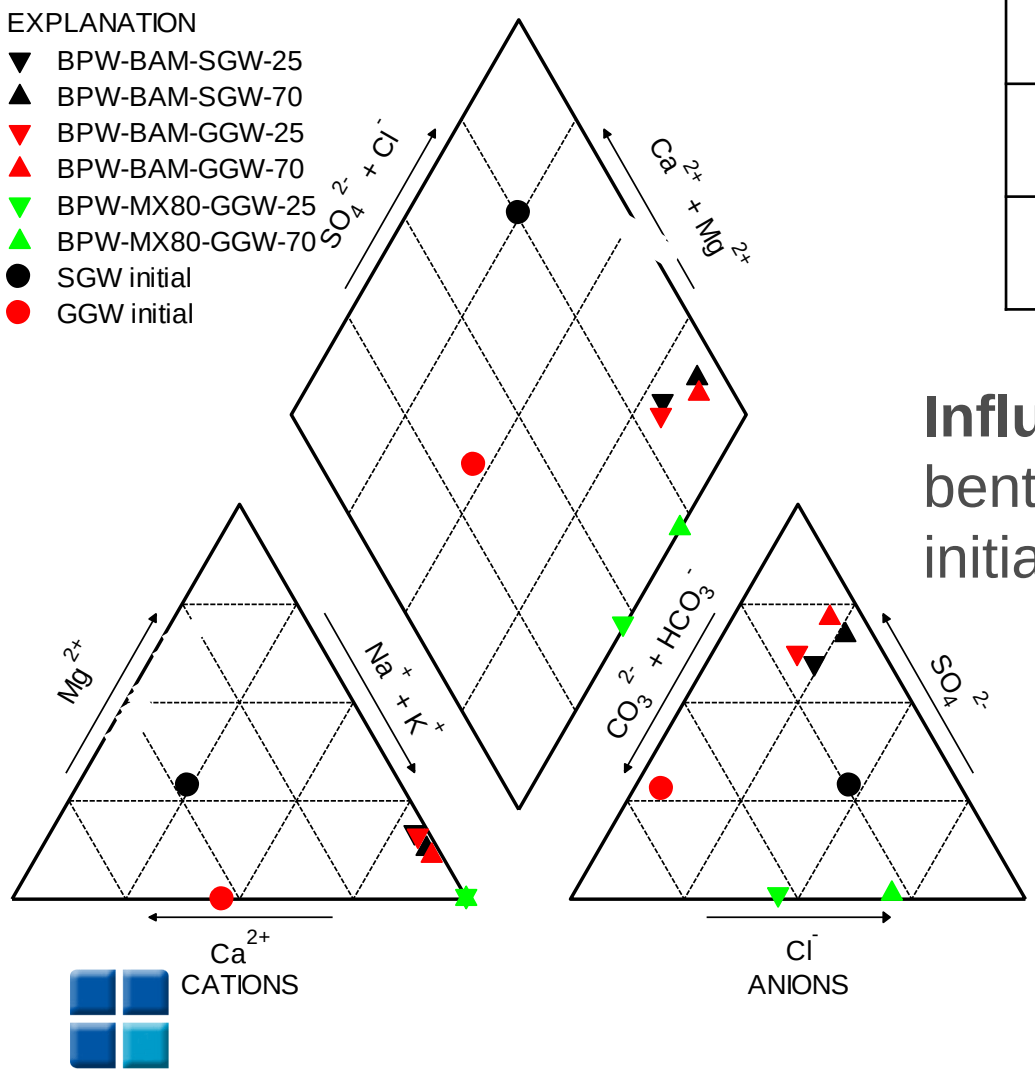
- **Revision and update of geochemical reactive transport model in PHREEQC (dtb Thermodem); aplication to additional systems (MX80, in situ experiment, other temperatures)**

- **Steps**
  Equilibrium model → Kinetic model → Complex reactive–transport model

- **Included processes**

Chemical reaction in water; mineral dissolution/precipitation (including Fe corrosion and corrosion/alteration product formation); cation exchange; surface reaction; kineticks; transport; oxic/anoxic condition

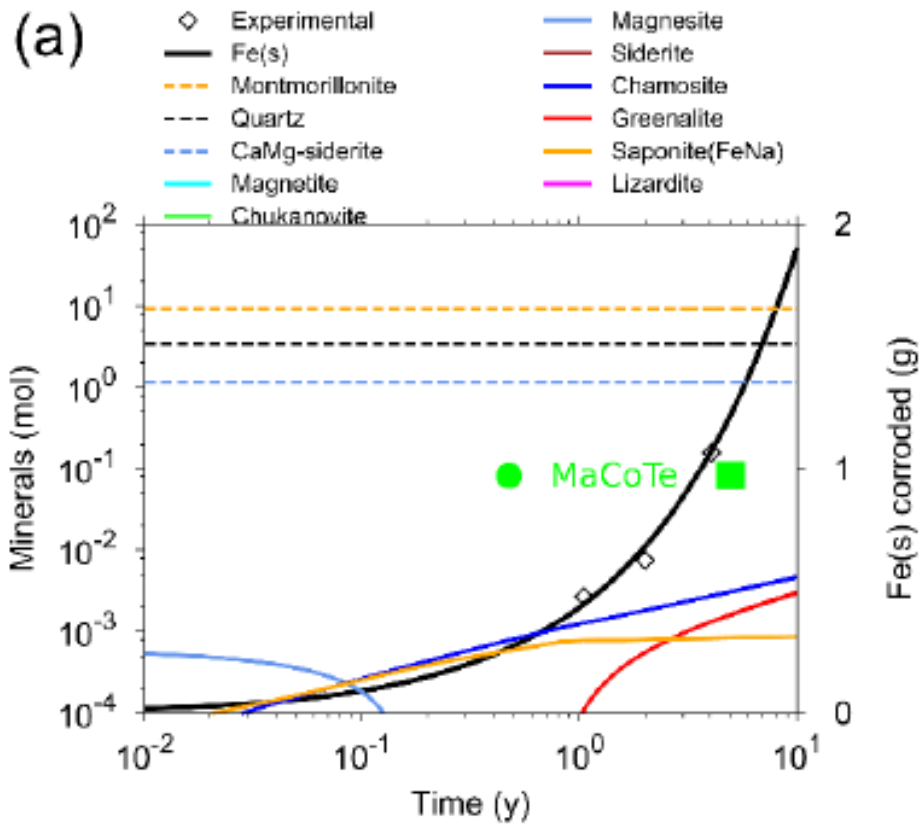
Bentonite pore water development

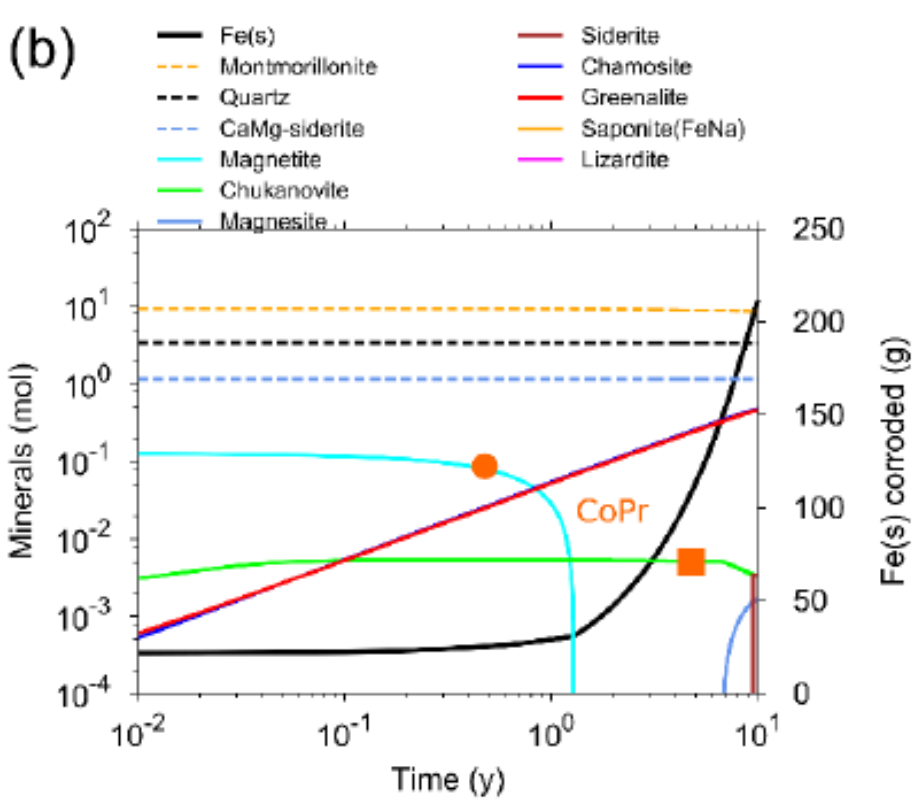


Bentonite	GW	Project(s)	*t* (°C)	BPW model identifier
BaM	SGW	CoPr, UOS	25	BPW-BAM-SGW-25
			70	BPW-BAM-SGW-70
BaM	GGW	MaCoTe	25	BPW-BAM-GGW-25
			70	BPW-BAM-GGW-70
MX-80	GGW	MaCoTe	25	BPW-MX80-GGW-25
			70	BPW-MX80-GGW-70

Influence on bentonite pore water:
bentonite composition > temperature > GW initial composition

Corrosion product development (1)

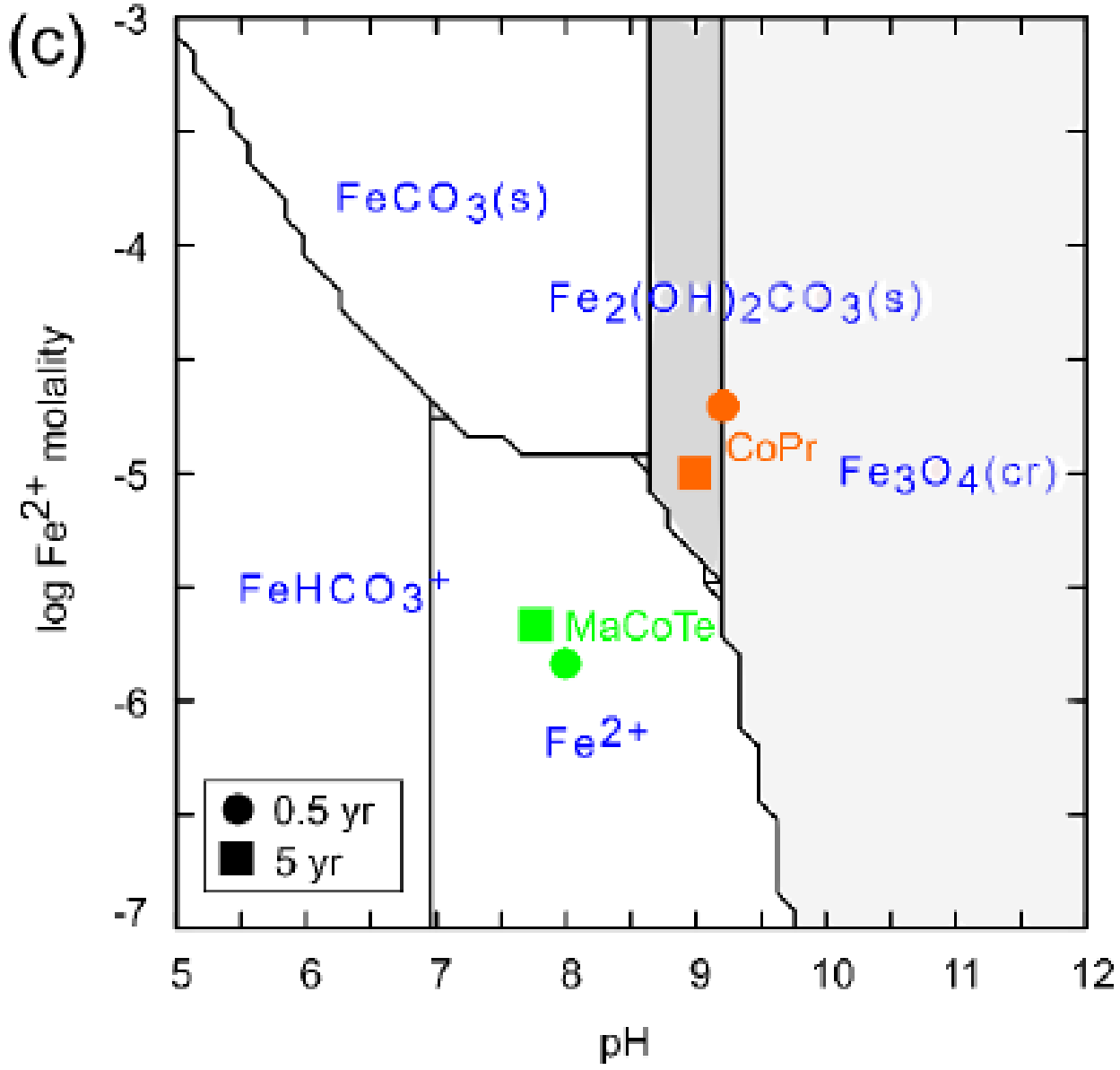




MACOTE in situ

CoPr (Fe powder included)

Corrosion product development (2)



Summary

- Bentonite composition is a leading force for development of pore water chemistry; saturation media composition is off importance
- Kinetic modelling of 3 corrosion experiments revealed importance of Fe ions concentration and pH for development of corrosion products
- Chukanovite and magnetite can develop within 10 year of experimental progress only under such a conditions

- Modelling will continue with corrosion transport modelling study, including corrosion products into the bentonite

Acknowledgement

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Thank you for your attention

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