Reactive transport modelling of alteration assemblages at Butte magmatic-hydrothermal system

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Methods

A coupled reactive transport code CSMP++GEM was applied to model alteration assemblages at Butte magmatic-geothermal system. CSMP++GEM combines the control volume – finite element method (CVFEM) to solve PDEs for two phase flow and heat transport in terms of pressure, enthalpy and salinity on unstructured grids [1] and Gibbs energy minimizaton method, implemented within GEM3K standalone library [2] to perform chemical equilibrium computations including mineral solid solutions. Conceptual model, rock and fluid composition were adapted from [3].

Results

Magmatic fluid expelled at 600°C and 1kbar is pH neutral and at equilibrium with Butte granite. As it is flowing up, cooling and reacting with the rock, it becomes increasingly acidic and produces alteration assemblages from high-temperature potassic to low-temperature serisitic.

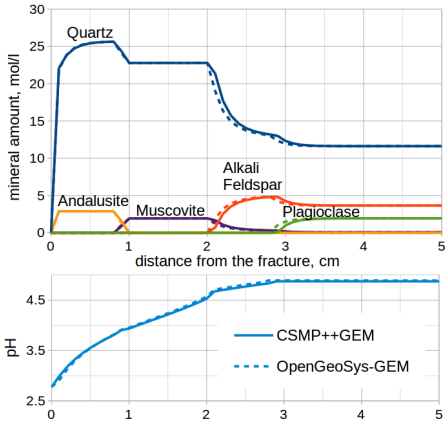

Figure1: Alteration assemblage at 400°C, 500bar after 5years.

Our reactive transport modelling results reproduce alteration halos from Butte drill cores [3]. Benchmarking with OpenGeoSys-GEM resulted in a good match.

[1] Weis *et al.* (2014) *Geofluids* **14**, 347-371. [2] Kulik *et al.* (2013) *Comput. Geosci.* **17**, 1-24. [3] Reed *et al.* (2013) *Economic Geology* **108**, 1379-1396.