Modeling multiphase flow of H_2O-NaCl fluids by combining CSP5.0 with SoWat2.0

T. DRIESNER[1], S. GEIGER[2], AND C.A. HEINRICH[1]

[1] Institute of Isotope Geochemistry and Mineral Resources, ETH Zurich; thomas.driesner@erdw.ethz.ch, heinrich@erdw.ethz.ch

[2] Department of Earth Science and Engineering, Imperial College, London; s.geiger-boschung@imperial.ac.uk,

Following up on our earlier developments, we have recently improved (a) our model of the system H_2O-NaCl to describe accurately the phase relations [1], volumetric properties, enthalpies and heat capacities [2] now to 1000°C, 500 MPa, and 0 to 100% NaCl, and (b) algorithms for multiphase fluid flow in this system.

The fluid properties are formulated entirely in terms of temperature, pressure, and composition, and have been implemented as the C++ library "SoWat2.0" (for **So**dium chloride – **Wat**er). The new flow algorithms modify our earlier decoupled temperature-pressure scheme [3,4,5] towards an enthalpy-pressure based approach. Enthalpy conservation and correct distribution of enthalpy between multiple fluid phases and rock is obtained in the isobaric step by a simple Newton iteration. The iteration is carried out by using novel expressions of the apparent heat capacities of all possible fluid mixtures in the systems. The algorithms have been incorporated as C++ modules into our simulation platform "CSP5.0". During the iteration, calls to the SoWat module ensure that the phase state is detected correctly and the respective apparent heat capacity is chosen automatically in each iteration step. In this way, the iteration can be carried out correctly even across phase boundaries at moderate computational costs.

We describe the CSP algorithms and SoWat fluid model and show example applications relevant to fluid flow in high temperature hydrothermal systems.

Figures, etc. are optional. This is maximum size.

References

[1] Driesner T. and Heinrich C.A. *GCA* **(in press)**
[2] Driesner T. *GCA* **(in revision)**
[3] Geiger S. et al. (2005) *JGR* **100**, B7
[4] Geiger S. et al. *Transport in Porous Media* **(in press)**
[5] Geiger S. et al. *Transport in Porous Media* **(in press)**