Geophysical Research Abstracts
Vol. 20, EGU2018-19799, 2018
EGU General Assembly 2018

The energetics of non-isothermal transport in porous media

Lars H. Rüpke (1) and Yury Podladchikov (2)

(1) GEOMAR Helmholtz Centre for Ocean Research, Kiel, (2) Institute of Earth Sciences, University of Lausanne

Non-isothermal porous transport is ubiquitous in geosciences and controls a variety of geological systems including magmatic hydrothermal systems, geothermal energy, and gas in shallow marine sediment. Numerical simulations of such systems requires resolving multi-phase multi-component flow over large spatial as well as temporal scales and remain numerically challenging – especially when phase transitions such as boiling and condensation phenomena occur.

While practically all non-isothermal porous transport models are based on conservation equations of mass, energy, and momentum, it has become customary to re-formulate the basic conservation equations to make them numerically more tractable or simply consistent with a discipline's conventions. Although mathematically correct, such algebraic modifications often result in governing equations that are not conservative. The most common example is the split of the total energy equation into a "mechanical" and a "thermal" part and the re-writing of the thermal part with temperature or sometimes enthalpy as primary variable.

Here we show that some of the numerical problems associated with simulations of large volume changes during phase changes can be avoided by using numerical schemes that directly solve the full energy balance instead of re-writing and solving it in non-conservative form. Using the multi-phase flow of seawater through boiling submarine hydrothermal systems as an example, we investigate a novel numerical scheme that directly solves the fundamental conservation equations and show how its use results in more stable and physically more consistent solutions than more conventional schemes based on non-conservative governing equations.