Geophysical Research Abstracts
Vol. 14, EGU2012-2805-1, 2012
EGU General Assembly 2012

Heat transfer and fluid flow modelling in supra-detachment basins: a case study of the Devonian basins of western Norway

A. Souche, M. Dabrowski, T. B. Andersen, and S. Medvedev
University of Oslo, Physics of Geological Processes (PGP), Norway (alban.souche@fys.uio.no)

The Devonian basins of western Norway are supra-detachment basins located above a large crustal-scale detachment system, so-called the Nordfjord Sogn Detachment Zone. These basins are characterised by a thick succession (>10km) of siliciclastic sediments ranging in size from coarse conglomerates to fine grain sandstones and organized into narrow half-graben systems. Their architecture and geometry is closely controlled by the development of the coeval (i.e. Early to Middle Devonian) detachment acting as a normal fault/shear zone beneath the basins. The exhumation of rocks within the footwall of the detachment was subsequently followed by an increase of the geothermal gradient at the base of the sedimentary successions. Shear heating resulting from the intense rock deformation within the shear zone also played a role in increasing the temperature at the base of the basins. These two significant processes might have in turn contributed to the fluid mobility in the basins.

In this study, we explore the feasibility of porous convection to occur spontaneously in sedimentary basins due to a regional increase of the geothermal gradient. Such process can be approximated by Darcy flow through porous media where the fluid density in the system might introduce a buoyancy-driven instability between lighter hot fluids at the base and denser cold fluids at the top of the basin. In geological systems porous flow might be inhibited by the closing of pores with depth, which leads to a reduced permeability and a limited amount of heat carrying fluids. Also, geological heterogeneities inherited from the layered structure of the sedimentary strata introduce large variations in the rock transport properties. We address these problems numerically by modelling heat and mass transport in porous media assuming quasi-incompressible Darcy flow. The fluid (water) density, viscosity, and specific heat are computed from the pore fluid pressure and the temperature. We investigate the onset of convection for various geological settings considering the internal sedimentary architecture of the supra-detachment basins of western Norway.