Geophysical Research Abstracts
Vol. 19, EGU2017-6256, 2017
EGU General Assembly 2017

Understanding the physics of the Yellowstone magmatic system with geodynamic inverse modelling

Georg Reuber (1) and Boris Kaus (2)

(1) Johannes Gutenberg-Universität, Mainz, Germany (reuber@uni-mainz.de), (2) Johannes Gutenberg-Universität, Mainz, Germany (kaus@uni-mainz.de)

The Yellowstone magmatic system is one of the largest magmatic systems on Earth. Thus, it is important to understand the geodynamic processes that drive this very complex system on a larger scale ranging from the mantle plume up to the shallow magma chamber in the upper crust. Recent geophysical results suggest that two distinct magma chambers exist: a shallow, presumably felsic chamber and a deeper and partially molten chamber above the Moho [1]. Why melt stalls at different depth levels above the Yellowstone plume, whereas dikes cross-cut the whole lithosphere in the nearby Snake River Plane is puzzling.
Therefore, we employ lithospheric-scale 2D and 3D geodynamic models to test the influence of different model parameters, such as the geometry of the magma chamber, the melt fraction, the rheological flow law, the densities and the thermal structure on their influence on the dynamics of the lithosphere. The melt content and the rock densities are obtained by consistent thermodynamic modelling of whole rock data of the Yellowstone stratigraphy. We present derivations in the stress field around the Yellowstone plume, diking areas and different melt accumulations.
Our model predictions can be tested with available geophysical data (uplift rates, melt fractions, stress states, seismicity). By framing it in an inverse modelling approach we can constrain which parameters (melt fractions, viscosities, geometries) are consistent with the data and which are not.

[1] Huang, Hsin-Hua, et al. "The Yellowstone magmatic system from the mantle plume to the upper crust." Science 348.6236 (2015): 773-776.