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Numerical modeling of continental collision magmatism on Turkish-Iranian plateau

L. Kaislaniemi, J. van Hunen, and M. B. Allen
Durham University, Department of Earth Sciences, Durham, United Kingdom (l.m.kaislaniemi@durham.ac.uk)

The production of magmatism at orogenic plateaux is not well understood. Multiple different mechanisms have been proposed to explain the generation and the geochemical variation of the igneous rocks in continental collision: Delamination of thickened mantle lithosphere, slab break-off, edge-driven convection, radiogenic heat production, and slab dehydration. Our purpose is to model proposed mechanisms using finite element code CitCom, combined with thermodynamic modeling (e.g. PerpleX) of phase equilibria to account for possible melt composition. We concentrate on the Plio-Quaternary volcanism at the active Arabia-Eurasia collision. Previous work on the geochemistry of the relatively primitive (MgO>10%) volcanic rocks of Iranian plateau gives us comprehensive dataset rather free from effects of differentation and crustal contamination to compare the results to.

Of the various proposed mechanisms for orogenic magmatism, we test the edge-driven convection model. Two other models proposed specifically to Arabia-Eurasia collision zone are slab break-off and lithosphere delamination. Of course, combined action of multiple processes is also possible. Previous work on numerical modelling has already shown that thickness gradients in lithosphere can produce edge-driven convection that will not be dominated by the large scale convection of mantle. It has been shown to be able to explain the topography and the magmatism of the Colorado Plateau, where lithosphere thickness variations are pronounced. Prerequisites to apply it to continental collision setting exist: Firstly, at the Turkish-Iranian plateau, volcanism is situated on the plateau but at the sides of the thick (>280 km) Precambrian core — i.e. on the sites of greatest thickness gradient. Secondly, outside the thick core area, where the thickness gradient is provided by the difference in thicknesses of the Eurasian and Arabian plates, the volcanism is found on the side of the locally thinner plate, Eurasia, as predicted by the theory.