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Understanding temporal and spatial migration of orogenic magmatism: A numerical modelling approach

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Magmatism occurs at all stages of orogenesis, i.e. oceanic subduction, continental subduction, and orogenic collapse. During these stages, magmatism varies in terms of volume, composition, spatial extent and temporal distribution, but the apparent causes and mechanisms of these changes still remain unsolved.
Therefore, we have conducted a series of 2-D petrological-thermomechanical numerical experiments on oceanic subduction and subsequent collision to study the link between lithospheric scale processes and orogenic magmatism.
Our results show that the resulting magmatic arc may have been built of magmatic rocks of distinct chemical characteristics and spatial distributions, depending on the crustal rheology, the thermal age of the oceanic lithosphere, the width of the ocean and the convergence rate. Although most models reveal a movement of the magmatic front towards the lower plate, subduction of very young oceanic lithosphere or collision of strong continents inhibits migration, i.e. the magmatic arc remains fixed during the whole model evolution. Despite temporal and spatial migration patterns of the magmatic front the studied experiments also display compositional changes, i.e. variations of the magmatic source. The dominant magmatic source varies during orogenesis from ultramafic (wet peridotite) to hybrid (wet peridotite, tectonic mélange and lower continental crust) and finally felsic (crustal material).
Our numerical experiments yield new insights into the coupling between magmatism and lithospheric scale processes in the Dinarides Mountains of the Central Europe.