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Magmatism in Lithosphere Delamination process inferred from numerical models

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The peel away of the oceanic/continental slab from the overlying orogenic crust has been suggested as a ubiquitous process in the Alpine-Mediterranean orogenic region (e.g. Carpathians, Apennines, Betics and Anatolia). The process is defined as lithospheric delamination where a slab removal/peel back may allow for the gradual uprising of sub-lithospheric mantle, resulting in high heat flow, transient surface uplift/subsidence and varying types of magma production. Geodynamical modeling studies have adressed the surface response to the delamination in the context of regional tectonic processes and explored wide range of controlling parameters in pre-syn and post collisional stages. However, the amount and styles of melt production in the mantle (e.g. decompression melting, wet melting in the wedge) and the resulting magmatism due to the lithosphere delamination remains uncertain.

In this work, by using thermomechanical numerical experiments, designed in the configuration of subduction to collision, we investigated how melting in the mantle develops in the course of delamination. Furthermore, model results are used to decipher the distribution of volumetric melt production, melt extraction and the source of melt and the style of magmatism (e.g. igneous vs. volcanic). The model results suggest that a broad region of decompression melting occurs under the crust, mixing with the melting of the hydrated mantle derived by the delaminating/subducting slab. Depending on the age of the ocean slab, plate convergence velocity and the mantle temperature, the melt production and crust magmatism may concentrate under the mantle wedge or in the far side of the delamination front (where the subduction begins). The slab break-off usually occurs in the terminal stages of the delamination process and it may effectively control the location of the magmatism in the crust. The model results are reconciled with the temporal and spatial distribution of orogenic vs. anorogenic magmatism in the Mediterranean region in which the latter may have developed due to the delamination process.