The complex dynamics of collisional orogens unveiled by numerical modeling

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We performed numerical modelling of continental collision following oceanic subduction, and analyze metamorphic processes and the thermo-tectonic evolution of the resulting orogens as a function of key parameters such as crustal strength and radiogenic heating, fluid migration and convergence rate. The common and more important features we found for all models are crustal thickening, formation of mid-crustal partially molten levels extruding laterally, exhumation of medium to high grade metamorphic rocks with clockwise P-T-t paths and a style of post-collisional orogens that ranges from symmetric (stiff lower crust), two-sided collision zone to classical asymmetric orogen (weak lower crust). Crustal radiogenic heating favor the formation of partial melting in the mid-crust and exhumation at the surface of an inverted metamorphic sequence. Fluids affect mainly the plate boundary, reducing the viscosity of the lubricated plate interface leading to one-sided, asymmetric subduction zones. If wetting of the plate interface is very efficient, plate decoupling occurs followed by retreat and delamination of the subducting continental plate.

The results are in good agreement with geological, metamorphic, geochemical and geophysical observations from natural mountain belts (e.g. Himalaya, Western Alps, Apennines) and previous numerical studies of similar geodynamical settings.

The role of oceanic sediments in the metasomatism of subpatagonian lithospheric mantle beneath Cerro del Fraile (Argentina)

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A detailed petrological study of mafic and ultramafic xenoliths from the Cerro del Fraile (CF, Southern Patagonia, Argentina) was developed in order to decipher the the nature of the metasomatising agents which infiltrate the mantle wedge above the Antarctic subducting Plate, as well as the role of material dragged down in the subduction zone and recycled within the South patagonian sub-arc mantle.

CF mantle xenoliths comprise peridotites, cumulitic pyroxenites and composite samples. On the basis of HREE and major element mineral melting models, the peridotites record a partial melting degree variable between 10 and 25%. They also experienced a contemporaneous or subsequent refertilisation event, caused by the percolation of SiO_2-Al_2O_3-rich slab-derived metasomatic agents. The similarity between cpx and opx of the pyroxenites and those in the pyroxenitic part of the composite samples suggests that the cumulitic process occurred within the mantle. The reaction of the variously depleted mantle with the incoming melt took place under reduction conditions ($\Delta logfO_2$ (QFM) -1.21 to -0.34), unusual for mantle wedge settings.

Calculated melts in equilibrium with the most enriched opx and cpx in peridotites and with the pyroxenes of the cumulites have LREE, Zr (Hf), Th and U contents higher than those of AVZ natural adakites. This result speaks in favour of the melting of oceanic sediments, which are composed of a remarkable amount of manganese nodules and micronodules and, possibly, organic matter, in agreement with the estimated low oxygen fugacity conditions. The amount of sediments involved in the genesis of the infiltrating melts is larger than that previously proposed for the genesis of the erupted Patagonian adakites [1]. At mantle conditions the percolation of SiO_2-rich magmas is allowed by their high Al_2O_3 and water content and is favoured by the molar volume reduction due to the growth of opx at the expenses of olivine.

[1]. Stern, C. R. & Kilian, R. (1996). *Contribution to Mineralogy and Petrology* 123, 263-281.

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