Geophysical Research Abstracts
Vol. 19, EGU2017-6943-2, 2017
EGU General Assembly 2017
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How inheritance, geochemical and geophysical properties of the lithospheric mantle influence rift development and subsequent collision

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In magma-poor rifted margins, the rift structures, width of necking zones and overall geometry are controlled by the heterogeneities of geochemical and geophysical properties of the crust and mantle. In this presentation we focus on the mantle heterogeneities and their major implications on the closure of a hyper-extended rifted system. In our study, we review the clinopyroxene and spinel major element composition from the Liguria-Piemonte domain, the Pyrenean domain, the Dinarides and Hellenides ophiolites and the Iberia-Newfoundland rifted margins (Picazo et al, 2016). It would seem that during an extensional cycle i.e. from post-orogenic collapse to polyphase rifting to seafloor spreading, the mineral compositions of mantle peridotites are systematically modified. The initially heterogeneous subcontinental mantle cpx (inherited mantle type 1) equilibrated in the spinel peridotite field and is too enriched in Na2O and $Al2O_3$ to be a residue of syn-rift melting. The heterogeneous inherited subcontinental mantle becomes progressively homogenized due to impregnation by MORB-type melts (refertilized mantle-type 2) during extensional thinning of the lithosphere. At this stage, cpx equilibrate with plagioclase and display lower Na2O and $Al2O_3$ and high $Cr2O_3$ contents. The system might evolve into breakup and oceanization (mantle type 3) i.e. self-sustained steady-state seafloor spreading.
The different mantle-types are present in various reconstructed sections of magma-poor margins and display a systematic spatial distribution from mantle type 1 to 3 going oceanwards in Western and Central Europe. We estimated the density of the three identified mantle types using idealized modal peridotite compositions using the algorithm by Hacker et al, (2003). The density of the refertilized plagioclase peridotite is predicted to be lower than that of inherited subcontinental and depleted oceanic mantle. This has some interesting consequences on the reactivation of rifted margins. Conversely to a classical subduction where the oceanic lithosphere being subducted produces a mobile component that contributes to the formation of long-lived volcanic arcs, a hyper-extended rifted system and small oceanic basins (<300m wide) might not go to self-sustained subduction with limited production of arc magmas. Such a mantle wedge might remains fertile with a high potential to melt during the first stages of subsequent extension.

Hacker, B. R., Abers, G. A., and Peacock, S. M. (2003). Subduction factory 1. Theoretical mineralogy, densities, seismic wave speeds, and H_2O contents. Journal of Geophysical Research, 108(B1):2029.

Picazo, S., Müntener, O., Manatschal, G., Bauville, A., Karner, G., & Johnson, C. (2016). Mapping the nature of mantle domains in Western and Central Europe based on clinopyroxene and spinel chemistry: Evidence for mantle modification during an extensional cycle. Lithos, 266, 233-263.