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Petrostructural constraints in the Lanzo Massif in the light of geochemical data. A contribution to slow spreading systems

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The plagioclase lherzolite of Lanzo Massif (Western Alps) is considered to be a residual piece of upper mantle, floor of the slow spreading Piemont-Ligurian Ocean. In the frame of the present studies on slow and ultraslow spreading ridges, we wish to recall and update some keypoints concerning petrostructural and geochemical constraints on this massif.

The Lanzo massif is not petrologically homogeneous. The small northern body displays only incipient re-equilibration in the plagioclase lherzolite facies, preserving lithospheric affinities, whereas the central and southern bodies are equilibrated in this facies, with a gradation towards a more residual character marked in the southern body. Detailed structural mapping has shown that plagioclase has crystallized from a mixture of melts produced in situ and percolating from below, which were produced by asthenospheric flow during mantle uplift.

On a geochemical ground, the fertile character marked by major elements and REE distribution, and their heterogeneity at the scale of the massif were acquired as a result of melting and melt-rock interaction process associated with the thermomechanical erosion of lithospheric mantle by upwelling asthenosphere. The partial melting event responsible for the chemical trend of the peridotite took place mainly in the spinel stability field, up to the transition to the plagioclase stability field, at relatively shallow level and probably accompanied by various degree of melt extraction.

Dunite lenses as well as gabbro dikes, both reactive and intrusive, are concentrated in a western domain represented by the southwestern body and the western margin of the northern body. One group of dunite lenses are concordant and associated with olivine gabbro dikes; the second group located in the Monte Arpone area are discordant and associated with parallel ferrogabbro dikes. Whatever the melt extraction model leaving residual dunite lenses, this process is controlled by a thermal boundary, and dunites do not image a steady state process of melt extraction from the mantle.

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A >26 Myrs record of melt supply variations and axial tectonics in a magma-poor region of the very slow spreading Southwest Indian Ridge

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Our study area is one of the deepest, and presumably most magma starved regions of the very slow (14-16 mm/yr) Southwest Indian Ridge (SWIR). Previous near axis studies have shown that ridge segmentation, melt supply variations, and tectonic style in this magma-poor context are distinct from those observed at faster ridges, and at less magma-starved portions of the SWIR [1,2]. We report on the bathymetry, gravimetry, and magnetic results of a recent cruise that has extended existing data coverage to before magnetic anomaly 8 (>26 myr) on both ridge flanks, over the 61°E to 67°E region of the SWIR. We find that the spreading rate (~14.5 km/myr), and the geometry of the ridge axis in this region have remained almost the same over this period. By contrast, bathymetry and gravity data suggest that magma supply to the ridge has been very irregular in space and time. Thick crusted off-axis reliefs are interpreted as former axial volcanic centres. These appear to have been active for a few myrs only, and there is little to no evidence for durable along-axis segmentation of melt delivery. This is very different from the long-lasting segmentation of melt supply that is observed at Mid-Atlantic-type ridges. We use available on-axis basalt chemistry data and discuss the possible origin of such short-lived and apparently randomly distributed pulses in axial magma delivery.

In addition to these variations in melt supply, there is evidence for very large offset axial normal faults producing extensive "corrugated surfaces" in the off-axis domains. There is also evidence for a pronounced tectonic asymmetry between the two ridge flanks. These characteristics are consistent with the axial lithosphere being very thick, a predictable consequence of the very slow spreading rate and of the reduced magma supply.

References

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