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Hyperextension of continental lithospheric mantle to oceanic-like lithosphere: the record of late gabbros in the Ronda subcontinental lithospheric mantle section (Betic Cordillera, S-Spain)

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Rupturing continents is a primary player in plate tectonic cycle thus longevity, stability, evolution and breakup of subcontinental lithosphere belongs for a long time to a class of basic geological problems among processes that shape the view of our Earth. An emerging body of evidences – based on mainly geophysical and structural studies – demonstrates that the western Mediterranean and its back-arc basins, such as the Alborán Domain, are hyperextended to an oceanic-like lithosphere. Formation of gabbroic melts in the late ductile history of the Ronda Peridotite (S-Spain) – the largest (ca. 300 km2) outcrop of subcontinental lithospheric mantle massifs on Earth – also attests for the extreme thinning of the continental lithosphere that started in early Miocene times.
In the Ronda Peridotite, discordant gabbroic veins and their host plagioclase lherzolite, as well as gabbroic patches in dunite were collected in the youngest plagioclase tectonite domains of the Ojén and Ronda massifs, respectively. In Ojén, gabbro occurs as 1-3 centimeter wide discordant veins and dikes that crosscut the plagioclase tectonite foliation at high angle (60°). Within the veins cm-scale igneous plagioclase and clinopyroxene grains show a shape preferred orientation and grow oriented, subparallel to the trace of high temperature host peridotite foliation and oblique to the trend of the vein. In contrast to Ojén, mafic melts in the Ronda massif crystallized along subcentimeter wide anastomozing veins and they often form segregated interstitial melt accumulations in the host dunite composed of plagioclase, clinopyroxene and amphibole. Despite the differences in petrography and major element composition, the identical shape of calculated REE patterns of liquid in equilibrium with clinopyroxenes indicates that the percolating melt in Ronda and Ojén shares a common source. However, unlike gabbros from the oceanic lithosphere that shows clinopyroxene in equilibrium with LREE-depleted MORB, our calculated liquids reflect LREE-enriched compositions and negative Eu anomalies, therefore, involve a parental melt other than MORB and/or processes more complex than a simple fractional crystallization common in oceanic ridges.