Mafic crustal xenoliths from the East Indian shield: Evidence for recycled continental crust in the Palaeoproterozoic and Archaean mantle

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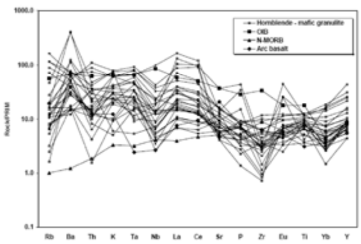
Three groups of mafic xenoliths, namely, hornblende-mafic granulite, biotite-mafic granulite and pyroxinite, are commonly hosted by massif-type charnockites in the Eastern Ghats granulite belt, India. Based on major element composition, the granulite xenoliths are interpreted as solidified tholeiitic melts; while the pyroxinite xenoliths are likely to be cumulates. In terms of tectonic setting, hornblende-mafic granulite xenoliths are described as arc-derived basalts; while the biotite-mafic granulite xenoliths are described as oceanic island basalts. Low values of primitive mantle normalized Nb/U ratios in the mafic xenoliths clearly indicate recycled continental crust in the mantle source region. Two granulite facies events, at ca. 1.6 and 3.0 Ga, beside the widespread Grenvillian granulite imprint in the Eastern Ghats granulite belt, are recorded in the charnockite suites. Two periods of mafic magmatism at ca. 3.3 and 2.5 Ga, in the East Indian shield is evident, based on the average crustal residence ages of the mafic xenoliths. Evolved isotopic compositions: high initial $^{87}Sr/^{86}Sr$ values and negative epsilon (Nd) values at 1.6 and 3.0 Ga clearly indicate recycled continental crust in their mantle source. Furthermore, recycling of the continental crust prior to 3.0 Ga in the marginal segments implies growth of the continental crust in the early Archaean, presumably forming parts of the Ur supercontinent.



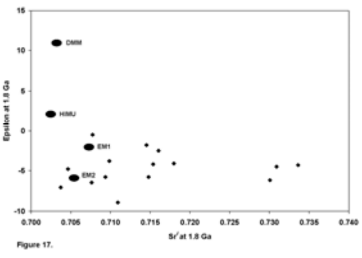


Figure 17.

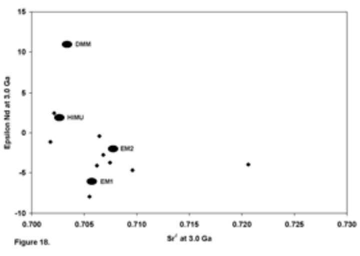


Figure 18.

Subduction and crust recycling - Petrological evidence and U-Pb dating in mantle xenoliths from the Betic area (Spain)

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Mantle xenoliths from Tallante (Betic Cordillera, Spain) include samples recording a peculiar distinct style of metasomatism that induces orthopyroxene (opx), plagioclase (pl), phlogopite (ph) and amphibole (amph) crystallisation, forming mantle domains characterized by 'hydrous' opx-rich peridotites, locally crosscut by felsic veinlets containing pl and opx + quartz + ph + amph, i.e. ph/amph-bearing anorthosites, diorites and gabbronorites [1, 2]. This indicates that the causative agents were hydrous silica-oversaturated melts rich in alkalis, in turn related to the recycle - via subduction - of continental crust components within the mantle.

To find new evidences we sampled and carefully sliced ca 250 xenoliths finding 10 samples with clear evidences of felsic (gabbroic) veins/lenses cross-cutting the peridotite matrix. These are extremely variable in size, from millimetric up to centimetric. In general, we observed that thinner lenses (possibly representing apophyses of bigger veins) tend to have more complex mineral parageneses, also including traces apatite, zircon, Ti (Nb) oxide (rutile), and crystals mainly made by thorium +cerium, lanthanum, phosphorous (huttonite/monazite mineral groups).

In situ U-Pb datings on zircons from two different samples by laser-ablation microprobe (GeoLas200Q-Microlas) coupled to a magnetic sector HR-ICPMS (Element from ThermoFinnigan) indicate that the age of the veining event ranges between 4.4 and 2.2 Ma, thus implying a clear relation with the Tertiary subduction process that ultimately lead to the formation of the Betic Cordillera.

In this framework, we propose relationships between these exotic mantle lithologies and the Cenozoic subduction related magmas (including lamproites; [3]) that are widespread in the region.

[1] Beccaluva *et al*. (2004) *Lithos* **75**, 67-87. [2] Shimizu *et al*. (2004) *Trans Royal Soc Edinburgh: Earth Sci* **95**, 265-276. [3] Conticelli *et al*. (2009) *Lithos* **107**, 68-92.