Source characteristics of Jurassic ferropicrites from Dronning Maud Land, Antarctica

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Middle Jurassic basalts of Vestfjella, western Dronning Maud Land comprise an Antarctic extension of the Karoo large igneous province. In addition to intrusive equivalents of the lavas, crosscutting dolerite dikes include a group of picrites with unusually high total FeO (>14 wt.%) and low Al_2O_3 (<10 wt.%) at given MgO (10–18 wt.%). The picrites are probably coeval, or nearly so, with the lavas, although precise age data are lacking. Mantle-normalised incompatible element fingerprints indicate two subgroups of such ferropicrites; these have similar high $(Sm/Lu)_N$ (~5), but quite different $(La/Sm)_N$ (1.6–1.7 and 1.1–1.4, respectively). The smooth fingerprint of the relatively more enriched ferropicrites (initial ε_{Nd} +1 to +4) resembles that of average OIB, whereas the upward convex fingerprint of the relatively depleted ferropicrites (initial ε_{Nd} +5 to +9) has marked positive LILE and V anomalies and resembles that of oceanic gabbros. We regard that the V anomaly, which is not typical of continental and oceanic basalts, reveals a "ghost clinopyroxene" fingerprint that can be ascribed to incorporation of clinopyroxene-rich recycled oceanic cumulate into the mantle source of these rocks. Positive LILE anomalies infer presence of cumulus plagioclase in the recycled component. Our results lend support to Gibson's recent conclusion that, in contrast with previous models, the mantle source of ferropicrites was not excpetionally Fe-rich and that ferropicrite melts can be generated from eclogite-bearing mantle sources. The discovery of a strong cumulate fingerprint in ferropicrites implies that in some cases the eclogite component probably was recycled oceanic lower crust. A similar, albeit weaker, cumulate fingerprint has been reported in some Hawaiian basalts and we have identified it in other ferropicrites and Fe-rich primitive magma suites; Mesozoic and Precambrian ferropicrites and modern OIB have probably had rather similar sources, and ferropicrites can be regarded as the epitome of hotspot-related magmas derived from mixed eclogite-peridotite sources.

References

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The Azores hotspot: A lower mantle origin for Terceira magmas as shown by Ne isotopic data

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The collection of helium isotopic data in the last twenty years has shown different signatures for MORB and OIB basalts and this has been used as the basis for the two-layer mantle model. However, for some OIB that appear in the vicinity of mid-ocean ridges, He isotopic ratios are similar to those typical of MORB, leading some authors to argue against the deep mantle plume hypothesis particularly in areas where geophysical evidence is lacking (Anderson, 2000).

For Terceira island (Azores), located close to the Mid-Atlantic Ridge, we analysed neon from olivine phenocrysts in order to better constrain the nature of the Azorian plume. Some of the analysed samples show higher $^{20}Ne/^{22}Ne$ and $^{21}Ne/^{22}Ne$ ratios than air suggesting the presence of a mantle component in the olivine melt inclusions. Moreover, in a three-Ne isotope diagram, the samples define a trend with a higher slope than the MORB line (Sarda *et al*., 1988) arguing for a lower mantle origin. One basaltic sample coming from the 1998 submarine Serreta eruption is plotted along this line, suggesting that the influence of a deep plume is still active. In a plot of $^{21}Ne/^{22}Necorr$ *vs.* $^{4}He/^{3}He$, Terceira data is plotted in the same hyperbolic mixing line that encompasses Iceland, Shona and Discovery data (Moreira et al., 1995, 2001; Sarda et al., 2000). The data suggests the existence of plume-ridge interaction for these hotspots resulting on mixing between degassed MORB-type and deep plume-type magmas. In such an environment the data shows that neon is a better tracer of primordial material than helium.

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