CRETACEOUS PICRITES AND HIGH-MG BASALTS FROM SW COLOMBIA: IMPLICATIONS FOR THE MANTLE PLUME SOURCE OF THE CARIBBEAN OCEANIC PLATEAU

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ABSTRACT

The accreted ocean plateau terrain in SW Colombia is perhaps most famous for its 89 Ma komatiites on the island of Gorgona (Kerr et al., 1996a; Arndt et al., 1997) perhaps the only genuine occurrence of komatiites since the early Precambrian. Of course, these are not the only representatives of ultramafic lavas in the accreted ocean plateau. Spadea et al. (1989) have described high-Mg basalts and picrites at a number of localities throughout SW Colombia. Picrites are known from other localities in the Colombian/Caribbean oceanic plateau such as Curaçao in the Southern Caribbean (Kerr et al., 1996b), Hispaniola in the Northern Caribbean (Lapierre et al., 1999), Costa Rica in Central America - all of which could be related to a major mantle plume which ascended beneath the region (most likely at the Galapágos hotspot) 91-87 Ma ago, with a subsidiary younger pulse at 78-72 Ma. The picrite extrusions are mostly associated with the older phase.

Both picrite (and picritic tuffs) and komatiites occur on Gorgona. In the rest of SW Colombia picritic flows, picritic pillows lavas and picritic tuffs & breccias occur interspersed with basaltic compositions. In Curaçao they are mainly flows, and concentrated near the base of the exposed section. None of the samples is completely fresh, but quite frequently the pyroxenes and plagioclases are unaltered. The olivines vary from porphyritic (5 mm) to microspinifex porphyritic (nothing approaching the very coarse spinifex olivines seen on Gorgona). The olivines at Rio Boloblanco range from Fo_{89-81}, whereas those at Los Azules are Fo_{88-91} compared with Fo_{91} for Gorgona komatiites and Fo_{93} for Gorgona picrites. These olivine compositions would have been in equilibrium with liquids containing 14-20 wt% MgO respectively.

Compositionally, the Gorgona komatiites are LREE-depleted relative to chondrites, the picrites even more so. The associated basalts however conform to two different geochemical groups: one is slightly depleted (d-basalt), the other (e-basalts) is LREE-enriched. On Curaçao the basalts and picrites have essentially parallel REE patterns, both slightly LREE-enriched. In Hispaniola, the picrites are distinctly LREE-enriched, whereas the associated basalts tend to have flat to depleted REE patterns. In SW Colombia the picrites have variable REE distributions. In samples with 7–10 wt% MgO the REE patterns are flat to quite strongly enriched; in the 12–17 wt% MgO group, one type has flat patterns, another markedly enriched patterns; but in the 21–31 wt% MgO group the patterns are quite strongly enriched. None of the compositions has significant negative Nb anomalies which might suggest interaction with continental crust or sub-continental mantle.

Isotopically, in terms of the ε_{Nd} - $^{87}Sr/^{86}Sr$ diagram there is quite a range of compositions, from +3 to +12 in ε_{Nd} and 0.7028 to >0.7045 in $^{87}Sr/^{86}Sr$, with the Gorgona komatiites being amongst the most primitive, but the picrites are quite variable (even more so than the basalts). This implies that there is quite significant time-integrated heterogeneity within the ocean plateau mantle-source regions. On the $^{208}Pb/^{204}Pb$ vs $^{206}Pb/^{204}Pb$ diagram the rocks form a good linear array from the Gorgona komatiites to the Gorgona e-basalts, with all the picritic and basaltic rocks of the rest of the plateau falling in-between. Similarly the Gorgona ultramafic suite shows a large range in initial Os isotopic compositions (Walker et al., 1999) with γOs varying from –0.5 to +12.4. Conversely, the Os isotope composition of Curaçao is more restricted, in keeping with its more uniform Nd isotopic composition. It is becoming apparent that the small island of Gorgona encompasses most of the range of isotopic, REE and trace element variation of the huge Caribbean-Colombian accreted oceanic plateau. This close correlation between isotopes and trace elements must mean that the overall compositional character of the components making up the ocean plateau may have been set a long time ago.

Whereas crystal accumulation may partly account for the compositions of the picrites, there are clearly many more processes involved. For instance, dynamic melting within the ascending plume (Arndt et al. 1997), mixing of recycled components inherited from the lower mantle, entrainment of asthenospheric mantle and interaction with the lithosphere may all be involved to a greater or lesser extent. Picrites are quite commonly associated with ascending mantle plumes (cf. Iceland); similar processes may be involved.

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