

Hf-Nd isotope systematics of the Gorgona komatiites, and their relationship with the Caribbean Plateau

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The Gorgona komatiites are the only known example of Phanerozoic komatiites, and represent part of an intrusive and extrusive complex exposed on Isla Gorgona, Colombia. Picrites, volcanoclastics, and both enriched and depleted basalts are associated with the komatiites. The similarity in age and geochemical character to Caribbean plateau sequences has led most workers to conclude that the Gorgona komatiites represent part of the 90 Ma Caribbean plateau.

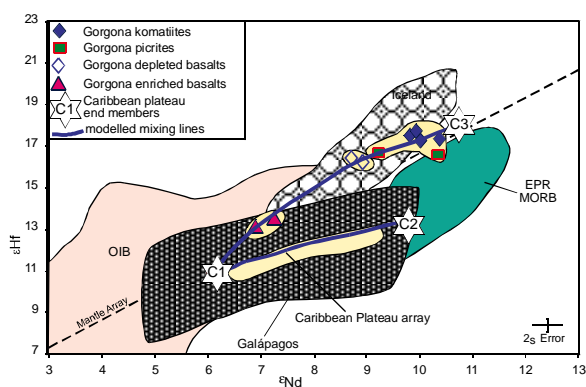


Figure 1. Plot of ϵ_{Hf} - ϵ_{Nd} for the Gorgona rocks and the Caribbean plateau, with other fields shown for comparison.

This work represents the first coupled Hf-Nd isotopic study of the Gorgona komatiites and associated rocks. Gorgona komatiites (and to a lesser extent picrites) are isotopically depleted, whereas the depleted basalts show more intermediate values. This correlates with trace element depletion. All of the Gorgona lithologies sampled appear to be isotopically distinct from the main Caribbean plateau array. Whereas the main Caribbean array can be explained through the binary mixing of enriched plume mantle (C1) and ambient depleted upper mantle (C2), the Gorgona rocks lie on a separate mixing line between C1 and C3, a distinct high ϵ_{Hf} component. The isotopic and trace element characteristics of this C3 component indicate a long-lived depleted mantle source. This could be explained by partial melting -in the presence of garnet- of a recycled MORB-source residue that has resided in the deep mantle for some time, allowing the $^{176}\text{Hf}/^{177}\text{Hf}$ ratios time to evolve to more radiogenic compositions, whilst retaining its MORB-like trace element compositions.

The timing of glacial terminations from open-system ages of corals

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The source of excess ^{234}U observed in fossil corals and its relationship to conventional closed-system age determinations is an outstanding problem in U-series geochronology. With significant improvements in analytical precision through mass spectrometry, it has become apparent that a substantial fraction of observed isotope ratios cannot be explained by closed-system evolution. Moreover, observations of a positive correlation between the $^{234}\text{U}/^{238}\text{U}$ and $^{230}\text{Th}/^{238}\text{U}$ ratios in corals from the same stratigraphic level¹ are difficult to explain. However, the initial decay product of ^{238}U is ^{234}Th . The decay of aqueous U and the α -recoil mobilization of U daughters produce particle reactive ^{234}Th and ^{230}Th , whose coupled addition could simultaneously increase the $^{234}\text{U}/^{238}\text{U}$ and $^{230}\text{Th}/^{238}\text{U}$ ratios of fossil corals². A quantitative model, based on the decay-dependent redistribution of ^{234}Th and ^{230}Th , permits the calculation of open-system coral ages³. The error in open-system age determinations due to errors in estimated parameters and assumptions of the model appears to be comparable to or less than analytical uncertainties in conventional U-series age determinations for an excess of ^{234}U up to 5%, which is the upper limit of 90% of the data.

Open-system ages determined from >90 new analyses of Barbados corals, as well as those calculated from previously published U-series measurements, constrain the history of sea-level over the last 340 ka. These ages are in good agreement with the SPECMAP chronology. In particular, Barbados corals collected from the top of the last interglacial terrace indicate that sea level was higher than modern between 120 and 125 ka. Ages of corals below the terrace top show more scatter, but the majority are in reasonable agreement with the timing of Termination II. The available data also suggest the timing of Terminations III & IV are in reasonable agreement with SPECMAP.

References

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