Massive assimilation of continental crust by low-K subduction-related magmas: the Plio-Quaternary Ambon arc (Eastern Indonesia)

C. Honthaas — UMR 6538 "Domaines océaniques", Université de Bretagne Occidentale, 6 avenue Le Gorgeu, BP 809, F-29285 Brest, France

M. Polve — Géochimie UMR-CNRS 5563, 38 rue des 36 Ponts, F-31400 Toulouse, France

R. C. Maury — UMR 6538 "Domaines océaniques", Université de Bretagne Occidentale, 6 avenue Le Gorgeu, BP 809, F-29285 Brest, France

S. Fourcade — Université de Rennes 1, Géosciences Rennes - CNRS, F-35042 Rennes cedex, France

The Ambon Plio-Quaternary arc includes the islands of Ambelau, Kelang, Seram, Ambon, Haruku, Saparua, and Banda Api, Eastern Indonesia. It results from the subduction of the Western Papua-New Guinea continental shelf along the Seram trough. Its magmatic rocks present the common petrologic and chemical characteristics of island-arc magmas. They include low-K calc-alkaline basalts, andesites, dacites and rhyolites together with high-K calc-alkaline andesites, dacites, rhyolites and granites. Low-K and high-K magmas were emplaced, often concomitantly, during two events which occurred at *c.* 5–3.2 Ma and 2.3–1 Ma.

The low-K suite parent magmas likely derived from the melting of a depleted mantle wedge having incorporated a continental component as described by Vroon *et al.* (1993) for the Banda arc, possibly through contribution of subducted continent-derived sediments. The high-K suite is represented in Ambon by cordierite-bearing dacites (ambonites) and granites. Both of them contain numerous Al-rich sanidinite-facies xenoliths which display various stages of thermal metamorphism, melting and assimilation of cordierite-sillimanite-garnet-bearing migmatites from the substratum of the arc. The high-K suite is characterised by a strong continental crust

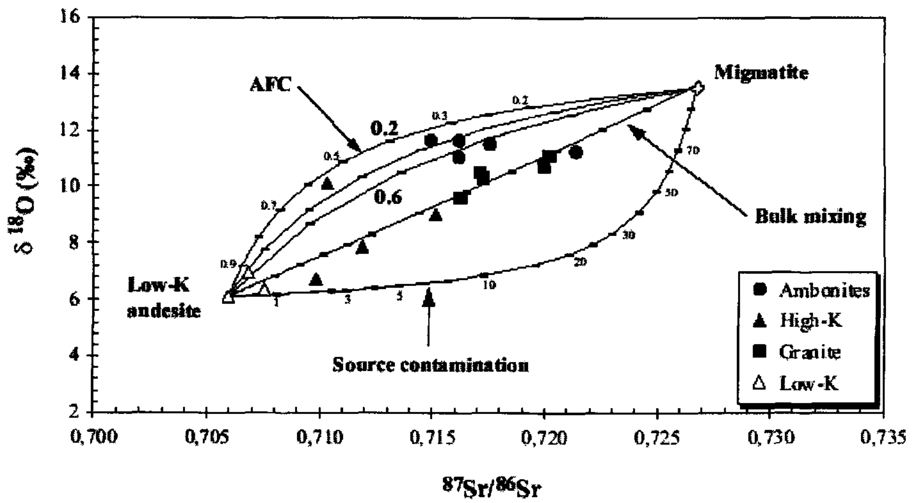

FIG. 1.

imprint on its Sr-Nd-O isotopic signatures.

The present study leads to the conclusion that the origin of the high-K suite is linked to the massive assimilation of cordierite-sillimanite-garnet-bearing migmatites by low-K basaltic to andesitic magmas. The extremely common occurrence of sanidinite-facies xenoliths display mineralogical evidence of thermal metamorphism under upper crustal conditions (750–800°C and 4 kbar) followed by partial melting and assimilation. We show that these features are consistent with assimilation of continental crust by andesitic magmas rather than with mantle-source contamination by continent-derived sediments, although the latter process may account for the origin of the low-K suite. The combined Sr-Nd-O isotopic relationships for granites are best explained by bulk mixing between low-K andesite and migmatite involving high percentages of crustal assimilation (40 to 70 %). The role of assimilation coupled with fractional crystallisation (AFC; DePaolo, 1981) in the genesis of the ambonites is restricted by the incomplete separation of calcic plagioclase phenocrysts from their host dacitic melts, as proposed by James (1981). The variable but generally high r (the ratio of the rate of assimilation to the rate of fractional crystallisation) is in agreement with this assumption. The AFC process evolved to a two-component bulk mixing between low-K andesite and migmatite as the granites, when there is no more plagioclase separation. Effectively, the Sr-O isotopic ratios of the younger ambonite are best explained by this bulk mixing.

References

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