Geochemistry of quachities and associated minettes from Schirmacher Oasis, East Antarctica

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Based on chemical and mineralogical evidences the ultramafic lamprophyres (UML) from Schirmacher Oasis are classified as quachitites. The rocks are silica undersaturated (35.8–36.5 wt.% SiO_2) and characterized by relative low MgO concentrations but high abundances of Al_2O_3 (up to 11.94 wt.%). They are also distinctly enriched in alkalis, with Na_2O (4.90–5.24 wt.%) predominating over K_2O (3.02–3.34 wt.%).

In general, magmas of ultramafic lamprophyres are believed to originate within the subcontinental mantle (Rock, 1991 and references therein). Accordingly, high concentrations of compatible elements and high mg# would be expected, but the Schirmacher quachitites are unusually in that they contain extremely low contents of Cr (10–44 ppm) and Ni (39–54 ppm) and also have low mg# with a maximum of 53.3.

Mantle-normalized trace element patterns of the Schirmacher quachitites compared to the trace element distribution of average quachitite data represent the unusual geochemical composition of the Schirmacher samples (Fig. 1). The studied rocks show significantly lower abundances in Th, U, Sr and *LREE* than observed in other UML, but substantial higher amounts of Rb. Strong Ba enrichments and negative Nb and Ti anomalies observed in the normalized element patterns of associated minettes (Fig. 1) are absent in the Schirmacher quachitites.

The chondrite-normalized *REE* patterns of the studied quachitites show a flattened primitive *REE* profile with relatively low enrichments in *LREE* (La = 47–64 times chondritic) and *HREE* resulting in La/Yb ratios between 9 and 13. Nd/Sm values are around 4.3 indicating that the quachitite magmas are slightly enriched in *LREE* (chondritic Nd/Sm ~ 3). $^{143}Nd/^{144}Nd$ ratios range from 0.511644 to 0.512708 giving positive ε_{Nd} values. The $^{87}Sr/^{86}Sr$ ratios are between 0.706409 and 0.707493. In contrast, the associated minettes of Schirmacher

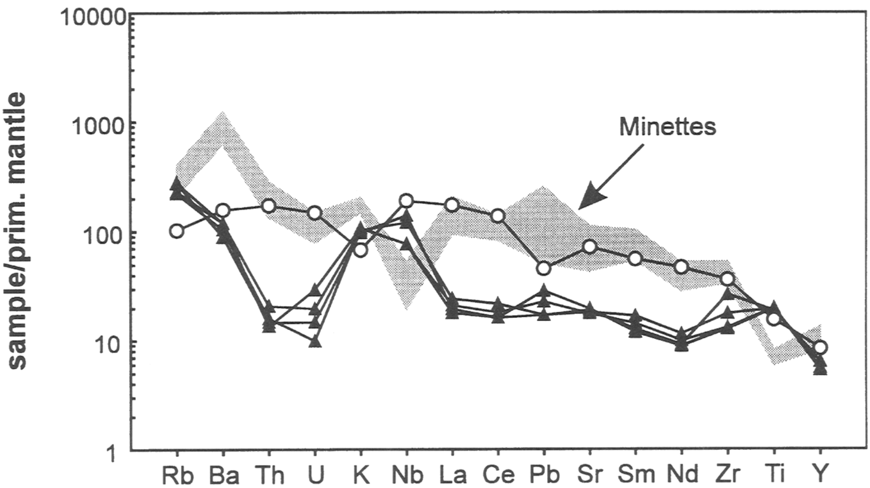

FIG. 1. Mantle-normalized trace element patterns of Schirmacher quachitites (filled triangle) compared to associated minettes and the average data of quachitites (open circles) given by Rock (1991). Normalizing data of primitive mantle contents are taken from Hofmann (1988).

TABLE 1. Average isotope compositions of quachitites from Schirmacher Oasis compared to associated minette occurrences

	Minette	Quachitite
$^{87}Sr/^{86}Sr$	0.709899	0.707010
$^{143}Nd/^{144}Nd$	0.511888	0.512696
ε_{Nd}	−14.32	1.13
$^{206}Pb/^{204}Pb$	17.490	18.689
$^{207}Pb/^{204}Pb$	15.517	15.532
$^{208}Pb/^{204}Pb$	38.502	38.377
$\delta^{18}O$	+7.8‰	+4.5‰

Oasis are much stronger enriched in *LREE* and Rb leading to higher $^{87}Sr/^{86}Sr$ and lower $^{143}Nd/^{144}Nd$ (Table 1). Pb isotope compositions of the quachitites are similar to those of MORB with a slight Dupal anomaly (Δ 7/4 = 0.3–2.6 and Δ 8/4 = 14.6–16.3). In a diagram $^{206}Pb/^{204}Pb$ vs $^{207}Pb/^{204}Pb$ they occur on the right side of the geochrone while the Schirmacher minettes plot on the left side. $\delta^{18}O$ values of whole rock quachitite samples range between 4.1 and 4.7 which are lower than those characteristic for mantle-derived magmas. This indicates a decrease of ^{18}O which may be caused by interactions with meteoric water after emplacement.

Lamprophyres emplace at high temperatures and cool rapidly suggesting that their chemical composition is not fundamentally changed by interactions with the continental crust en route to the surface. Consequently, geochemical signatures of lamprophyric magmas are inherited from their mantle reservoir.

The minettes from Schirmacher Oasis show geochemical features which are consistent with a small-degree partial melting of an enriched mantle source modified by an ancient subduction process (i.e. negative Nb-and Ti-anomalies and significant fractionation between LILE and HFSE). It is assumed that subducted sediments are the source of the added metasomatic component in the genesis of this minette magmas (Hoch, 1997).

According to trace element and isotope signatures the quachitites are not derived from the same mantle reservoir than the minettes. Enrichments in LILE and *LREE* caused by subduction-related event(s) has to be rejected in the petrogenesis of these rocks.

References

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