Element flows during fenitization of amphibole-rich pyroxenite by carbonatite intrusion

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The origin of carbonate magmas is still enigmatic. The composition of carbonatites with their peculiar mineral association and chemistry have profound implications for the geochemistry of the mantle and the distribution of many incompatible trace elements.

We present preliminary EMPA data for minerals from an amphibole-rich pyroxenite body fenitized by carbonatite intrusion as well as for secondary phlogopites and apatites grown at the contact of these rocks. The carbonatites are composed of 3–12 mm calcite grains with homogeneous major element composition both from the massive occurrences as well as from enclosures within amphibole/pyroxene clus-ters. Minor amounts of Mg (0.4 wt.%), Sr (0.8 wt.%), Fe (0.6 wt.%) and Mn (0.1 wt.%) are typical, irrespective of the textural setting of the carbonate mineral. Large apatite xeno-crysts (0.2–5 mm) occur at the contact between carbonate and pyroxene–amphibole clusters. The apatite has uniform composition characterized by the presence of F (3.1 wt.%), Na (0.1 wt.%) and Sr (0.4 wt.%). Notably, calcite is depleted in Mg (0.3 wt.%), and Sr, Fe and Mn are not present in the 10–25 μm thick zone at the contact with apatite. This can be explained by the migration of Sr, Fe and Mn from calcite into crystallizing apatite during the intrusion of the carbonatite magma into the pyroxenite. The fenitization has produced Na-rich clinopyroxenes and amphiboles in the pyroxenites. Beside the apatite, both titanite and phlogopite (0.1–5 mm grains) occur in the contact zone between carbonate and pyroxene–amphibole. Titanite from the contact zone is remar-kably enriched in Nb (up to 2.3 wt.%). In contrast, Nb con-tent in small accessory titanite grains in the relatively pristine pyroxenite is <0.2 wt.%. Phlogopite and titanite appear to be formed as direct products of reactions between carbonatite magma and pyroxenite. Allanite is a significant accessory phase in carbonate with up to 8.4 wt.% La and 12.4 wt.% Ce. The presence of phases enriched in alkali elements, F, REE, and Nb can be viewed as a product of reaction between carbonatite magma and surrounding pyroxenite indicates a significant role of incompatible element-enriched melts and fluids associated with carbonatite magma.

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