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Abstract

Cumulate Ultramafic Xenoliths from the Mt. Melbourne Volcanic Province (Antarctica): Evidence of Crustal Underplating Processes During the Ascent of Alkaline Magmas of the McMurdo Volcanic Group

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Two suites of ultramafic xenoliths have been collected in the Mt. Melbourne Volcanic Province, respectively from Browning Pass, near the coast of the Ross Sca and from Deception Plateau, at the base of Mt. Overlord, about 80 km inland. At both sites, xenoliths were brought to the surface by basanitoid lavas and are mainly represented by cumulates of pyroxenite and wehrlite composition. Mineral deformation structures occur only rarely. Widespread metasomatic effects led to the formation of composite nodules in which the original mineralogy is joined by pyroxenite veins in the samples from Browning Pass and by kaersutite-bearing pyroxenite in the samples from Mt. Overlord.

In both suites, CO_2-rich fluids produced widespread trains of high pressure fluid inclusions; their study, coupled with geothermometric estimates based on the Ca partitioning between olivine and clinopyroxene, allowed the determination of the formation pressure of the cumulates. Primary CO_2 inclusions thus indicate a pressure of 0.6-0.8 GPa for the nodules of Browning Pass and of 0.8-0.9 GPa (preliminary estimates) for those of Mt. Overlord. These pressures correspond approximately to the base of the crust that is at 20-25 km in the coastal area and which deepens to about 40 km beneath the Transantarctic Mountains (McGinnis et al., 1985; Trehu et al., 1989).

These cumulate xenoliths are compositionally related to the alkaline magmas within which they are found and may thus represent the products of fractionation processes undergone by McMurdo alkaline magmas before reaching the surface. This hypothesis is supported by the lack in the area of primary magmas directly issued from their mantle source. Even if extensive pyroxenitic fractionation (kaersutite +olivine) could explain the degree of evolution reached by magmas of the area, it does not explain the relatively high contents of compatible trace elements found in the more primitive magmas of the Province (Armienti et al., 1992).

Thus, RTF processes acting on underplated magmas accreting at the base of the continental crust of Northern Victoria Land may be invoked as the most probable mechanism capable of generating both the suites of ultramafic cumulates and the geochemical features of the less-evolved magmas. The proposed model probably holds in the whole context of the McMurdo Volcanic Group within which less evolved magmas of basanitoid and alkali basaltic composition share the same geochemical imprint and the suites of cumulate pyroxenites are widespread (Kyle et al., 1987). In this context the crust of the western Ross Sea embayment can be regarded as a filter that inhibits the passage of primary mantle-derived melts having a strong density contrast .

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