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Source area effects and crustal contamination in the Hekpoort Formation of South Africa

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The Hekpoort Formation represents a period of widespread volcanism prior to the Bushveld Magmatic Province (BMP). Crow and Condie [1] suggested that Hekpoort magmas were derived from a mantle source with a subduction-related component. However, subduction-related features may be difficult to distinguish from crustal contamination [1]. In an effort to discriminate between these two types of effects, we compare Hekpoort compositions with those of nearby Mesozoic Karoo continental flood basalts (Fig. 1), which experienced minimal contamination [e.g., 2]. Both units have chondrite-normalized Nb, Sr, P, and Ti depletions, which may be source-related. Abundances of Ba, Rb, and K are comparatively enriched for Hekpoort units and probably result from crustal contamination. A phlogopite-rich source and AFC processes have been suggested for the Montefiascone Volcanic Complex (Italy), which displays some similar compositional features [e.g., 3].

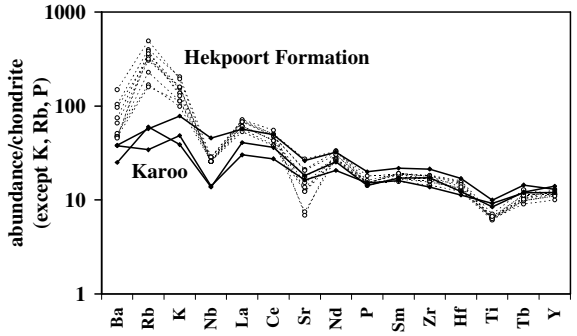

Fig. 1. Compositions of Hekpoort samples and of central Karoo basalts [from 2, 4], normalized according to Thompson et al. [5].

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Metasomatic overprint of trace-element signatures of eclogites and peridotites in cratonic roots

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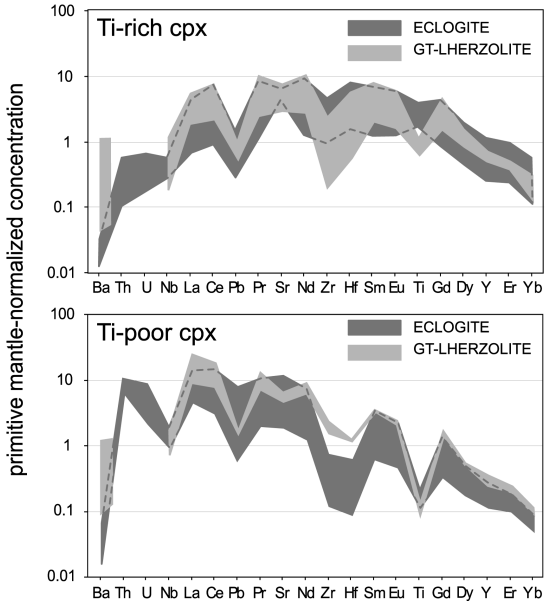
The Kaalvallei kimberlite contains abundant eclogitic and lherzolitic mantle xenoliths. Garnet-lherzolites equilibrated at pressures of 30-75 kbar and follow a ca. 40mW/m^2 geotherm. They can be divided into a high-*T*, Ti-rich and a low-*T*, Ti-poor group. A similar division, corresponding to Group I and Group II eclogites, respectively, can be made for the eclogites. Trace-element patterns of clinopyroxenes (LA-ICP-MS) show remarkable similarities between Ti-poor grt-lherzolites and Group II eclogites, and between Ti-rich grt-lherzolites and Group I eclogites (see Figure).



Ti-poor xenoliths are strongly depleted in more compatible elements, HFSE and Pb, but enriched in highly incompatible elements. Ti-rich xenoliths show less depletion in more compatible elements and HFSE, whereas incompatible elements are depleted. As eclogites and grt-lherzolites must have very different origins, the similarity in their trace-element patterns suggests a strong metasomatic imprint. Lack of trace-element zoning suggests that metasomatism is ancient. We conclude that any inference of protoliths (e.g., eclogites from subduction origin or mantle cumulates) based on trace-element signatures alone is problematic. Detailed study of metasomatic processes in both xenolith suites may be the key to deciphering their initial compositions.