COMPOSITION OF CLINOPYROXENES FROM MANTLE XENOLITHS AS INDICATOR OF LITHOSPHERIC EVOLUTION

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Abstract

Knowledge of the composition of the subcontinental lithospheric mantle (SCLM) and how it varies with time is essential to large-scale models of Earth's geochemical evolution. Data from a very large mantle-derived Cr-pyrope garnets data set indicate that the SCLM has undergone a long term evolution from a highly depleted mantle in the Archean to a more fertile one in Phanerozoic time, reflecting both refertilisation and changes in the processes that generate SCLM. With this contribution we continue the search for geochemical fingerprints in the SCLM using clinopyroxene trace element patterns which can provide a wider sampling of the SCLM than garnets alone. Cr-diopside is in fact the only mantle phase still stable in the lower part of the upper mantle, and represents the best tool for recording SCLM compositional variations related to depletion and enrichment processes over a large time span. The original data set, which includes Cr-diopsides from both spinel and garnet peridotite xenoliths, was empirically reduced by selecting xenoliths with >5% modal clinopyroxene, whose mg# ranges from 88 to 92. Diagrams based on major oxides was designed to distinguish between primary and secondary clinopyroxenes, as well as between clinopyroxene from garnet- and spinel-bearing peridotites. A particularly useful plot is (Sm/Yb)n vs (Ce/Nd)n, the first ratio being an indicator of both depletion and coexistence with garnet, while the second would identify the enrichment events. All clinopyroxenes from Archean cratonic gnt-lherzolites show (Ce/Nd)n higher than that of the SPCgnt (Suggested Primordial Clinopyroxene compositions in garnet facies), lending support to the hypothesis of an extensive refertilisation of cratonic mantle since Archean time. Only off-craton gnt-bearing lherzolites contain clinopyroxenes that record a "simple" partial melting history. On the other hand, Cr-diopsides from shallow, sp-bearing lherzolites show almost equal abundances of restitic (reflecting various degrees of partial melting) and enriched (reflecting later metasomatism) types. The simple compositional variables proposed for clinopyroxenes seem to suggest that only the off-cratonic lithospheric mantle (in both garnet and spinel facies) may still record the signature of an "original" mantle, which was affected by various degrees of partial melting. In this framework, the quest for "primordial" mantle portions (if any) has to be focused on the margin of (or far from) the cratonic shields.