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Dunite-pyroxenite xenoliths from South African kimberlites: Former cumulates of Archean oceanic crust?

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Dunite, wehrlite and pyroxenite xenoliths are widespread in South African kimberlites, but are less well studied than lherzolites and eclogites.

During the early Archean the Earth was probably hotter and more melt was generated at mid-ocean ridges, leading to a thicker crust with a more magnesian bulk composition [1]. Eclogites are widely accepted to represent basaltic and gabbroic parts of Archean oceanic crust, whereas rocks representing former ultramafic cumulates within the oceanic crust have not yet been identified. Following high pressure metamorphism, these ultramafic cumulates and picritic rocks would yield pyroxenites [2].

Four xenolith types in South African kimberlites are potential candidates for cumulates, namely pyroxenites, spinel-bearing wehrlites, spinel-free wehrlites and low-Mg dunites. These types differ in modal composition and structure, as well as major and trace element composition. Pyroxenites have equigranular structures with coarse grained garnet (Grt) in some samples and fine grained Grt in others, the latter crystallising along grain boundaries. Spinel-free wehrlites and dunites have equigranular or porphyroclastic structures, whereas spinel-bearing wehrlites have equigranular, porphyroclastic or foliated porphyroclastic structures. Silicate minerals in pyroxenites and spinel-free wehrlites have the lowest Mg# (100*Mg/(Mg+ΣFe)) of the four xenolith types; Ol has Fo89 and cpx Mg# 87 to 92. Pyroxenites also contain Opx with Mg# 88 to 91 and Grt with Mg# 72 to 77. Oxide minerals in pyroxenites and spinel-free wehrlites are magnetite, whereas dunites have Ol with Fo89-93 and contain ilmenite and magnetite. Spinel-bearing wehrlites have silicate minerals with the highest Mg# of the four xenolith types: Ol = Fo90-93, Cpx = Mg# 90 to 93, Opx = Mg# 92 to 93 and Grt = Mg# 82 to 85. Cr-spinel is always present, and magnetite, ilmenite and/or rutile may occur in different abundances. Pyroxenites and wehrlites have Cpx, Grt and Opx with consistently different REE patterns. In comparison to wehrlitic Cpx, pyroxenitic Cpx is more enriched in LREE and has a steeper REE slope. Spinel-free and spinel-bearing wehrlites have similar REE patterns.

References

[1] Zegers T.E. and van Keken P.E. (2001) *Geology* **29,** 1083-1086.

[2] Foley S.F., Buhre S., and Jacob D.E. (2003) *Nature* **421,** 249-252.

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Heterogeneous and metasomatized mantle recorded by mineral trace elements in Donghai garnet peridotites of the Sulu UHP terrane, eastern China

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Garnet peridotites from the Sulu terrane of eastern China were derived from the mantle wedge above a subduction zone of the Yangtze craton beneath the Sino-Korean craton. They underwent Triassic ultrahigh-pressure (UHP) metamorphism with their country rock gneisses. Mineral trace elements of Donghai garnet peridotites were analyzed by laser ablation ICPMS. One Zhimafang peridotite (porphyroblastic texture) consists of olivine ($Fo_{91.2\text{-}91.8}$), enstatite ($En_{92.0}$), garnet ($Prp_{66.5\text{-}70.7}$) and diopside (Di90.8). Four Xugou samples contain nearly equigranular olivine ($Fo_{90.6\text{-}92.2}$), enstatite ($En_{92.0\text{-}92.7}$), garnet ($Prp_{63.2\text{-}87.1}$) and diopside ($Di_{93.7\text{-}95.7}$) with additional minor phlogopite. Garnets from both localities have low LREE and show negative Ce anomalies, but the Zhimafang garnet has higher HREE (8-15) than those from Xugou (2-6). Zhimafang diopside shows sinusoidal REE pattern with flat HREE. Xugou diopsides, in contrast, have LREE-enriched patterns with large variation in HREE. Diopsides from both peridotites have low abundance of Yb, Y and Ti, and low Ti/Eu (517-1158), but high and variable Sr/Nd (4800-22000) and $(La/Yb)_n$ (40-100). Geochemical modeling indicates that the concentrations of moderately incompatible trace elements such as Y, Ti, Yb and Dy in diopside fit a fractional melting trend with about 30% partial melting of a primitive mantle source. However, Zr and Gd in the Zhimafang diopside, and the highly incompatible trace elements (such as Nb and especially LREE, Sr, Th and U) of diopside from both bodies, cannot be described by this model, and are attributed to carbonatitic metasomatism. The Sr isotopic composition of diopside and garnet, and marked negative Ce anomalies of garnets, suggest a sedimentary fluid source. Hydrous silicates (eg. Phlogopite) and low whole rock CaO/Al_2O_3 suggest a later silicate metasomatism related to subducted crustal materials. Systemic differences in the Ni content and Mg of olivine, and the Y, Al, HREE, Nd/Y and Sc/Y of garnet, show that the mantle volume represented by the Zhimafang peridotite is less depleted than the Xugou mantle. Such differences indicate that the garnet peridotites derived from a heterogeneous mantle in which different volumes had different evolution histories prior to their involvement in Triassic continental subduction.