

Metasomatized peridotite xenoliths from the cretaceous rift-related Natash volcanics and their bearing on the nature of the lithospheric mantle beneath the southern part of the Eastern Desert of Egypt

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Highly carbonated mantle xenoliths have been found in rift-related alkaline basalts at the Wadi Natash area in the southern part of the Eastern Desert of Egypt. Although all olivine and most orthopyroxene were replaced by carbonate and/or quartz, textural and mineral chemical features show that they are plagioclase-free spinel peridotites (Iherzolite to harzburgite). The correlation between Cr# (0.06 to 0.45) and Mg# (0.73 to 0.81) of the Cr-spinel in the studied xenoliths is weakly negative. Its TiO₂ content is slightly higher than in abyssal peridotite that was not affected by melt injection. The clinopyroxene composition of high Na₂O contents (>1.0 wt %) and Al^{VI}/Al^{IV} ratios (1.2–2.6) suggests its distinct signatures of a sub-continental mantle source. Two-pyroxene geothermometry indicates a temperature of about 900 °C, which is slightly lower than that of ordinary spinel peridotite xenoliths from other rift zones. The studied peridotite xenoliths had experienced mantle processes (e.g., decompression melting, magma upwelling, and metasomatism) at a higher pressure than abyssal peridotites. The trace-element chemistry of clinopyroxene, e.g., high LREE/HREE ratios {(Ce/Yb)_n = 7}, high LREE contents (>3.6 ppm and up to 30.0 ppm Ce) and high Sr between >85.6 ppm and 466 ppm indicates metasomatic alteration of the peridotite. Clinopyroxene in one sample has very low Ti/Eu and high LREE/HREE ratios. Clinopyroxene with (Ce/Yb)_n higher than 3–4 and Ti/Eu ratio lower than 1500 may have experienced carbonatite or carbonate-rich melt metasomatism prior to their incorporation into the host basalt. The basalt itself is almost devoid of any carbonatization. Hence, the studied mantle peridotites were carbonatized before the generation of the basaltic magma but following an earlier event of K-metasomatism as indicated by the presence of phlogopite. The studied peridotites from the Wadi Natash area were altered by a carbonate-rich melt during a rifting stage. The results of the present paper indicate that the Natash basalts with their peridotite xenoliths extruded along with transversal fractures of the NW-trending Nuqra-Kom Ombo-Kharit continental rift on its western shoulder in the south Eastern Desert of Egypt.