Multistage Evolution of sub-continental Lithospheric Mantle beneath Ethiopian plateau and rift

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The petrology and geochemistry of peridotite xenoliths in the Cenozoic basalts from Ethiopian plateau (Gundweyn area) and rift (Dillo and Megado areas), provide important information on the evolution of sub-continental lithospheric mantle. These peridotites are mainly spinel facies lherzolites with minor harzburgites and show positive Fo content of olivine versus Cr# in spinel, suggesting the occurrence of variable degrees of partial melting and melt extraction. The lherzolite clinopyroxene (cpx) shows both LREE-depleted and -enriched patterns with higher HREE abundances than harzburgite cpxs that reveal LREE enriched patterns. The $^{143}Nd/^{144}Nd$ and $^{176}Hf/^{177}Hf$ of lherzolite cpxs range from 0.51285 to 0.51370 and 0.28289 to 0.28385, respectively. Most peridotite samples plot between 900–500 Ma Sm–Nd and Lu–Hf reference isochrones that fall within the age range of the Pan-African orogeny. The initial Nd and Hf isotopic ratios calculated using previous ages determined from the study areas and this study plot away from the trend of the various types of MORBs, indicating that the peridotite could have been produced by melt extraction from the asthenospheric mantle. Petrographical observations combined with geochemical compositions of the peridotite show the occurrence of four major events. These are initial melt extraction, late metasomatism, later metasomatism and latest metasomatism. Initial event is identified by LREE depleted pattern, low $^{87}Sr/^{86}Sr$ and, high $^{143}Nd/^{144}Nd$ and $^{176}Hf/^{177}Hf$ in cpxs. Late metasomatism event is sown by LREE depleted pattern in amphibole and later metasomatism event is indicated by LREE enriched pattern and correlated high $^{87}Sr/^{86}Sr$ and low $^{143}Nd/^{144}Nd$ isotopic compositions in cpxs. The event of latest metasomaticmelt infiltration is responsible for the formation of spongy texture. There is no significant difference between initially depleted and late metasomatised cpxs in $^{87}Sr/^{86}Sr$ ratios. This suggests that the metasomatic agents were mainly derived from asthenospheric mantle.