Mineral Chemistry of Peridotite Xenoliths in Trachybasalt from Mt. Baekdu (Changbaishan)

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We have determined mineral compositions of peridotite xenoliths in trachybasalt from Mt. Baekdu to understand the lithospheric mantle formation and evolution in the northeast China craton. The peridotites studied are manily spinel lherzolites and harzburgites with an olivine websterite. The peridotites consist of olivine ($Fo_{89.3\text{-}91.5}$), enstatite ($Wo_{0.8\text{-}1.8}En_{88.3\text{-}90.6}Fs_{8.1\text{-}10.6}$), diopside ($Wo_{45.5\text{-}49.5}En_{45.4\text{-}50.6}Fs_{3.9\text{-}5.6}$) and spinel (Cr#=8.9-54.7). The websterite is composed of olivine ($Fo_{89.8}$), enstatite ($Wo_{1.0}En_{89.1}Fs_{9.9}$), diopside ($Wo_{48.4}En_{47.0}Fs_{4.6}$) and spinel (Cr#=12.7). The peridotites are mantle residues after up to 25% degree of partial melting of a fertile MORB mantle. The websterite is considered to be a cumulate origin of basaltic melt possibly in the mantle depth. Plots of the Cr# of spinel against Mg# of coexisting olivine or Mg# of spinel are within the field of abyssal peridotites. Comparison of spinel Cr# and TiO_2 also suggests an abyssal peridotite composition; however, harzburgites show high TiO_2 characteristics of a MORB-like melt reaction. Equilibration temperatures and pressures estimated using the two-pyroxene thermometers and the Ca-in-olivine/clinopyroxene barometer range from 750 to 1050℃, and 0.5 to 3.0 GPa, respectively, reflecting their lithospheric mantle origin. The rare earth element (REE) patterns in clinopyroxenes (Cpx) of the peridotites vary from LREE depleted, through spoon shaped to LREE enriched, reflecting secondary overprinting by metasomatic melts or fluids. Cpx from the websterite exhibits a convex-upward shaped REE pattern. Based on trace element distribution patterns, four types of equilibrium melt with Cpx were identified. Type 1 melts exhibit MORB-like LILE depleted patterns. Type 2 melt are characterized by significant Nb depletion with LILE enrichment. Type 3 melts show no significant Nb depletion with LILE enrichment. These features indicate multistage melting and metasomatism of the lithospheric mantle beneath Mt. Baekdu. Type 1 event might be related with formation of depleted MORB-like lithospheric mantle in this area. Type 2 event could be associated with the subduction of the Pacific plate. Host basalt-like small degree of partial melt might produce the Type 3 melt. The Lu-Hf isochron diagrams for Cpx grains show rough positive correlations. Type 1 Cpx plot along a 2.6 Ga reference isochron. The Type 2 and 3 Cpx do not define a meaningful isochron age, supporting again their secondary overprinting events.