Petrographical characteristics of mantle xenoliths from Loggang area, northeast China

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In northeast China, intraplate magmatism has been active, and Cenozoic basalts are widely distributed. This region has a unique tectonic setting, in that the subducted Pacific slab remains stagnant in the mantle transition zone. There is now a consensus that the magmatism has been caused primarily by decompression melting within the upwelling asthenospheric mantle. However, some contributions of fluids derived from the stagnant slab to magma genesis is indicated by seismic tomography. The mantle processes, including the upwelling of asthenospheric mantle and/or influx of fluids derived from the stagnant slab, may have affected not only the magma source region but also the overlying lithospheric mantle beneath NE China. Thus, it is important to investigate the time-integrated mantle processes recorded in the lithospheric mantle, as well as researching the magma genesis. In this context, petrographic investigation has been carried out on mantle xenoliths from Longgang area, NE China, using microscopic observation, as well as whole-rock and mineral compositions.

In this study, seven mantle xenoliths were analysed. They are various in terms of petrography and chemistry, consisting of spinel lherzolite, spinel harzburgite and dunite. Major constituent minerals are olivine, orthopyroxene, clinopyroxene and spinel, and some contain plagioclace, Fe-Ni sulfide and glass. Plagioclaces are found only at the outer margin of clinopyroxene crystals. Glasses are found as inclusions in spinels, clinopyroxenes and orthopyroxenes, and at grain boundaries. Reaction rims are commonly observed between spinel and intergranular glass, and clinopyroxenes and spinels occur in some glass inclusions. In terms of whole-rock compositions, modal abundance of olivine shows a positive correlation with Mg#, and negative correlations with Al_2O_3, CaO, Na_2O contents. A noteworthy feature among mineral compositions is highly various CaO contents in olivine, ranging from 0.04 to 0.19 wt.%. Based on pyroxene geothermometery, the equilibrium temperatures are basically 950-1050^{o}C, but one sample shows low temperature of 830^{o}C, while another shows high temperature of up to 1210^{o}C. Glasses have wide range in SiO_2 content of 49-64 wt.%, and total alkali content is 4-8 wt.%, MgO content is 0-7 wt.%, and total oxide content is 94-99 wt.%. The compositional range of glass in spinels are less scattered than that of glass in clinopyroxenes and at grain boundary.

The variations in compositions of mantle xenoliths, such as whole-rock major element compositions, Al_2O_3 content in pyroxenes and Cr# in spinel, are consistent with those expected from variable degrees of melting of the upper mantle. These samples show wide range in equilibrium temperatures compared with the geotherm corresponding to the spinel stability field, and show no correlation with the whole-rock compositions. The high equiliburium temperature of 1210^{o}C and chemical zoning in some constituent minerals for one lherzolite sample may suggest that the mantle experienced a remarkable heating event. Glasses observed in some mantle xenoliths are suggested to contain volatile up to 6 wt.%. The high volatile content may reflect that water has played important roles in the magmatism beneath the Changbaishan area.