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Structural analyses and seismic properties of peridotite xenoliths from the Ichinomegata volcano (Oga peninsula, Akita prefecture)

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The aim of this study is to evaluate the microstructure of the peridotite xenoliths obtained from the Ichinomegata volcano and to consider about the structure of the uppermost mantle below the back-arc region of the northeast Japan arc. The peridotite xenoliths are 5~10cm in size. They are mainly spinel lherzolites with a few hartzburgites. The mineralogical composition is ol+opx+cpx+sp+pargasite. The peridotite xenoliths show granular texture, and have shape preferred orientation (SPO) of olivine that is oriented oblique to the main foliation. This 'oblique foliation' is a typical microstructure resulting from shear deformation. Crystal-preferred orientations (CPO) of olivine and pyroxene were analyzed using a Scanning Electron Microscope (SEM) and Electron Back Scattered Diffraction (EBSD) technique. Olivine CPO data show {0kl}[100] patterns, with [100] axis slightly oblique to the main foliation. The fabric strength expressed by the J-index varies from 4.2 to 11.48. The peridotite xenoliths that have higher J-index values tend to show smaller angles between [100] direction and the main foliation, suggesting that these composite planar structures resulted from shearing in the uppermost mantle.

Comparing with seismic anisotropies observed in the northeast Japan, seismic properties of the peridotite xenoliths have been calculated from their CPO data. To average the seismic properties below Ichinomegata volcano, all CPO data have been sum up. Combined with the average modal composition of the main constituting minerals, seismic properties have been estimated. From given seismic properties, a thickness of an anisotropic layer to explain the observed S-wave delay time (i.e. 0.22s) is about 30km. Consequently although the observed delay time has been explained by the present mantle flow, the occurrence of anisotropy layers in the uppermost mantle lithosphere in the back-arc region is possibly one of the dominant sources of the observed seismic anisotropy. This anisotropic layer might be due to the back-arc spreading along the northeast Japan arc.