Seismic reflectivity in the lower crust - upper mantle beneath the Chugoku region based on xenolith data of the Oki-Dogo Island

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An integrated seismic reflection profiling across Southwest Japan in 2002 revealed the presence of seismic laminations beneath the seismic-refraction Moho (Kurashimo et al., 2003) in the Chugoku region (Ito et al., in press). In order to investigate the origin of the seismic laminations in the uppermost mantle, we have examined the seismic reflectivity in the lower crust and upper mantle based on acoustic impedance values of xenoliths in alkali basalt from the Oki-Dogo Island.

Based on xenolith studies, Takahashi (1978) proposed a petrologic model beneath the Oki-Dogo Island such that the lower crust is composed of olivine gabbro and granulite, and that the uppermost mantle is composed of thick cumulate layers of plagioclase- and spinel-bearing peridotites and pyroxenites. We have collected xenolith samples of the lower crust and upper mantle in origin, and obtained for each sample modal compositions and crystallographic orientations of constituent mineral grains by EBSD measurements of 2500 -3000 grains with a grid spacing of 500 microns. From these data together with densities and elastic constants of constituent minerals, we then calculated rock densities, P-wave velocities and acoustic impedance values (Z). The results show large contrasts in acoustic impedance between lower crustal rocks (Z = 20.3~21.4 10^6 kg/m^{2}s) and upper mantle rocks (Z = 25.2~27.8 10^6 kg/m^{2}s), but also contrasts between plagioclase peridotite (Z = 25.2 10^6 kg/m^{2}s) or pyroxenites (Z = 25.8 10^6 kg/m^{2}s) and the other peridotites (Z = 27.3~27.8 10^6 kg/m^{2}s).

We constructed a model of horizontal lithologic layering with acoustic impedance values obtained above, and generated synthetic seismograms for near-vertical ray propagation through the layering. The results show that, in the case of interlayering with layer thicknesses of less than 100 m, strong seismic reflections are apparent not only between the lower crust and the upper mantle (Moho), but also in the uppermost mantle between plagioclase peridotite or pyroxenites and the other peridotites. Thus seismic laminations beneath the Moho in the Chugoku region are possibly due to interlayering between plagioclase peridotite or pyroxenites and the other peridotites in the uppermost mantle.