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Contrasting seismic reflectivity of the lower crust and uppermost mantle between NE Japan and SW Japan

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For each of lower-crust and upper-mantle xenolith samples collected at Ichinomegata in NE Japan, and at Oki-Dogo and Noyamadake in SW Japan, we measured crystallographic orientations of 250 0 to 3000 constituent mineral grains with spacing of 0.5 mm, and obtained crystallographic orientation data as well as modal compositions. Together with density and elastic-constant data of the constituent minerals, we calculated the density, orientation-dependent P-wave velocity, and acoustic impedance value of each sample. Large contrasts in acoustic impedance are found between lower crustal rocks and upper mantle rocks both in NE and SW Japan. In contrast to minor contrasts in acoustic impedance among lower crustal rocks and among upper mantle rocks in NE Japan, relatively large contrasts in acoustic impedance are found in SW Japan between granulite and gabbro in lower crustal rocks, and between plagioclase peridotite or pyroxenites and other cumulous peridotites in upper mantle rocks.
Based on the petrological models of the lower crust and upper mantle in NE and SW Japan, we constructed acoustic impedance structures to simulate near-vertical ray propagation. The resulting synthetic seismograms revealed a strong seismic reflection between the lower crust and the upper mantle (Moho) both in NE and SW Japan. No other significant seismic reflection is recognized in NE Japan. In contrast in SW Japan, many strong seismic reflections due to the above contrasts in acoustic impedance are recognized both in the upper crust and in the uppermost mantle. Thus a remarkable contrast in seismic reflectivity in the lower crust and upper mantle is present between NE Japan and SW Japan.

Keywords: xenolith, crystallographic orientation analysis, acoustic impedance,
1D seismic reflection modeling, seismic reflectivity