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Internal structure of distinct S-wave reflectors in the crust beneath the northeastern Japan arc

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Distinct later phases were occasionally observed both in vertical and transverse component seismograms of shallow inland earthquakes recorded at nearby seismic stations of the Tohoku University network. Based on particle motions of these later phases and travel time differences between these later phases and direct waves, we interpreted these later phases as PxP and SxS waves reflected at the same plane of the reflectors in the crust. Assuming a planar reflector, we determined its location from PxP-P and SxS-S times by an image station method (Horiuchi et al., 1988). The reflector was located beneath the focal area of 1998 M5.0 earthquake, which occurred at the deepest portion of the Nagamachi-Rifu fault. The depth of the reflector is ~ 13 km, and the strike and dip-angle of the reflector are almost the same as those of the M5.0 earthquake fault plane. Distinct reflectors were also located at a depth of ~3 km and ~11 km beneath Mt. Kurikoma and Lake Tazawa close to the volcanic front in the northeastern Japan arc. The strike and dip-angle of the reflector beneath Mt. Kurikoma are NE-SW and almost vertical, and those beneath Lake Tazawa are N-S and ~45 degrees, respectively.

We estimated P- and S-wave velocity structure in the reflector bodies and their thickness from spectral amplitude ratios of reflected waves to direct waves. Corrections for the effects of radiation pattern and geometrical spreading were made for the observed spectra of direct and reflected waves. Since differences in incident angle between direct and reflected waves at observation stations were less than 5 degrees, the correction for the effect of site amplification factor can be neglected in this study. Assuming appropriate values for seismic wave velocity and Q-value outside of the reflector bodies, the best fit model for the internal structure of the reflector bodies was estimated by grid search varying parameters such as thickness, seismic wave velocity and Q-value of the reflector. The thicknesses of reflector bodies are estimated to be about 100 m in the three regions. P wave and S wave velocities in the reflector bodies are estimated to be 40~45% and 29~43% of those in the surrounding crust, respectively. Assuming that the reflector body is modeled by a composite material having randomly oriented and distributed spheroidal inclusions, we calculated the effective elastic constants of the composite by a new self-consistent scheme (Yamamoto et al., 1981). Observed P and S wave velocities in the three regions suggest that cracks in the reflector bodies are filled with H_2O rather than partial molten materials.