

Simultaneous measurement of P and S wave velocity at high P-T conditions for Ichinomegata xenoliths, northeast Japan

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P-wave velocity (V_p) and S-wave velocity (V_s) of Ichino-megata mafic xenoliths, northeast (NE) Japan, were measured simultaneously within the solidus P-T conditions in this study, so that we can interpret petrologically the inhomogeneous V_p , V_s and V_p/V_s structure of the NE Honshu arc crust to upper mantle estimated by Nakajima et al. (2001). The V_p values for Ichino-megata xenoliths were previously reported by Nishimoto et al. (2005), which were measured up to 400 deg.C and 1.0 GPa. In this study, the new cell design was developed which could be measured V_p and V_s simultaneously at high P-T conditions up to 800 deg.C and 1.0 GPa. Travel times of elastic-wave through the rock sample were determined with the pulse echo technique. The piezoelectric LiNbO₃ transducers were located on both ends of Pt buffer rod; V_p transducer (36 deg. Y-direction) and V_s transducer (X-direction) were placed on the bottom and top end, respectively. A sample length was cut into about 14mm diameter core and doubly polished to a length of about 12 mm. Before velocity measurements, the rock sample was oven-dried at 120 deg.C for 24 hours and the H₂O was not added to the rock sample. The measured samples include the hornblende gabbro (41.3 wt% SiO₂), hornblende-pyroxene gabbro (48.5 wt% SiO₂) and amphibolite (38.7, 44.3 wt% SiO₂) of Ichino-megata xenoliths, which has ultrabasic composition. V_p and V_s values were measured in temperature conditions from the room temperature (25 deg.C) to 600 deg.C (at constant pressure of 0.6 GPa), 700 deg.C (0.8 GPa) and 800 deg.C (1.0 GPa), respectively. Experimental results of V_p and V_s in each sample are summarized as follows; at constant pressure of 0.6 GPa, the V_p of the hornblende gabbro decreased from 6.91 km/s at 25 deg.C to 6.69 km/s at 600 deg.C and the V_s values reduce from 3.87 km/s at 25 deg.C to 3.73 km/s at 600 deg.C. Similarly V_p and V_s of the hornblende-pyroxene gabbro decreased from 7.07 km/s and 4.10 km/s at 25 deg.C to 6.90 km/s and 3.97 km/s at 600 deg.C, respectively. Also the V_p and V_s values of the amphibolites lower from 6.91 km/s, 7.11 km/s and 3.84 km/s, 4.02km/s (25 deg.C) to 6.56 km/s, 6.82 km/s and 3.62 km/s, 3.83 km/s (600 deg.C), respectively. At constant pressure of 0.8 GPa, the V_p and V_s of the hornblende gabbro decreased from 7.13 km/s and 3.95 km/s at 25 deg.C to 6.87 km/s and 3.79 km/s at 700 deg.C, respectively. V_p and V_s of the hornblende-pyroxene gabbro decreased from 7.25 km/s and 4.17 km/s at 25 deg.C to 7.08 km/s and 4.04 km/s at 700 deg.C, respectively. The V_p and V_s values of the amphibolites lower from 7.02 km/s, 7.23 km/s and 3.89 km/s, 4.09 km/s (25 deg.C) to 6.81 km/s, 6.93 km/s and 3.75 km/s, 3.87 km/s (700 deg.C), respectively. At constant pressure of 1.0 GPa, V_p and V_s of the hornblende-pyroxene gabbro decreased from 7.34 km/s and 4.20 km/s at 25 deg.C to 7.12 km/s and 4.02 km/s at 800 deg.C, respectively. The V_p and V_s value of the amphibolite lowers from 7.03 km/s and 3.90 km/s (25 deg.C) to 6.68 km/s and 3.67 km/s (800 deg.C), respectively. In the present results, velocity-temperature correlation for all rock samples show non-linear at each constant pressure conditions. It shows slight V_p and V_s decrease up to 300-400 deg.C [-0.01 to -0.03 km/s/100 deg.C for dV_p/dT and -0.01 to -0.02 km/s/100 deg.C for dV_s/dT]. On the other hand, the rock samples show significant V_p and V_s decrease above 400 deg.C [-0.05 to -0.1 km/s/100 deg.C for dV_p/dT and -0.04 to -0.07 km/s/100 deg.C for dV_s/dT]. Cusp locates at various temperatures (300-400 deg.C) depending on the rock sample measured. It is supposed that these significant V_p and V_s decrease were perhaps caused by the thermal cracking (e.g., Kern, 1982) and/or phase transition in plagioclase and amphibole (e.g., Miyake et al., 1999; Camara et al., 2003). It is suggested that the phenomenon of sudden decrease in the measured V_p and V_s might cause low V_p and V_s in the tomography images.