Melt distribution in the mantle wedge beneath NE Japan inferred from seismic velocity and attenuation structures

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Our recent tomographic work [Nakajima et al., 2001] revealed detailed P- and S-wave velocity structures beneath the northeastern (NE) Japan arc. The results show that inclined seismic low-velocity zones are continuously distributed in the mantle wedge in parallel to the down-dip direction of the subducting Pacific slab. These zones have been interpreted as the ascending flow from deeper portion of the back-arc side, which perhaps contains large amount of fluids. In order to know the shape of fluid-filled pores and volume fraction of fluid in these low-velocity zones, we first estimated temperature distribution in the mantle wedge by applying experimental results of high-temperature and low-frequency internal friction in Peridotite [Kampfmann and Berckhemer, 1985] to the P-wave attenuation structure [Tsumura et al., 2000]. Estimated temperature in the mantle wedge ranges from 1000C to 1200C. We calculated values of dlnVs/dlnVp by using the results of Nakajima et al. [2001] after correcting the effect of temperature variation on P- and S-wave velocities, which enables us to know whether or not melt or aqueous fluid in the low-velocity zones is in the state of textural equilibrium [Takei, 2002]. As a result, it is found that fluid phase exists in the low-velocity zones of the mantle wedge in NE Japan. We infer that the fluid phase in the low velocity zones is not H2O but melt, since the estimated temperature in the low velocity zones exceeds wet solidus of Peridotite [Kushiro et al., 1968]. Aspect ratios of melt-filled cracks and their volume fractions are approximately 0.01-0.1 and 0.1-1 %, respectively, which suggests that melt pockets are distributed in the low velocity zones. Aspect ratio of melt-filled cracks varies with depth. It is approximately 0.1 at a depth of 90 km or so and less than 0.1 at shallower depths. This indicates that the melt existing in rocks is far from textural equilibrium at shallower depths (at least shallower than 65 km), which suggests that melt migration through interconnected cracks is dominantly occurring in the shallow part of the ascending flow in the mantle wedge of NE Japan.