Estimation of the low velocity region beneath Mt. Fuji revealed by inversion of receiver functions

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Mt. Fuji, the largest stratovolcano in central Japan, has ejected a huge amount of basaltic products during the last 100,000 years. Although the reason for this high eruptive rate has not been well understood yet, a complicated tectonic setting is likely to be responsible for this uniqueness. Because the Izu-Bonin-Mariana arc (IBM) with a thickened crust is colliding and subducting below the Eurasian and Okhotsk plates around Mt. Fuji, a generic magma plumbing model for arc volcanoes is not readily applicable.
In this study, we conduct a receiver function (RF) analysis to investigate the seismic structure around Mt. Fuji including the distributions of the subducting IBM and the magma chamber below Mt. Fuji.
Cross sections of radial RF amplitudes reveal distinct positive velocity boundaries at depths of 40–60 km and 20–30 km around Mt. Fuji. We interpret the velocity boundary at 40–60 km depth as the lower boundary of the crust of IBM and that at 20–30 km depth as the lower boundary of the magma chamber of Mt. Fuji. Also, the velocity boundary representing the lower boundary of IBM crust does not continue just below Mt. Fuji at a depth of about 50 km, representing a locally weakened velocity contrast.
Next, we conducted an inversion analysis of receiver functions to investigate absolute S-wave velocities around Mt. Fuji, because the thick volcanic sediment layer and low velocity layers below Mt. Fuji change the amplitude of radial RFs. In RF inversions, there is a trade-off between the depth of the velocity boundary and the average velocity over the boundary, so we constrained results of the inversion by inverting receiver functions and dispersion curves of surface waves together. Our results are characterized by the following three features: 1) The north-south cross section of absolute velocities reveals that the width of IBM crust is developed down to a depth about 40 km. 2) Subducting oceanic crust, about 30–100 km to the southwest and 60–100 km to the northeast of Mt. Fuji, is represented by a low velocity body. 3) A distinct low velocity region exists below Mt. Fuji with a width of 40 km in horizontal direction and 20 km width in vertical direction, representing a crustal magma chamber of Mt. Fuji.
Our findings suggest that 1) Mt. Fuji has ejected mostly basaltic rocks because the crustal magma chamber is deep, and 2) an anomalously high eruption rate of Mt Fuji is because it hosts a large crustal magma chamber.

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