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Seismic velocity structure around Mt. Fuji, Japan

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Mt. Fuji, one of the arc volcanoes associated with westward subduction of the Pacific plate, is located near the triple junction among the Philippine Sea, Eurasia, and North American (or Okhotsk) plates, where the Philippine Sea plate collides to the rest of two at the northern tip of the Izu Peninsula, and subducts from Suruga and Sagami troughs. Mt. Fuji has been active for last 10,000 years with its total eruptive products of about 400 cubic kilometers, much greater than ordinary arc volcanoes. Also, eruptive products are almost exclusively basaltic with their chemical composition similar to that of mid-ocean ridge basalt, atypical for an arc volcano. The first question is thus what controls the chemical composition and volume of rocks in Mt. Fuji. Takahashi [2000] proposed a model in which the subducting Philippine Sea plate is torn beneath Mt. Fuji to produce large amount of basalt, but his hypothesis is not supported by seismic observations; for example, Iidaka et al. [Tectonophysics, 1990] demonstrated that the the Philippine Sea plate is not actually torn beneath Mt. Fuji by detecting P-to-S converted waves.

To address the question, we delineated the P and S wave velocity structure around Mt. Fuji using seismic networks consisting of about 160 sites in total. This will address the following second question: how deep low-frequency tremors, which have been observed beneath Mt. Fuji for more than 20 years and activated in 2000 and 2001, are related to material properties. Although deep low-frequency tremors have been observed in several geological settings, including non-volcanic regions, the mechanics of them remains unsolved. Understanding the seismic structure around the hypocenter of the deep low-frequency earthquakes will be the first step to unravel the mechanics of deep low-frequency earthquakes.

We employed the double-difference tomography [Zhang and Thurber, BSSA, 2003], a method to obtain seismic velocity structure and precise earthquake locations simultaneously, to invert P and S wave first arrival times for seismic velocity. A preliminary result with about 800 earthquakes and 30,000 arrival times seems to indicate a dipping iso-velocity surface to the west, consistent with the Bouguer gravity anomaly and the shallow seismic structure derived by an active source experiment. Also, there is no evidence for tearing of the Philippine Sea plate so far. Incorporating more earthquakes in the analysis will improve our result.