Crustal and upper mantle structure deduced from seismic refraction and reflection data on the Northeast Hawaiian arch

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The Hawaiian Islands in the center of the Pacific plate are one of the best known volcanic chains formed by a mantle plume (Wilson 1963; Morgan 1971). The volcanic centers are characterized by an age-progressive island chain on the old seafloor caused by intraplate volcanism away from a mid-ocean ridge. The seafloor surrounding the chain of islands is anomalously shallow, relative to normal seafloor of the same age because of plate flexure due to the load of the islands (e.g., Crough 1978; Ribe 2004). Therefore, the temperature at Moho depths is inferred to be low (~150 ℃) based on the half-space thermal model. For this reason, the North Hawaiian arch is one of the feasible candidates for ocean drilling to the Moho. However, the crustal structure around the islands is potentially affected by the hotspot volcanism. In order to investigate the detailed seismic structure of the crust and the uppermost mantle, we carried out an active-source refraction and reflection survey on NE Hawaiian arch. The age of the seafloor around our survey area ranges from 65 to 85 Ma (Muller et al. 2008); the estimated half-spreading rate is intermediate (~40 mm/yr). For the acquisition of the seismic data, five ocean bottom seismometers (OBSs) were deployed, then an airgun array (volume 7800 cubic inches) mounted on R/V *Kairei* was fired along the profile parallel and perpendicular to the magnetic anomalies. Multi-channel seismic reflection (MCS) data were also collected with a 444-channel, 6000-m-long streamer cable. The result of the traveltime analyses with forward modeling (Zelt and Smith 1992) shows typical seismic velocity structure of the old oceanic crust (White et al. 1992). In addition, we identified remarkably high P-wave velocities of ~8.7 km/s and strong seismic anisotropy in the uppermost mantle, which suggests that the alignment of olivine crystals in response to mantle flow has been preserved in the uppermost mantle (e.g., Kodaira et al. 2014). Moreover, we observed wide-angle reflection phases at offsets up to about 670 km, which are similar to observations in the other area in the Pacific basin (Ohira et al. 2017). As a result of the traveltime mapping analysis (Fujie et al. 2006) and ray tracing for these reflection phases, we estimated that the mantle reflectors mainly exist at the mid-lithosphere depths (30 to 90 km).

