Detailed Crustal Structure across the Itoigawa-Shizuoka Tectonic Line from Reanalysis of the 2002 Seismic Expedition Data

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The 250-km long Itoigawa-Shizuoka Tectonic Line (ISTL), running with NS direction in Central Japan, is a major tectonic boundary between the NE and SW Japan arcs. The northern segment of the ISTL coincides with the western rim of the northern Fossa Magna basin (NFMB), which is a Miocene rift system formed in the final stages of the opening of the Sea of Japan (ca. 17 Ma). Under a compressive stress regime starting in the late Neogene, the northern to central part of the ISTL has behaved as an active fault system with a large slip rates (4-9 mm/yr). In 2002, an intensive seismic expedition (Itoshizu 2002) was undertaken in the northern part of the ISTL. On a 56.5-km profile, crossing the ISTL, the NFMB, Central Uplift Zone (CUZ) and Komoro Basin (KB) from west to east, CMP reflection and refraction/wide-angle reflection data were acquired using explosive and vibroseis sources. Integrated refraction/wide-angle reflection analysis for this data set delineated detailed crustal heterogeneities including the deep geometry of the ISLT active fault, the basin structure of the NFMB and the eastward dipping of the pre-Neogene basement. We incorporated large amounts of travel time data from the CMP reflection profiling to elucidate fine-scale structural variation across the ISTL and NFMB. The ISTL active fault dips eastward with an angle of 25 degrees in its uppermost part, but flattens at a depth of 3-4 km with a horizontal extent of 10-12 km. East of this flat portion, the fault dips again to the east with a lower angle of 10-15 degrees. The NFMB is filled with 4-5 km thick Miocene sediments of 1.6-5.2 km/s. Beneath the CUZ, the crystalline basement is situated at a very shallow depth of 1-1.5 km forming a domed structure. In the westernmost part of the profile, the pre-Neogene basement also shows an eastward dip down to 4 km under the ISTL fault. Miocene sediments of 3-4 km/s between the ITSL and the pre-Neogene basement form a low velocity layer beneath the NFMB and crystalline unit of CUZ. Integrated interpretation of the present structure model and the crustal image from the CMP reflection profiling indicates the thin-skinned inversion tectonics ongoing in the studied region. The ISTL, originally formed as a normal fault by the Miocene back-arc spreading, has been reactivated as a reverse fault under the compressional stress regime since Pliocene. The domed body under the CUZ represents the hanging-wall side of the pre-Neogene unit formed at the time of normal faulting, now thrust up from the east along the ISTL fault due to the present compressional stress field. Below depths of 10-12 km, the crust becomes reflective with less seismic activity. This part almost coincides with a conductive zone controlled by fluids, probably expressing the ductile part of the crust.