Crustal Structure around the Northern Part of Itoigawa-Shizuoka Tectonic Line, Central Japan

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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).

So far, several seismic reflection experiments provided structural images in the northern part of the ISTL. The seismic profile in 2002 (Itoshizu 2002, Sato et al., 2004) from the NFMB to the Komoro Basin (KB) delineated detailed crustal heterogeneities including the deep geometry of the ISLT active fault, the basin structure of the NFMB and the eastward dipping structure of the pre-Neogene basement. 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 (Sato et al., 2004, Iwasaki et al., 2007). 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. The obtained structure model indicates the thin-skinned inversion tectonics ongoing in the studied region (Sato et al., 2004).

The wide-angle reflection data collected in 1991 slightly north of the Itoshizu 2002 also support the gentle eastward geometry of the ISTL and domed structure of the CUZ. Such an eastward dipping structure of the ISTL is recognized further south by the seismic reflection profiling across the Matsumoto Basin. The seismic image obtained presents no indication of high-angle fault geometry extending to a deeper part of the crust. According to Ikeda et al. (2004), slip partitioning is taking place between the East Boundary Fault (thrust) and the Gofukuji Fault (left slip), but they merge into a single plane at depth. Around the Suwa Lake, the ISTL shows different geometry from that in the northern part. The 2007 seismic line crossing the Suwa Lake delineated a fault plane dipping westward with high angle of 70 degrees (Ikeda et al., 2008, Kobayashi et al., 2008). These results strongly indicate that the ISTL has the segment boundary around the Suwa lake.

Based on the wide-angle data in 1991, the velocity of the crystalline basement becomes slightly low west of the northern ISTL, beneath which the velocity reversal is recognized, probably dominated by the magmatic activity in this area. Seismic activity is characterized by shallow normal earthquakes and low frequency events at a depth range of 12-40 km. Hence, fluids released from magma may play important role to control the seismic activity or even the activity of the ISTL itself. On this profile, deeper wide-angle reflections are recognized. Moho depth is rather deep (35-40 km) beneath the ISTL, which is also consistent with the case of the Itoshizu 2002 determined by the RF analysis (Abe et al., 2007).