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Detailed seismological structure of eastern Kyushu - Structural inference on left-lateral motion in southernmost Kyushu-

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Kyushu Island is located at the westernmost part of the subduction zone of the Philippine sea plate. This island is under a complex tectonic environment. Northern Kyushu has been dominated under the extensional stress regime. In the Beppu-Shimabara graben, a number of normal faults were formed with E-W strike diretion. Central Kyushu is characterized by zonal structure of accretionary prisms with a NE ? SW strike. Southern Kyushu has been affected by the subducted Kyushu-Palau ridge and Okinawa trough which is back arc basin behind the Kyushu island and Ryukyu Island chains. Paleomagnetic analysis by Kodama et al. (1995) indicated the existence of left lateral shear zone in the southeastern part of Kyushu. This shear zone was confirmed by the recent GPS research by Wallece et al. (2009).

The crustal and uppermantle structure of the Kyushu Island, however, remains enigmatic. In 1994 and 1996, refraction and wide-angle reflection survey using dynamite shots were carried out in eastern Kyushu. The about 230 km-long seismic line was laid out in NS direction, crossing major tectonic lines of OKTL, Usuki-Yatsuchiro tectonic line, BTL and NTL. To obtain new knowledge of deep structure of the individual geological blocks, We reanalyzed these refraction/wide-angle reflection data. Then, to obtain deeper structure of crust and upper mantle, an integrated seismic tomography method was undertaken using combined data set of active and passive sources.

The seismic tomography and ray-tracing for first arrivals reveals lateral structural variation of upper crustal model. The results include volcanic sedimentary packages (Vp = 3.3-4.9 km/s) with a thickness of 2 ˜ 3 km north of the OKTL in Northern Kyushu. The seismic velocity south of the OKTL increases to 5.4 km/s, which corresponds to the Sanbagawa belt. Shallow geometry in OKTL is high-angle northward dip. The Chichibu belt has a velocity of Vp = 5.4 km/s. Further south, a low velocity body of the Hyuga complex (Vp=3.9 ˜ 5.8 km/s) shows a northward dip of 15 degrees with a thickness of 6.5 km. The northern boundary of this body is interpreted to be the Nobeoka Tectonic Line (NTL). In the southernmost part of Central Kyushu, high velocity layer (Vp =5.3 ˜ 5.8 km/s) with thickness of 3.7 km correspond to intruding granodiorite close to Mt.Osuzu. This area is characterized by small Vp/Vs value. In Southern Kyushu, low velocity packages (3.3˜5.8 km/s) exists with thickness of 12km.

The travel-time and amplitude calculations for the wide-angle reflection data provides deep crustal structure. In Northern Kyushu, a northward dipping reflector with a low angle was imaged at a depth of 10 ˜ 15km beneath OKTL, probably representing the deeper extension of OKTL. This geometry of OKTL is in good agreement with the reflection image of MTL in Beppu Bay (Yuasa, 1992), providing a strong indication that the OKTL is interpreted to eastward continuation of MTL.

A northward dipping reflector with low angle is imaged from the wide-angle data in Southern Kyushu at a depth of 15 ˜ 25 km beneath Miyazaki Group. This boundary was first found out by the present study. It is noted that this northward dipping structure is characterized by high seismicity. Focal mechanism solutions of these earthquakes are of left lateral shear, which is well consistent with the crustal movement deduced by the Paleomagnetic analysis (Kodama et al,1995) and GPS analysis (Wallace et al ,2009). So, it is quite plausible that the eastward motion of the southern tip of Kyushu occur along this structural boundary.