南西諸島弧における胴切り断層の地震学的構造

Seismic characteristics around the Kerama Gap in the Nansei-Shoto (Ryukyu) Island arc

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The Nansei-Shoto (Ryukyu) Island arc is generally divided into three parts based on topography, geology, biology and other characteristics. The most significant boundaries are the Tokara Gap between the Tokara and Amami Islands in the northern arc, and the Kerama Gap between the Okinawa and Miyako Islands in the southern arc. Other than the two gaps, some large topographical saddles along the island arc characterize the Nansei-Shoto Island arc. We carried out seismic refraction and reflection surveys to investigate seismic structure around the Kerama Gap, which gives us key information to consider the tectonic evolution of the Nansei-Shoto Island arc-backarc system. Two seismic profiles, ECr25 and ECr31, are designed to cross the Kerama Gap and Miyako Saddle in the southern arc and forearc regions.

Line ECr25 along the forearc has a length of 415 km from the Nansei-Shoto (Ryukyu) Trench at the southwestern end, through the Miyako Saddle, to the Kerama Gap at the northeastern end.
Multi-channel seismic (MCS) profile reveals many normal faults in the shallow sedimentary layer below the Kerama Gap and some faults reach to the seafloor, which suggests the deformation is in progress at the present time. The MCS record also shows clear reflection signals from the top of the subducting Philippine Sea plate. The depth of the plate boundary was estimated to be around 15 km below the forearc region from the reflection and refraction measurements. The ECr25 P-wave velocity (Vp) model reveals the top of 4-5 km/s layer is much shallower in the forearc regions to the southwest of the Kerama Gap, where higher free-air gravity anomaly and lower seismicity are different from other region.

Another line ECr31 with a length of 228 km was planned to be located along the Nansei-Shoto Island arc and cross the Miyako Saddle at the southwestern end and the Kerama Gap at the northeastern end. The MCS record for ECr31 show many normal faults beneath the Miyako Saddle and Kerama Gap, which indicates extensional regime along the island arc. Several conspicuous and almost continuous reflectors with small normal faults are detected at 1-2 s below the seafloor of the Miyako Saddle. On the other hand, some reflectors beneath the Kerama Gap are rather discontinuous due to large offsets of the normal faults, which indicates larger deformation in this region.

Vp model of ECr31 reveals a typical island arc structure. Although the thickness of the middle crust with Vp of 6.1-6.5 km/s varies along the seismic line, the variation seems to be independent of the positions of the Kerama Gap and Miyako Saddle. Therefore, the topographical deformation may not reach to the depth of the middle crust. We estimated the Moho depth of around 30 km from PmP arrivals. Some reflection signals from deeper than the Moho are also observed and they may reflect at the top of the subducting Philippine Sea plate or at its oceanic Moho. Traveltime mapping of these signals results in many scattering reflectors and it is difficult to determine the depths of deeper reflectors precisely.

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