Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SSS02-19 Room:IC Time:May 25 15:45-16:00

Plate geometry, splay fault and tsunamigenic earthquake in the southernmost Ryukyu trench

ARAI, Ryuta[1*] ; KAIHO, Yuka[1] ; TAKAHASHI, Tsutomu[1] ; NAKANISHI, Ayako[1] ; FUJIE, Gou[1] ; NAKAMURA, Yasuyuki[1] ; MIURA, Seiichi[1] ; KODAIRA, Shuichi[1] ; KANEDA, Yoshiyuki[2]

[1]CEAT, JAMSTEC, [2]Nagoya University

In the last few decades, a series of megathrust earthquakes and their ensuing tsunamis worldwide required us to reassess seismic potentials in subduction zones. A typical example in controversy is the Ryukyu subduction zone, extending 1,200 km from Kyushu, SW Japan, to Taiwan collision zone (e.g., Lin et al., 2014). Along this subduction zone, historical evidence for great interplate earthquakes (M>8) has been poorly documented and ongoing back-arc rifting along the Okinawa trough implies that the plate coupling is weak (Peterson and Seno, 1984). In more recent years, a variety of seismic activities including large earthquakes with M>7 (Engdahl and Villasenor, 2002), repeating slow-slip events (Heki and Kataoka, 2008) and very low frequency earthquakes (Ando et al., 2012) were found indicative of spatial variation in frictional property along the plate boundary and surrounding faults. Historically, the Yaeyama earthquake in 1771 with M~8 is thought to have ruptured a shallow portion of the plate interface and generated devastating tsunami with a maximum run-up height of ~30 m, causing approximately 12,000 fatalities (Nakamura, 2009). Although these documentations imply that a diversity of seismogenic processes along the Ryukyu subduction zone, fundamental structural features associated with plate subduction are not well understood. Moreover, the slab geometry itself is poorly constrained due to the sparse seismic observation networks.

In order to improve our understanding seismic potentials and structure controlling the seismogenic process in the Ryukyu subduction zone, we started a new 8-year project that consists of four two-dimensional active-source seismic experiments and extensive passive-source seismic observations covering the entire Ryukyu arc. In 2013, active-source seismic data were collected in the southernmost Ryukyu trench that crosses the potential source region of the 1771 Yaeyama earthquake (Nakamura, 2009). For refraction/wide-angle reflection analyses, seismic wave from air-gun shots were recorded at a total of 60 ocean bottom seismographs with approximately 6-km spacing on a ~390-km-long profile. On the same line, multichannel seismic (MCS) reflection profiling using the ~6-km-long, 444-channel streamer cable was also carried out.

Using this data set, we succeeded in imaging the plate boundary down to ~30 km depth. The dip angle of the slab increases from ~5 degree closer to the seafloor to ~20 degree at greater depths. In the fore-arc region, we found a fault branches from the plate boundary to the seafloor and they form a low-velocity accretionary wedge in between. This splay fault and accretionary wedge almost overlap the source region of the 1771 Yaeyama earthquake proposed by Nakamura (2009) and thus may have played a role in tsunami generation. The slab contacts with the overriding wedge mantle at depths greater than ~25 km. This region shows greater reflectivity at the plate boundary and is also coincident with repeating slow-slip events (Heki and Kataoka, 2008). These results probably suggest a changing frictional property along the plate interface with increasing depths.

Keywords: Ryukyu subduction zone, Philippine Sea plate, Accretionary wedge, Reflection/refraction analysis