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Subduction structure revealed by seismic experiments at the southern Ryukyu Trench

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The Ryukyu Trench (Nansei-Shoto Trench), extending to the east-south of the Ryukyu Arc, is formed by subduction of the Philippine Sea Plate below the Arc. Although great earthquakes have been rarely observed around the Ryukyu Arc and plate coupling at the Ryukyu Trench had been believed to be weak, enormous disasters were induced by earthquakes. Yaeyama Earthquake (M7.4) occurred in 1771 induced large tsunami, which killed more than 11,000 people of the Ryukyu Islands. It is important to determine structure models of a subduction zone to understand mechanism of earthquakes even in a weak plate coupling area.

Although the length of the Ryukyu Trench is longer than the Japan Trench and the Nankai Trough, number of seismic surveys conducted around the Ryukyu Trench to obtain structure models of the subduction is much less than those around the two trenches. Only several structure models of the Ryukyu Trench and the subducting Philippine Sea Plate in shallow area have been constructed until present. In this meeting, we will report a new structure model of the southern Ryukyu Trench at where Japan Coast Guard has been conducted seismic survey.

In 2009, we conducted a seismic reflection experiment with 3,000 m multi-channel streamer cable and a seismic refraction experiment with ocean bottom seismographs (OBSs) on a survey line named ECr5 which runs across the Ryukyu Arc, the Hateruma Basin and the Ryukyu Trench from north to south to the east of the Ishigaki Island. Total volumes of airgun arrays for the reflection and the refraction experiments are 1,050 $inch^3$ and 6,000 $inch^3$, respectively.

To construct a P-wave velocity structure from the OBS records, a ray tracing method with graph theory was used for first arrivals and various reflected signals including reflected signals from the top of the subducting plate and its Moho. A depth scale of the constructed structures was converted to two-way travel time to lay the structure over the multi-channel seismic profile for further interpretation.

Characteristic features of our structure model are follows.
1) Backstop structure is located below an edge of the Hateruma Basin.
2) Thickness of an accretional prism is thicker than 10 km.
3) Approximate subduction angle of the Philippine Sea Plate is 5 degree at shallow (<20 km) part and is 25 degree at deep (20-35 km) part.
4) Large fault connecting to the plate boundary at a depth of 15 km reaches to seafloor with an approximate angle of 40 degree.