Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SSS34-P13 Room:Convention Hall Time:May 21 13:45-15:15

Upper surface of Philippine Sea plate and asperity in the south Ryukyu arc

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We determined the focal depths of hypocenters of earthquakes near the Ryukyu Trench using the arrival time of the depth phase, and estimated the position of the upper interface of subducted Philippine Sea plate beneath the south Ryukyu arc. The Ryukyu trench is a convergent plate boundary extending about 1200km from Kyusyu to Taiwan. The Philippine Sea plate is subducting at a rate of 5- 7 cm/yr northwestward. The seismic coupling is assumed to be weak. However, recent observations showed that the plate interface is regionally coupled along the Ryukyu Trench. The occurrence of very low frequency earthquakes and slow slip events are implicated as the locked plate interface. Fine structure of the subducted plate interface is important to estimate the pressure and temperature condition of the coupled and decoupled zone, which inform us what is the essential parameter for the formation of interplate coupling in the Ryukyu trench. However, depths of the hypocenters have large errors for the hypocenter determination near the Ryukyu Trench region because the seismic stations are limited to the islands and far from the trench. We relocated the hypocenters of earthquakes using the arrival times of the sP phases. The sP phase is the S-to-P converted phase at the seafloor. The phase velocity of the sP phase is the same as that of the P phase. The particle motion of the sP phase is dominant with vertical component. Using the sP-P delay time, we can estimate the accurate focal depths. The waveforms at the JMA stations are used for the analysis. We used the earthquakes whose magnitudes were over 3.5. We selected two areas, southern Iriomote area and southern Miyako area. For the southern Iriomote area, we selected the earthquakes which occurred in the range of 123.4E to 124E, and 23.2N to 23.5N. The epicentral distances of earthquakes range from 87km to 120km from Iriomote Island, and sP-P times are at the range of 0.64- 5.98s. The other is the southern Miyako region ranging from 125E to 125.4E, and 23.7N to 24.4N. The epicentral distances of the earthquakes range from 35- 113km from Miyako Island. First we picked the arrival times of the sP phases from the waveforms. sP-P times in the events which occurred in the south Iriomote area and south Miyako area are 0.64- 5.98s and 0.72- 4.11s, respectively. Second we computed the focal depth of earthquake using sP-P time delays. The 2D velocity structure was employed for the calculation of the sP travel times. And sP-P times of the events in the southern Miyako region 0.72- 4.11s. Then we estimated focal depths using sP-P time delays. The results show that the focal depths are 7.1- 26km in the Iriomote area, and 6- 20.3km in the Miyako area. Next, we relocated the hypocenters using P, S, and sP arrival times. The relocated hypocenters are distributed at the depth range from 5- 20km in the southern Iriomote region near the trench, while the hypocenters are at the depth range of 35- 50 km by the JMA catalogue. in this area. In the southern Miyako region, The hypocenters are distributed at the depth from 5- 20km, while the hypocenters are at the depth range of 10- 50km by the JMA catalogue in this area. The strike-slip faulting type earthquakes are dominant at the south of the Iriomote Island. Since the relocated depth of the earthquakes are 5- 20km and these are in the subducted Philippine Sea plate, the earthquakes occurred in the Philippine Sea plate. Thus, the estimated depth of the plate interface is shallower than that estimated using the usual hypocenter catalogue. And, if the estimated depth is shallower, we consider that temperature and pressure are higher than before.

Keywords: Philippine Sea Plate, depth phase, relocation, asperity