Long-term seafloor seismic observation at the Chile triple junction

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The area in southern Chile off the Taitao Peninsula has a complicated tectonic setting, as shown in the Figure. The active Chile ridge is currently subducting eastward at the Chile trench beneath the South American plate, which makes the Chile triple junction (CTJ). We have conducted seafloor seismic observations twice around the CTJ to study crustal activities associated with subduction of the active ridge and seismic structures affected by anomalous heat of the ridge subduction. In the first observation, 5 long-term ocean bottom seismometers (LTOBS) were installed at intervals of about 30 km from 2009 to 2010. We confirmed both non-volcanic tremors along the ridge axis (Saez et al. 2019) and micro-seismic activities near the ridge axis and the Darwin fault zone (Shinohara et al. 2010). However, the accuracy in the hypocenter depth was not sufficient due to small number of stations and long distances between stations. Constraining the hypocenter depth is crucial to discuss the effect of the hot ridge subduction. We conducted the second observation from 2019 to 2021 with shorter station distances. We will present the outline of new observation and the preliminary results of seismic activities.
We used 13 ocean bottom seismometers (OBS) consisting of 8 broadband ocean bottom seismometers (BBOBS) and 5 LTOBS. Two of the BBOBS were equipped with differential pressure gauges (BBOBSP). BBOBS is useful to study the long-period crustal activities such as non-volcanic tremors and low-frequency earthquakes, and also to obtaine deep seismic structure in the wide area. We deployed OBSs from January 17th to 20th, 2019 using the R/V "Mirai" operated by Japan Agency for Marine-Earth Science and Technology (MR18-06 Leg2 cruise) (see Figure). The average station interval was about 10 km, and the observation period was set as two years. The recovery was carried out from January 25th to 31st, 2021 by the Chilean Navy's General service patrol boat "Cirujano Videla". Although all 13 OBSs were successfully released from the seafloor, one BBOBS was lost unfortunately by collision with the ship’s body during recovery due to stormy weather. We retrieved the seismic data (SD card) from 12 OBSs at the Chilean navy base soon after the cruise and repacked OBS instruments for the shipping. These instruments had finally returned to the Earthquake Research Institute, the University of Tokyo in January 2022, about one year after the recovery. All 12 OBSs successfully worked for two years. We calculated noise spectrum for the data, and confirmed that the quality is equivalent to that of past observations. Although we found some troubles in the data, they did not become serious problems. Two LTOBSs had sensor troubles in the latter half of the recording period. Also, data errors for a few hours occurred on the SD card in three BBOBSs and we were required several months to recover those data.
Currently, we are detecting local earthquakes using the STA/LTA method, manually picking the P- and S-wave arrivals, and determining hypocenters. In the past 10 years, only dozens of earthquakes were detected in this study area by the global seismic network. We determined over 2000 small earthquakes in the two-years observation. Focusing on hypocenter depths determined, they are systematically different in north and south bounded at 46.4˚S, where the hot ridge subducts. We will investigate seismic activities due to the ridge subduction in detail by estimating the mechanism solution.

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