Seafloor Crustal Deformation Measurement along the Nansei-shoto Trench, Japan

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The Nansei-Shoto Trench, also called Ryukyu Trench, is located along the southeastern edge of the Ryukyu Islands, Japan. Although the Philippine Sea plate subducts beneath the Amurian (Eurasian) plate from the trench, there have been no records of destructive subduction earthquakes along the trench for the last 300?years [e.g., Ando et al., 2009]. The Nansei-Shoto Trench has been considered to be aseismic without interplate coupling [Kao, 1998]. The Headquarters for Earthquake Research Promotion, Japanese government has not evaluated long-term probability of earthquake occurrence in the Nansei-Shoto Trench region yet due to lack of information about regional characteristics of earthquake occurrence along the trench.
We performed seafloor crustal deformation measurement with the GNSS/acoustic technique at two sites along the Nansei-Shoto Trench. The first site, RKA station, is located at about 80 km to the south of the Okinawa Main Island and 45 km from the Nansei-shoto Trench axis. We measured six times at the station RKA from 2008 to 2010. The second site, RKB station, is located at about 85 km to the northeast of RKA site. We have performed the seafloor crustal deformation measurements seven times from 2011 to 2017. Three sea-bottom transponders are installed at each site. We fixed the triangular configuration of the transponders at the averaged one throughout the whole observation period to omit the trade-off between the transponder position and the estimated sound speed in the sea; then we solve the positions of the weight center for each observation epoch. We derived the averaged site velocities fitting a straight line to the time series data of the site position by means of the robust estimation method employing the Tukey’s biweight function to prevent from the effect of position bias.
The site velocities are 83+/-22 mm/y to a direction of N5+/-7W and 20+/-5 mm/y to a direction of N22+/-16W (tentative) at the RKA and RKB sites, respectively, with relative to the southern end of the Okinawa Main Island (Chinen on-land GEONET station of Geospatial Information Authority of Japan). The Daito Islands, located on the subducting Philippine Sea plate, is moving with a rate of 95 mm/y to a direction of N50W with relative to the Chinen station. The results show that there is clear contrast of interplate locking condition though the separation between the two stations is only 85 km. The RKA site remarkably moves toward the Okinawa Main Island, indicating high interplate locking beneath the site RKA; the site RKB, on the other hand, hardly has any relative motion to the Okinawa Main Island, indicating extremely low interplate locking beneath the site RKB. Short term slow-slip events [Nishimura, 2014] and very low frequency earthquakes [e.g., Nakamura and Sunagawa, 2015; Nakamura, 2017] are repeatedly observed around the site RKB. In contrast, few such events have been recognized around the site RKA that is located in the region of extremely strong interplate locking. It is considered that the difference in interplate locking condition around the present study area is related to the activities of above-mentioned strain release events around the present study area.
We have additionally installed other two stations to the southwest of site RKA in September 2016 to derive information about interplate locking condition in wider area along the Nansei-shoto Trench.

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