

Evidence for prehistoric large earthquakes in the central Ryukyu Trench ? : Tsunami sediments at the Haneji Inner Bay

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The recent finding of the asperity along the southeastern edge of the main Okinawa Island has suggested huge earthquakes have occurred on the Ryukyu Trench in the subtropic East Asia region. Since documentary evidence of seismic and tsunami events are only available for the past 300 years, long records from continuous sediments are important to clarify the frequency and magnitude.

We have undertaken echo-sounding and coring surveys in the Ryukyu archipelago for the last two years. A preliminary survey was conducted at the Haneji and Shioya bays located along the western coast of the main Okinawa Island. These have semi-closed basin due to the development of coral reefs. It was clarified that the basins were old river channels in the last glacial period and are filled with stably deposited mud layers thicker than 10 meters. Finally, we collected the sediment cores were collected using a Mackeleth piston corer in 2010 and 2012.

The lithology of the cores from the two sites showed a similar pattern, i.e., both sediments are mostly composed of light grey to slightly olived-grey silt with 5 to 10 cm-thick shell fragment assemblage layers intercalated. On the Haneji Inner Bay, the number of this intercalated layer was three at 80, 180, and 280 cm. The lower-most one is the thickest, including coral fragments and rounded pumice. On the Shioya Bay, two layers were recognized at 110 and 280 cm. The ¹⁴C dates at the bottom were 2,100 and 1,500 cal yr BP for the Haneji and the Shioya sites, respectively. A linear age-depth model demonstrated that the coral-dominant layers were formed ca. 600-800 cal yrBP, 1300-1500 cal yrBP and 2200-2400 yrBP for the Haneji site and 700-900 cal yrBP and 1400-1600 cal yrBP on the Shioya site, respectively. Hence it could be concluded that the formation emerged almost simultaneously between the two different sites.

It is well known that such layers can be formed by a typhoon or a heavy storm. However, sediments composed of homogenous silt regardless of these catastrophes have been occurred every year on the sites, suggesting that it can exclude such atmospheric events. Hence, these intercalated shell fragment layers (with coral reef fragments and rounded pumice) may be derived from open shallow sea caused by tsunami attacks.

A tsunami simulation model (the width=approx.50 km, the length=200 km, movement=20 m, M=8.5) on the Ryukyu Trench demonstrated that the maximum wave height can be around 15 meters (more than 20-m in case closed-off section of bay) along the east coast of the main Okinawa Island and 8 to 10 meters at the west coast where our sites are situated.

Our result suggests that the possible tsunami deposits found at the Haneji and the Shioya sites may have formed by past huge earthquakes on the Ryukyu Trench. Future efforts should concentrate on investigating not only the recurrence period of the past tsunami events but also the distribution of asperity along the Trench by the observation at the ocean area.

Keywords: central Ryukyu Trench, large earthquake, tsunami, tsunami sediment