

Low-frequency earthquakes triggered by teleseismic surface waves by Ryukyu subduction zone.

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We investigated low-frequency earthquakes (LFEs) in the Ryukyu Trench region that were triggered by surface waves from teleseismic earthquakes. Although these LFEs in the southwestern Ryukyu arc have previously been explored by Chao et al. (2016), their hypocenter distribution is not known in detail.

We selected 50 earthquakes from January 2004 to December 2016, which had magnitudes greater than 7.5 and epicentral distances between 9–150°. We used the waveforms of 6 broadband seismometers in the Ryukyu arc from F-net (NIED) to analyze the surface waves. We also used the waveforms of 20 short-period seismometers in the Ryukyu arc from the Japan Meteorological Agency to detect trace LFEs in Ryukyu Island and determine their hypocenters.

The LFEs in the Yaeyama and Okinawa regions were observed. In the former region, during the passage of the surface waves, spindle-shaped LFE waveforms were first observed at Hateruma (south of Yaeyama Islands), and later at other stations in the Yaeyama region. Similarly, for the latter region, during the passage of the surface waves, spindle-shaped LFE waveforms were first observed at ZMM or Tamagusuku (south of Okinawa Island), and later at other stations in the Okinawa region. These observations suggest that the sources of the triggered LFEs were near or south of Hateruma and Tamagusuku.

We subsequently determined the hypocenters of the triggered LFEs. We computed the LFE travel-time difference between two stations using cross-correlations of the waveforms (Obara, 2002). The travel-time difference of waveforms of the LFEs corresponded to travel-time difference of the S-phase because S-waves were dominant in the LFEs, and P-waves were weak. The hypocenters were determined using the grid search method (Chao et al., 2013). In the Yaeyama region, the LFE hypocenters were mainly distributed near Hateruma Island. In the Okinawa region, they were distributed south of Okinawa Island. These positions are similar to the positions of the LFE hypocenters that accompany very low frequency earthquakes (LFE-VLFEs). This suggests that faulting in a cluster of LFE-VLFEs would be active with dynamic stress change.

In the Okinawa and Yaeyama regions, LFEs are triggered when the peak ground velocity of the surface wave is greater than 0.1 cm/s. This threshold value is similar to that for LFEs in Taiwan (Chao et al., 2013), suggesting that the weak friction coefficient at the plate interface of the Ryukyu Trench is similar to that in Taiwan.

Keywords: low frequency earthquake, surface wave, Ryukyu Trench