

Seismicity on Okinawa Island around 1858, estimated from observations by a French missionary

Takuma Oda¹, *Mamoru Nakamura¹

1. Faculty of Science, University of the Ryukyus

In the middle of the 19th century, people from western countries visited the Ryukyu Islands to initiate trade with the Ryukyu Kingdom. Some of these visitors carried out weather and earthquake observations while staying on Okinawa Island, especially at Naha. Their records reveal details of historical earthquakes that were otherwise poorly recorded in the Ryukyu Kingdom era. Louis Furet, a French Missionary, visited Naha from 1857 to 1860, and undertook weather and earthquake observations at Naha during this period. The records were in French, and have now been published by Demarée et al. (2016). Using these records, we analyzed the seismicity in Naha from 1857 to 1860.

The occurrence times and intensities of earthquakes were recorded, and the intensity categorized according to the severity of the shaking as “la secousse” , “légère secousse” , “forte secousse” , “violente secousse” , and “secousse assez forte” . In one event, the shaking was recorded as “Secousse assez forte” and was so strong that cracks appeared in the houses. In this case, we estimated the seismic intensity as 5 (Japanese seismic intensity scale). When the shaking was recorded as “ Secousse assez forte” but the damage was not recorded, we set the seismic intensity to 4. Then we set “ violente secousse” , “ forte secousse” , “ la secousse” , and “ légère secousse” to seismic intensities of 3, 2, 1, and 1, respectively.

Next we estimated the epicentral distances and magnitudes of the earthquakes, using the durations of the shaking and the seismic intensity. The recorded durations of 6 events ranged from approximately 60 s to 120 s. The theoretical seismic intensity was calculated using the equation by Si & Midorikawa (1999). The duration of the ground shaking was calculated using the equation by Nojima (2014), which uses the magnitude of the event and the epicentral distance, and calculates the timespan within the seismic intensity was above the specified threshold.

The results show that seven earthquakes with seismic intensities greater than 3 were observed in 1858. In the observations by the Okinawa Meteorological Observatory at Naha, since 1923, there have been only 4 occasions when seismic intensities over 3 were observed 3 times or more within a year. Moreover, there were no years in which seismic intensities of 3 or more were recorded 7 times in a year. This suggests that the seismic activity in 1858 was very high compared with that during the last 90 years.

Moreover, for three earthquakes that occurred from September 22, 1858, to November 7, 1858, we estimated the epicentral distances and magnitudes to be 50-100 km and 5.5-6.5, respectively. These suggest that the swarm activity from September to December accompanied the maximum magnitude of class 5-6 earthquakes, which occurred far from Okinawa Island when Furet was staying at Naha.

Keywords: Okinawa, seismicity, earthquake swarm