

Learning from Earthquakes

The February 17, 1996 Irian Jaya Earthquake and Tsunami

The information in this report was collected by an International Tsunami Survey Team (ITST), consisting of scientists and engineers from Indonesia, Japan, and the USA. The team visited the affected area from March 4 to 8, 1996.

Introduction

On February 17, 1996 at 05:59 GMT (14:59 local time) a major ($M_w = 8.2$) earthquake occurred near Biak Island, Indonesia (S 0.6°, E 136.5°). It generated a deadly tsunami which reached a maximum measured height of 7.7 m. As of March 4, the official death toll from the earthquake and tsunami included 107 at Biak Island and 3 at Yapen Island. Fifty-one persons remained missing. About 100 persons were seriously injured, and 10,000 were made homeless. Biak and Yapen Islands are situated off the north shore of the Irian Jaya portion (western half) of the island of New Guinea.

Earthquake

Previous earthquakes in the area occurred in 1914 (7.9), 1957 (7.5) and 1979 (7.9). The duration time of rupture for the 1996 event was reported at 28 seconds. The Harvard "quick" CMT solution suggests a $M_w = 8.2$ low-angle thrust event in the New Guinea Trench, at 15 km depth, with a rupture length of 180 km and width of 50 km. However, USGS calculations indicate $M_w = 7.9$ and a depth of 21 km; the University of Tokyo reports $M_w = 8.0$ at a 33 km depth; and Caltech calculates $M_w = 8.1$ at 33 km depth. The Biak earthquake was followed within one day by a flurry of aftershocks featuring an unusual diversity of

focal mechanisms: thrust, normal, and strike-slip. The thrusting nature of the event suggests a complicated tectonic interaction for this region.

The epicenter was located in the Pacific Ocean north and east of Biak Island, a long, narrow strip of land (about 150 km by 30 km) which runs roughly east-west across the northern end of the Teluk Cenderawasih bay. Yapen Island, of similar size and orientation, lies about 50 km south of Biak, also in Teluk Cenderawasih.

In the village of Bosnik in eastern Biak, almost all the houses collapsed due to ground shaking. Many sand boils were observed by the ITST in this area of soft sand. In northern Biak 11 persons were killed, 183 houses collapsed, and 192 houses were heavily damaged by the shaking.

Tsunami

The earthquake generated a large tsunami, which struck the Irian Jaya coast with heights of about 5-7 meters. Reported tsunami heights include:

- 4 m at Manokwari (western New Guinea)
- 7 m at Sarmi (central New Guinea)
- 6-7 m at Korim (northern Biak)
- 3-5 m at Biak
- 7 m at Yapen Island

The tsunami caused damage as far away as Japan, where a wave height of nearly 1 m was reported and several fishing boats were washed away. A tsunami warning was issued at 17:00 local time in Japan; the first waves struck about 20 minutes later. No severe damage occurred in Japan,

although this was the largest tsunami generated by a far-field earthquake to be recorded since the 1960 Chile earthquake and tsunami.

The ITST collected information on tsunami runup heights from measurements of clear tsunami traces and from eyewitness reports. On the northern coast of Biak, facing the tsunami source, the heights were 3-5 m, the largest measured on the island. Especially large tsunamis were observed in small bays such as Korim and Waru, suggesting concentration of tsunami energy or seiche action in the bays. The eastern part of Biak is surrounded by a shallow sea with many small islands. This region, close to the tsunami source, did not experience tsunamis as great as did the northern shore.

The maximum tsunami height of 7.7 m was measured at Farusi, Wardo in western Biak, which is located on the side of the island furthest from the tsunami source. A tsunami phenomenon such as a trapped wave on a coral reef may have caused this local phenomenon.

The most severe damage due to the tsunami occurred at Korim, where the height was 4-5 meters and the inundation area about 700 m long and 400 m wide. Sixty-four of the dead and 18 missing people were reported from the area in and around Korim. About 380 homes were completely destroyed by the inundation.

Remarkable sand deposition and erosion were observed along the coast at Korim. The volume of deposited sand was estimated to be about 3,000 m³. The volume

of erosion estimated is less than that of deposition, suggesting that the tsunami transported the sand from the shallow sea bottom in the area around Korim.

In eastern Biak, local people report that the level of high tide is now 0.5 to 1.0 m higher than in the past, indicating the land in that area has subsided due to the earthquake.

To assist in planning the ITST survey, the tsunami simulation model TSUNAMI was used to estimate the probable tsunami heights along the Irian Jaya coast. Actual measurements on Biak Island compared well to the predicted values.

ITST Members

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Learning from Earthquakes

The March 28, 1996 Ecuador Earthquake

At 6:03 p.m. local time (23:03 GMT) on March 28, 1996, a Richter magnitude 5.7 earthquake struck the Ecuadoran province of Cotopaxi, about 120 km south of Quito. The epicenter was located at S 1.06° W 78.60°. A total of 70 rural communities were affected. The 27 most severely affected communities included Pujili, San Juan, La Victoria, Mulalillo, Zumbahua, Nagsiche, Pucara and Cusubamba. These communities are located at an average altitude of 3,000 m. The quake was also felt in the cities of Quito, Latacunga and Ambato, where minor damage to windows and masonry occurred.

The official reports cite 19 deaths and 58 people injured. Approximately 1,000 families have been left homeless. The majority of the housing in the affected area is built with adobe walls and heavy tile roofs. In areas of concentrated population, such as Pujili and San Juan, up to 85 percent of the housing has been totally or partially destroyed. In some of the smaller towns and villages, 100 percent of the houses collapsed, either in the main shock or in the continuing aftershocks. It has been reported that in some of the most severely damaged areas, people have begun to move en masse in search of relief. Authorities fear that this will lead to abandonment of agricultural land and will have a further negative impact on the area in the future.

Water supply systems were also affected. At least 1,000 m of water pipes, servicing 3,000 people, are damaged. Numerous small landslides occurred, blocking secondary roads. Collapsed bridges have made access to some communities impossible by land.

Learning from Non-Earthquakes

Oregonians Are Ready for an Earthquake

The following article was published in the March 22, 1996, Seattle Post-Intelligencer.

Military jets staging a mock battle rocked northwestern Oregon with a pair of thunderous sonic booms yesterday, panicking some coastal residents who thought a tidal wave was headed their way.

The booms, just before and after 9 a.m., felt like earthquakes to people from Astoria on the northern coast to Albany, 160 miles to the southeast.

Authorities in Cannon Beach,

population 1,300, activated the tsunami warning system, sending virtually the entire town to high ground. In Tillamook, the courthouse was evacuated.

The noises were caused by three Oregon Air National Guard F-15 fighter jets and two Air Force B-1 bombers that had joined a military exercise off the coast.

The jets were 100 miles offshore, said an Air National Guard spokeswoman, but atmospheric conditions apparently amplified the sound, and caused a highly unusual atmospheric disturbance.