

## Okushiri Tsunami Generated by Southwest-off Hokkaido Earthquake July 12, 1993 at Okushiri Island off the Hokkaido southwest coast

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A powerful earthquake of magnitude 7.8 occurred southwest of Hokkaido in the Sea of Japan and unleashed a tsunami that devastated nearby Okushiri Island. Strong shocks, tsunami waves, fires and mudslides claimed 230 lives including the ones missing and feared dead on the small Okushiri Island with a population of 4,700. In all affected areas, mostly in Hokkaido, the disaster killed 200 (one in Aomori), injured 236, and 34 people were missing.

### 1. Event

A powerful earthquake of magnitude 7.8 occurred southwest of Hokkaido in the Sea of Japan and unleashed a tsunami that devastated nearby Okushiri Island. Immediately after the earthquake, a tsunami struck the island, causing fires and mudslides. The number of missing and dead from the disaster stood at 230.

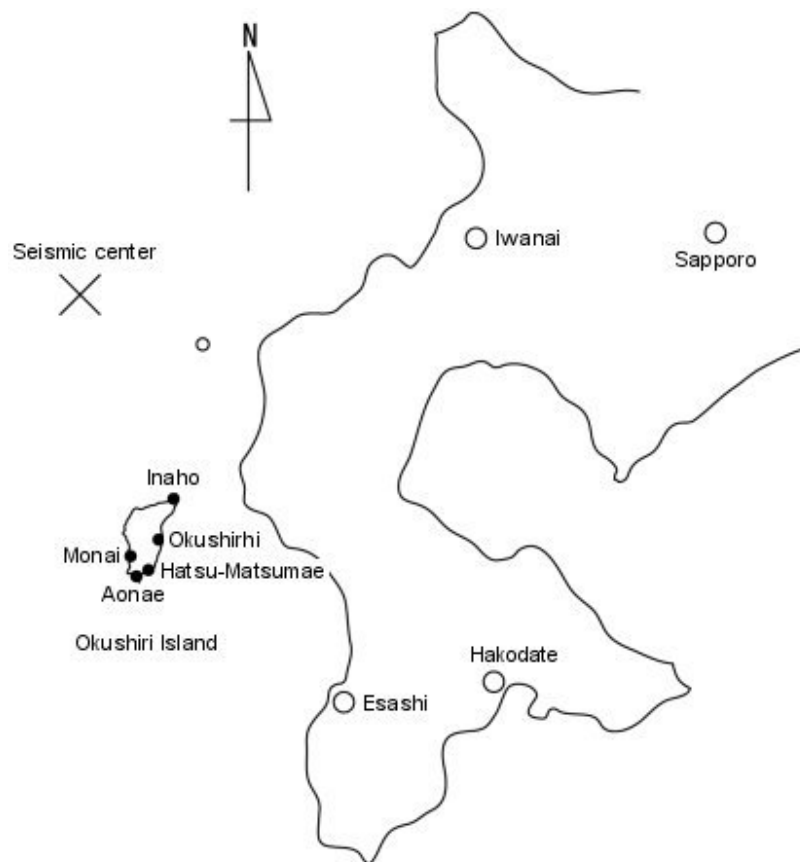


Figure 1. Seismic Center of Southwest-off Hokkaido Earthquake

## 2. Course

At 22:17 on July 12, 1993, an earthquake occurred southwest (at latitude 42.47 north and longitude 139.12 east) of Hokkaido in the Sea of Japan. The powerful 7.8 magnitude quake had its epicenter at a depth of about 34 km on the sea floor very close to the Okushiri Island (Figure 1). The island was hit by a tremor measuring 6 on the Richter scale (estimated because the island did not have a seismograph).

At around 22:20, the first wave of the tsunami struck the island, sweeping away many people and homes (385 homes out of 504) in the Aonae district of the island. Structures of 190 homes remaining after the wave attack were destroyed by the fires that engulfed the area (total 51,000 meters squared) due to broken gas lines and toppled fuel containers. The quake triggered a mudslide in the Okushiri district of the island, sending a huge chunk of mud and rocks onto a hotel. The mudslide killed 29 people including the guests staying at the hotel.

At the northern tip of the island, the tsunami waves swept the Inaho district, taking 70 homes.

About 5 minutes after the quake at 22:22, the Sapporo District Meteorological Observatory issued tsunami warning.

Among the tsunami waves that struck the coastal towns of the Sea of Japan, the ones that hit the Okushiri Island were the strongest. Waves reported variously as being between 6.7 and 30.6 meters in height swept through the coastal areas: 8.5 m in Inaho, 3.5 m in Okushiri, 16.8 m in Hatsu-Matsumae, and 6.7 m in Aonae. In the Monai district located west of the island, the wave height reached 23.2 m at the high-pitched river mouth, and 30.6 m at the inland riverfront. The highest inundation height of 11 m was observed in the west part of the island, and the lower one of 5 m in the east part of the island.

The disaster caused considerable damages including earthquake cracks, subsidence damage, destroyed structures, liquefaction of ground, and leakage of kerosene from toppled fuel containers.

The tsunami waves also struck the west part of the Oshima peninsula (located in Hi yama, Hokkaido) and Tohoku prefectures.

Photo 1 shows the devastated fishing port of Aonae, and Photo 2 the landslide in the Okushiri district.

People in the Okushiri Island had experienced a tsunami generated by the Japan Sea earthquake 10 years before, in which the tsunami struck the island 20 minutes after they felt shocks beneath their feet. 7% of the island's population, who assumed that tsunami would not reach the shore so soon, took time to evacuate and failed to escape from the waves.

The waves propagated to the island in approximately 3 minutes, which allowed enough time for the healthy young to run or cycle and evacuate safely to an elevated inland location. In response to the 1993 tsunami, 6.6 m-tall artificial ground facilities was created at the port of Aonae as evacuation and communication routes leading to an elevated inland location.



Photo 1. Devastated Aonae Port [1]



Photo 2. Landslide in Okushiri [1]

### 3. Cause

A powerful 7.8 magnitude earthquake occurred southwest (at latitude 42.47 north and longitude 139.12 east) of Hokkaido in the Sea of Japan. Because the quake had its epicenter at a depth of 34 km on the sea floor very close to the Okushiri Island, the tsunami struck the island in less than 4 minutes after the tremor, leaving no time for the people of the island to evacuate. The massive tsunami swept across the island, destroying homes and towns in an instant. It caused the most of the casualties.

The location of many homes by the seaside contributed to high toll of victims.

### 4. Immediate Action

The Sapporo District Meteorological Observatory processed data quickly and issued tsunami warning at 22:22, within 5 minutes after the quake. However, it was just the propagation time of the first wave to the southern tip of the Okushiri Island.

## 5. Countermeasure

As the disaster prevention measures, the local government constructed tide embankments, installed two tsunami sluices on a river (the sluice gates shown in Photo 3 automatically close after one-minute emergency broadcasting when a quake of magnitude 5 is detected), and reinforced slopes. For measures that help emergency evacuation, the local government created artificial ground facilities as evacuation and communication routes, distributed a disaster prevention handbook to residents, and supported individual household for purchasing emergency broadcast receiver.



Photo 3. Tsunami Sluice [1]

## 6. Summary

The tsunami-earthquake occurred in a quiet zone within a seismic gap, where fewer earthquakes had been experienced historically. The total damage caused by this tremendous disaster was the biggest in past 45 years in Japan. The disaster is called “Okushiri earthquake disaster” because the Okushiri Island received the heaviest damage in the disaster from strong shocks, tsunami waves, fires and mudslides.

## 7. Knowledge

This disaster provided a stark lesson on safety action. When we felt an earthquake, we must:

- (1) Put out the fire first,
- (2) Never go to low ground, and
- (3) Immediately escape to high ground.

Evacuation warning may arrive too late, if we wait for an official warning of a natural disaster. In this Okushiri disaster, although issued quickly after the earthquake, the tsunami warning did not arrive in time to save lives from the first tsunami wave.

## 8. Background

The Okushiri Island, so-called “Okinawa in the north”, is surrounded by deep blue water and blessed with an abundance of seafood such as sea urchin, abalone, flounder, squid and atka mackerel. Unexpectedly to all, a tsunami attacked this beautiful island rich in water resources and woods.

The 1983 southwest-off Hokkaido earthquake occurred in a quiet zone within a seismic gap, which is located between the epicentral area of the 1983 Japan Sea earthquake (magnitude 7.7) and that of the 1940 Shakotan earthquake (magnitude 7.5). It is just off the west coast of the main island where the North American and Eurasian plates collide. These three earthquakes were all caused by the Eurasian plate being subducted underneath Japan. The 1983 southwest-off Hokkaido earthquake had a scale and a focal mechanism similar to the 1983 Japan Sea earthquake. Crustal deformation caused by fault motion resulted in depression (20 cm – 80 cm) and movement (1 m – 2 m to the west) of the Okushiri Island.

## References

- [1] Administrative Association for the Hokkaido Hiyama Area, “Yomigae-ru Yume-no Shima (Reviving Beautiful Island) – Report on the Southwest-off Hokkaido Earthquake”, <http://www.hiyama.or.jp/earthqu/default.htm#saigai>
- [2] The General Insurance Association of Japan, *Jishin! Guratto Kuru Mae-ni – Jishin Saigai-no Kowasa-o Mise Tsuketa Hokkaido Naisei-Oki Jishin (Earthquake! Before Shocks Hit – Southwest-off Hokkaido Earthquake That Demonstrate the Threat)*, The General Insurance Association of Japan.