Japan Sea Earthquake

May 26, 1983 along the coast of the Sea of Japan between Akita and Aomori

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A powerful earthquake of magnitude 7.7 occurred 70 km northwest off the Oga peninsula in Akita and unleashed a tsunami that devastated 8 prefectures located along the coast of the Sea of Japan. Waves struck the coastal towns before and after a warning was issued, claiming lives of more than 100 people. The earthquake itself damaged Akita and Aomori the most, killing 4 people and destroyed structures, roads, railroads and embankments. Ground liquefaction that occurred as a result of combination of earthquake and tsunami heavily increased the damages. The disaster killed 104 people and destroyed 3,049 homes for a total of $180 billion in property damage.

1. Event

A powerful earthquake of magnitude 7.7 occurred at around noon on May 26, 1983, at the central Japan Sea 70 km northwest off the Oga peninsula. It unleashed a tsunami that devastated 8 prefectures located along the coast of the Sea of Japan and claimed lives of more than 100 people. The earthquake itself damaged Akita and Aomori the most, killing 4 people and destroyed structures, roads, railroads and embankments. Ground liquefaction heavily increased the damages in various regions. The disaster killed 104 people, destroyed hundreds of boats, and damaged 3,049 homes for a total of $180 billion in property damage.

2. Course

From the beginning of May 1983 before the tsunami-earthquake occurred, there had been several little earthquakes northwest off the Oga peninsula, including the ones measured at magnitude 5.0 on May 14 (observed magnitude 1 in Akita and Morioka), magnitude 2.3 and 2.4 on May 22.

At around noon on May 26, 1983, a strong earthquake of magnitude 7.7 occurred 70 km northwest off the Oga peninsula.

The earthquake transmitted moderate shocks of magnitude 5 in Fukaura (Aomori), Mutsu (Aomori) and Akita, and those of magnitude 4 in Aomori and Hashinohe (Aomori). It is reported that residents in various regions from Hokkaido down to Chugoku noticed tremors under their feet.

Figure 1 shows the epicenter and the intensity of the earthquake.

The earthquake generated a destructive tsunami in the Sea of Japan. The first tsunami wave took only 7 minutes after the earthquake to strike the coast of Fukaura. At 12:07, the sea abruptly withdrew away from the shore, then 8 minutes later at 12:15, it rushed back onto the shore. The first wave was followed by numbers of runups and backwashes in 10-minute cycle, raising the runup heights of the tsunami wave to the maximum 65 cm at 13:36 in Fukuhara (initially reported to be 55 cm), 53 cm at 12:08 in Oga, 194 cm

at 12:24 in Noshiro (Akita) and 82 cm at 12:42 in Sakata (Akita). The field study reported that the wave height was 5 – 6 meters along the coast between Aomori and the Oga peninsula, by 3 – 4 meters in the Okushiri Island (Hokkaido), and by 2 – 3 meters in Sado (Niigata), the Noto peninsula (Ishikawa) and Oki (Shimane).

Figure 1. Epicenter and Intensity of Japan Sea Earthquake [1]

At 12:14, the Sendai District Meteorological Observatory issued tsunami warnings for the coastline of the Sea of Japan in the Tohoku region and the Mutsu bay. However, tsunami waves had already devastated

Fukaura and Oga by the time the warnings reached the area.

The earthquake and the tsunami killed 104 people, destroyed 706 boats, and damaged 3,049 homes for a total of $180 billion in property damage. The disaster devastated 8 prefectures located along the coast of the Sea of Japan. Among the dead, 100 people were killed by tsunami waves. The earthquake caused the heaviest damage in Akita and Aomori, killing 4 people and destroyed structures, roads, railroads and embankments. Ground liquefaction heavily increased the damages in various regions.

3. Cause

The tsunami-earthquake occurred just off the west coast of the main island where the North American and Eurasian plates collide. It is likely that the earthquake was caused by the Eurasian plate being subducted underneath Japan. It is inevitable to receive structural damages to buildings, roads, railroads and embankments when an earthquake occurs. However, it is regrettable that a total of 100 of the 104 earthquake-related fatalities were caused by the tsunami.

The Sendai District Meteorological Observatory issued tsunami warnings at 12:14, but it was too late to save lives of people in Fukaura and Oga. The focal region of the earthquake was close to land, so the tsunami struck the coast very quickly after the earthquake. This resulted in the death of many people who were unable to flee in time.

Table 1. Victims of the Japan Sea Earthquake [5]

Death Caus	e	Location/Activity (Number of People)	
Total 104	Tsunami 100	Port construction site	41
		Fishing 17	
		On the sea	8
		Sight seeing	14
		Seaweed harvesting	2
		On the quay	1
		Refitting a ship	1
		Farm working	4
		Others 4	
	Earthquake 4	Shocks of the earthquake	2
		Fall of a billboard	1
		Fall of a chimney	1

The Graduate School of Engineering at Tohoku University analyzed and published an interesting document of the study on life-or-death factors. The work discussed the cause of heavy toll of lives in this disaster.

According to the study, 41 among 100 tsunami victims were working at the port construction site, 17 were fishing and 13 were children sight seeing at that time as shown in Table 1.

Based on the interviews and the news articles, the study team obtained whereabouts of 201 people (101 survived and 100 dead) at the time when the earthquake and the tsunami occurred. It found out where the

victims were, what they were doing, when they evacuated, whether or not they heart earthquake warnings, and whether or not they were swallowed up by the waves. The obtained information were then put together with the time when the waves struck the coast towns, the time when warnings were issued, the circumstances and the survival determination. Figure 2 summarizes the factors that determined survival of people in the catastrophic event.

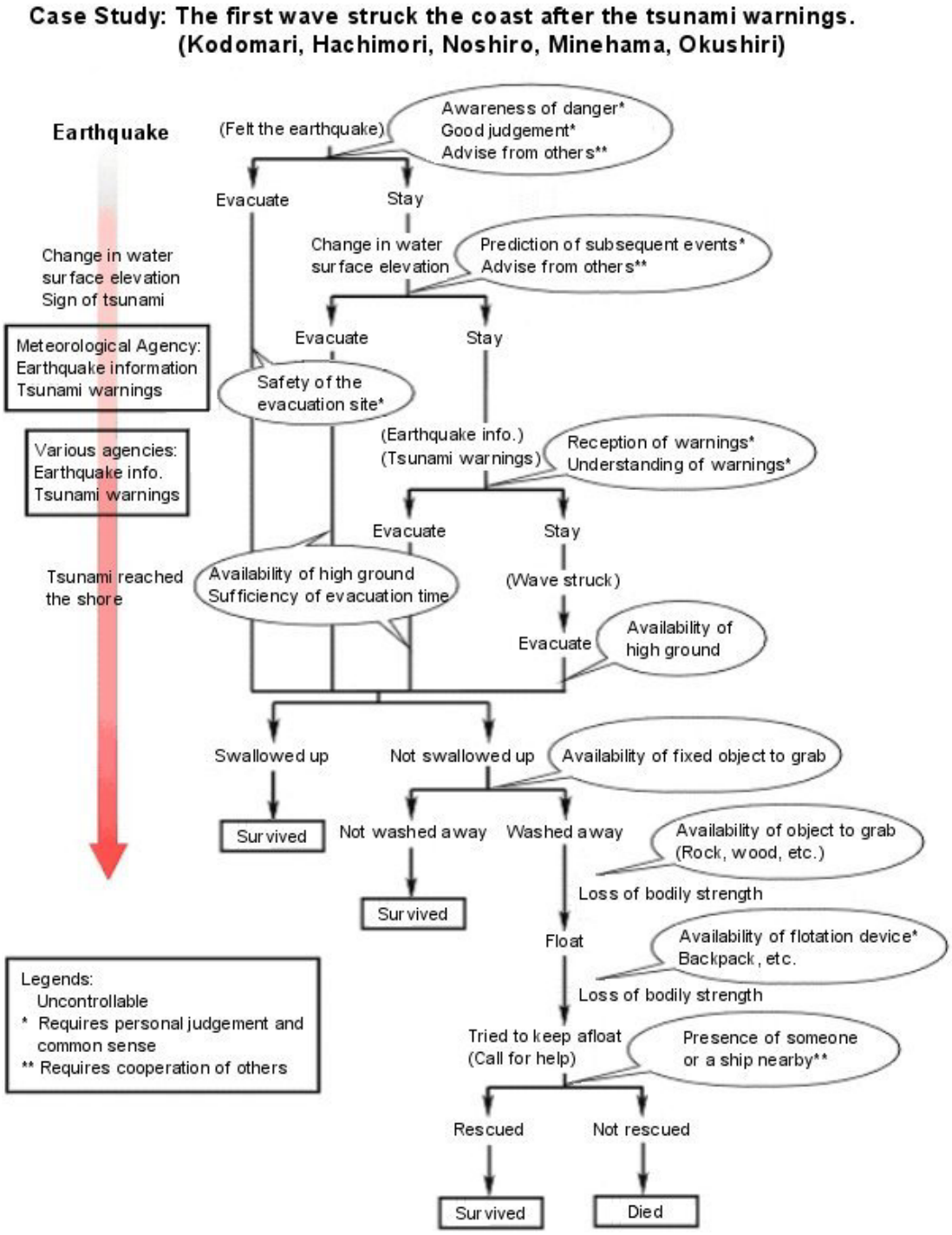

Figure 2. Life-or-Death Decisions and Factors [5]

What determined the fate of people were their actions taken before waves reached the shore, and once on the water, their strength to keep being afloat until they are rescued.

The study team found the following factors that caused a delay in evacuation:

(1) People were underestimated the power of the earthquake. (Some, including children on a field trip and those who were fishing, did not know that an earthquake occurred.)
(2) People did not expect that the earthquake would generate a tsunami. (The agency issued tsunami warnings 14 minutes after the earthquake, which gave only 7 minutes for people to escape from the first tsunami wave. Some residents evacuated to a nearby beach because they remembered that it was safe in the past earthquake disasters. Some went to check on their boats after the earthquake.)
(3) Evacuation directives were issued too late to save lives. (Concerned only about the earthquake, the port construction workers simply followed the site supervisor's instruction. People received evacuation directives too late to escape from the waves. There was no means to quickly convey evacuation directives.)
(4) People did not have a device to receive tsunami warnings. (Those who were fishing at the time)
(5) There was no safe place nearby. (People, such as those who were fishing, were on a rock or an island where a high ground was nowhere to be found.)

4. Immediate Action

To prepare for aftershocks, the Graduate School of Science, Tohoku University conducted a special observation in Oga and Gojome to further enhance the existing micro-earthquake observation network. To observe aftershock activities in all surrounding areas, Tohoku University and Hirosaki University worked together to enable processing of all data collected from each university's seismograph networks. The seismic waveform data was collected from two seismograph stations at Iwasaki and Minmaya, which are located close to the focal region, and transmitted via a dedicated circuit to Akita and then to Sendai.
Immediately after the earthquake, the Sendai District Meteorological Observatory and the Aomori Local Meteorological Observatory set up an investigation team and conducted a field study on the tsunami waves along the coast of the Sea of Japan. Figure 3 shows the direction and runups of tsunami waves measured at coastal locations indicated by numbers.

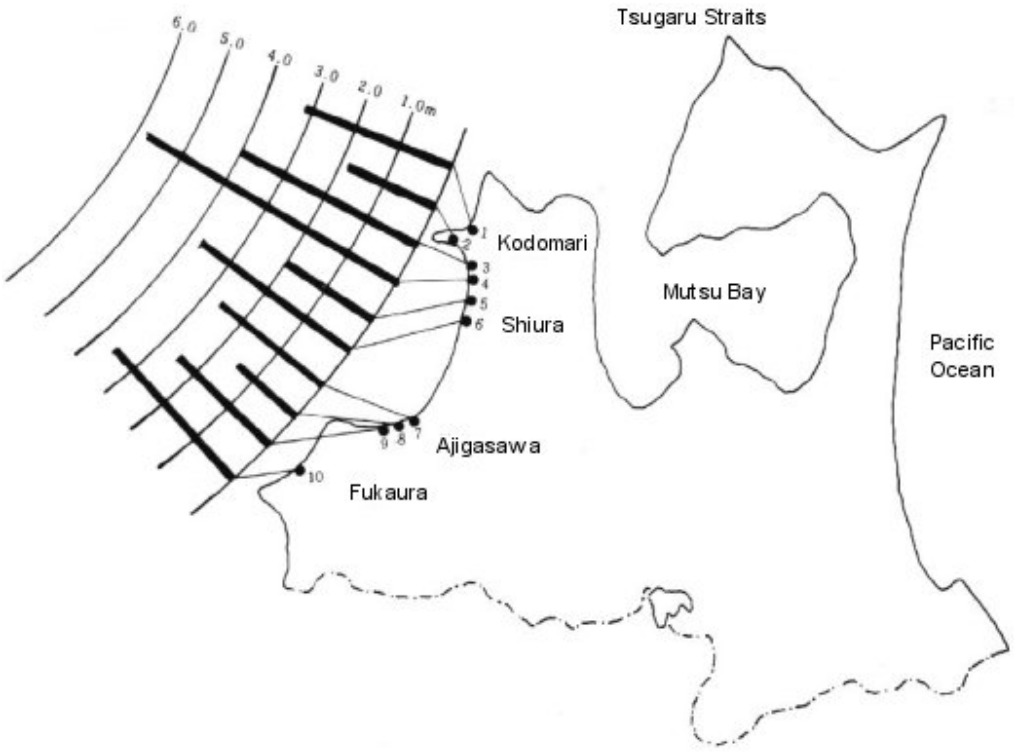

Figure 3. Direction and Runups of Tsunami Waves [1]

As shown above, the wave height of a tsunami can be highly variable in a local area depending on the underwater topography, orientation to the oncoming wave, the tidal level, and the natural period of the bay. For example, the Kodomari peninsula has two nearby ports, the Kodomari port on its north and the Shitamae port on its south. Tsunami waves that travel from the northwest will result in different wave heights at these two ports. Compare to the other ports, smaller waves were observed in Ajigasawa, which is probably because the shoreline defenses such as breakwaters were effective in weakening the magnitude of the tsunami.

5. Countermeasure

In order to prepare for a tsunami further, seven ministries, Cabinet Office of Government of Japan, National Police Agency, Ministry of Land, Japan Coast Guard, Japan Meteorological Agency, Ministry of Posts and Telecommunications, and Fire and Disaster Management Agency, had a meeting "Tsunami Keiho Kankei Syocyo Renraku Kaigi (meeting of various bureaus in government ministries responsible for the tsunami warning)" on June 1983. On July 15, the government ministries and agencies arrived at a consensus about improvement in tsunami warning system on coastal areas.

The Akita prefecture improved the system to collect and transmit information, as well as the earthquake disaster prevention and tsunami risk reduction measures.

Based on the data obtained from this disaster, the government developed the recovery plan and

implementation of liquefaction countermeasures for lifeline utilities.

6. Summary

The 1983 Japan Sea earthquake was the strongest of all that occurred on the Sea of Japan in history. The area had not have an earthquake as powerful as magnitude 5 since May 16, 1968 when the Tokachi-Oki earthquake of magnitude 7.9 occurred at the Japan Trench. Japan Meteorological Agency named this earthquake "Nihonkai-Chubu (Japan Sea) Earthquake of 1983".

In addition to the earthquake, tsunami waves caused extensive damages to the communities. A total of 100 of the 104 earthquake-related fatalities were caused by the tsunami. The resulting death toll indicates that the people failed to evacuate within the period of time between the earthquake and the tsunami.

While foreshock activity was observed beginning on May 14 in an area near the epicenter of the main shock, crisis management may not have been strong enough to prepare for the main shock and a tsunami. Local residents, who had been advised in the past to evacuate to a beach during an earthquake, failed to take an appropriate action for a rare tsunami-earthquake on the Sea of Japan.

7. Knowledge

Personal judgment, common sense and other people's action determine the fate of people in a tsunami disaster. The learned lessons are:

(1) A tsunami may strike coastal towns before tsunami warnings.

(2) An efficient and reliable means of communication is required for a better assessment of the situation.

(3) A local community must be prepared for disaster relief and rescue plan.

(4) People must know how to keep afloat on the water without needlessly exhausting themselves.

8. Background

Since the beginning of the Showa era (1926) until the 1983 Japan Sea earthquake, there had been three earthquakes occurred west off the Tohoku region in the Sea of Japan as shown in Table 2. None of them did much damage with tsunamis.

There is also the Niigata earthquake occurred off the main island in the Sea of Japan on June 16, 1964 that measured magnitude 7.5. It did not cause any damage in Aomori.

Table 2. Earthquakes Occurred West off Tohoku in the Sea of Japan during the Showa Era [1]

Date Epic	enter				Scale	Magnitude		Tsunami
L	atitude	Longitude	Depth	Area	(Magnitude)	Fukaura	Aomori	
May 1, 1939	40.1	139.5	0 km	Off Akita	6.8	4	3	Tsunami
May 7, 1964	40.3	139.0	0 km	Off Akita	6.9	4	3	Weak tsunami
Dec. 11, 1964	40.4	138.9	40 km	Off Akita	6.3	3	3	Very weak tsunami

It is also documented that in the period between September 1978 and the fall of 1979, a series of earthquakes had occurred in the town of Iwasaki located at west coast of Aomori. While earthquake swarm activities had rarely occurred in the area, such activities are documented in Omagoshi about 10 years before the powerful earthquake in Aomori and Akita. Before that in history were in 1694 (Genroku 7) and in 1704 (Hoei 1). Understanding the pattern, Hirosaki University decided to observe the area after the earthquake swarm activities calmed down. It planed to install a seismograph on the Kyuroku Island located 40 km off the town of Iwasaki in Aomori, and visited the island in 1980. However, the plan was aborted because it found that the island and surging waves did not provide desirable surroundings for observation.

References

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[5] Motoko Kaneda, et al., "Tsunami Raisyu-ji-ni Seishi-o Wake-ta Yooin (Factors Determined Survival in Tsunami Disaster) – Case Study of 1983 Japan Sea Earthquake", *Koen Gaiyoo (Summary of Lecture) at Tohoku Chapter, Japan Society of Civil Engineers*, Graduate School of Engineering, Tohoku University.