仙台湾海底遺跡発見と仙台平野を襲う巨大津波

Discovery of underwater ruin in Sendai bay and gigantic tsunami attack to Sendai plain

Tohoku-Gakuin University　Yukio Kono

1. Introduction

Sandai Jitsuroku is the official written history of governments of Nara period and Heian period, AD 710 - 1192. This is the only certain reference describing about Johgan tsunami. According to Sandai Jitsuroku, on May 26, AD 869 (the year of Johgan 11), The direct translation becomes as follows; the large earthquake struck in Tohoku area, northern Japan. Light flowed over like daytime. At this time, people started to scream and call. They could not stand up. Houses were broken down and people were killed under the houses. The earth cracked and torn, people were buried to death. Horses and cows moved around and crashed one another. Many storage houses, gates, and watching towers in the castle fell down and the walls of them were torn.

The occurred tsunami made sound as thunder. Waves and tide suddenly appear, growing, flow out, causing vortex, surging upon and finally reached the town of the Tagajo castle quickly. Several ten and hundred of leagues from the ocean became like sea and could not see the boundary of new lake. All of the roads and wilderness were under the dark blue ocean. It can be read as " 7 km from coastline to inland and 70 km from Tagajo, Miyagi prefecture to Soma, Fukushima prefecture became like sea."

2. Discovery of the submerged island

In order to search for the sunken island by the earthquake and tsunami that is a legend passed down among the fishermen around the coasts of Sendai, Shiogama, Matsushima and Shichigahama. Underwater investigation has been conducted for ten years after four years study on reference documents and the field survey. In the ocean of Tohoku area, especially in the sea off the coast the wave is violent and the water is very cold with bad transparency, and also underwater investigation is attended with danger and difficulty. Because of these reasons the area has never been investigated before.

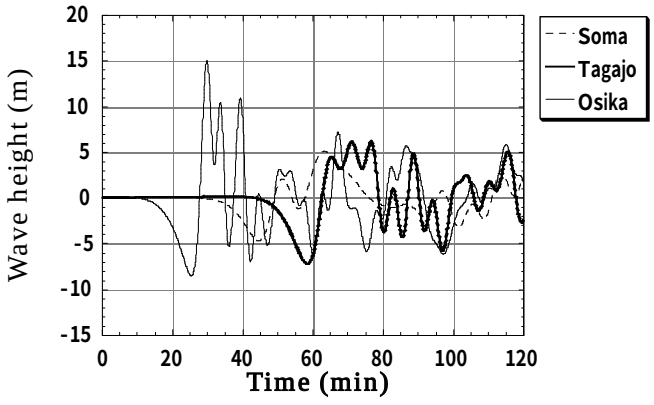

Fig.1 Model M8.2

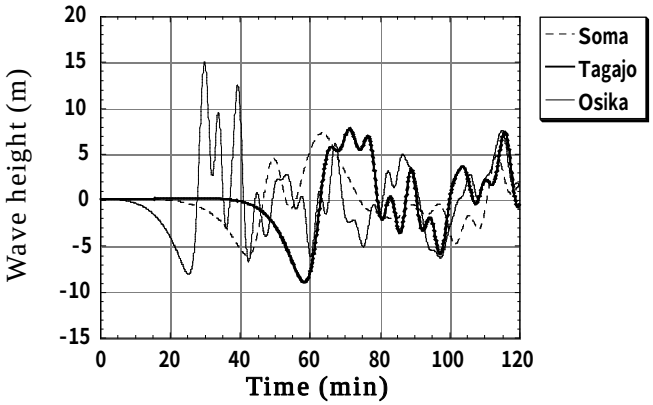

Fig.2 Model M8.3

3. Johgan tsunami model

We use the Miyagi-Ken-Oki model for Johgan tsunami basically, extending the area of origin, using the dislocation 10 and 15 m, and changing magnitude from 8.0 to 8.5 for tsunami calculation. The dislocations of 15m is used because the submerged island was found at this depth by our underwater diving research. Normal fault model is used throughout because this area is not the Japan Trench but the continental shelf.

4. Tsunami wave variation with time

Fig. 1 and Fig.2 show the tsunami wave height variation with time at three locations in Miyagi-Fukushima coastline (Oshika, Tagajo, and Soma). Fig.1 and Fig.2 are magnitude 8.2 and 8.3 respectively.

At Fig.2 of M8.3 the maximum wave height of 15 m reaches to Oshika 25 minutes after the tsunami occurrence. The maximum wave height of 7 m reaches Tagajo and Sendai area in 70 minutes after the tsunami occurrence. The maximum wave height of 7 m reaches to Soma at 65 minutes.

5. Indian ocean tsunami field research

The tsunami attacked beach side area of Chennai and the height of tsunami was from 6 m to 7 m as shown as Fig. 3. Houses from 500 m wide to several km long were completely destroyed to pieces of bricks. This size of tsunami attacked Sendai plain in AD869 and predicting in nearly future.

Fig.3 Chennnai in India

6. Conclusion

1. The lost island was found by our underwater diving research and the depth, 15 m of the found artificial structures was successfully applied to analysis as dislocation of the normal fault. 2. The result of Johgan tsunami model by using Miyagi-Ken-Oki earthquake is satisfactory. 3. The origin of Johgan tsunami must be very special and considered to be occurred in the continental shelf by the normal fault, not at the Japan Trench by the reverse fault. 4. The magnitude of the earthquake caused Johgan tsunami is considered 8.2 or 8.3 according to the result of analysis. The height of tsunsmi wave became about 7 m in Tagajo and Sendai plain according to analysis. The inundation area of tsunami shows similarity to the description of Sandai Jitsuroku which was written on May 26, AD869. 5. The result of tsunami analysis is compared with the field investigation of Indian Ocean tsunami successfully. It is predicted that the same scale of tsunami will occurred in Sendai area again.

7. References

[1] Iinuma, Y. : Historical tsunami in Sendai plain, Syobun do publishers, 1995

[2]Abe, K., Okada, Y., Shimazaki, K. and Suzuki, Y. :Earthquake fault parameters in Japan,1989.

[3] Usami, T. : New Japan earthquake damage soran , 1989

[4] Watanabe, I. : Japan tsunami damage soran , 1985.

[5]Yoshikawa, K. : Ezo shiryou, Yoshikawa Kobunkan Publishers, 1957

[6] Murakami, H. , Kono, Y. , and Imamura, F.: Numerical study on the 869 Johgan tsunami., Science and engineering reports of Tohoku Gakuin University, vol. 34 No.1, pp. 33-37, 1999

[7] Murakami, H., Kono, Y. , and Imamura, F.: Numerical study on 869 Johgan tsunami by theory in the bay of Sendai., Science and engineering reports of Tohoku Gakuin University, vol. 34 No.2, pp. 101-106, 2000

[8] Kono, Y., Murakami, H. , and Imamura, F.: Historical tsunami that occurred 1,100 years ago and underwater diving research., The Fourth International Conference on Hydro-science and Engineering, IAHR, CD-ROM, pp. 11, September 2000