

# **IMPORTANCE OF THE INHERITED MEMORIES OF GREAT TSUNAMI DISASTERS IN NATURAL DISASTER REDUCTION**

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**ABSTRACT:** The two gigantic tsunamis, the 869 Jogan tsunami and the 1611 Keicho tsunami, which had attacked the Sendai plain prior to the 2011 Great East Japan earthquake/ tsunami, are reflected. Pioneering works in the historical field by Mr. Y. Iinuma and in the scientific field by Prof. K. Minoura are introduced. To mitigate the damages by natural disaster, the knowledge on the past natural disasters occurred in an area should be properly shared by the people in that area. Necessity of the continued education on disaster reduction in schools and in regional societies is pointed out.

**Key Words:** Great East Japan earthquake, Jogan tsunami, Keicho tsunami, disaster mitigation, disaster education

## **INTRODUCTION**

The gigantic tsunami caused by the 2011 Great East Japan Earthquake gave enormous disaster to the wide coastal areas from Aomori Pref. to Ibaragi Pref. on the Pacific Ocean. The damages to Iwate, Miyagi and Fukushima Pref. were especially large. The Sanriku ria coast areas in Iwate and in northern Miyagi have been exposed to frequent attack of large tsunamis and the people in those areas have been quite aware of tsunami disasters. On the other hand, the long flat coasts in southern Miyagi and in Fukushima had few experience of large tsunami in these several hundred years, by which reason very few people there had expected the attack of tsunami before the gigantic tsunami of 2011.

However, there were persons, though a few, who anticipated the attacking of gigantic tsunami based on their works and were giving strong warning to the society. In this paper, I introduce the works of Mr. Y. Iinuma, a local historian living in Sendai, and Dr. K. Minoura, a professor of geology at Tohoku University. We can learn much from their pioneering works and get deep insight and suggestion toward the future.

## **HISTORIC GIGANTIC TSUNAMIS THAT ATTACKED SENDAI PLAIN**

The Pacific coast of Eastern Japan has been regularly attacked by big tsunamis. The recent major

tsunamis in this area since Meiji period are the 1896 Meiji Sanriku tsunami (M8.2 – 8.5, deaths 21915, missing 44), the 1933 Showa Sanriku tsunami (M8.1, deaths 1522, missing 1542). These tsunamis caused severe damage in the ria coasts of Iwate and northern Miyagi, and have left long-lasting strong memories to the people. In the flat coasts of Sendai plain of southern Miyagi and the coast of Fukushima, however, the memory of tsunami have almost vanished from the people’s mind, which is not right if we look back on the history of tsunamis in Sendai plain.

The two gigantic tsunamis that attacked Sendai plain in the past were recorded on the old historical documents.

The one is the Jogan tsunami of May 26, 869 (M8.3 according to Chronological Scientific Tables, Maruzen, Japan), which is more than 1100 years ago. It was described as follows in “Sandai Jituroku”, an authentic court chronicle in Heian period (Saeki 1940).

“The large earthquake was accompanied by a luminous phenomenon, and coastal areas were illuminated in the dark. Some time after severe seismic shocks, a gigantic tsunami reached the coast and invaded entire Sendai plain. Rising seawater flooded an old castle town (Tagajo), causing the loss of 1000 lives.”(translation by Minoura)

The person who first noticed the importance of the documents on the 869 Jogan tsunami described in “Sandai Jituroku” was Togo Yoshida (1864 – 1918), who wrote the voluminous book, “Comprehensive Dictionary of the Name of Places in Japan”, only by himself. He studied carefully in his paper the various situations of Jogan tsunami described in the paragraphs of “Sandai Jitsuroku” from the viewpoint of historical geography, and stated that there would be much more interesting findings in future if we investigated the traces of old tsunami that were left around the estuary of the rivers (Yoshida 1906). (Photo 1)



Photo 1 The paper by Togo Yoshida (1906)

The other is the Keicho Tsunami of October 28, 1611 (M8.1), which is 400 years ago. It is described in “Teizannkou Chika Kiroku” (an authentic chronicle of the Lord Date Masamune, a volume of “Date Chika Kiroku” series) as follows (Taira 1972). The tsunami occurred when the Lord Date Masamune was 45 years old.

“The large earthquake occurred in the fief on October 28 and the tsunami followed. 1783 persons were drowned and 85 cattle and horses drowned.

On November 30, Date Masamune had an audience with Tokugawa Ieyasu, and, after presenting cod as the first product to the season, he reported the situations caused by tsunami. Masamune made his man tell the following story: Just before the coming of tsunami, two warriors were about to sail out

for fishing together with fishermen by the order of Masamune. A fisherman noticed a strange change of tide and proposed the warriors not to sail out. One warrior accepted the advice. But the other warrior dared to sail out because he could not disobey the order of the lord. Soon the large tsunami came and their ship was tossed about severely. Finally the ship went aground up to the mountain nearby and they tied the ship to a pine tree there. After the tsunami ended, they returned to the port to find that all the people who stayed were drowned. The pine tree, the top of which the ship was hung down, was called “Sengan Matsu” (Pine of a Thousand Kan (Money Unit)”. An ancient transmission much older than Keicho tsunami states that a ship was once tied to a cedar tree in that mountain.”

Akitsune Imamura (1870-1948), a seismologist at the University of Tokyo, published a paper just after the 1933 Showa Sanriku Tsunami, in which he made a survey on the past large tsunamis in the Sanriku coast including Jogan and Keicho tsunamis and stated that the 1611 Keicho tsunami would be larger in scale than the 1896 Meiji Sanriku tsunami (the largest tsunami ever recorded at that time).



Photo 2 Date Chika Kiroku (Sendai City Museum)

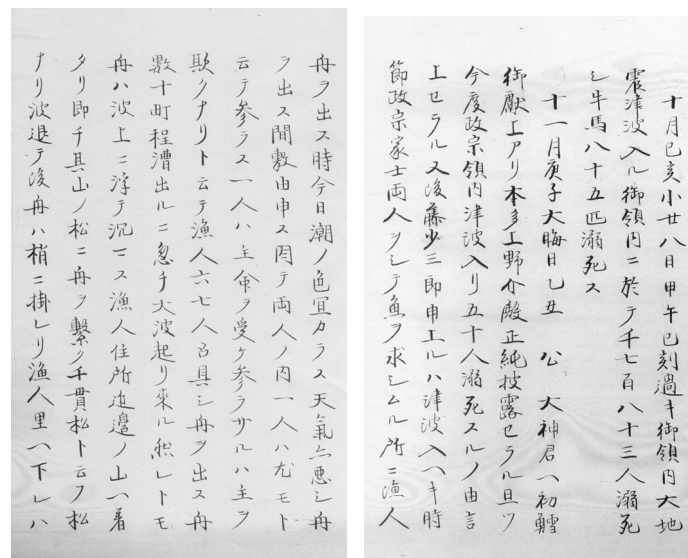


Photo 3 Description on Keicho Tsunami (Teizankou Chika Kiroku)

Photo 2 shows the original of the whole “Date Chika Kiroku” including “Teizankou Chika Kiroku” and Photo 3 shows a part of the description on the 1611 Keicho tsunami.

“Sengan shrine” referred in the old document still exists in Iwanuma city. It is located about 7km from the present coastline which is a little far and the discussions have been made on the reliability of the description about the story of “Sengan Matsu”.

A similar description in contents to the one in “Teizankou Chika Kiroku” is also found in “Sunpu Ki” ( the diary about the affairs in Sunpu Castle (home of Tokugawa Ieyasu) from 1611 to 1615) and was often quoted in the previous studies.

## RESEARCH ON HISTORIC TSUNAMIS BY MR. YUGI IINUMA

Mr. Yugi Iinuma, a local historian living in Sendai, has long been studying the gigantic tsunamis which attacked Sendai plain and published his research results as a book, “Historic Tsunamis in Sendai Plain – Gigantic Tsunami Will Attack Sendai Plain Again!”, in 1995, 16 years ago, from a local publisher Hobundo in Sendai (Iinuma 1995). (Photo4)

He studied especially two tsunamis, the 869 Jogan tsunami and the 1611 Keicho tsunami, and investigated persistently the legends and transmissions on old tsunamis that have been left in local areas, the results of which were included in his book. He himself suffered from the tsunami this time and had to live in refuge house for two months, during which he published a new book, “3.11, We Shall Never Forget the Day” (Iinuma 2011).

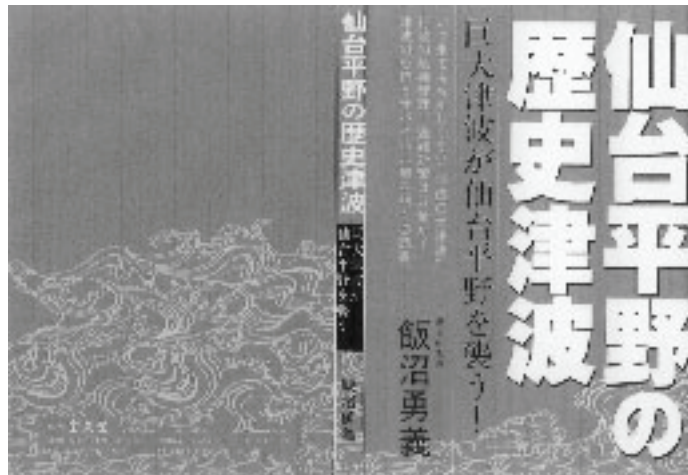


Photo 4 “Historic Tsunamis in Sendai Plain” by Yugi Iinuma (1995)

The legends on the 869 Jogan tsunami have been handed down up to the present in various forms.

The spot “Sue no Matsuyama”, a small hill in Tagajyo city adjacent to Sendai city, is famous from olden times as a place of poetical association. This spot has long retained the ancient memory of Jogan tsunami that even the big tsunami wave had not overflow that hill.

A well-known poetry by Kiyohara no Motosuke (908 – 990, father of Seisho Nagon (a famous female essay writer)) is as follows.

“Chigiri ki na katami ni sode wo shibori tsutsu,  
Sue no Matsuyama nami kosa ji to wa”

(Didn't we promise each other, while weeping until our clothes were wringing wet, that like the Tsunami never flows over the top of the Sue no Matsuyama, we would always be true to each other?)

The above poetry is included in the popular ancient anthology, the “Ogura Hyakunin Isshu” (the Ogura Anthology of One Hundred Tanka Poems by One Hundred Poets. -).

At present, two old big pine trees soars on the hilltop of “Sue no Matuyama” and the tsunami of 2011 hardly reached there. Photo 5 shows the trace of tsunami wave in 2011 at the hoot of the hill.

The following is the old legend “Kosaji Monogatari” (Tales of Kosaji) related to the large tsunami and “Sue no Matuyama” that has been handed down in Tagajyo area from ancient times.



Photo 5 Sue no Matsuyama (Mark of the 2011 tsunami)

The village of Yawata in Tagajyo was a prosperous area with “Thousand Shops in Uptown, Thousand Shops in Downtown”. There was a bar shop in the village and a black chimpanzee of heavy drinker frequently visited there. He paid his drink money by his blood, because his blood could be sold by high price as the medicine for eternal youth. The evil wife of the bar came to think of killing the black chimpanzee to take the whole blood of him. A kind-hearted young maid of the bar, named Kosaji, happened to hear the wife and her husband discuss their plan of killing the chimpanzee and taking all the blood.

When the black chimpanzee visited the bar again, Kosaji advised him not to come again telling the wicked plan by them. The chimpanzee answered that he was very thankful for her advice but he could not stop drinking here, and continued that if he was killed, the big tsunami would attack here within three days, and then you should escape to Sue no Matsuyama in the west where you would be quite safe.

One night the black chimpanzee appeared in the bar again and the wicked wife tempted him into the back room. She forced him heavy drinking, stabbed him to death to take his fresh blood and threw the dead body away to the pond nearby.

Next morning, Kosaji saw the black clouds moving fast in the east sky and, intuitively perceiving the big tsunami, she ran and ran to Sue no Matuyama hill. No Sooner than she got to the hill, the giant tsunami came surging with the violent sound and all houses, people and farms were swallowed by angry waves. It is said that Kosaji, who narrowly escaped from death by Sue no Matuyama, went to Kyoto afterwards and died there as a nun.

In olden times, infectious diseases inevitably prevailed after the attack of large tsunamis and we can infer the same for the Jogan tsunami.

There is an old Sinto shrine named “Suzumine Jinjya” (Shrine on the Hill of Clean Water) on top of the hill in Natori city next to Sendai city. (An ancient mound of large scale named “Raijinnyama Kohun (from the end of 4C to the beginning of 5C) is located very near, which means that the area had been civilized from very early ages.) The old document of the shrine’s history describes the following story. The shrine was settled one year after the Jogan tsunami and had the origin in Okayama. At that time the bad infectious diseases prevailed around there and people suffered greatly. So they settled a shrine by bringing the god famous for treating disease from Okayama. Their prayer reached to the god and the diseases ended. The story does not mention on the tsunami at all but we can infer the relation with Jogan tsunami in it. Suzumine shrine gave me the solemn feeling of long untold history when I visited there. (Photo 6)

On the both sides of the mouth of Natori river where the damage by tsunami was most severe in the 2011 tsunami, there are two old shrines, the one in Yuriage on the left shore and the other in Hujizuka



Photo 6 Suzumine Shrine (Natori city)

on the right shore. The both shrines have the similar legend that the statue of god on the raft of wisteria vine was washed ashore. According to Mr. Iinuma, this is considered to be the legend associated with the Jogan tsunami or much older tsunami.

We can also find many legends related to 1611 Keicho tsunami in various parts of Sendai plain. There is a small shrine named “Namiwake Jinjya” (Shrine of Dividing Waves) in Kasuminome in Sendai city, about 5 km from the coast. The legend says that Keicho tsunami reached to that point and went back in two directions. According to the board hung in the shrine telling the history, the shrine was moved to the present place some time after the Keicho tsunami and there had been several tsunamis before it was moved. (Photo 7)



Photo 7 Namiwake Shrine (Sendai city)

In Nagamachi in Sendai city, there is a shrine named “Tako Yakushi” (Shrine of Octopus). The legend in the shrine says that the statue of Kannon (Goddess of Mercy) clung by octopus was washed ashore by tsunami and they built the shrine to worship the Kannon as Yakushi Nyorai (God of Medicine). Though it is not explicitly told, we can feel the fact of tsunami disaster behind this legend.

There is a legend about the two small hills, Nirayama and Manekimata, in Shobutahama, Hichigahama machi, in the eastern part of Tagajyo city. At the time of Keicho earthquake, the people who escaped to Nirayama could not climb the steep hill in time and were all drowned, while those who

escaped to Manekimata were all safe. Since then they called the hill as Manekimata that means “the Inviting Place”. It is to be noted that many people escaped safely to Manekimata hill also in the 2011 tsunami.

Mr. Inuma shows many other examples of the legends and transmissions related to tsunami. It is to be pointed out that tragic memories on tsunami disasters tends to be driven out of our consciousness and important historical facts have often been buried.

After the 1611 Keicho tsunami, Date clan promoted strongly the new development of rice fields which had once been surged over by tsunami and covered by sand and mud. But any description or referring concerning tsunami disaster and restoration after tsunami are not found in the authentic records of Date clan afterwards.

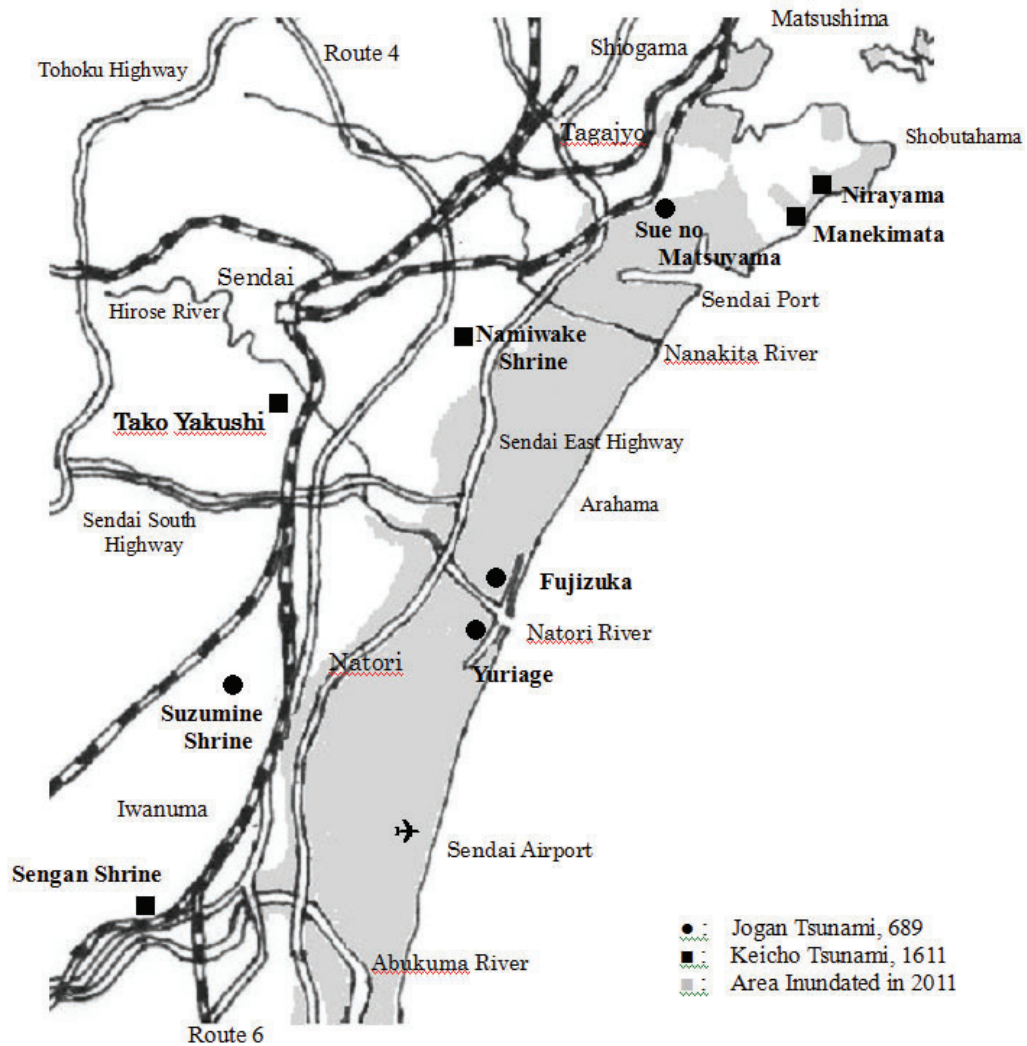


Fig. 1 The legendary spots in Sendai plain concerning old tsunamis and the inundated area in 2011

Mr. Inuma thought based on his research on the historical and legendary evidences on tsunami that the return period of gigantic tsunami would be about 1000 years and that of large tsunami would be about 200 years. However, the 400 years from Keicho tsunami to the present was a long blank period, and the memory of the society on tsunami had been wiped out as the time passed, which was his keen concern and anxiety. He presented a petition to the then governor of Miyagi prefecture Mr. Asano and the then mayor of Sendai city Mr. Fujii on the urgent necessity of preparing the countermeasures for

large tsunami in Sendai plain, the content of which was shown in his book published in 1995. His anticipation became a reality. I would like to pay deep respects to his foresight and passion for historic tsunami research.

Fig.1 shows the points related to tsunami legends in Sendai plain together with the rough sketch of inundated areas in 2011. In the 2011 tsunami, the Sendai east highway behaved effectively as the protective for tsunami waves. In the older large tsunamis of the past, the tsunami waves would have gone into much inner areas.

### GEOLOGICAL RESEARCH ON OLD TSUNAMIS BY PROF. KOJI MINOURA

In 2001, Professor K. Minoura at the geological department of Tohoku University contributed an essay in the publicity magazine of Tohoku University “Manabi no Mori” (Forest of Studies), in which he explained about the past three gigantic historic tsunamis that invaded the Sendai plain in these 3000 years based on his research on sediment layers, and strongly warned to the public the coming of huge tsunami in the future (Minoura 2001).

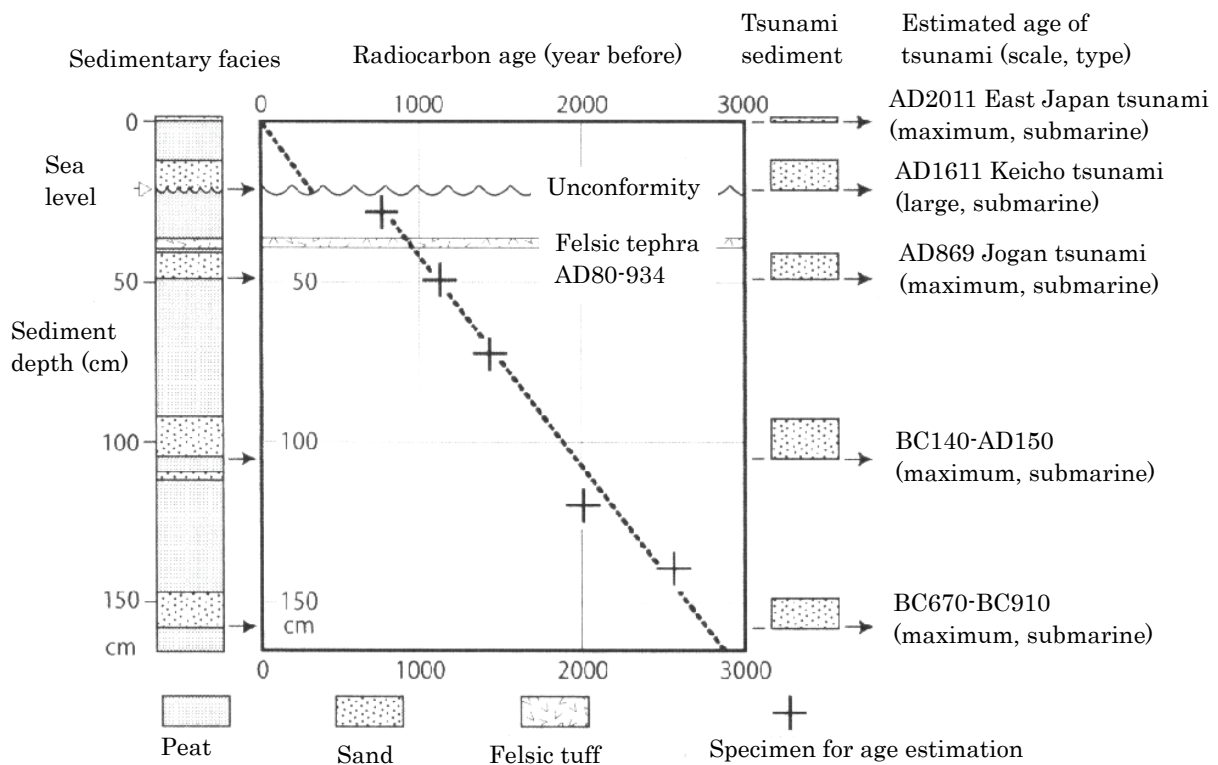


Fig. 2 Sediment layers left by tsunami in Sendai plain (adapted from Minoura 2011)

Prof. Minoura published a paper in the Journal of Geology in 1991 on the analysis of layered deposits produced by tsunamis in Tsugaru, Aomori Pref. and in Sendai, Miyagi Pref. In this paper, he pointed out the existence of two sediment layers in Sendai plain by the old historic tsunamis under the sand sediment by the 689 Jogan tsunami, and the ages of the two old tsunamis were estimated as BC 140 – AD 150 (about 2000 years ago) and as BC 670 – BC 910 (about 3000 years ago), respectively.

The thickness and the special distribution of sand deposits of the two old tsunamis were almost the same for the Jogan tsunami. Hence, it was inferred that the three gigantic tsunamis attacked Sendai plain during 3000 years and that the average return period of gigantic tsunami in Sendai plain would be 800 – 1000 years. The sand deposits corresponding to the 1611 Keicho tsunami were also found



and the thickness and the special distribution were identified, which were almost comparable to those for the old three gigantic tsunamis, though the size of the Keicho tsunami was evaluated to be a little smaller than the three older ones considering the spatial distribution of the deposits. The sand deposit corresponding to the 2011 East Japan tsunami was also confirmed but the thickness was very small compared to the old ones, which is considered due to the artificial changes in the environment of coastal areas. (Minoura 1991) Prof. Minoura stated in his paper that “Will the dwellers in the coastal areas of the Sendai Plain be secure from a serious tsunami disaster for the next four hundred years?”

After the 2011 East Japan earthquake, he contributed an article for the magazine of seven national universities, “Gakusikai Geppou”, No. 890, on his past tsunami trace research and the 2011 gigantic tsunami (Minoura 2011). (Fig. 2)

Mr. H. Abe et al at Tohoku Electric Power Company made a field research on the tsunami traces in Sendai plain and published a paper entitled “Estimation of the Height of the Sanriku Jogan 11 Earthquake - Tsunami (A.D. 869) in the Sendai Plain” in “Zisin 2” (the Journal of the Seismological Society of Japan. 2nd ser.) . (Abe 1990)

They adopted the investigation method that had been used by Prof. Minoura for the research on sediment layers in Lake Jusan in Aomori Pref. (Minoura 1987). They dipped the test pits and observed the soil layers of the side wall minutely to find the sand layers brought by tsunami. The chemical analysis and the measurement of the age by  $^{14}\text{C}$  method were also adopted. It was concluded from the results of investigation that the inundated area is about 3 km from the coast line and that the height of Jogan tsunami was estimated to be 2.5 – 3m at the general area in Sendai plain and several meters higher than that at the coast line. It was also checked that the results obtained from the scientific study were not inconsistent with the descriptions which appeared in the old documents “Sandai Jitsuroku”. The information obtained in this research was effectively utilized in the planning and design of Onagawa Nuclear Power Plant No.2 and thereafter.

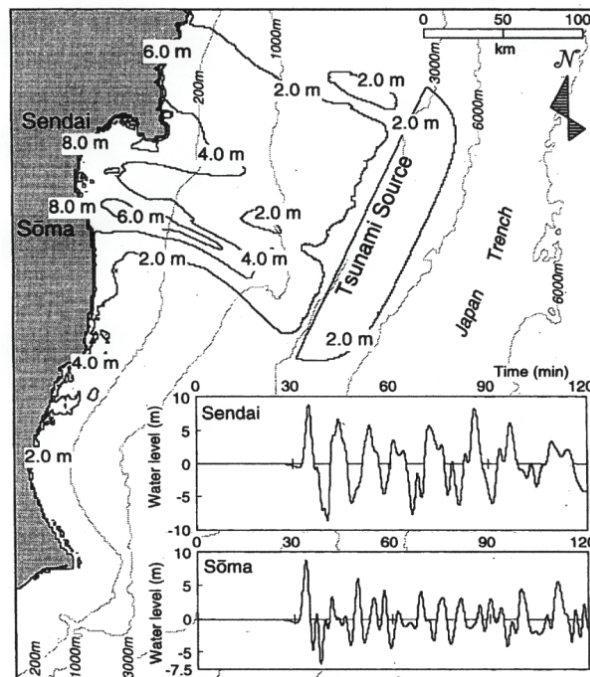


Fig. 3 Computer Simulation of the Jogan Tsunami

In 2001, Prof. Minoura and Prof. F. Imamura at the Disaster Control Research Center, Tohoku University, published a paper on the computer simulation of Jogan tsunami in the Journal of Natural Disaster Science, and estimated the height of tsunami at the shore of Sendai plain as 8m by the numerical simulation based on the proposed Jogan tsunami model (Minoura et al. 2001). (Fig.3)

In 2007, the research group at the National Institute of Advanced Industrial Science and Technology made an extensive investigation on the sediment layers left by Jogan tsunami in Sendai plain and estimated the return period of gigantic tsunami in Sendai plain to be 600 – 1300 years (Sato et al. 2007)

From 2005 to 2007, the Ministry of Education, Culture, Sports, Science and Technology conducted a research program, “Intensive Research and Measurement on Miyagi-Ken-Oki Earthquake” under the collaboration of three institutes, that is, the Science Department of Tohoku University, the Earthquake Research Institute of the University of Tokyo and the National Institute of Advanced Industrial Science and Technology. In this research program, Prof. T. Imaizumi et al. conducted the research on the sediment layers left by the past tsunamis in the broad areas from Sanriku coast to Jyoban coast, in which the traces of the 689 Jogan tsunami were also found in Soma city and Namie city in Fukushima Prefecture, the place of Fukushima Daiichi Nuclear Power Plant (Imaizumi 2007).

As seen in the above, the researches on the Jogan and other old tsunamis had recently been conducted extensively, bringing many scientific findings to us, prior to the 2011 Great East Japan Earthquake and Tsunami Disaster.

### **NECESSITY OF EDUCATION ON NATURAL DISASTER IN SCHOOLS AND REGIONAL SOCIETIES**

In order to mitigate the damage by natural disaster, the essence of historical and scientific knowledge on the great natural disasters occurred in a local area should be properly shared by the people living in that area. The education in primary schools is of most importance. Children acquire the knowledge concerning the area they live by the side readers edited by the localities. Sendai City published two side readers, “Our City Sendai” for social studies and “Nature of Sendai” for science studies.

The “Our City Sendai” includes three pages concerning earthquake disaster prevention (tsunami not referred). The related section describes the emergency things stored in school against earthquake, the various actions of city office just after the earthquake, and the preparations of the society against the anticipated earthquake, such as the seismic diagnosis and retrofit of the buildings, the disaster drill and training, the preparation stocks for earthquake emergencies in city centers and community centers.

“Nature of Sendai” includes two pages concerning the earthquake and the damage. The related section describes the 1978 Miyagiken-Oki earthquake that gave severe damage to Sendai and around, the seismic retrofit of schools, the mechanism of earthquake occurrence (interplate and intra-plate earthquakes), and the explanation of the seismic intensity by the Japan Meteorological Agency.

The Sendai City Board of Education is presently working to revise side readers for the next year by increasing largely the parts for earthquake safety including tsunami. The appropriate texts to be used for the education on earthquake disaster reduction in primary schools should be different according to the areas and should have their own unique characteristics taking account of the special features of the locality of the earthquakes and the disasters caused by them, which have left long inherited memories of the tragic events in every area of Japan. The same should be for the other natural disasters.

To promote the earthquake disaster mitigation, the continued efforts of local communities to spread the knowledge on earthquakes and disaster prevention is also very important. There have been many activities for this purpose all over Japan. To show an example, the Yagiyama liaison council for disaster prevention is a committee by the resident groups, the primary, secondary and high schools as well as various institutions such as zoo, play land and police stand in Yagiyama area in Sendai. It was organized in 2010 headed by Prof. R. Tanaka, Tohoku Institute of Technology, and 33 groups are now participating in it. It has four sectional meetings, that is, mutual aid, safe and pleasant town, disaster medical network, and youth/children. The Yagiyama Civic Center of Sendai city and the Local Safety Center of Tohoku Institute of Technology, of which campus is located in that area, support its activity. Catering lessons on earthquake safety, easy seismic diagnosis of wooden houses and other activities have been provided by the Local Safety Center. The collaboration of the specialists in earthquake engineering and the local society has to be promoted further.



Photo 8 Description on earthquakes and disaster prevention in the sub reader “Our City Sendai”

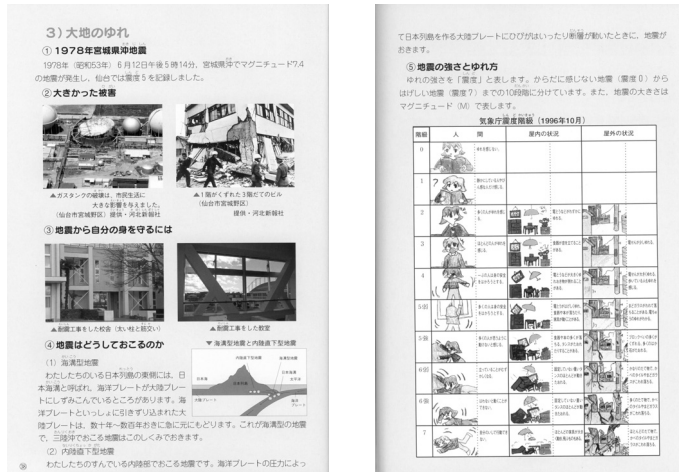


Photo 9 Description on earthquakes in the sub reader “Nature of Sendai”

## CONCLUSIONS

Preceding information on the past gigantic tsunamis had already existed around us with a variety of faces before the occurrence of the 2011 Great East Japan Earthquake. Many important knowledge and findings had been accumulated. In Tohoku University, the Tsunami Engineering Section of the Disaster Control Research Center was working so actively for the knowledge transfer on tsunami disaster and the education on tsunami disaster prevention. However, our society could not have the time and the foresight to accept the information properly and build up the social system safe for gigantic tsunami.

After 1100 years from Jogan tsunami and 400 years from Keicho tsunami, the maximum gigantic tsunami attacked us again, causing the complete destruction of the wide coastal areas along the Pacific coast in East Japan and the unprecedented disaster of Fukushima Nuclear Power Plant.

The serious examination of all the events occurred and the influences followed after the Great East Japan Earthquake and Tsunami has to be promoted continuously. Above all, the education to inherit the memories of natural disaster to children at schools and societies is most important.

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