The effect analysis of 1741 Oshima-Oshima tsunami in the West Coast of Japan to Korea

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1. Introduction

On March 11th, 2011, a tremendous earthquake and tsunami occurred on the west coast of Japan. After this extreme earthquake and tsunami, tsunami became a major external event in nuclear power plant in Korea. But there are very few tsunami records in Korea. Therefore, it is very difficult to determine and assessment for tsunami hazard.

For determining a tsunami risk for NPP site, a development of tsunami hazard is one of the most important. Through the tsunami hazard analysis, a tsunami return period can be determined. For the performing a tsunami hazard analysis, empirical method and numerical method should be needed. Kim et al [2010], already developed tsunami hazard for east coast of Korea for the calculation of tsunami risk of nuclear power plant. In the case of tsunami hazard analysis, a development of tsunami catalog should be performed. In the previous research of Kim et al [2010], the maximum wave height was assumed by the author's decision based on historical record in the annals of Chosun dynasty for evaluating the tsunami catalog.

Therefore, in this study, a literature survey was performed for a quantitative measure of historical tsunami record transform to qualitative tsunami wave height for the evaluation of tsunami catalog.

2. Historical Record about 1741 Tsunami

There are 5 tsunami record can be founded in the annals of Chosun dynasty. One of the tsunami record are shown in Figure 1.

Figure 1. 1741 tsunami record in the annals of Chosun dynasty

Table 1 summarized that the tsunami record which can be found in the annals of Chosun dynasty. And Figure 2 show a historical tsunami record which considered in stress test for Kashiwazaki Kariwa nuclear power plant in Japan. There is no same tsunami record in two historical tsunami records between Korea and Japan. There is only one same tsunami record can be founded which occurred in 1741 but both tsunami records are not coincidence in occurrence date.

Table 1. The historical tsunami records which founded in the annals of the Chosun dynasty

Date	*Location*	*Historical Record*
1643. 6. 21.	Ulsan	Big waves reach to a 12 steps from a seashore
1668. 7. 25	Cheolsan	Waves were very high and an earthquake happened.
1681. 6. 24	Yangyang	Sea water drawdown to 100 steps from a seashore
1702. 11. 28.	Gangwon	Tsunami run up at the east coast of Korea, so many houses were inundated
1741. 7. 19	East coast	The sea level decreased and inundated to the nine villages of east coast of Korea. Many houses and fishing boats were destroyed.

発生 年月日 元号	震央位置 [注1] （緯度・経度）	地震 規模 M [注1]	津波 規模 m [注2]	地震・津波の概要 [注3]
701.5.12 大宝 1	若狭湾	－	－, － [2]	丹波　地震うこと３日。若狭湾内の丹海郷が海に没したという「冠島伝説」があるが疑わしい。
850.11.27 嘉祥 3	山形県沿岸 39.0° N 139.7° E	≒7.0	2, － [2]	出羽　地裂け，山崩れ，国府の城柵は傾頽し，山裂け圧死者多数。最上川の岸崩る。海水は国府から 6 里(3km)のところまで迫った。
863.7.10 貞観 5	新潟県沖	－	－, － [2?]	越中・越後　山崩れ谷埋まり，水湧き，民家破壊し，圧死者多数。直江津付近にあった数個の小島，この地震のために壊滅したという。
887.8.2 仁和 3	新潟県南部沖	－	－, － [2]	越後で津波を伴い，溺死者数千という。京都有感。越後に関する史料の信憑性不十分。
1092.9.13 寛治 6	新潟県沖	－	－, － [2?]	越後　和崎～岩船間の沿岸，海府浦・親不知大津波におそわる。「地震」とある古記あるも，地震の状況を記した古記録未発見。疑わしい。
1341.10.31 興国 2	青森県西部沖	－	－, － [3?]	青森県西方沖　『東日流(つがる)外三郡誌』によれば，朝地震とともに三丈余(9m)の津波が津軽半島の十三湊を襲い 26,000 人が溺死したとある。最近発見された古文書であるが，疑問視する人もいる。
1614.11.26 慶長 19	新潟県南部沖	－	2, － [2]	従来，越後長岡沖の地震とされていたもの。大地震の割に史料が少なく，震源については検討すべきことが多い。京都で家屋・社寺などが倒壊し，死 2，傷 370 という。京都付近の地震とする説がある。
1741.8.28 寛保 1	北海道南西沖 41.6° N 139.4° E	6.9	3, － [3.5]	渡島西岸・津軽・佐渡　渡島大島この月の上旬より活動，13 日に噴火した。19 日早朝に津波，北海道で死 1467，流出家屋 729，船 1521 破壊。津軽で田畑の損も多く，流失潰家約 100，死 20 余。佐渡・能登・若狭にも津波。
1792.6.13 寛政 4	北海道西方沖 43¾° N 140.0° E	≒7.1	2, － [1]	後志　小樽から積丹岬辺で有感，津波あり。忍路で港頭の岸壁崩れ，海岸に引き揚げていた夷船漂流。出漁中の夷人 5 人溺死。美国でも溺死者千。
1833.12.7 天保 4	山形県沖 38.9° N 139.25° E	7½±¼	2, － [2.5]	羽前・羽後・越後・佐渡　地震被害は山形庄内地方で最も多い。海野浜～鼠ヶ関間で最も激しい津波，局地的に 7～8m に達した。波源から遠い輪島中心部に津波遡上。
1940.8.2 昭和 15	北海道西方沖 44.15° N 139.28° E	7.5	2, 2 [2]	神威岬沖　震害はとんどなく，津波による被害が大きかった。波高は，羽幌・天塩 2m，利尻 3m，金沢・宮津 1m，天塩河口で溯死 10。
1964.6.16 昭和 39	新潟県沖 38° 22.9′ N 139° 12.9′ E	7.5	2, 2 [2]	新潟県沖　【新潟地震】新潟・秋田・山形の各県を中心に被害があり，死 26，家屋全壊 1960，半壊 6640，浸水 15298，その他船舶・道路の被害も多かった。津波が日本海沿岸一帯を襲い，波高は新潟県沿岸で 4m 以上に達した。粟島が約 1m 隆起した。
1983.5.26 昭和 58	秋田・青森県沖 40° 21.4′ N 139° 4.6′ E	7.7	2.5, 3 [3]	秋田県沖　【昭和 58 年日本海中部地震】被害は秋田県で最も多く，青森・北海道がこれに次ぐ。日本全体で死 104(うち津波によるもの 100)，傷 163(同 104)，建物全壊 934，半壊 2115，流失 52，一部破損 3255，船流没 255，流失 451，破損 1187。津波は早い所では津波警報発令以前に沿岸に達した。石川・京都・島根など遠方の府県にも津波による被害が発生した。
1993.7.12 平成 5	北海道南西沖 42° 46.8′ N 139° 11.0′ E	7.8	－, 3 [3]	北海道南西沖　【平成 5 年北海道南西沖地震】地震に加えて津波による被害が大きく，死 202，不明 28，傷 323。特に地震後間もなく津波に襲われた奥尻島の被害は甚大で，島南端の青苗地区は火災もあって壊滅状態，夜 10 時すぎの闇のなかで多くの人命，家屋等が失われた。津波の高さは青苗の市街地で 10m を越えたところがある。

Figure 2. Historical tsunami record which considered in a stress test in Japan [TEPCO, 2012]

3. Literature survey about 1741 Tsunami in the west coast of Japan

Few researches about 1741 Tsunami in Japan can be found in literature survey. Satake [2007] studied about 1741 tsunami. Satake [2007] reveals that the 1741 tsunami was volcanic origin. August 28, 1741 of Japanese historical records were a solar calendar and the July 19, 1741 of the annals of the Chosun dynasty was a lunar calendar were described in Satake [2007] research. Therefore different two tsunami events which were recorded in Korea and Japan's history were a same tsunami event (Fig. 3). In Satake's research, the tsunami wave height of east coast Korea was summarized based on Japanese historical record (Fig 4).

Figure 3. The eruption of Oshima-Oshima and the tsunami on the Hokkaido coast on August 29, 1741 (1st year of Kampo, 7th month, 19th day on the Japanese lunar calendar), as described in "Hokkaido Kyu-san Zue". Courtesy of Hakodate City Central Library [Satake, 2007]

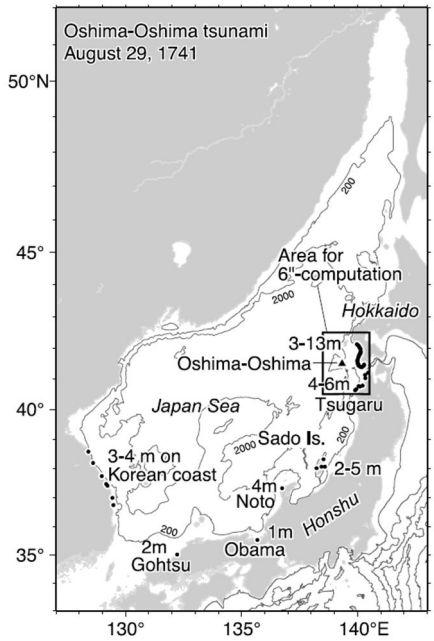

Figure 4. The recorded tsunami heights around the coastal area of Japan and Korea

4. Numerical Simulation

In the stress test report for Kashiwazaki Kariwa Nuclear power Plant in Japan, the magnitude of 1741 tsunami was estimated as M6.9. But even the 1741 tsunami was a volcanic origin, if the tsunami was an earthquake induced tsunami, the magnitude might be as M8.4 [Abe, 1999]. For the estimation of tsunami wave height caused by M 8.4 earthquake, a numerical analysis was performed by JNES tsunami code. The simulation results are shown in Figure 5.

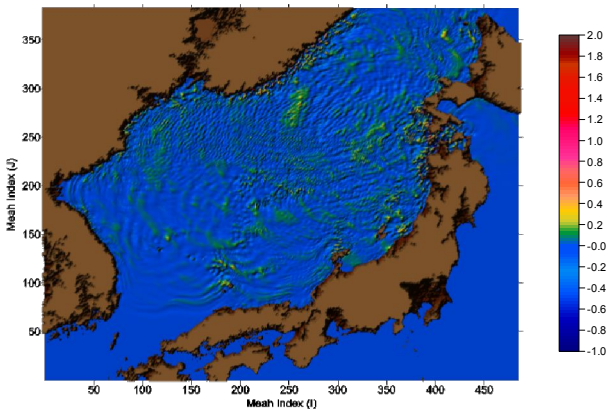

Figure 5. A tsunami simulation results for 1741 tsunami

5. Conclusions

In this study, the 1741 tsunami was determined by using a literature review for the evaluation of tsunami hazard. The 1741 tsunami reveals a same tsunami between the historical records in Korea and Japan. The tsunami source of 1741 tsunami was not an earthquake and volcanic. Using the numerical analysis, the wave height of 1741 tsunami can be determined qualitatively.

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柏崎刈羽原子力発電所１号機における安全性に関する総合評価（一次評価）の結果について（報告）平成２４年３月,東京電力株式会社