The formation of the tsunami sediments under the upper bathyal environment, based on the numerical reconstruction of tsunamis

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As the records of ancient tsunamis, tsunami sediments are often reported in the Quarternary sediments of coastal environments. But the examples of marine environments, especially formed under deep marine environments, are not so many. The conglomeratic sediments we focused in this study (in following documents we all these sediments Tsubutegaura Conglomerates) are one of rare examples.

The purpose is the examination of possibility that tsunami sediments are formed under the upper bathyal environments. To this purpose, we reconstructed tsunamis by numerical calculations (tsunami simulations), based on the geological data. Results of the simulation show that conglomeratic tsunami sediments are able to be formed by tsunamis. The results also show that the huge earthquake, Magnitude 9 class, is needed.

Tsubutegaura Conglomerates are included in the Miocene Morozaki Group distributed in the southern part of the Chita Peninsula, Aichi Prefecture. These conglomerates were formed under the upper bathyal environment, which are proved by starfish fossils. These conglomerates are interpreted as tsunami sediments by sedimentological observations (e.g. Shiki and Yamazaki, 1996). But the large boulders included in the conglomerates mean that the flow of the transportation and the deposition of the boulders has very high speed. Then, it was not certain that the tsunami forming the conglomerates was possible seismologicaly or hydrologicaly.

Thus, we reconstructed tsunamis by the numerical simulations using the reconstructed paleogeography, and estimated the speed of the flow of the upper bathyal seafloor. We compared the results of the simulations with the threshold speed of the maximum boulder of the conglomerates. The threshold velocity of the maximum boulder is calculated as 3 m/s.

We simulated three pattern tsunamis caused by earthquakes having different magnitudes; Magnitude 9 class, Magnitude 8.5 class, Magnitude 8 class. As the M9 class earthquake, we set the fault length 1000 kilometers, the slip 30 meters. This earthquake is correspond to Off-Sumatra Earthquake (2004) or Nin'na Earthquake (887). As the M8.5 class, we set the fault length 600 kilometers, the slip 13.9 meters, correspond to Hoei Earthquake (1707). As the M8 class, we set the fault length 300 kilometers, the slip 4 meters, correspond to Ansei-Tokai Earthquake (1854).

Results of the M9 Class simulation show over 3m/s, offshore flow in the area sallower than 300 meters depth. Therefore, the tsunami caused by the M9 Class earthquake has the possibility of transporting the largest boulder and forming the conglomerate in the upper bathyal environment. But tsunamis by M8.5 Class and M8 Class are not able to form such conglomerate.

We also examined the relationship between sea level changes and speed changes. In M9 Class, the strongest flow is present during the standing wave condition, which is formed by overlapping the reflected wave and the travelling wave. The maximum speed of the standing wave is doubled to that of the travelling wave. This is good agree with the theory of the linear long wave.

Summary of this study is followed; Tsubuegaura Conglomerates deposited under the upper bathyal environments were formed by the tsunami caused by the M9 Class earthquake. The strongest offshore flow is present during the standing wave conditions.

REFERENCES

Shiki and Yamazaki (1996) Tsunami-induced conglomerates in Miocene upper bathyal deposits, Chita Peninsula, central Japan, Sedimentary Geology, 104, 175-188