Distribution and grain size variation of tsunami deposits: some implications from the hydraulic experiment

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The Sumatra-Andaman islands earthquake off the west coast of northern Sumatra on 26th December, 2004 generated the largest tsunamis (the Indian Ocean tsunamis) in the human history. The tsunamis were attacked the coastal area of the countries in the Indian Ocean. This kind of large tsunami could have transported a great amount of sediment particles toward the land and/or ocean. In fact, the Japanese research group reported tsunami deposits around the western coast of Banda Ache, Indonesia, where ~34.9 m wave height of tsunami attacked. Large number of ancient tsunami deposits have been reported from outcrops on land and drilling cores of lake sediments, and sediment transportation mechanisms induced by the tsunami are investigated to evaluate magnitude and generation mechanisms of ancient tsunami based on variation in thickness and composition of such tsunami deposits (e. g. Minoura and Nakaya, 1991). However, there is no way to estimate the magnitude of ancient tsunami except for the information from tsunami deposits. Therefore, it is difficult to test the validity of estimated magnitude of ancient tsunami from tsunami deposits. In this point, the magnitude and mode of the Indian Ocean tsunamis will be understood. Thus, it is possible to clarify the formation process of the tsunami deposits and its relation to the magnitude of the tsunamis in case of the Indian Ocean tsunamis.

On the other hand, hydraulic experiment of the tsunami is also important to clarify the relationship between the magnitude of the tsunami and formation process of the tsunami deposit (e. g., Sugawara et al., 2004). Comparison between the tsunami deposits generated by the Indian Ocean tsunamis and the results of the hydraulic experiment could be useful to understand the formation process of the tsunami deposits. Therefore, we conducted hydraulic experiment using one dimensional water tank and investigated the distribution and grain size variation of the tsunami deposit in order to clarify the relationship between the magnitude of the tsunami and formation process of the tsunami deposit.

The length of water tank is 7 m and we placed a slope of 3 m in length with gradient of 1/10 at the end of the tank. The magnitude of the tsunami is possible to be adjusted by the amount of water in the water storage tank, and the tsunami is created by sudden release of the pneumatic gate. A tsunami wave runs up the slope, return to the water storage tank, and then dewatered from the drain gate. In order to investigate the influence of runup wave, we divided the sands on the slope and the bottom of the tank every 20 cm intervals using a sand-trap equipment (Sugawara et al., 2003) when the tsunami wave reached at the top of the slope. We also divided the sands in similar way after the dewatering in order to investigate the influence of backwash. Then, we collected the sands from each interval in each case, and measured their dry weights. We also measured the grain size distribution to investigate the variation of grain size. As a result, we found that the sands on the slope were extensively eroded by backwash and re-deposited on the lower slope and the base of the tank. Grain size distributions of sands in each interval, which were deposited by runup wave, were modified by backwash and extent of their modification depends on the magnitude of backwash.