Hydraulic Experiment of Tsunami Sedimentation

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Tsunamis erode deposits from sea floor and transport toward land. In consequence, traces of tsunami inundation are preserved in sedimentary sequences as tsunami deposits. Studies of tsunami deposits have brought significant results from the reconstruction of ancient tsunamis and clarification of the recurrence history of tsunamis. More over, these studies have elucidated that tsunami deposits have distinctive sedimentological characteristics. For example, the thickness of tsunami deposits decreases landward, forming a tapering wedge. It is a common feature of tsunami deposits in coastal plain, and thought to be formed by the declination of current strength. But specific relationship is still unknown. Hydraulic experiment is functional for the clarification of the relationship if the distribution, volume, and formation of sedimentological characteristics of tsunami deposits are controlled by the magnitude of tsunami. For this reason, we carried out the hydraulic experiment to reveal the relationship between the sedimentation process and the magnitude of tsunami inundation.

Whole length, width and height of the channel to be used are about 9 m, 30 cm, and 50 cm, respectively. The base plain of the channel is made of veneer board, and the wall surface is made of glass or veneer boards. The water tank of 300 cm length is comparted from one end of the channel, and the simulated tsunami is made by instantaneous release of the pneumatic gate. The volume of water in the tank controls the strength of the current. We placed the slope that has the length of about 3 m and gradient of 1/10 in the channel. The transportation mode of sand in fluid is divided into two types. The one is traction mode that particles are conveyed being contacted with undersurface. Another one is suspension mode that whole transportation of particles occurs in fluid from top to bottom. As the current velocity of actual tsunami invasion often exceeds several m/s, the suspension mode should be distinctive in the particle transportation. We made the suspension mode by injection of standard sands to the front edge of wave in conjunction with the release of the gate. The experiment was executed repeatedly with the alteration of the experimental conditions, such as the water depth of the tank and generation of outgoing flow.

We comparted the slope every 20 cm and collected the deposited sand. And we measured the weight of the deposits after desiccating it. The characteristics of tsunami deposits, that the thickness of deposits decreases landward, were found under the condition of no outgoing flow. Under the generation of outgoing flow condition, almost all deposition was observed in the under part of the slope. Here we define M1 and M2 as the weight of the deposit with and without outgoing flow conditions, respectively. If M1 is less than M2, it describes that erosion occurred in certain partition by the outgoing flow. In contrast, if M1 is greater than M2, secondary deposition by the outgoing flow occurred in certain partition. Our results show that sands deposited upper part of the slope were eroded by outgoing flow, and that they deposited in the under part of the slope. In order to examine the relationship between the current strength and volume of deposits, we measured the time variation of current velocity on the slope by every 20 cm and calculated the integration of it. The result indicates that the volume M2 is proportional to the velocity integration of the imcoming flow under no outgoing flow condition. The volume of erosion and the velocity integration of the outgoing flow are also proportional when the current strength is great. No relationship is found between the volume of deposition by outgoing flow and the velocity integration. The volume M1 seems to be related to the combined velocity integration of incoming and outgoing flow.