Basic hydraulic experiment on tsunami sand deposits related with sand grain size and bore wave

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A massive tsunami occurred with the earthquake in Tohoku district on March 11th, 2011. This tsunami attacked coastal areas and caused serious damage. Tsunami measures must be reconsidered to prepare for the Nankai Trough tsunami. Many of the tsunami measures are based on historical records of earthquake and tsunami. Amount of the records are limited, because these disasters are low frequency. Tsunami sand deposits are left many of tsunami records and are expected to analyze paleotsunamis. However, tsunami sand deposits are only used to show the fact of tsunamis and to determine the relative magnitudes. The thickness of sand layer and grain size are considered to relate with tsunami force. These relations could clarify the tsunami source. This study focused on the relationship between the grain size and tsunami force. The objective of this study is investigation on the formation mechanism of tsunami sand deposit by hydraulic experiment.
A two dimensional water channel consisted of a wave maker, a flat section and a slope section. A movable bed section with various grain sizes of sand was set at the end of flat section. The condition of sand used three uniforms and three mixed grain sizes in this experiment. Bore waves of several heights transported the sand to the slope section by run-up. Sand deposit distribution were measured when run-up reached at the highest or after the return flow. The former condition assumed that water permeated in the ground. Water surface elevation and velocity were also measured at several points.
The grain size of sand deposits and the magnitude of incident waves were related distance of run-up. The distances from the shoreline of run-up (DW) and sand deposits (DS) were different. In the case of the smaller grain size, DS/DW became higher and the amount of sand deposits increased. Further, in the case of the plural incident waves inputted, DS/DW became higher in all cases. The sand deposit increased clearly on the halfway of slope area. The distance from shoreline of this position became longer, when the magnitude of incident waves was large. However, the position did not move by the difference of grain size. In the case of mixed sand with three grain sizes, the mixed ratio in sand bed section corresponded with the composition ratio of the sand deposit near the shoreline. However, they were different near the front of run-up. By the condition of the any mixed sand, the total amount of sand deposits was similar. The relation with the number and magnitude of incident waves showed two patterns. In the case of same magnitude waves inputted, the sand deposit increased by each wave near the front of run-up. On the other hand, the sand deposit did not increase by each wave near the shoreline. In the case of decreasing magnitude waves inputted, the sand deposits increased clearly by the lower incident wave near the front of run-up. As in the case of same magnitude waves inputted, the sand deposit did not increase by each wave near the shoreline. The amount of sand deposit related with or without return flow. The type of flow without return preserved the much of sand deposit. On the other hand, return flow took away the most of sand deposits on the slope area. However, when the wall was installed to reflect the wave in the slop section, the sand deposits remained there. Because the wall increased water depth and reduced velocity rapidly, tractive force near the wall became small. The distribution of sand deposits repeatedly increased and decreased on the slope because of limited return flow. On the other hand, when the wall was installed near the front of run-up, the most of sand deposits took away on the slope area by the large return flow.

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