Experimental study on the effect of unidirectional-flow velocity on suspended sediment concentration and grain-size distribution

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Deep-sea drift deposits record the conditions of bottom currents, which links the global climatic change. Although grain-size analysis of deep-sea drift deposits enables us to reconstruct the changes in the relative intensity and position of bottom currents (e.g., Yokokawa and Franz, 2002), there has been no fundamental experimental result to reconstruct the absolute condition of the bottom currents. Therefore, we designed an experiment analogue to the transportation by the deep ocean currents. Fine-grained glass-spheres were employed because they are easy to use.

A race-track-type flume (3.1 m in length, 0.2 m in width at the observation windows, and 0.6 m in depth) in Osaka Institute of Technology was used. To generate currents, a propeller is mounted at the opposite side of the observation windows. Glass-spheres, which D50 is 7.68 micron meter, had been well-mixed with water, then were poured into the unidirectional flow in the flume. The sediment concentration after diffusion throughout the entire flume was 0.64 g/l and 0.32 g/l. The water depth was 35.0 cm and the average velocity at 10cm above the bottom of the flume was changed from 4.9 - 43.5 cm/sec. After the pour and successive diffusion of glass-spheres, sediment concentration is measured by a turbidimeter. After the sediment concentration reached equilibrium level, the suspended sediments 20 cm above the bottom was siphoned out of the flow. The grain size distribution of the suspended sediments was then measured by the laser diffraction-scattering method at Geological Survey of Japan.

The time series of the sediment concentration have a common pattern, i.e., a sudden decrease at the beginning of the run and getting slowly to the equilibrium level. The equilibrium level depends on the flow velocity. The lower velocity yields the lower equilibrium level. The grain size distribution of the suspended sediments also depends on the flow velocity. The values of D50 and standard deviation decrease respectively as the flow velocity decreases. These results can be attributed to the decrease of upward components of the turbulent currents. The grain-size distribution curves, on the other hand, show simultaneous decrease of the finer fraction. It might suggest the effect of concentration of sediments.