

Effect of surge-duration on the velocity distribution of turbidity current and resultant cyclic step morphology: PIV measurements of the surge-type turbidity currents in flume experiments

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Cyclic steps are often found in channels on the prodelta surfaces or submarine canyons, which is attributed to turbidity currents. Field observations of turbidity currents and seabed topography on the Squamish delta in British Columbia, Canada revealed that cyclic steps formed by the surge-type turbidity currents. The high-density portion of the flow, which affects the sea floor morphology, lasted only 30-60 seconds (e.g., Hughes Clarke, 2016). We are doing flume experiments aiming to investigate the relationship between the condition of surges and resultant morphology.

Experiments had been performed at Osaka Institute of Technology. A flume, which is 7.0 m long, 0.3 m deep and 2 cm wide, was suspended in a larger tank, which is 7.6 m long, 1.2 m deep and 0.3 m wide, filled with water. The inner flume tilted at 7 degrees. As a source of turbidity currents, mixture of salt water (1.17 g/cm³) and plastic particles (1.3 g/cm³, 0.1-0.18 mm in diameter) was prepared. The concentration of the sediments was 6.1 weight % (5.5 volume %) in the head tank. This mixture of salt water and plastic particles poured into the upstream end of the inner flume from head tank for 3-, 5-, and 7-seconds and continuous flow. For 3-, 5-, and 7-seconds-surges, 130 or 140 surges were made respectively. Discharge for unit time ranges 102 to 290 mL.

As a result, surge-type turbidity currents, regardless the surge duration, formed cyclic steps, but the continuous currents did not form cyclic steps. Moreover, the locations where the steps moved upstream vigorously differ from each other, the shorter the duration, the closer to the upstream end.

The velocity distribution of the profile of the turbidity currents were measured using PIV. Comparing the median velocity of 3s-, 5s-, 7s-surges and continuous turbidity currents, it is revealed that the longer the surge duration, the faster the median velocity for the same unit discharge.

Keywords: Surge turbidity current, cyclic step, flume experiment, surge duration, PIV measurement