

An experiment on combined-flow-generated bedforms

Tomohiro Sekiguchi[1]; Miwa Yokokawa[2]

[1] Geoenvironmental Sciences, Univ. of Tsukuba; [2] Lab. Geoenviron., Fac. Info. Sci., OIT

Combined flow, which usually indicates combination of oscillatory and unidirectional flow, is considered common in the natural shallow marine environment. The previous laboratory studies showed that characteristic bedforms develop under combined flow conditions (e.g., Yokokawa, 1995; Dumas et al., 2005), and such bed forms have provided keys to interpret ancient sedimentary processes. However, the previous experiments examined bedforms under limited combined-flow conditions, and our knowledge of combined-flow bed forms is relatively limited; for example, Yokokawa (1995) examined combined flow with oscillatory period 0.5-1.25 sec, and Dumas et al. (2005) 8.5-11 sec. Based on this background, an analog experiment was designed to investigate bedforms, which develop under non-examined combined-flow conditions.

This combined-flow experiment was carried out using a recirculating flume with a wave generator at Department of Environmental Systems Science, Doshisya University. The flume was 12 m long, 20 cm wide, and 50 cm deep. It had a plunger-type wave generator at the one end, and oscillatory flow component of combined flow was produced by surface waves. Unidirectional flow component was generated with a slurry pump that was integrated into a closed recirculating loop. A sand bed, on which bedforms developed, was 4 m long, 20 cm wide, and 5 cm thick. Bed material was quartz sand with grain diameter 0.2 mm. Water depth over the sand bed was 20 cm. Near-bottom (1 cm above the bed) combined-flow conditions, which were measured with an acoustic Doppler velocimeter, were as follows: the period of oscillation was 1.5 sec or 2.0 sec, the maximum oscillatory velocity, U_o , was smaller than 60 cm/sec, and the absolute value of unidirectional velocity, $|U_c|$, was smaller than 40 cm/sec.

The following three kinds of bedform formed in the experiment: (1) relatively symmetrical small ripple with an angular crest, hereafter called as 'SSRac,' (2) asymmetrical small ripple with a round crest, 'ASRrc,' and (3) asymmetrical large ripple, 'ALR.' Development of these bedforms significantly depended on $|U_c|$, but did not on U_o . SSRac, which corresponds to 'wave ripple' or 'wave-dominated combined-flow ripple' in Yokokawa (1995), formed when $|U_c|$ is smaller than 12 cm/sec. ASRrc, which corresponds to 'current-dominated combined-flow ripple' in Yokokawa (1995), developed when $|U_c|$ ranged from 12 cm/sec to 23 cm/sec. ALR, which did not form in Yokokawa's (1995) experiment, occurred when $|U_c|$ is larger than 23 cm/sec. Comparison between this experiment and Yokokawa's (1995) experiment showed that ASRrc form with smaller $|U_c|$ -value with the increase in oscillation period.

Yokokawa, M. (1995) *Memoirs of the Faculty of Science, Kyusyu University, Series D, Vol. XXIX, No.1.*

Dumas S., Anott R.W.C., and Souhard J.B. (2005) *Journal of Sedimentary Research, Vol. 75, No. 3, 501-513.*