SEDIMENT TRANSPORT AND GRAIN SIZE DISTRIBUTION AROUND IMAGIRE-GUCHI

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1. Introduction

Around Imagire-guchi, alongshore sediment transport from the east is interrupted by a jetty, and a large amount of sediment accumulates at the east-side of the jetty. On the contrary, a shoreline retreats due to a decrease of sediment supply from the east. The shoreline positions at the east-side and the west-side of Imagire-guchi are much different. Furthermore, surface water level, current speed and direction are much affected by the tidal oscillation. The current direction turns over due to the tide condition in one day. Inside the channel, a maximum instantaneous current speed over 1.0m/s was measured in the previous observation. These current conditions will have much influence to sediment transport and a distribution of sediment material at the bottom around Imagire-guchi. This study conducted to investigate the particle size distribution around Imagire-guchi and the relationship between sediment size distribution and the condition of waves and currents.

2. Sediment Sample Analysis

The sediment samples were collected around the Imagire-guchi at Hamamatsu City in Shizuoka Prefecture, Japan. Sediment samples obtained from a sea bottom and near a shoreline consist of four groups. The positions of A (A1, A2, A3, A4, A5, A6), B (B1, B2, B3, B4, B5, B6), C (C1, C2, C3, C4, C5, C6, C7) and D (D1, D2, D3, D4, D5) are respectively given in Figure-1. All samples (24 samples) were analyzed in the laboratory.

At D2, D4 and D5, fragment of shell and/or material which bigger than 1.4 mm are included in the samples. These components are separated from the samples before sieve analysis (Photo-1). Grain size analysis was conducted by using a set of standard sieving equipment made by SINPO Co, Tokyo-Japan. About 200 gram weight of each material was sieved by mechanical shaker. Then, the material retained on the sieve was measured. Total error of the measurement was kept less than 0.3% of its initial weight. A median size of each material is obtained from the result of sieve analysis.

Figure-2 shows the distribution of d_{50} around Imagire-guchi. The samples are separated into three groups, by the size of d_{50}, which is less than 0.1mm (light blue), from 0.1 to 0.3mm (yellow) and greater than 0.3mm (red). Sediment size is getting smaller as the sample position as with going offshore. Along a channel fixed with jetties, grain sizes are bigger than others.

3. Observation of Waves, Currents and Turbidity

Measurements of waves, currents and turbidity were conducted on 29th July, 2009 to investigate effects of waves and currents to turbidity generation. The place of this observation was indicated by a star mark (☆) in Figure-1. Turbidity is measured as surrogated data of suspended sediment concentration. The suspended sediment transport is important because it contributes to the coastal morphology dynamic due to its deposition and re-suspension process (Syamsidik, 2009). Two turbidity

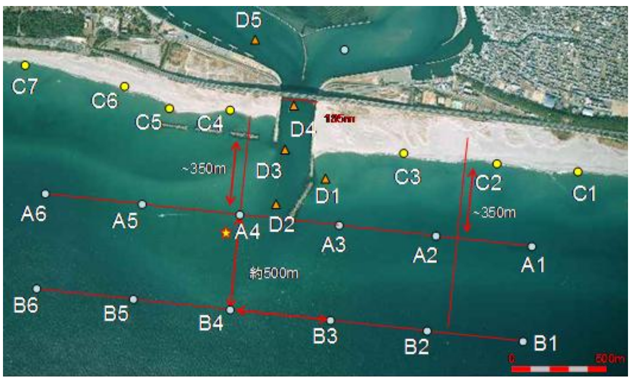

Figure-1　Positions of sediment samples

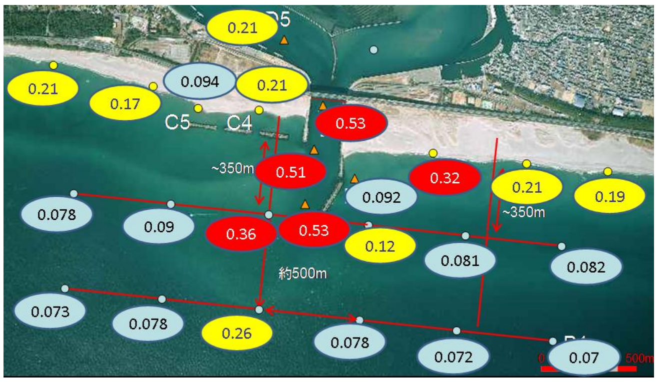

Figure-2　Distribution of d_{50} around Imagire-guchi

Photo-1　Sediment samples mixed with shell and big materials meters were installed in this measurement at the same point. Sea surface elevations, currents and turbidity were measured continuously every 0.5 seconds near the sea bottom. The measurements were continued about 3 hours, from 14:20 to 17:30.

Figure-3 shows the time series of a depth (10-minute averaged water level), waves ($H_{1/3}$, $T_{1/3}$), turbidity and currents (current speed of EW and NS component, current vector). The wave information is estimated from sea surface elevations every 20 minutes. The 1-minute averaged data of currents and turbidity are used in Figure-3. During this observation, a change of mean water level was less than 10cm, and wave condition did not change significantly. However currents and turbidity changed remarkably though the occurrence of strong currents and high turbidity was not simultaneous.

In our past observations off Imagire-guchi, high turbidity was generated with strong currents under an ebb tide (Syamsidik *et al*., 2009). The past observations were carried out under the condition of mean water level oscillation over 1.0m. A change of the mean water level has significant influence on the wave condition because a depth of the observation point is shallow, around 4 to 5m (Syamsidik *et al*., 2009). The sediment transport in a shallow area is much complicate because of complex of related phenomena. We have to analyze the observation data in detail with consideration of suspension from a bottom by wave forces, advection effect and so on.

4. Relationship between Sediment Size Distribution and Sea Conditions

As mentioned above, in the observation on July 2009, strong currents and high turbidity were not generated simultaneously. But it will be easy to expect high turbidity generation with strong current. Figure-4 indicates the result of a measurement of current distribution around Imagire-guchi. This measurement was conducted under the ebb tide condition on 2nd July, 2008. Strong offshore-going currents were generated along the channel. And these currents reached close to B4 that d_{50} was a little bigger than other offshore locations. This strong current pattern corresponds to sediment sample points which are the location of d_{50} bigger than 0.3mm. The reason will be that fine sediment is flushed out by these strong currents. Therefore, the distribution of bottom material size, especially the area of coarse sand, may have close correlation with the strong current distribution. Investigation of strong current distribution under the ebb and flood tide will result in the characteristics of sediment transport and grain size distribution around Imagire-guchi.

5. Conclusion

- Sediment grain size (d_{50}) is much different between inside the channel and others. The d_{50} inside the channel is much bigger than that of other points.
- Strong offshore-going currents were measured along the channel by the ebb tide. These currents may be flushed out a fine component of bottom sediment around the channel.

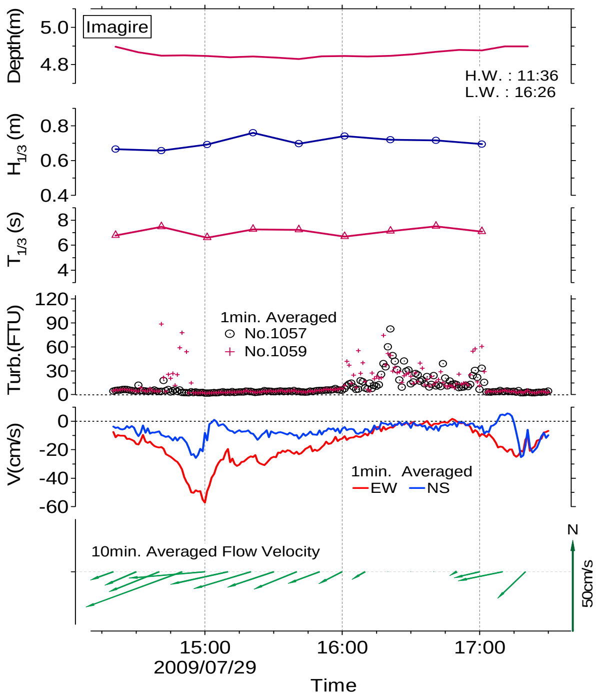

Figure-3 Time series of measurements

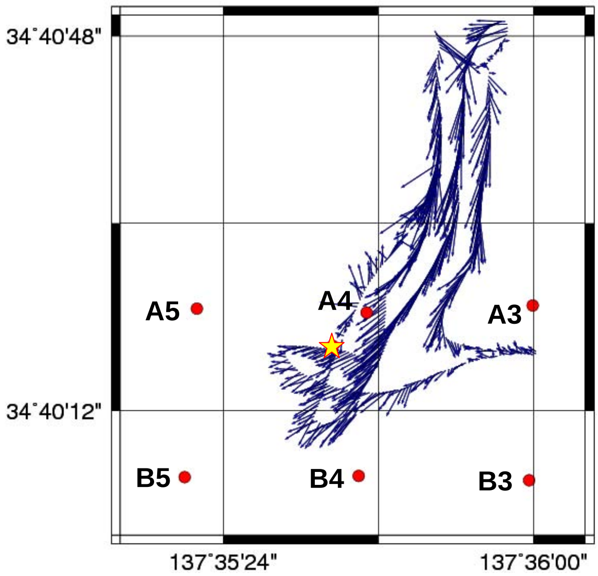

Figure-4 Current distribution under an ebb tide

- At the offshore point (B4 in Figure-1), the d_{50} is a little bigger than other sample points on the same lateral line (B-line). The reason will be that strong offshore-going currents will reach to B4.
- Therefore, the sediment size distribution corresponds to the current distribution. Investigation of current distribution will be useful to know sediment characteristics around Imagire-guchi.

References

Syamsidik (2009): Characteristics of Suspended Sediment Transport off River Mouth and Inlet, D.r. Thesis, Toyohashi University of Technology, January 2009.

Syamsidik, S. Aoki, S. Kato and T. Okabe (2009) : Sediment Suspension due to Strong Currents around a Tidal Inlet, Annual Journal of Coastal Eng., JSCE.