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CROSS-SHORE BOTTOM PROFILES ALONG AN OBSERVATIONAL PIER AND ITS SEASONAL VARIATIONS

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Joetsu-Ogata coast is located along Japan Sea coast and has been suffered from severe beach erosion since 1960s. Ogata Wave Observatory (OWO) is one of observational facilities belonging to Disaster Prevention Research Institute (DPRI), Kyoto University, and the cross-shore bottom profiles along the T-shaped Observation Pier (TOP) of OWO have been measured once a month. The cross-shore profiles of the grain size distribution have also been observed along the TOP of OWO several times in a year.

This paper shows the interannual variations of cross-shore bottom profiles along the pier. This observation site is located in Joetsu-Ogata coast, and the coastal area along Japan Sea like Joetsu-Ogata coast have severe high-wave conditions in every winter season. On the other hand, wave conditions in summer seasons are very calm except the approach of the typhoon. Under the influence of these wave conditions, cross-shore bottom profiles around the observational pier have cyclic annual process of erosion and accumulation. The characteristics of seasonal variations of cross-shore bottom profiles are discussed with the results of the grain size distribution.

Key Words : *Field observation, cross-shore bottom profile, seasonal variation*

1. INTRODUCTION

Waves and currents generate sediment transport in the coastal zone associated with the properties of the bottom material, and the balance of sediment transport in longshore and cross-shore directions determines the evolution of beach profile. Many coastal areas in Japan have been suffered from severe beach erosion, and proper management in both coastal zone and river basin is required to maintenance coastal environment.

Field observation can play a fundamental role in order to investigate beach profile change in near-shore region. In the present paper, observation results on cross-shore bottom profiles and grain size distribution are shown and the characteristics of seasonal variations of cross-shore bottom profiles are discussed.

2. FIELD OBSERVATIONS IN JOETSU-OGATA COAST

Field observations on wave and bottom profiles have carried out for some years at the Ogata Wave Observatory (OWO) belonging to the Disaster Prevention Research Institute (DPRI), Kyoto University, Japan (Yamashita et al., 1998; Baba et

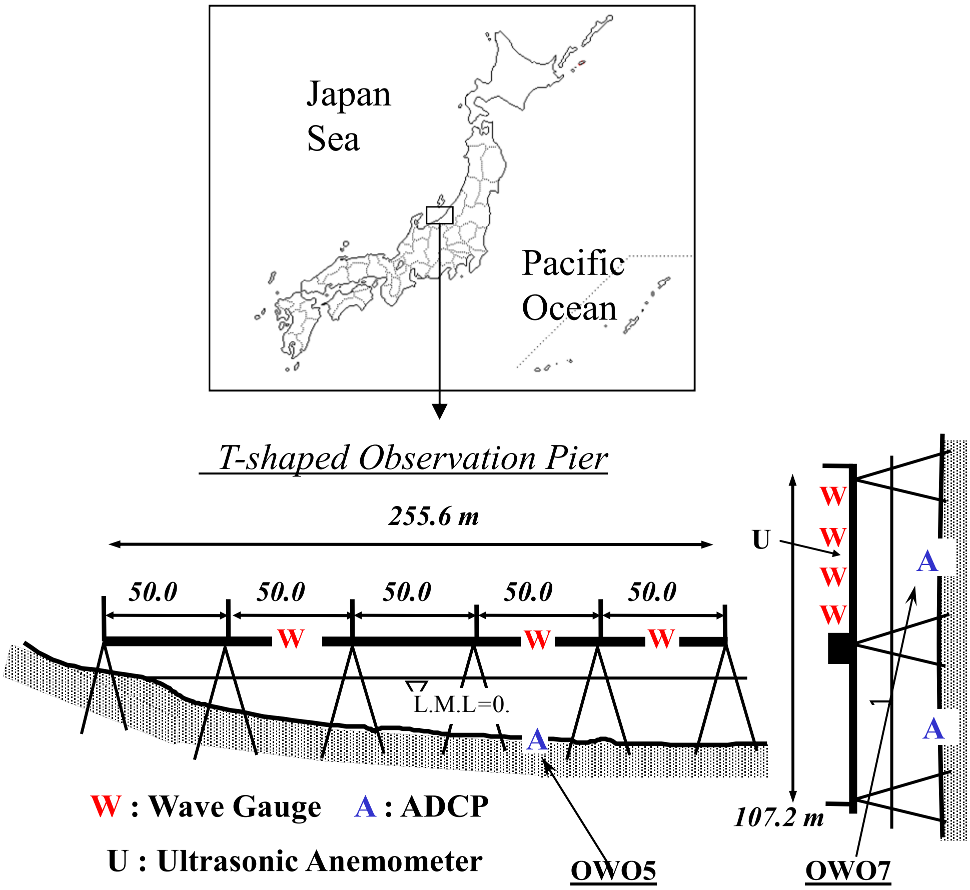


Fig.1 T-shaped Observation Pier at Ogata Wave Observatory and measurement set-up

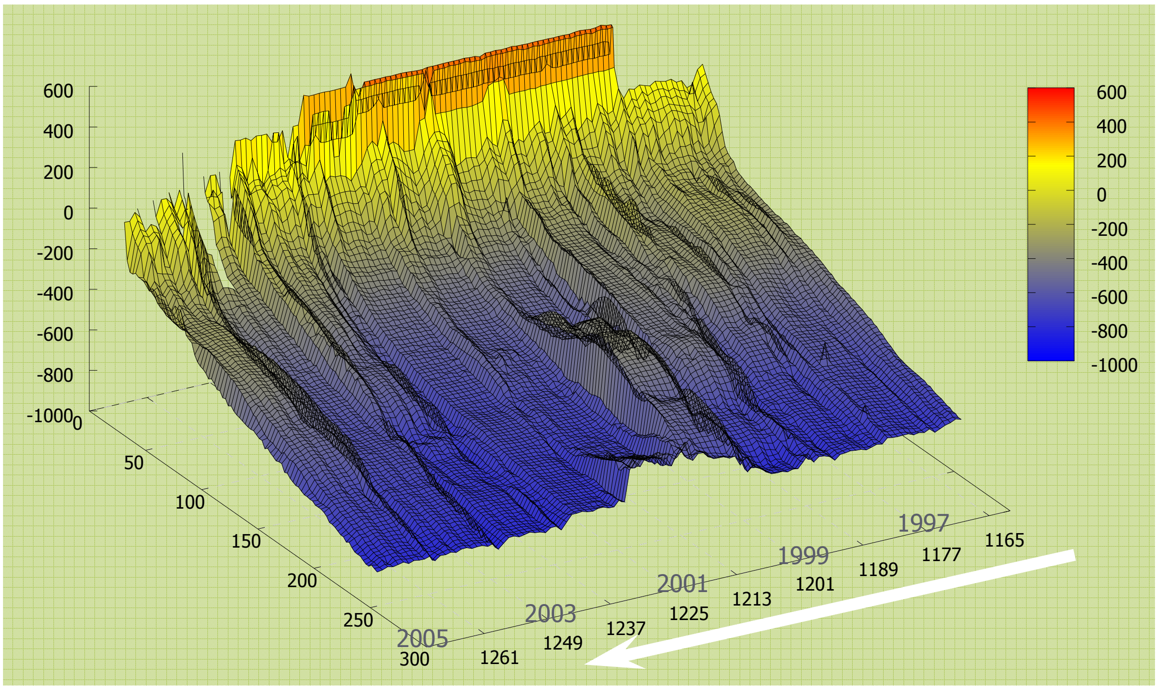


Fig.2 Temporal variations of cross-shore bottom profile along the observation pier

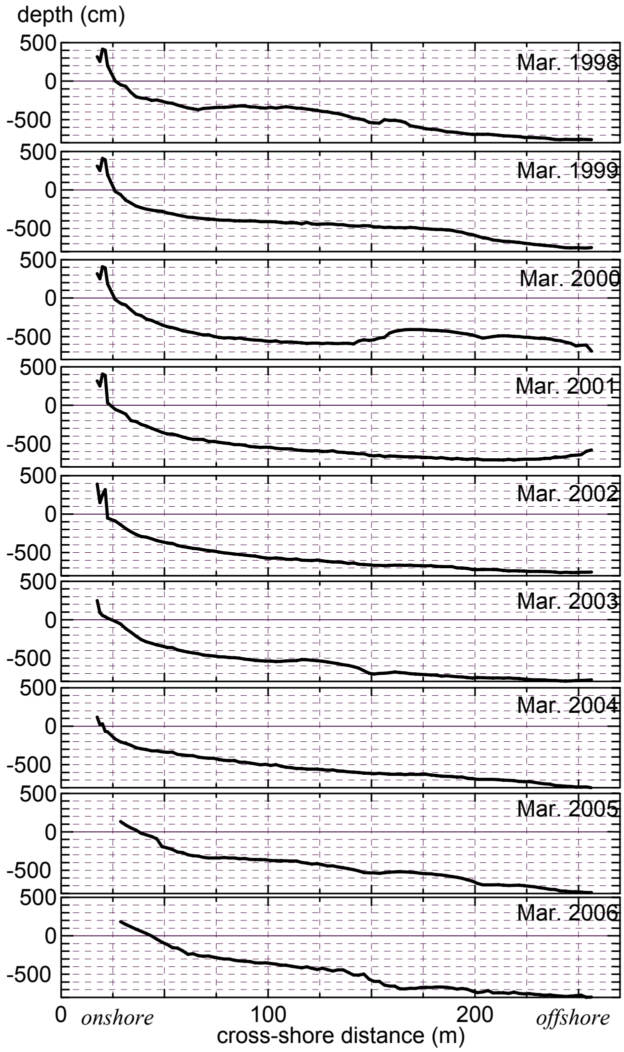
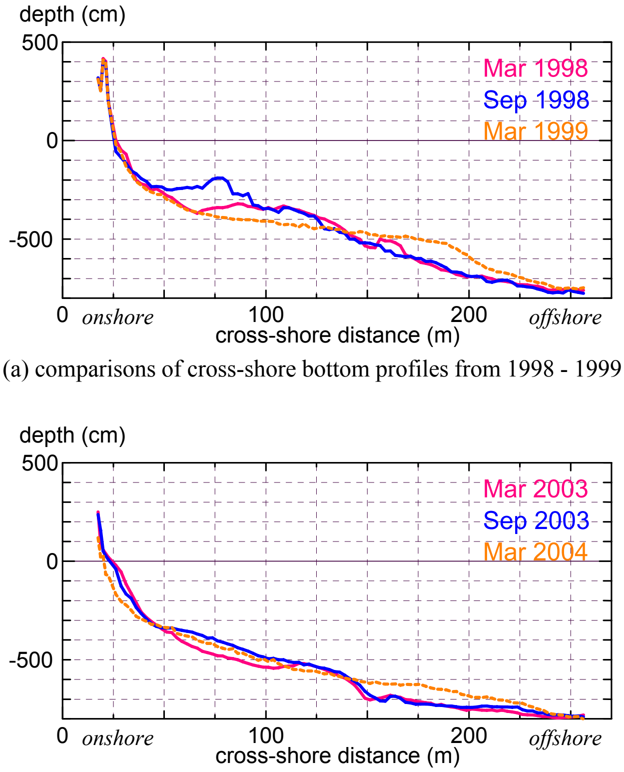


Fig.3 Cross-shore bottom profiles past winter season
(March from1998 to 2006)

al., 2000). OWO is located in the middle of Joetsu-Ogata coast in Niigata prefecture, and faces to Japan Sea. **Fig.1** shows the set-up of the field observation at OWO.

In winter season, strong monsoon wind continuously blows from northwest in the Japan Sea, and it causes high wave condition along Japan Sea coast. The average duration of typical storm condition is 2-3 days and the number of storm conditions is 4-5 times a month. These storm conditions cause severe beach erosion along the coast facing the Japan Sea. On the other hand, wave conditions in summer seasons are very calm except the approach of the typhoon.

At OWO, the cross-shore bottom profiles along the T-shaped Observation Pier have been measured once a month for more than 20 years. **Fig.2** shows temporal variations of cross-shore bottom profile along the observation pier since 1997. The variations of cross-shore bottom profile around the



(a) comparisons of cross-shore bottom profiles from 1998 - 1999

(b) comparisons of cross-shore bottom profiles from 2003 - 2004

Fig.4 Seasonal variations of cross-shore bottom profiles

observational pier show cyclic annual process due to the iteration of severe and clam wave conditions. **Fig.3** displays the interannual variations of the cross-shore bottom profiles in March from 1998 to 2006. In March, winter storm period draws to an end, and cross-shore bottom profiles in **Fig.3** are close to the terminal beach profiles past winter storm season. The cross-shore profiles after 2001 are similar to each other, although the cross-shore profiles before 2000 have some different characteristics from the profiles after 2001. The retreat of shore line makes progress until 2004.

As mentioned above, wave conditions around Joetsu-Ogata coast differ with the season, severe in winter and clam in summer. Seasonal profile changes in cross-shore direction shows in **Fig.4**. In **Fig.4 (a)**, onshore sediment transport in Sep 1998 and offshore sediment transport in Mar 1999 are observed clearly. This means that the cross-shore bottom profiles have cyclic annual process associated with the seasonal variation of wave conditions. On the other hand, the cyclic annual change of cross-shore bottom profile is not clear in **Fig.4 (b)**, although small shoreline retreat and accumulation around 75m in cross-shore direction are shown.

3. GRAIN SIZE DISTRIBUTION ALONG THE OBSERVATION PIER

The cross-shore profiles of the grain size distribution have been observed along the observation pier of OWO several times in a year. **Fig.5** shows the seasonal variation of cross-shore distribution of D_{50} (median grain size), and these profiles have similar characteristics to each other except around shoreline. This result means that the sediments are sorted well by wave motion (Another reason is also assumed that sediment supply is not enough from updrift side).

Fig.6 illustrates the comparisons of cross-shore bottom profiles & D_{50} in February and March in 2005. Several storm conditions occurred between February and March in 2005, and considerable erosion is caused within one month. However, cross-shore distributions of D_{50} don't have so much difference except around shoreline.

If a beach with a specific grain size exposes to constant forcing conditions (like monochromatic waves or random waves with constant statistical properties), the beach profile will show no net change in time. The beach profile with no net change in time is called an equilibrium beach profile (EBP), and its concept has been useful in both theoretical and practical engineering considerations.

The model of the EBP first presented by Bruun (1954) and the most used model were documented by Dean (1977, 1991). This simple form for the EBP is represented by the following simple algebraic form;

$$h(x) = Ax^{2/3} \qquad (1)$$

in which *h(x)* is the water depth at a distance x from shoreline and *A* is representing a sediment scale parameter which depends on the sediment size D. **Fig.7** displays comparisons of cross-shore bottom profiles & EBP in March of 2004, 2005 and 2006. The sediment scale parameter A = 0.161 corresponds to observed median grain size (0.5mm) and is employed in **Fig.7** (CEM, 2002). In each case, the EBPs derived by the simple power law form show close fits with observed bottom profiles except adjacent area of shoreline.

In last 2 years (2005 & 2006), shoreline advance is observed. It is also found that the median grain size around shoreline tends to be finer year by year in **Fig.5**. This means that the mechanism of sediment transport in this area would have different trend in recent years even though the reason why the mechanism change occurs is not unknown.

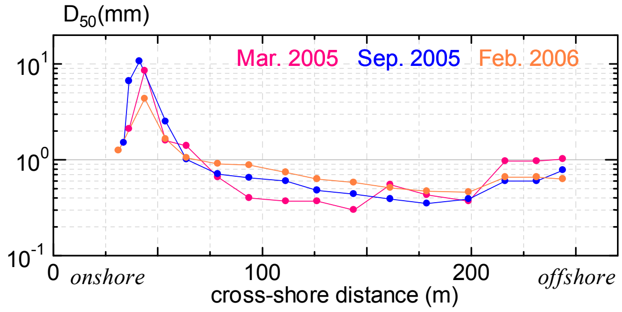


Fig.5 Cross-shore distributions of D_{50} from Mar 2005 to Feb 2006

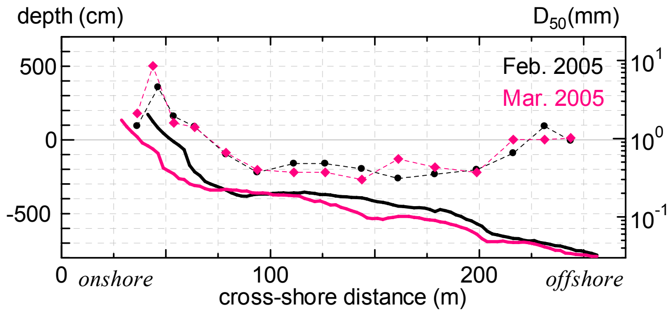


Fig.6 Comparisons of cross-shore bottom profiles & D50
(solid lines: bottom profiles, dots & broken lines: profiles of D50)

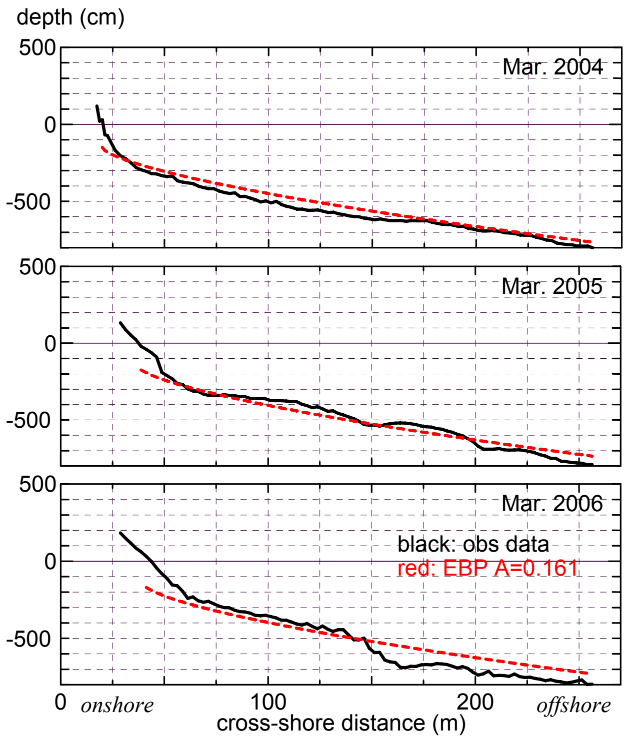


Fig.7 Comparisons of cross-shore bottom profiles & Equilibrium Beach Profiles
(solid black lines: bottom profiles, red broken lines: EBPs)

4. CONCLUSIONS

The cross-shore profiles of bottom topography and grain size distribution observed in Joetsu-Ogata coast were presented in this paper. Joetsu-Ogata coast is one of Japanese coasts where severe beach erosion has already advanced for several decades. It is found in observation results that further beach erosion still continued until 2004 and that the cross-shore bottom profiles have cyclic annual process associated with the seasonal variation of wave conditions.

The cross-shore distributions of median grain size in recent years are similar to each other except the adjacent area of shoreline. The cross-shore bottom profiles with close grain size distributions are described by the simple EBP function employed constant sediment scale parameter A, which corresponds to observed grain size.

The results and discussions presented here are based on the cross-shore profiles of bottom topography and grain size distribution. Needless to say, the sediment transport system in both longshore and cross-shore directions has an important role for beach evolution. Further data analysis and discussions including neighboring areas are required in order to obtain an in-depth understanding of beach evolution system.

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