GPR survey for estimating the internal structure of the beach levee formed in the coastal lowland of Enshunada Sea

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1. Introduction

Since the 2011 off the Pacific coast of Tohoku Earthquake, it has been pointed out that it is necessary to reconsider the unique seismic theory at the plate boundary, and that would require similar considerations in the case of the Nankai Trough. Therefore, we are conducting study to clarify the diversity of Nankai Trough earthquakes by reconstructing the crustal deformation during and between earthquakes from the development history of Holocene terrain in the coastal lowlands of Enshunada Sea. In order to clarify the development process of the topography of the beach levee, it is necessary to understand the internal structure of it. Therefore, we applied GPR (ground-penetrating radar) survey to beach levees, and the performance of identifying the internal structure was examined.

2. Study outline

Fig. 1 shows the survey area and GPR survey lines. GPR survey was conducted from March 26 to 27, 2019. The red lines are the survey lines. Twenty survey lines were set, and the total length was about 10,160 m. These survey lines were zoned to the six sites shown in Fig. 1. GPR survey was performed using Noggin Plus system of Sensors & Software Inc. with an antenna center frequency of 250 MHz. The data was analyzed with EKKO_Project5 software. In the analysis, basic processing (Gain recovery processing etc.) was performed.

Bristow et al. (2006), Takagawa et al. (2008), etc., show examples of GPR surveys for beach topography, and they indicated that GPR survey is effective for estimating the internal structure of the beach topography. However, our survey area in this study was basically an asphalt road in the urban area or paddy field, which means that the survey conditions were not good.

3. Result & Discussion

Representative results are reported for the Tarosuke site and the Yokosuna site.

At the Tarosuke site, on the long survey line crossing the artificial sand dunes and the interdune lowland from the beach, a clear reflection structures that descends toward the sea side were identified at 2 to 5 m underground of the seaside slope of the sand dune near the coast, the depression formed on the sand dune and the seaside margin of the low relative height sand dune. This is similar to the structure seen in the sand dune shown in Takagawa et al. (2008) and is thought to indicate the sedimentary structure of the past shoreline advance. Although Matsuta et al. (2016) argued that these sand dunes are artificial dunes, it is possible that natural sand dunes were formed on the base.

On a survey line of the Yokosuna site, a reflection structure that descends toward the sea side was identified at a 1 to 3 m underground on the seaside slope near the top of the beach levee. Also, in another survey line, a folded reflection structure that descends toward the land side was identified at a 1 to 3 m underground on the land side slope near the top of the beach levee. Although these may indicate the natural sedimentary structure at the time of the formation of the beach ridge, houses are lined up on the beach bank of this site and the depth of the reflection structure is shallow, which suggests that it may be the structure by artificial modification.

4. Challenges

There is few direct underground structure data such as boring data in the GPR survey area. In the future, we would like to conduct GPR survey even at location where boring data exists, and try to interpret the survey results more accurately.

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References:

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