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Detection shallow subseafloor resistivity change by electric survey and relativity with tide

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1.Back ground And Goal
For disaster prevention, environmental preservation and natural resource management, technological development for the subseafloor monitoring is required. We expect that ocean-bottom electromagnetic surveys could be used to detect subseafloor structural changes including fluid movements. Because of few practical examples of monitoring by ocean-bottom electromagnetic surveys, the change in physical properties in shallow subseafloor structure, that might be sensitively reflecting seawater current or sedimentary environment, should be identified first. In this study, we monitor the shallow (down to about 20 meters' depth) subseafloor resistivity change using controlled current source and try to detect structural changes.

2.Observation system and Analysis
In this study, we use data acquired by the off-Toyohashi submarine cable which length is about 50 km from the shore. Observation sensors, such as the ocean-bottom electrometers and seismometers, are attached at the cable-end on the seafloor whose water depth is about 1300 meters. Using the current of variable amplitude applied to the seafloor sensors with a period of 12 0 seconds, we are able to conduct the ocean-bottom electric survey to measure electric potential signals that are received by seafloor electrometers. We analyzed this received signals to investigate the resistivity change beneath the seafloor.
For the off-Toyohashi observation system, the distance between transmittable electrodes is much longer than that between receivable ones. So we applied the pole-dipole DC resistivity method to our data, and obtained the apparent change in resistivity for a few months. In our processing, we obtained the ratio of the electric voltage and current by the least-square method. The maximum depth of our survey is estimated to be about 30 meters according to our numerical calculations.

3.Result and Discussion
We found the periodic change of apparent resistivity with a period of approximately 14 days. After the comparison with the temperature observed above the seafloor by thermisters equipped with ocean-bottom electrometers, we suggest that the cause of the apparent resistivity change is not from sea water but from changes of subseafloor structure. The periodic resistivity change implies that the tide causes the change in electrical voltage. Since there is an array of thermisters beneath the seafloor aligned along a stinger of several tens of centimeters, we could compare the temperature profile with the apparent resistivity change to consider how the shallow subseafloor resistivity change be related with seafloor pressures or ground water movements. For more quantitative analyses, we try to show the resistivity change relativity with tidal level changes applied in the sedimentary consolidation theory used at the civil engineering area.

Keywords: subseafloor, monitoring, resistivity, submarine cable, Toyohashi, consolidation