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INTERFACE DYNAMICS IN COASTAL ENVIRONMENTS

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LONG-TERM GOALS

The ultimate goal of this research project is to improve understanding of the dynamic pore water pressure gradients in shallow-water, surficial sediments generated by wind waves, and the impact of these gradients on burial of seafloor-resting mines by sediment scour and liquefaction.

OBJECTIVES

The objectives of this study are to identify and quantify all physical factors that can influence the magnitudes of the pore water pressures recorded by the Multi-Piezometer Array System (MPAS). This information will be used to establish a list of premises under which the MPAS data may be interpreted and to establish the accuracy of the MPAS as a scientific measurement system.

APPROACH

The technical approach is to first consider the physical environment at the surface of the sea floor and mechanical behavior of the probes in that environment. Behavioral equations (mathematical representations of the probe behavior) are then derived to represent interaction between the probe and the physical environment. From these equations, key parameters that need to be quantified in order to fully describe the measured pore pressures are identified. In order to quantify the effect of these key parameters on the accuracy of the measured pore pressures, verification tests are conducted where MPAS measured pore pressures can be compared to reference pore pressures in a controlled environment. A testing matrix is established wherein the magnitudes of all of the key parameters are varied over their potential range and the deviations of the MPAS pore pressure measurements from the reference pore pressure measurements are documented.

WORK COMPLETED

Initial studies have been initiated to resolve the physical factors that can influence the measured pore pressures. Factors dealing with the internal mechanics of the probes have been identified, modeled, and validated. A journal article has been published that documents these results (Andersen et al. 1996). Deployment strategies have been developed to quantify all of the key parameters that are necessary to describe the behavior of the MPAS probes in terms of these factors and hence to quantify their potential bias on any given set of field data.

Studies aimed at quantifying the effect of hydrodynamic forcing of the upper probe housing on the measured pore pressure response have been initiated. Simplified models to identify the most significant parameters that can influence the dynamic behavior of the probes have been developed.

RESULTS

Initial results from the physical and numerical modeling studies indicate that the tie between pore pressures measured by the MPAS system and pore water pressure expected to be generated under a buried mine is more compicated than anticipated. In order to make the tie, it will be necessary to measure the dynamic behavior of the probes directly (during the measurement) and to determine soil constitutive behavioral

properties independently of the pore pressure measurements. The nature of the difficulty in making this tie and the magnitude of the expected accuracy of the resulting comparison will be fully investigated in the second year of research.

IMPACT/APPLICATIONS

The results from this research will have a direct and significant impact on the scientists and engineers who will attempt to use the MPAS pore pressure data in the future to infer basic behavioral mechanisms or to validate scientific models.

TRANSITIONS

The dynamic pore water pressure data sets obtained in this project will be used to validate, or improve, analytical models for predicting such pore pressure gradients in the 6.2 Mine Burial Processes Task Area. The validated models, in turn, will be used in that 6.2 project to better understand when one can expect mine burial due to sediment scour and/or liquefaction. Improvements in the mine burial models will eventually find their way into MEDAL used in the field by MCM forces. In addition, the interpretation schemes that will be proposed as a result of these studies will be used by scientists and engineers attempting to "correct" the measured pore pressures to quantities that are relevant to their particular investigations.

RELATED PROJECTS

Nato Experiment Multi-Piezometer Support, ONR Code 322GG, P.I. Jeffrey Becklehimer NRL Code 7432.
Mine Burial Processes, NRL Task Area BE-35-02-27, P.I. Michael Richardson, NRL Code 7431.

REFERENCES

1) Andersen, G.R., Bennett, R.H., Barber, M.E., Todorovski, L., and Maynard, G.L. (1996), "A Multi-Sensor Piezometer for Shallow Marine Sediments in Coastal Environments", American Society for Testing and Materials (ASTM) Geotechnical Testing Journal, GTJODJ, Vol. 19, No. 4, pp. 373-383