

## Subsurface physical property prediction from 3-D seismic data: the challenge for marine geotechnical studies

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Three-dimensional seismic data have revolutionized the petroleum industry by providing images of subsurface stratigraphy and structure that are much more accurate than could previously be mapped(1). Furthermore, new approaches to the analysis of 3-D seismic data aim at creating 3-D physical property volumes for intervals of interest. In this work, attributes (instantaneous frequency, reflection strength, etc.) are derived from the seismic traces. Empirical correlations are then sought between these attributes and physical properties (porosity, fluid saturation, etc.) derived from corresponding borehole logs. If statistically valid correlations can be established, and other parameters can be satisfied (2), they can be used to predict physical properties throughout the 3-D survey area, thus creating a 3-D physical property volume. Numerous case studies document the viability of this methodology.

We seek to adapt this approach to the study of underwater landslides. Seismic response is a function of density and velocity and these, in turn, are related to properties of interest in geotechnical studies. The work consists of collecting high-resolution 3-D seismic data over suitable areas, then correlating the seismic data with physical property information obtained from long cores. The result of the 3-D seismic attribute analyses can be one or more physical properties volumes that capture the extent, thickness, and 3-D geometry of "geotechnical layers" (e.g., "weak layers"). These results can then be integrated with the results of conventional seismic interpretations that address the 3-D geometry of the seafloor, slip surfaces, debris mounds, scarps, etc.

One of the major challenges in submarine slide risk assessment is to integrate all the uncertainties in a regional framework and it is believed that this will be eventually achieved by integrating the 3-D seismic and geotechnical properties (including variability and uncertainty). One way to approach this is to use a reliability method so as to: (1) provide a coherent approach to submarine risk assessment evaluation and (2) reduce the cost of site selection. This means that we will have to develop an approach which works at a regional scale and is flexible enough to enable zooming on particular site. Using existing and new data acquired as part of COSTA, we will work on modeling uncertainties and variability of the main parameters needed for slope stability evaluation (i.e., soil properties and slope geometry) and then integrate them with the 3-D seismic. This integration should provide a fundamentally new way of approaching this field.