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Site Characterization through the Integration of Geophysical and Geotechnical Data

C.J. Ehlers and G.M. Lobley, Chevron Energy Technology Company; D.R. Spikula and J.R. Brand, Geoscience Earth & Marine Services Inc.

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Abstract

This paper illustrates how the integration of geophysical and geotechnical data can be used to characterize and provide an explanation for variations in soil properties across a deepwater development site.

At a deepwater offshore development site, a high-resolution geophysical survey identified the presence of current scour features at the seafloor, in-filled and buried scour features, and thinning parallel-continuous stratigraphy across the site. A subsequent geotechnical investigation was performed at three anchor cluster locations with Piezocone Penetration Tests (CPTs) and Jumbo Piston Cores (JPCs) targeting areas both inside and outside of the scour features to assess soils variability. The investigation revealed the presence of sand in one surficial scour feature, no significant change in shear strength within a buried scour feature, the presence of deep, localized “weak” soil zones at varying depths with sudden decreases in cone tip resistance of up to 30 percent, and a variation in OCR across the site.

Integration of the geophysical and geotechnical data revealed that the local presence of sand across the area could not be determined by strictly geophysical data alone and required confirmation with geotechnical data. The “weak” soil zones detected in the CPT data could be correlated to a discernable seismic reflector, permitting the mapping of the depth to top of the “weak” soil zones over the entire site. This in turn allowed the CPT data to be used to characterize these weak layers, and thus variations in shear strength, across the site. Finally, the thinning stratigraphy due to erosion observed in the geophysical data supported the trend in the OCR and associated shear strength variation across the site.

Introduction

A turret-moored FPSO with a three point mooring system is being installed in about 1100 meters of water at a deepwater oil development site. A shallow, high-resolution, AUV geophysical survey and geotechnical investigation were performed at the development site to investigate seafloor and shallow geologic features and to define soil conditions within the foundation zone of the anchors for the mooring system. The geophysical survey revealed the presence of seafloor and buried in-filled scour features that result from seafloor currents. These results were used in the scoping of the geotechnical investigation, which targeted these scour features to determine if variations in soil conditions might exist. The geotechnical investigation in turn revealed conditions that were not identified in the high-resolution geophysical survey. The results of the geotechnical investigation were then integrated with the geophysical data to identify and explain trends or correlations between the data sets.

Geological Setting

The study area is located along the north flank of a significant submarine canyon as shown by the grayscale seafloor rendering Figure 1.