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"CPT Stinger" - An Innovative Method to Obtain CPT Data for Integrated Geoscience Studies

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Abstract

A new deepwater static cone penetrometer system, “CPT Stinger”, was used to investigate subsurface conditions at a number of production sites in the deepwater Gulf of Mexico. Same site high-resolution geophysical data and long cores obtained with a Jumbo Piston Core (JPC) system illustrate the excellent correlation obtained with continuous geotechnical and geophysical data for defining the spatial variation in soil properties.

The high cost of drilling deepwater borings and sampling at widely spaced intervals imposes a significant constraint on obtaining a sufficient quantity of high quality soils data. Thus, improved methods are desirable for more quickly assessing requisite soil properties without sacrificing accuracy. The “CPT Stinger” system is a new tool that can fill this role.

This new system allows the same general suite of JPC coring equipment to be modified for CPT testing and can be deployed from an oilfield supply vessel. By simply replacing the standard piston core liner with a CPT system containing thrusting rods, a power/control module, and CPT data logging system, the field operation can quickly be converted from sampling to in situ testing mode. The results show that the new system provides continuous soundings with centimeter-depth accuracy and stratigraphic consistency. In addition to the acquisition of high-quality static CPT data, the sampling rate of the CPT logger allows the acquisition of dynamic CPT data during free fall that can be adjusted for velocity differences to emulate static data

A particularly effective way to use the system is in conjunction with nearby, continuous sampling with JPC cores and subbottom seismic profiles. This allows the correlation of the CPT results with strengths from continuous samples over a significant depth of overlap and with the geophysical cross sections. Correlations are presented in the paper for undrained shear strength data from long cores with insitu CPT data. Following the premise that more information acquired for a given budget tends to reduce the risks associated with foundation design and installation planning, the economic benefits of rapidly acquiring the geotechnical data from a lower cost vessel are also discussed.

Introduction

The high cost of deepwater oil and gas developments has focused much attention on fast tracking these projects from discovery to production. An integrated geologic/geotechnical study including the “CPT Stinger” system provides an opportunity to characterize subsurface conditions in a cost effective manner. In contrast, the high cost of drilling deepwater rotary borings that sample at widely spaced intervals tends to limit the opportunity to acquire a sufficient quantity of high quality soils data to fully understand the site.

Background

The importance of conducting integrated geoscience (geologic/geotechnical) studies for deepwater developments has been clearly described by Campbell et al. (1988)[1] and Young and Kasch (2011)[2]. The three-dimensional integrated geoscience (geologic/geotechnical) model must be defined early to serve as a basis for planning the architecture of production facilities. The model serves to better understand the constraints imposed by: (1) geologic conditions and geo-hazards, (2) subsurface stratigraphy and its spatial variability, and (3) variable soil profiles and geotechnical properties. The resulting goal of the integrated geoscience model is to select facility sites with favorable conditions such as those with uniform geologic/geotechnical conditions and those most conducive to safe operations of planned seafloor supported structures.