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Geologic Setting of the Mad Dog Mooring System

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Abstract

The Mad Dog prospect is located along the Sigsbee Escarpment in the southeastern portion of the Green Canyon Area. The Mad Dog mooring system straddles the Sigsbee Escarpment (Figure 1). A total of eleven mooring piles arranged in three clusters were planned for this mooring system. Two clusters are situated along the Lower Continental Slope and one cluster is situated along the escarpment. The paper describes the complex surficial geologic setting as well as the geohazards present at the site and how they influenced the anchor locations of the chosen mooring pattern. The unique challenge of this project was the effort put forth to understand the mooring system in variable and complex areas at each anchor cluster.

Large slump events and other significant geologic events are prevalent along this portion of the Sigsbee Escarpment. The collection, interpretation, and integration of geophysical and geotechnical data were used to select favorable mooring cluster areas and conditions at each anchor site within this geologically complex area. The goal was to evaluate each mooring cluster area to 1) Identify and avoid any potential hazards or constraints, 2) determine seafloor and shallow geologic conditions within each cluster area, and 3) assess shallow spatial sediment variability within each cluster area.

The integration of the results was used to establish favorability criteria and guide further site-specific field programs. A detailed analysis of each mooring cluster was performed to 1) evaluate and predict spatial variability of the shallow sediments at each cluster, 2) design a site-specific geotechnical program at each cluster, and 3) evaluate general installation and retrieval performance of each suction anchor site. A site-specific geotechnical program was designed for each cluster specifying options that allowed the field program to be modified as needed.

The evaluation of the shallow sediment spatial variability within each mooring cluster area allowed a departure from the more traditional geotechnical field program, and ensured that all necessary data was obtained and limited field activity to the collection of data essential for successful installation and performance of the mooring system.

Available data

Numerous types of geophysical and geotechnical data have been collected within the Mad Dog area. Geophysical data is comprised of conventional 3-D seismic, high-resolution 3-D seismic, 2-D high-resolution seismic, multibeam bathymetry, side-scan sonar, and subbottom profiler data (Orange et al, 2003). Geotechnical data obtained before the anchor-specific geotechnical campaign included numerous several piston cores, jumbo piston cores, and rotary soil borings (Al-Khafaji et al 2003). This study integrated both types of data to identify, map, and extrapolate stratigraphic units (where applicable) and provide a preliminary interpretation of the geotechnical parameters for foundation design at the mooring locations.

Geologic background

The Mad Dog prospect is located along the Sigsbee Escarpment in the southeast portion of the Green Canyon area (Figure 1). The northwest half of the Mad Dog area is situated within the Lower Continental Slope (LCS), while the southeast half covers the Sigsbee Escarpment and the Upper Continental Rise. Water depth in the prospect area ranges from approximately 4,000 ft to over 7,000 ft.

Several publications describe the geologic framework and model of the Mad Dog prospect area (Brand et al, 2003, George et al, 2002, and Jeanjean et al, 2003).

In summary, the Sigsbee Escarpment is the most dominant feature within the study area. The Escarpment marks the seaward expression of the Louann Salt that has been progressively pushed down-slope by sediment loading and is associated with complex faulting and past slumping caused by the lateral and vertical movement of the salt.

The continual lateral and upward movement of the salt has induced stresses in the overlying sediment overburden causing the sediments to fracture (fault). The initial faults probably formed as thrust (compression) faults ahead of the salt nappe, while normal (expansion) faults formed above the salt formation (Orange et. al, 2003). These faults are a result of the salt uplifting the overlying sediments, causing fractures (faults) and eventual collapse of the overlying sediments. Fault grabens (fault bounded lows) are formed as the salt underneath is depleted and the overlying sediments collapse.

Large slump events, which are a direct result of slope instability, are prevalent along this portion of the Sigsbee