SEISMIC FEATURE OF TOPOGRAPHY OF A SHELF-SLOPE-TROUGH AND ITS GEO-ENGINEERING APPLICATIONS, WEST ARAFURA SEA, INDONESIA AND NORTHERN AUSTRALIA

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ABSTRACT

This study shows a map depicted over a limited time, which indicates an area of stability of surface and shallow sediments in a deepwater area. The map was a geo-engineering reference in evaluating and selecting drilling sites in deepwater. The area of study was located in the shelf-edge and upper slope off Northern Territory, Australia through the eastern part of the Timor Trough, West Arafura Sea, Indonesia. Plastic deformations are represented by various kinds of sea-bottom topography in the upper slope through the trough (water depths: ca. 400 to 2,000 mSS). Stability of the sediments is the subject critical for sea-bottom facilities in operations of drilling and facility-construction in the deepwater area.

A simple, quick-look method to identify an area of unstable sediments at the sea-bottom and shallow depths was proposed and examined. Sea-bottom topographic irregularity is eyeballed and semi-quantitatively measured mainly on 2D seismic images with an aid of a workstation for seismics. A mechanical model of bending plastic-rigid plates was applied to insure objectiveness in the semi-intuitive analysis. Bending rigidity is a key in this analysis. The differential profile was defined to estimate the sea-bottom-topographic irregularity. Cross plots of (X, $\theta$; X: distance of measuring point from a reference origin, and $\theta$: bending angle with reference to the horizontal datum, of plastic deformation of surface and near surface sediments in the area. The deformation begins at a critical angle ($\theta_c$) along a dip line of survey. $\theta_c$ varies from 0.7 to 3°, and is mostly 0.7° to 1.2°. 1,000 mSS in water-depth approximately corresponds to the $\theta_c$, and the contour line of the depth virtually indicates the boundary between the upper and lower slopes.

Actual drilling operations confirmed the pre-drilling diagnosis of the sediment stability in this study.

INTRODUCTION

The area of study includes the Masela PSC Block, and is located in the continental slope through the Timor Trough, West Arafura Sea, Indonesia and Northern Australia (Figures 1A and 1B). Water depths of the area range from ca. 400 to 2,000 meters below the mean sea level (hereafter, abbr. mSS), and water temperatures at sea-bottom range from 10 to 4 °C.

An active tectonic line (a red dashed line in Figure 1A) is represented by a topographic break line extending from Melville and Bathurst Islands to the East of Timor Island. The tectonic line is the boundary between the Recent carbonate topographic high (including the Greater Sunrise Gas Field), and gently depressed topographic low (including the Abadi Gas Field) (Honda, et al., 2006). The area of study is in the area of depressed topography.

Instability of surface and shallow sediments have been recognized as the most difficult hazard in development operations for hydrocarbon pools discovered in deepwater areas, especially in the Northern Gulf of Mexico (abbr. GOM) (Shipp, et al., 2004; Sawyer, et al., 2007, etc.). Clayey mud in deepwater normally causes fluidal behavior. In deepwater regime in GOM, flow and collapse of sediments often occur with operations in drilling and establishing production facilities on the sea-bottom.