



OTC 19352

Seabed Imagery and Chemosynthetic Communities: Examples From Deep Offshore West Africa

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This paper was prepared for presentation at the 2008 Offshore Technology Conference held in Houston, Texas, U.S.A., 5–8 May 2008.

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Abstract

Among marine geohazards, pockmarks are the most common features observed in deep-water environments. They are interpreted as the result of fluid flows at seabed, originating from shallow gas, shallow water over-pressure, or gas hydrate dissociation. Fluid migration pathways may be facilitated by hydro-fracturation, shallow faults, or stratigraphic boundaries.

The nature of fluid flows generating pockmarks relates to biological and/or geological processes. Methane is considered as the principal component, and may have a biogenic origin (generated within shallow sediments), or a thermogenic origin (from a source rock "kitchen"). Whatever its origin, once the methane-enriched fluid reaches the seafloor, it creates a morphology anomaly (crater-like depression), often associated with mineral precipitation, including methane-derived authigenic carbonates. In addition, pockmarks are usually associated to particular benthic communities, relying on microbial chemosynthetic production.

For deep-water E&P activities, such pockmarks may be considered as geohazards, and must be identified at an early stage of a project. Seabed depressions may affect subsea installations, authigenic carbonates may impact pipeline installation, fluid migration may induce slope instabilities, and hydrate dissociation may cause sediment liquefaction. In addition, chemosynthetic communities associated to these pockmarks are considered as unique and vulnerable. E&P activities must take those into account, in order to minimize the impact of developments, and to comply with company environmental policies.

This paper will present recent deep-water pockmark observations in West Africa (Nigeria and Angola), issued from 3D exploration datasets, conventional (hydrographic) surveys, and bottom surveys by AUV (Autonomous Underwater Vehicle), and ROV (Remote Operated Vehicle). These surveys were conducted in the frame of both E&P projects (drilling and subsea development) and R&D projects dedicated to deep-water seabed conditions. The data review leads to a better understanding of seepage features, in terms of geophysical interpretation of seafloor anomalies, trigger mechanisms, quantifying geohazards, and environmental stand-off distances.