IPTC 12124

# Improving the Detection and Analysis of Seafloor Macro-Seeps: An Example from the Marco Polo Field, Gulf of Mexico, USA

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This paper was prepared for presentation at the International Petroleum Technology Conference held in Kuala Lumpur, Malaysia, 3–5 December 2008.



## Abstract

The hunt for seafloor hydrocarbon seeps has become an important component of many deepwater exploration programs. Finding thermogenic hydrocarbons at the seafloor is evidence of a working petroleum system and the recovered hydrocarbons can be used to give insight into the contents of the subsurface reservoir. But hydrocarbon seeps are often small features not easily recognized on conventional seismic data and sampled seep oils often mix with recent organic matter and experience biodegradation that hamper the interpretation of thermogenic hydrocarbons.

To improve seep detection, high-resolution imaging of the seafloor and near-seafloor was used to characterize geomorphology. Data were obtained using an Autonomous Underwater Vehicle (AUV) equipped to collect detailed multibeam bathymetry, side scan sonar, and sub-bottom acoustic profiles. Using this information, potential hydrocarbon seep features were easily identified, then related to deeper structures and faults imaged on conventional seismic. This established links between potential subsurface reservoirs and the seafloor seeps.

A holistic approach using geochemical, sedimentological, and biological data was used to improve the analysis of seep samples. The sediments were examined for authigenic carbonates, chemosynthetic organisms, and other features characteristic of seep sites. Geochemical screening analysis utilized saturate fraction gas chromatography to get clearer views of the hydrocarbons distributions. Detailed biomarker analysis was used to distinguish the background geochemical noise from the seep signal. This analysis included an extended list of compounds from both background and potential seep samples.

This approach greatly enhances the probability that hydrocarbon seeps can be recognized, efficiently sampled, and analyzed for maximum benefit.

## Introduction

The search for seafloor hydrocarbon macro-seepage can provide evidence for the presence of a working petroleum system reducing the risk in deepwater exploration. Seep detection often begins with remote sensing, such as synthetic aperture radar, to look for sea surface slicks suggestive of seepage. This is usually followed by an examination of seismic data for potential seafloor seep features. Using only 2-D seismic data, the hunt for