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INTEGRATING HYDROGRAPHIC AND GEOLOGIC MULTIBEAM ECHOSOUNDER DATASETS: TOOLS AND TECHNIQUES FOR THE IDENTIFICATION OF DEEP WATER HYDROCARBON SEEPS

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Abstract

Hydrocarbon seep features are often difficult to identify on the seafloor. Locating geologic and biologic features created by the upward migration of hydrocarbon-rich fluids is greatly aided by the use of multibeam echosounders. Historically the analysis of the bathymetry has been used to identify features that had relief on the seabed, such as pockmarks, mud volcanoes, fault scarps, and so on. Over the last few decades, multibeam backscatter has been increasingly utilized to provide interpretable data regarding seafloor conditions, specifically the hardness of the substrate. This allows improved identification of seep features like authigenic carbonate deposits, chemosynthetic fauna with hard shells, sand versus clay deposits, or soft gassy sediments.

Unfortunately backscatter is still a poorly constrained science, with signal issues arising from geometry effects caused by the seafloor slope and also from artifacts in the equipment installation that can confuse the backscatter signal from seep-related hardgrounds. Methods that can improve the interpretation of the backscatter signal, by reducing the effects of geometry on the reflected signal and by improving the equipment installation parameters and settings, are available and are now being considered best practices for the collection of backscatter data. Furthermore there are still several differences noted in backscatter data when different processing software packages are used, suggesting that inconsistencies between how the various commercially available software packages process the data can affect the final interpretation of nature of the material and/or location of the feature.

Finally, the most recent dataset being offered by modern multibeam systems include backscatter collocated in the water column, to identify anomalies that can be interpreted as bubble plumes caused by active gas seepage, whether naturally occurring gas seeps or non-natural plumes rising from pipelines.

These multibeam datasets (bathymetry, seafloor backscatter, and midwater backscatter) are extremely useful tools for quickly and efficiently detecting and locating hydrocarbon seep features when the hydrographic acquisition/processing component and the geologic/oceanographic interpretation component are properly integrated. As frontier exploration moves into deeper waters in search of oil and gas reserves, studies that examine the acoustic frequency responses of seep features in deep water multibeam systems as well as a comparison of the processing software and acquisition parameters are critical to understanding the limitations of these datasets. Fugro is presently involved in large, commercial multibeam surveys encompassing large areas of unexplored frontier basins globally, in addition to several projects that have been within Colombian waters.

Fugro has looked at reducing geometry effects by acquiring data at completely overlapping coverage from different angles and merging the datasets. Our teams have used this methodology on several occasions for commercial jobs in Colombia and this has been examined as a technique to improve understanding of regions of high-biologic diversity for environmental purposes as well as an exploration tool. We have also spent years optimizing settings and parameters, including normalizing the backscatter between the echosounder sectors. We have compared different backscatter results from different processing software packages. We work closely with software developers on the beta testing of the newest generation of midwater feature detect tools that identify water column anomalies.

We present some of these seep detection methodologies and their results from both a hydrographic and a geologic perspective.