Paper 8

Surface geochemistry methods and applications in deepwater exploration

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Surface geochemical prospecting is a petroleum exploration tool based on the premise that upward migrated petroleum from deep source rocks and reservoirs can be detected in near-surface sediments and used to evaluate exploration potential. Surface geochemical exploration studies (piston coring and chemical analysis) are cost effective means of obtaining information ahead of the drill bit. The high cost of offshore exploration has made the identification of sea floor micro- and macro-seeps a well-accepted risk assessment methodology. The advantages of surface exploration are that the presence of macro-seepage and/or micro-seepage of oil and gas in near-surface seafloor sediments provides evidence of active oil generation and migration, it allows assessment of most prospective areas, and it provides an integrated seep signal over time. In addition, samples are available to characterize oil properties, maturity and source rock type. In addition, the spatial coincidence of seepage and geologic structure allows for the identification of the loci of natural hydrocarbon seepage and to infer possible migration pathways from the reservoir to the sea floor.

The authors have been involved in the collection of nearly 15,000 piston cores and over 1,000 surface heat flow measurements over the last twenty years as part of deepwater surface geochemical exploration (SGE) studies in frontier regions worldwide. We will discuss current methods and provide case studies and comparison of seepage hit rates from deep water coring programs in the northern and southern Gulf of Mexico, Trinidad, Angola, Nigeria,

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NW Africa/Nile Delta, NE Canada and SE Asia. The authors will show the increase in seepage hit rates as more recent coring studies have benefited from the increased use of 3-D seismic data over previous 2-D based site selection.

The first part of this paper will describe the current methods used in surface geochemical studies. Typically, geophysical surveys (2D or 3D) have been used to select coring locations based on surface expression of faults and other features related to conduits for upward migration of hydrocarbons. In order to correlate the seabed or sub-bottom feature to be cored with the available seismic records, survey lines are typically executed with the Chirp sub-bottom profiler to collect acoustic graphical data prior to core acquisition. The purpose of this effort is to obtain the best core location and information of sub-bottom structure and bottom hardness for each site. These survey lines are run at the same heading as the seismic line for the station (or its opposite heading), and at a ship speed to give the best image. Ship speed during surveys is typically 6 to 8 knots. Typically, the particular feature on the seabed is identified and matched against the 2-D seismic record. These matches with the seismic records are usually very consistent for most sites. This consistency adds validation to the location calibration data already generated, and eliminates any question as to whether the proper location or datum was specified.