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A*Near-Surface Hydrocarbon Migration: Mechanisms and Seepage Rates*@
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Surface geochemistry as an exploration tool: A comparison of results using different analytical techniques.

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Surface geochemical prospecting involves the search for surface or near-surface anomalies of hydrocarbons, which could indicate the occurrence of petroleum accumulations in the sub-surface. The methodology, as applied in offshore basins, covers a range of techniques, from observation of visible oil seepage at the surface, to detection of micro-seeps in near-surface sediments using sensitive analytical techniques.

Since most rock types are not totally impervious to hydrocarbons, both light and heavy hydrocarbons will migrate upwards, from either mature source rocks or reservoirs, to the near-surface sediments. While the methodology for surface geochemical surveys is the subject of continuous development, the current, most favoured practice is to detect possible migration pathways from the deep to the near-surface with the aid of seismic data, often together with remote sensing data (satellite imaging etc). The expression of such pathways at the surface is then the focus of surface geochemical prospecting grids.

A number of different analytical techniques have been introduced over the years, some being found to be extremely useful while others have been discarded after a short period of use. Of the currently standard techniques for gas analysis, one is the analysis of adsorbed (acid-released) gas by gas chromatography (gas GC). This has been used since the fifties, in laboratories both in the USA and Europe. Lately there has been considerable discussion regarding the merits of this technique, especially amongst USA-based companies. At Geolab Nor we have analysed more than 10 000 samples using this technique. We will present data from various studies, comparing the results from this technique with those from other gas analyses including headspace- and occluded (blender- or mechanically released gas) gas GC analyses. These comparisons clearly show the importance of adsorbed gas analysis, by virtue of the uniqueness of the data, i.e. the technique yields data reflecting a facet of hydrocarbon distribution in surface sediments that is not accessible from other analyses.

Headspace gas analysis has been traditionally applied to almost all surface geochemistry samples. However, when proper care is taken to avoid bacteriological activity, i.e. the samples are frozen to - 80^{o} C, most of the gas components do not disperse out of the sediment and into the headspace, i.e. consequently mainly only methane is recorded. Examples will be shown from various studies that raise questions regarding the usefulness of this analysis.

Solvent extraction followed by Total Scanning Fluorescence (TSF) and GC analyses of the extract (EOM GC) were introduced in the latter part of the 1980's. With regard to the latter, there

has been a great deal of discussion regarding the alternative ways for preparative treatment of the samples prior to solvent extraction, e.g. whether or not to employ sieving in order to remove clasts of any reworked material of source rock that may contribute spurious mature hydrocarbons. We will show examples of the results from extraction of different types of samples, which have been prepared in various ways. The data clearly show that careful sieving of the samples does not significantly affect the levels and distributions of the hydrocarbons of interest in the samples; however extraction of the non-sieved whole sample may bring forth large amounts of hydrocarbons from reworked material when this is present. There has also been considerable discussion regarding the usefulness of TSF analysis. Some laboratories/companies undertake this type of analysis on all samples, even when GC analyses clearly show that there are no petrogenic hydrocarbons present. We believe that this should not be necessary, i.e. TSF should only be undertaken on those samples that are found to contain petrogenic hydrocarbons by the GC analyses. This will be demonstrated using examples from various studies performed by Geolab Nor.