PS Evaluation of Sampling Methods and Various Preservation Techniques for Offshore Surface Geochemical Surveys*

Malvin Bjorøy[1] and Ian L. Ferriday[2]

Search and Discovery Article #40374 (2009)
Posted January 26, 2009

*Adapted from poster presentation at AAPG Annual Convention, San Antonio, Texas, April 20-23, 2008

Surface Geochemical Services AS (malvin@geolabnor.no)
[1]Geolab Nor AS, Trondheim, Norway

Abstract

There has been significant discussion regarding which sampling techniques give the best quality samples, the costs of using one technique compared with others, and how to preserve the samples after collection to ensure that there is no degrading bacterial activity. In order to get scientifically reliable answers to these questions, two different surveys have been undertaken.

The first is from the Barents Sea, where samples from 100 cores were quartered and treated to four different combinations of preservation methods, including presence/absence of bactericide, storage at room temperature or freezing to -20 or -80°C. The headspace and occluded gases were analysed for molecular composition and carbon isotope composition, with quite revealing results. There was no indication of bacterial activity in samples frozen to -80°C, but significant bacterial activity in the other aliquots, even for the samples with bactericide and freezing to -20°C. The conclusion from this is that the only preservation technique that will stop any bacterial activity in surface geochemical samples is freezing at very low temperatures, preferably -65°C or lower.

In the second survey, offshore Faeroes, for each of 10 stations, one gravity core and one piston core were collected close together. Samples were collected at 0.5 m depth intervals over the 4.8 to 5.5 m cores and preserved by canning / freezing to -80°C. All the samples were analysed both for gaseous and liquid hydrocarbons. There are no significant differences in the results from the parallel samples. The conclusion from this is that there is no difference in the quality of the samples from gravity or piston corers. However, there are significant differences in sampling time, the piston corer requiring 2.4 times as long as the gravity corer.

Evaluation of Sampling Methods and Preservation of Samples Used in Surface Geochemistry Projects

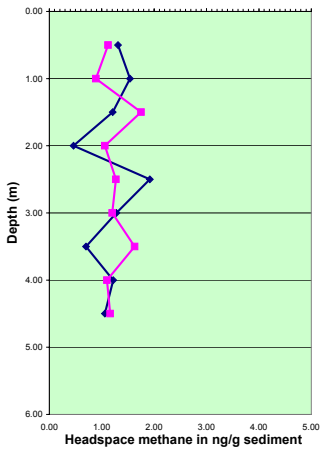
Malvin Bjorøy, Surface Geochemical Services AS & Ian L. Ferriday, Geolab Nor AS

Sampling Methods

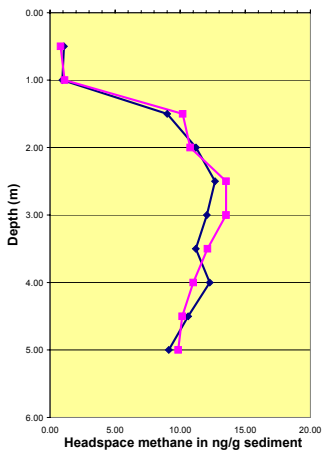
GC of Gaseous Hydrocarbons in Sediments:

Sampling Methods: Headspace Gas GC
(Methane only)

Site Without Seepage



Site With Micro-Seepage



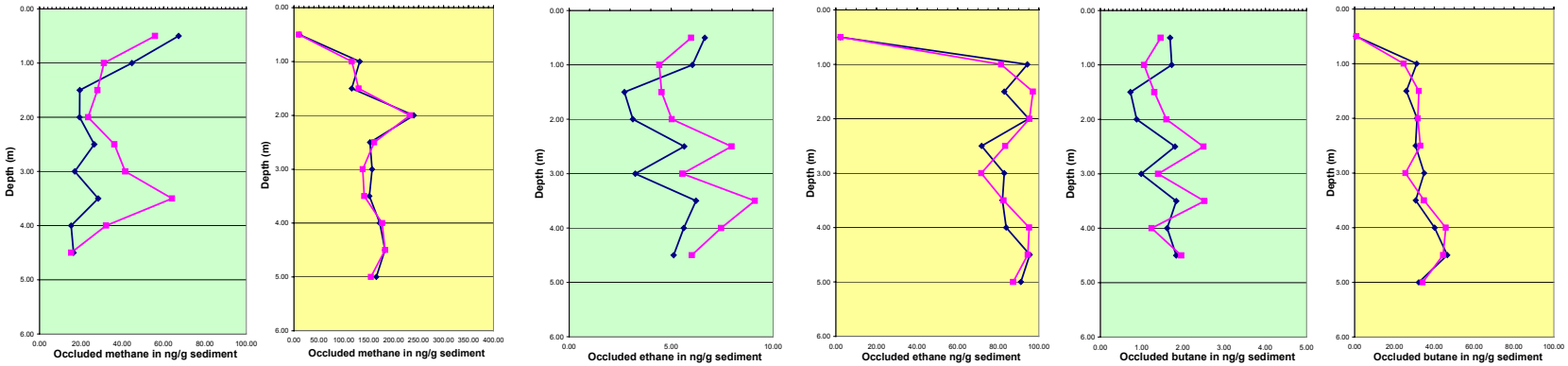
Core Aquisition Rates

Type of corer	No. Cores collected	Average water depth (m)	Total time used (hrs)	Average penetration (m)	Average core length (m)	Average distance from target (m)
Gravity corer	10	964	9.5	4.9	4.7	6.3
Piston corer	10	964	22	5.1	4.9	6.5

For the headspace methane yield there are no significant differences between sampling using a gravity corer (in red) or a piston corer (in blue). Gravity coring is however faster and less dependent on good weather for safe handling.

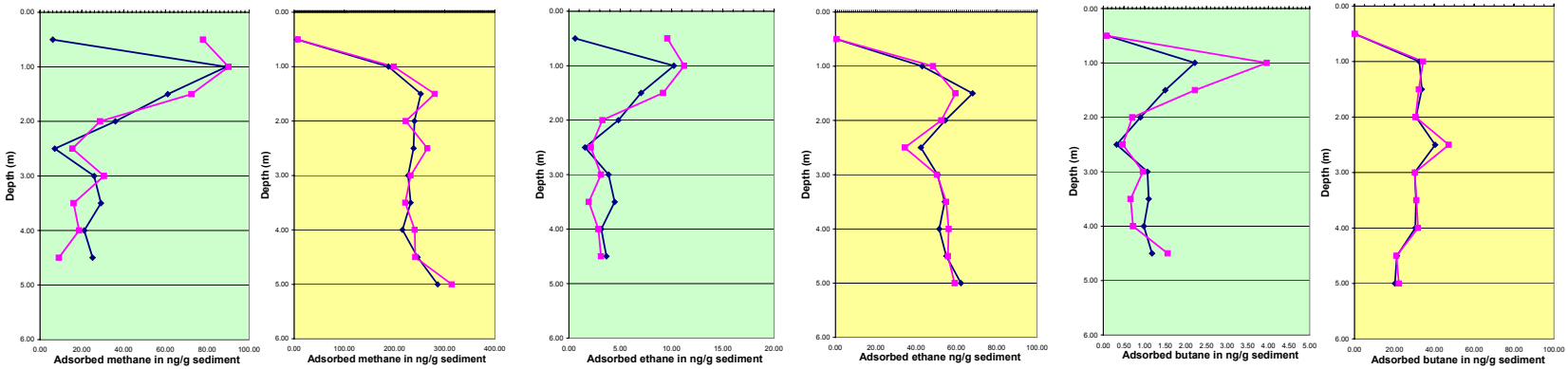
Sampling Methods: Occluded (interstitial or ball mill) Gas GC

Methane Ethane Butane



Sampling Methods: Adsorbed (acid released) Gas GC

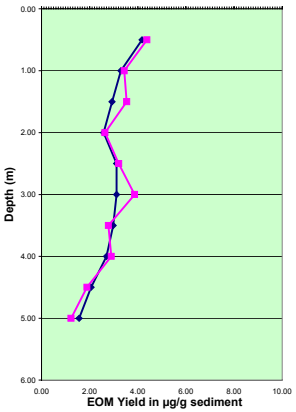
Methane Ethane Butane



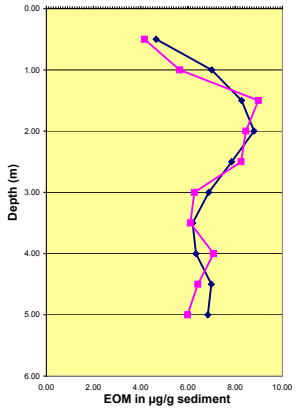
For the occluded and adsorbed gases of the sediments there is generally little difference between quality of samples collected using a piston corer (in blue) and those using a gravity corer (in red), from either sites with no seepage (green bkg) or from sites with micro-seepage (yellow bkg). These data also indicate little significant differences between core lengths of approximately 2 and 5 m.

Sampling Methods: GC of Extracted Liquid Hydrocarbons in Sediments:

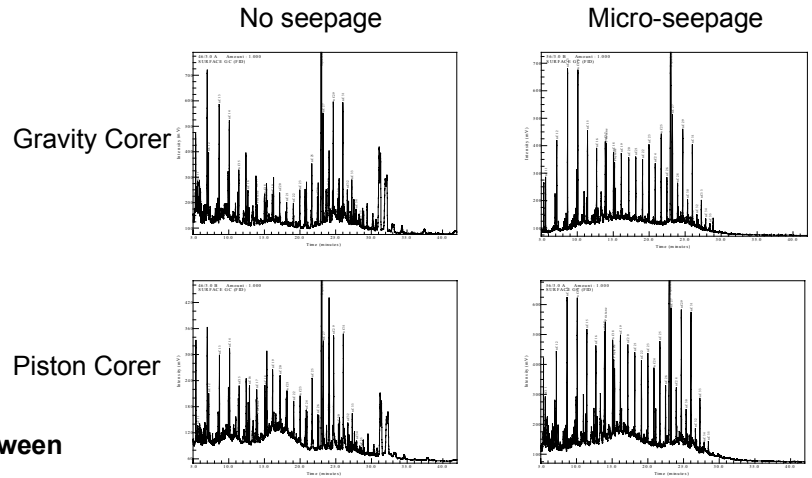
Site Without Seepage



Site With Micro-Seepage



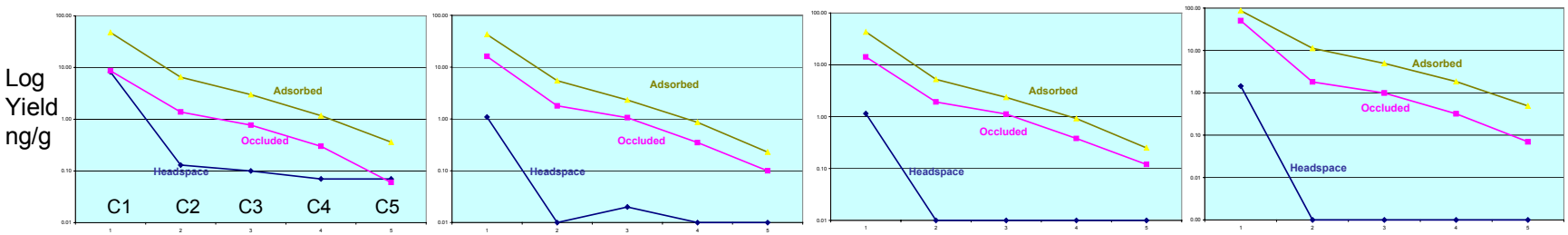
Extract GC Chromatograms (3m Depth):



Also regarding the liquid hydrocarbons, little difference is seen between the quality of the samples from the two coring methods.

Preservation Methods

GC of Gaseous Hydrocarbons: Average Yields of C1-C5



Ambient temperature with bactericide

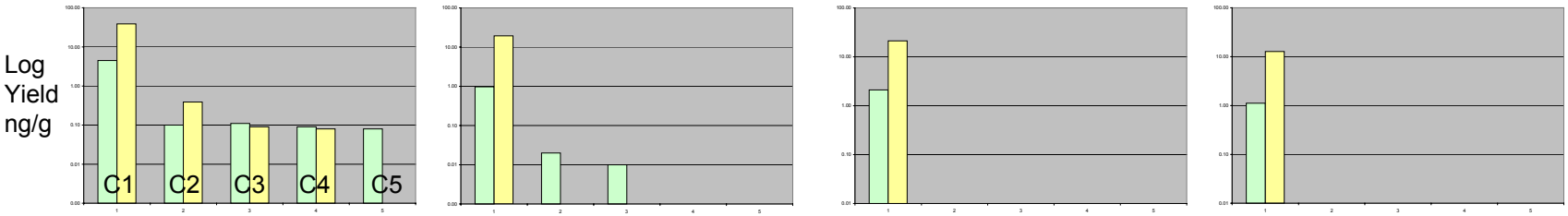
- 18 °C with bactericide

- 18 °C no bactericide

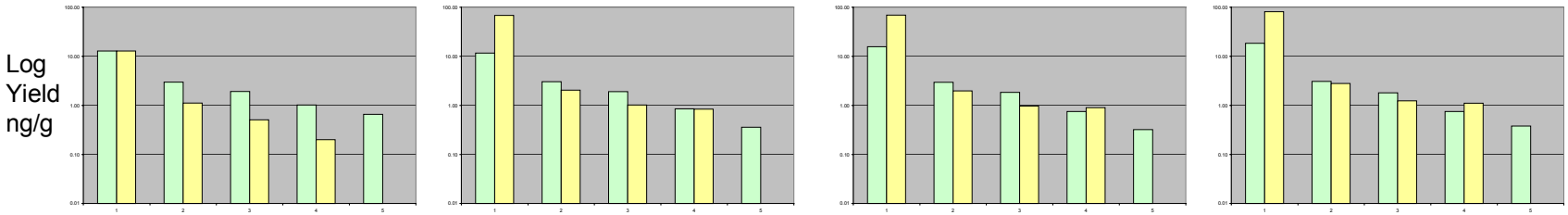
- 80 °C no bactericide

Preservation Methods: Headspace Gas GC, C1-C5

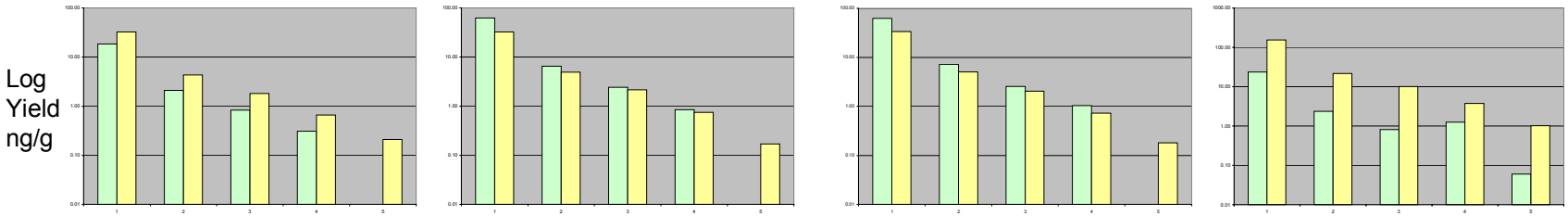
Site with no seepage
Site with micro-seepage



Occluded Gas GC, C1-C5



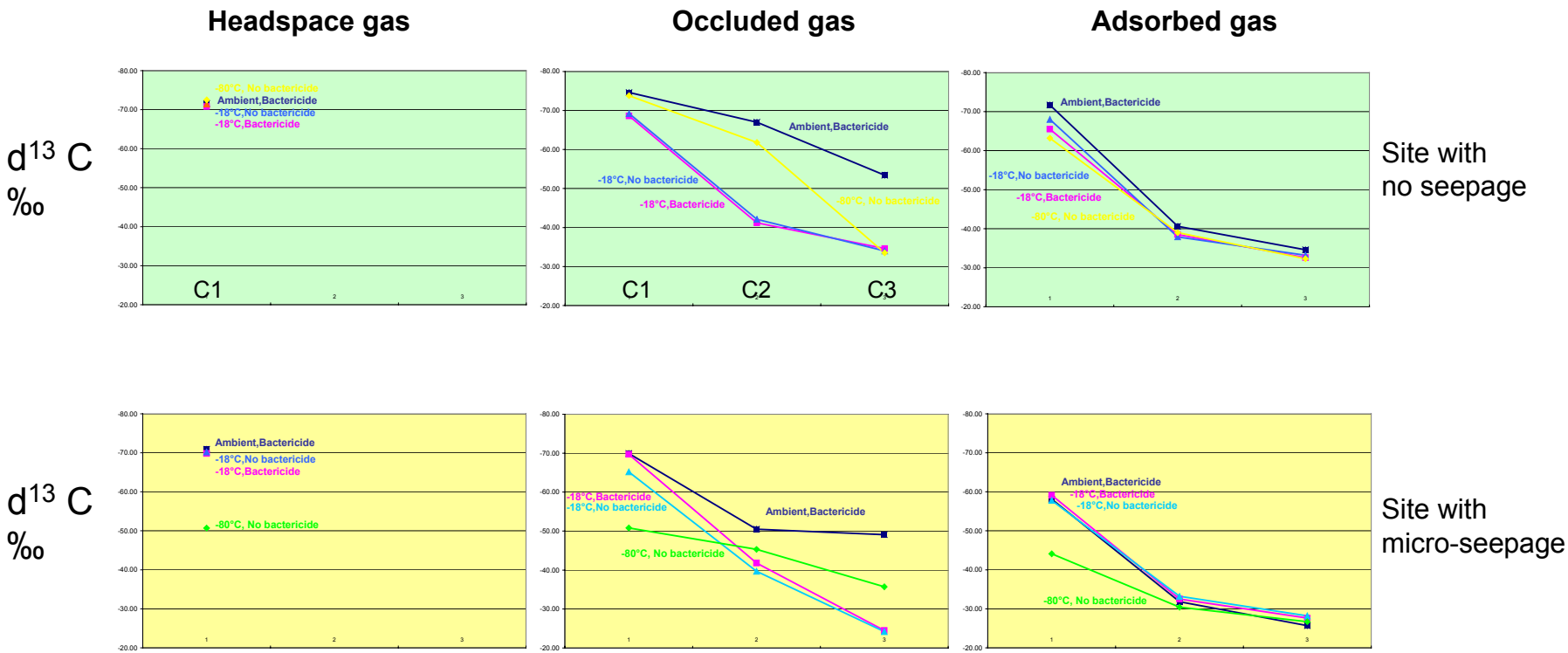
Adsorbed Gas GC, C1-C5



Ambient temperature with bactericide | - 18 °C with bactericide | - 18 °C no bactericide | - 80 °C no bactericide

Samples 'preserved' using the four different main methods which are generally in use show some significant differences. For headspace gas, as expected by the higher temperature of the 'ambient method' a greater amount has been released from the sediment and built up. This is often also mainly biogenic gas due to increased bacterial activity. For occluded and adsorbed gases, differences are less, but noticeable e.g. in greater yields for all adsorbed components with -80 °C preservation. There is no significant difference in using bactericide at -18 °C, except for headspace gas.

Preservation Methods:
Gas Carbon Isotope Analyses (GC-IRMS)



Samples from a site without seepage (green bkg) and a site with micro-seepage (yellow bkg) show some significant differences in carbon isotope compositions according to the preservation method used. The 'ambient' method in particular often shows isotopically less heavy compositions, mainly for headspace and occluded components i.e. reflecting formation of biogenic components via degradation of the original hydrocarbons in the sediments. Again there is little observable difference between the two -18 °C methods (one using bactericide). Overall, the -80 °C method shows the more reliably thermogenic values in the case of the site with micro-seepage. The isotopically light values shown by the -80 °C method, similar to the other methods, in the case of no seepage are to be expected since mainly only bacterial methane and ethane are likely to be present, from decomposition of indigenous recent organic matter in the sediments.

Conclusions

Sampling of sites with both micro-seepage of thermogenic hydrocarbons and no seepage, from different depths and using four different preservation methods reveal the following:

Sampling Methods:

The two main contesting methods used in clayey sediments, i.e. gravity coring and piston coring, are shown to produce equally good quality samples, at all depths tested, i.e. down to 5 m.

In practice however consider the more-than-twice-as-fast core aquisition of the gravity corer. Better economics, beside the wider weather window, i.e. more favourable for both production and safety, makes gravity coring the obvious choice for surface geochemical surveys in clayey seafloors.

Coring using an entry speed of 1.5 - 2.0 m/s is proven to be most effective, while a core barrel of 4m length is considered more than adequate for most surveys.

Preservation Methods:

Of the four methods tested, it is clear that as low a storage temperature as possible is most favourable , i.e. the -80 °C method.
Regarding the use of bactericide, this is shown to have little or no effect in the case of clayey sediments, probably due to the inability of this to physically penetrate the sediment sample.