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Geochemistry of NOCS Well 16/8-1.

S. Taylor and R.G. Jackson, BP Sunbury, 21/02/79

Memorandum



To CHIEF GEOLOGIST,
BP Petroleum Development of Norway,
Stavanger.

From GEOCHEMISTRY BRANCH,
Exploration & Production Division,
BP Research Centre, Sunbury.

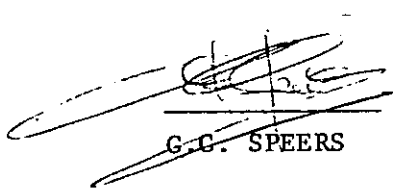
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Subject GEOCHEMISTRY REVIEW NOCS WELL 16/8-1

Date 21st February 1979

Attached is a copy of Review Note No. 4 containing some comments on RRI's Report on NOCS Well 16/8-1. The available information indicates the sediments encountered are immature down to TD. Attempts to extrapolate maturity trends, although undertaken by Sunbury, did not produce reliable results. This is clearly evident from the large error associated with the predicted OGT from vitrinite reflectance data, which is the result of excessive scatter associated with RRI's results.



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GEOCHEMISTRY OF NOCS WELL 16/8-1

by

S. Taylor and R.G. Jackson

This note examines the geochemical results and findings of Robertson Research International (RRI) on the NOCS Well 16/8-1. Analysis was undertaken on cuttings and sidewall core samples in the depth interval 1000 to 2300m. RRI suggest that the lithologies encountered indicate the ages of the samples to be Tertiary to Triassic. The vitrinite reflectance measurements have been examined to give the hydrocarbon generation thresholds. The source rock parameters used by Sunbury (TOC Values, TSE/TOC and SAC/TOC indices) have been derived from the source rock evaluation data of RRI.

(a) Vitrinite reflectance measurements determined on cuttings and sidewall core samples show the sequence examined to be immature. The estimates of the hydrocarbon generation thresholds are given below. These are based on a correlation of the vitrinite reflectance measurements on cuttings and sidewall core samples, by means of a linear regression programme. For this purpose the vitrinite reflectance measurements determined on the sidewall core sample from 2074.5m have not been included, as it is considered that they contain reworked vitrinite values of a higher reflectance.

Oil Generation Threshold	(R_o = 0.55%)	- 5900 <u>+</u> 4100m
Gas Generation Threshold	(R_o = 0.70%)	- 7550 <u>+</u> 5700m
Maximum Oil Generation Zone	(R_o = 0.80%)	- 8450 <u>+</u> 6550m
Oil Floor	(R_o = 1.30%)	- 11700 <u>+</u> 9700m

The small variation of vitrinite reflectance with depth and the scatter of the values ($R^2 = 0.26$), results in very large errors in the predicted thresholds. For this reason these estimates should not be used for regional assessment of DOD trends.

(b) Spore colouration, estimated by RRI on a 1-10 scale, varies from 1.5 - 2.0 in the 1396.5m sidewall core sample to 2.5 - 3.0 in the 2074.5 sidewall core sample. This indicates low levels of DOD in the section.

(c) UV-induced spore fluorescence indicates low levels of DOD. Yellow/Green to Yellow/Orange spore fluorescence (equivalent to an R_o of 0.30 to 0.40%) are reported throughout the well.

- (d) Spore colouration and spore fluorescence determinations on the 2074.5m sidewall core sample gave similar results to determinations on adjacent samples. The vitrinite reflectance measurements obtained on this sample are therefore considered to contain reworked values.
- (e) Light hydrocarbon analyses indicate an increase in the wet gas content of the headspace gases below 2000m, together with the presence of the ratio of the $i - C_4/n - C_4$ gases greater than 1.0 above 2000m. The transition ratio for this parameter to indicate maturity is disputed and is unreliable. The ease of migration of light hydrocarbons also affects the significance of such parameters. However, it appears that immature light hydrocarbons are certainly present above 2000m.
- (f) Samples from the depth interval 1000 - 1700m have moderate to good TOC contents in the range of 0.73 to 1.94%. Poor to moderate TOC contents, in the range 0.09 to 0.64%, are encountered between 1700 and 2055m. Four samples, from the interval 2060 to 2090m, have good TOC contents in the range of 3.30 to 7.20%. Below 2120m variable TOC contents are encountered, in the range of < 0.05 to 1.1%. RRI suggest that such variation may be due to cavings. This is illustrated by picking of the lithologies into groups and determining the TOC values on these. TOC values of the red-brown mudstone/siltstones, believed from sidewall core samples to be in situ, were poor (0.06 and 0.09%), whilst the olive-grey siltstones and silty-shales, believed to be cavings from the organically rich interval at 2060 to 2090m, gave TOC values of 0.35%. This illustrates that the sediments encountered below 2120m are likely to have poor TOC contents.
- (g) RRI did not carry out detailed visual kerogen analyses, but include the following comments in the report. Between 1369.5 and 1674.3m vitrinite is the dominant kerogen type, with some sapropel and generally minor inertinite. From 1674.3 to 2055m inertinite is the dominant kerogen type, with the samples at 1970 and 2024.6m rich in exinite. In the samples at 2060, 2065 and 2074.5m, sapropelic debris and degraded vitrinite are the dominant kerogen components, whilst at 2120m humic components are dominant.
- (h) TSE/TOC and SAC/TOC ratios are low to ~ 2300m, with no indication of significant hydrocarbon generation. This is consistent with the low DOD trends which indicate that the sediments examined were too immature for hydrocarbon generation. A high SAC/TOC ratio at 1100 - 1200m is probably due to oil-stain or contamination.

(i) RRI obtained only one reliable gas chromatogram. This was from the 2060 to 2090m cuttings sample. It is not presented by RRI but they describe it as containing an n-alkane distribution in the n - C₁₅ to C₂₅ range, peaking at n - C₁₈. This is consistent with an SAC derived from dominantly sapropelic, but with some land-derived, material.

CONCLUSIONS

The various DOD parameters indicate the immaturity of the samples examined. Vitrinite reflectance measurements suggests an oil generation threshold of ~ 5900m. The samples examined from the interval 1000 - 1647m have moderate to good TOC contents. Shale/mudstone sediments in the interval 2060 to 2090m have good TOC contents. Organically lean sediments are encountered in the intervals 1647 to 2060m and 2090 - 2300m. Comments included by RRI in the report, on kerogen type, indicate that the organically rich sediments in the 2060 to 2090m interval contain sapropelic debris and degraded vitrinite as the dominant kerogen type. TSE/TOC and SAC/TOC ratios indicate that no significant hydrocarbon generation is occurring.

The combination of good TOC values and the suggestion of larger quantities of sapropelic organic material in the shale samples at 2060 to 2090m indicate that this interval, at higher levels of maturity, may have a source potential for petroleum. A more detailed assessment of the kerogen type over this interval would give a more definite assessment of the source potential.

ST/JMP
16th February 1979