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## Geochemical Report for Well NOCS 9/2-1

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## Chapter 1

### INTRODUCTION

Well NOCS 9/2-1 was analysed on behalf of Norsk Agip by authorization of Bharam Fahti. Lithology description, TOC, Rock-Eval, vitrinite reflection and visual kerogen examination have previously been performed and are reported and interpreted in a report of 23.12.92 to Norsk Agip. These data and the interpretation are not repeated in this report, although references are made to these data. Data for an oil sample were also previously reported as data only. These data plus an interpretation of them are given in this report.

The well is located in the Norwegian sector of the North Sea and is situated in the (South) Egersund Basin, in the Norwegian-Danish Basin at 57°49'58.10"N, 04°31'27.92"E. The well was drilled by Statoil in 1987 to a total depth of 3756 m in the Triassic Skagerrak Formation and plugged/abandoned as an oil/gas discovery. The water depth at the location is 99 m and the Kelly Bushing elevation (KBE) was 29 m. All depths are relative to KB unless otherwise specified.

Three cuttings samples were extracted and analysed by GC-MS, carbon isotope composition of the saturated, aromatic and NSO fraction and carbon isotope composition of the individual components of the saturated fraction according to Norsk Agip's specifications. In addition, the report contains the data for one oil (DST-3) supplied by Norsk Agip.

The report is divided into chapters according to the various analytical methods used. Within the chapters the results are mainly discussed in a (descending) stratigraphic context.

## 1.1 General Comments

The samples used are those defined as potential source rocks in the previous study, plus one oil sample. The goal was to correlate potential source rocks with the oil sample.

## 1.2 Analytical Program

In accordance with the request from Norsk Agip, the following analytical program was carried out for well NOCS 9/2-1:

| <u>Analysis type</u>  | <u>No of samples</u> | <u>Figures</u> | <u>Tables</u> |
|---|----------------------|----------------|---------------|
| Soxhlet Extraction of organic matter  | 3                    |                |               |
| MPLC/HPLC separation  | 4                    |                | 1a-d          |
| Carbon isotope composition C <sub>15+</sub> fractions                         | 4                    | 1a-b,3a-b      | 2a-b          |
| Carbon isotope composition of individual components in the saturated fraction | 4                    | 2a-b           | 3a-b          |
| GC - MS of saturated and aromatic HC  | 4                    |                |               |
| GC - MS cross-plots   |                      | 4a-e           | 4a-e          |

## ***Experimental Procedures***

### **Headspace Gas Analysis**

The analysis is performed using a Perkin Elmer 8310 gas chromatograph with a 50 m Plot fused silica Al<sub>2</sub>O<sub>3</sub>/KCL column, loop injector and flame ionization detector. Nitrogen is used as carrier gas and the column is run from 70°C to 200°C, at a rate of 12°C/min. Final hold time is 5 min.

Two cm<sup>3</sup> of headspace gas are removed from each sample can for chromatographic analysis of the C<sub>1</sub> to C<sub>7</sub> range of hydrocarbons.

### **Occluded Gas Analysis**

The gas chromatograph used for this analysis is identical to that used for headspace gas analysis and is operated under the same conditions.

The canned samples are washed in thermostat-controlled water to remove drilling contaminants and sieved on a 2 mm mesh sieve to remove large, caved rock fragments. An aliquot (ca 25 mg) of sieved sample is crushed with 25 cm<sup>3</sup> water in an airtight ball mill. After crushing, 2 cm<sup>3</sup> of the released gas are removed from the ball mill for gas chromatographic analysis.

### **Total Organic Carbon (TOC) and Total Carbon Analysis**

This analysis is performed using a LECO CS244 Carbon Analyser.

Hand-picked lithologies from cuttings samples are crushed with a mortar and pestle and approximately 200 mg (50 mg for coals) are accurately weighed into LECO crucibles. The samples are then treated three times with 10 % hydrochloric acid to

remove oxidized (carbonate) carbon, and washed four times with distilled water. The samples are dried on a hotplate at 60 - 70°C before analysis of total organic carbon. Total carbon is also analysed on the same instrument using approximately 200 mg of untreated crushed whole rock. Oxidized (carbonate) carbon is calculated by weight difference.

Total organic carbon can also be analysed on the Rock-Eval II Pyrolyser during the normal run of the instrument.

### **Rock-Eval Pyrolysis**

This analysis is performed by using a Rock-Eval II Pyrolyser. Approximately 100 mg crushed whole rock is analysed. The sample is first heated at 300°C for three min in an atmosphere of helium to release the free hydrocarbons present (S1 peak) and then pyrolysed by increasing the temperature from 300°C to 600°C (temp. gradient 25°C/min) (S2 peak). Both the S1 and S2 yields are measured using a flame ionization detector (FID). In the temperature interval between 300°C and 390°C, the released gases are split and a proportion passed through a carbon dioxide trap, which is connected to a thermal conductivity detector (TCD). The value obtained from the TCD corresponds to the amount of oxygen contained in the kerogen of the sample and is reported as the S3 peak.

The Rock-Eval II Pyrolyser also analyses the TOC of each sample during the normal run of the instrument.

### **Thermal Extraction/Pyrolysis Gas Chromatography**

The instrument used for this analysis is a Varian 3400 Gas Chromatograph interfaced to a pyrolysis oven (the pyrolyser). Up to 15 mg of whole rock sample is loaded on the pyrolyser and heated isothermally, at 300°C, for 4 min, during which time thermal extraction of the free hydrocarbons occurs (equivalent to the S1 peak of the Rock-

Eval). The released gases pass to a 25 m OV1 column with a liquid nitrogen-cooled trap.

After 4 min the pyrolysis oven is temperature programmed up to 530°C, at a rate of 37°C/min, causing bound hydrocarbons to be released from the kerogen (equivalent to the S2 peak of the Rock-Eval). The released gases pass to a 25 m OV1 column with a liquid nitrogen-cooled trap.

The temperature program of the gas chromatograph oven, in which the columns are housed is -10°C to 290°C at a rate of 6°C/min.

Both the columns are linked to a FID.

### **Solvent Extraction of Organic Matter (EOM)**

The samples are extracted using a Tecator Soxtec HT-System. Carefully weighed samples are taken in a pre-extracted thimble. Some activated copper is added to the extraction cup and dichloromethane is used as an extraction solvent. The samples are boiled for 1 hour and then rinsed for 2 hours. If the samples contain more than 10 % TOC, then the whole procedure is repeated once. The resulting solution is filtered and the solvent removed by rotary evaporation (200 mb, 30°C). The amount of EOM is gravimetrically established.

### **Removal of Asphaltenes**

Asphaltenes are removed from the EOM by precipitation in n-pentane. N-pentane is added to the EOM and the solution is then stored in the dark and at ambient temperature for at least 8 hours. The solution is then filtered (Baker 10-spe system) and the precipitated asphaltenes dissolved in dichloromethane are returned to the original flask. The solvent is removed by rotary evaporation (200 mb and 30°C).

## Chromatographic Separation of deasphalted EOM

Chromatographic separation is performed using an MPLC system developed by the company. The EOM (minus asphaltenes) is injected into the MPLC and separated using hexane as an eluent. The saturated and aromatic hydrocarbon fractions are collected and the solvent removed using a rotary evaporator at 30°C. The fractions are then transferred to small pre-weighed vials and evaporated to dryness in a stream of nitrogen. The vials are re-weighed to obtain the weights of both the saturated and the aromatic fractions. The weight of the NSO fraction which is retained on the column, is obtained by weight difference.

## Gas Chromatographic Analyses

Saturated hydrocarbon fractions:

The instrument used for this analysis is a PERKIN ELMER 8320 Gas Chromatograph equipped with an FID detector and an OV1 column. The carrier gas is helium and the temperature program runs from 80°C to 300°C at a rate of 4°C/min. Final hold time is 20 mins. The saturated hydrocarbon fraction is diluted by 1:30 and a 1 microlitre aliquot of this is injected into the instrument.

Aromatic hydrocarbon fractions:

The instrument used is a Varian 3400 Gas Chromatograph with a 25 m SE 54 capillary column, split injector and a column splitter leading to FID and FPD detectors, which allows simultaneous analysis of co-eluting hydrocarbons and sulphur compounds. The carrier gas is helium and the temperature program runs from 40°C to 290°C at a rate of 4°C/min. Final hold time is 10 mins. The aromatic hydrocarbon fraction is diluted by 1:30 and a 1 microlitre aliquot of this is injected into the instrument.

### **Whole Oil/Whole Extract**

Whole oil chromatograms are determined on a Perkin Elmer Sigma 2000 gas chromatograph fitted with a split injector, 25 m SE54 capillary column and effluent splitter connected to FID and FPD detectors allowing simultaneous determination of hydrocarbons and sulphur compounds. Approximately 0.1 microlitres of whole oil are injected and the temperature program on the chromatograph runs from -10°C to 300°C at 4°C/min.

### **Vitrinite Reflectance Analysis**

Samples to be analysed for vitrinite reflectance are ground to small granules (if necessary) using a pestle and mortar and are then mounted in a fast setting resin. The resin blocks are first ground flat using a coarse corundum paper to expose the rock granule surfaces and then with three finer grades of corundum paper to improve these surfaces and reduce scratches. The blocks are finally polished on a rotating Selvyt-covered lap using three grades of diamond suspension fluid. An appropriate lubricant is used when necessary.

Reflectance measurements are made under oil immersion at 546 nm using a Zeiss Universal Photo microscope II equipped with a HP 9000 series computer system. The polished blocks are mounted on the microscope stage and scanned manually in order to locate and measure particles of vitrinite. An attempt is made to obtain readings from 15-20 individual particles per sample, but this is not always possible in samples with low amounts of phytoclasts.

### **Visual Kerogen Microscopy**

Kerogen concentrates are obtained from samples prepared by HCl and HF digestion followed by zinc bromide flotation to remove pyrite and other heavy mineral residues.



The cleaned concentrates are mounted on slides by smearing, these being analysed microscopically in transmitted white light and UV light (530 nm barrier filter) to determine the Spore Colour or Thermal Alteration Indices (SCI or TAI) and the colour and intensity of spore fluorescence. The spore colour index, backed by spore fluorescence, is used as an alternative maturity parameter to verify the results obtained from vitrinite reflectance.

| <b>Fluorescence Colour</b>    | <b>Colour Index</b> | <b>Corresp. Vitrinite Reflectance</b> |
|-------------------------------|---------------------|---------------------------------------|
| Green                         | 1                   | 0.2 %                                 |
| Green/yellow                  | 2                   | 0.2-0.3 %                             |
| Yellow                        | 3                   | 0.3 %                                 |
| Yellow/orange                 | 4                   | 0.4 %                                 |
| Light orange                  | 5                   | 0.5 %                                 |
| Moderate-orange               | 6                   | 0.6 %                                 |
| Dark orange                   | 7                   | 0.8 %                                 |
| Dark orange/red               | 8                   | 1.0 %                                 |
| Spore fluorescence extinction | 9                   | 1.3 %                                 |

NB. This table only provides a rudimentary correlation as vitrinite reflectance and spore fluorescence colour are both independently affected by factors such as depositional environment and catenanic history.

### **Combined Gas Chromatography - Mass Spectrometry (GC-MS)**

The GC-MS analyses are performed on a VG TS250 system interfaced to a Hewlett Packard 5890 gas chromatograph. The GC is fitted with a fused silica SE54 capillary column (40 m x 0.22 mm i.d.) directly into the ion source. Helium (12 psi) is used as carrier gas and the injections are performed in splitless mode. The GC oven is programmed from 45°C to 150°C at 35°C/min, at which point the programme rate is 2°C/min up to 310°C where the column is held isothermally for 15 min. For the aromatic hydrocarbons, the GC oven is programmed from 50°C to 310°C at 5°C/min. and held isothermally at 310°C for 15 min. The mass spectrometer is operated in electron impact (EI) mode at 70 eV electron energy, a trap current of 500 uA and a source temperature of 220°C. The instrument resolution used is 1500 (10 % value).

The data system used is a VG PDP11/73 for acquiring data, and a Vax station 3100

for peak processing the data. The samples are analysed in multiple ion detection mode (MID) at a scan cycle time of approximately 1.1 sec.

Calculation of peak ratios is performed from peak heights in the appropriate mass fragmentograms.

## Saturated Fractions

### Terpanes

The most commonly used fragment ions for detection of terpanes are M/Z 163 for detection of 25,28,30 trisnormoretane or 25,28,30 trisnorhopane, M/Z 177 for detection of demethylated hopanes or moretanes, M/Z 191 for detection of tricyclic, tetracyclic and pentacyclic terpanes and M/Z 205 for methylated hopanes or moretanes. The molecular ions M/Z 370 and 384 are also recorded for identification of C<sub>27</sub> and C<sub>28</sub> triterpanes respectively.

### Steranes

The most commonly used fragment ions for detection of steranes are M/Z 149 to distinguish between 5 $\alpha$  and 5 $\beta$  steranes, M/Z 189 and 259 for detection of rearranged steranes, M/Z 217 for detection of rearranged and normal steranes and M/Z 218 for detection of 14 $\beta$ (H) 17 $\beta$ (H) steranes.

The M/Z 231 fragment ion is used to detect possible aromatic contamination of the saturated fraction. It is also used for detection of methyl steranes.

## Aromatic Fractions

### Alkyl-substituted Benzenes

The M/Z 106 fragment ion is often used to detect the alkyl-substituted benzenes. It is especially useful for the detection of di-substituted benzenes. M/Z 134 can also be used for the detection of C<sub>4</sub>-alkylbenzenes, but benzothiophene will also give a signal with this fragment ion.

### Naphthalenes

Methyl naphthalenes are normally detected by the M/Z 142 fragment ion, while C<sub>2</sub>-naphthalenes are detected by M/Z 156 and C<sub>3</sub>-naphthalenes by M/Z 170.

### Benzothiophenes and Dibenzothiophenes

Benzothiophene can be detected, as mentioned above, by M/Z 134. The M/Z 198 and M/Z 212 fragment ions are used for methyl-substituted dibenzothiophenes and dimethyl-substituted dibenzothiophenes respectively.

### Phenanthrenes

Phenanthrene is detected using the M/Z 178 fragment ion. Anthracene will, if present, also give a signal in the M/Z 178 fragment ion. Methyl-substituted phenanthrenes give signals in the M/Z 192 fragment ion, while the M/Z 206 fragment ion shows the dimethyl-substituted phenanthrenes and the M/Z 220 fragment ion shows the C<sub>3</sub> substituted phenanthrenes.

## Aromatic Steranes

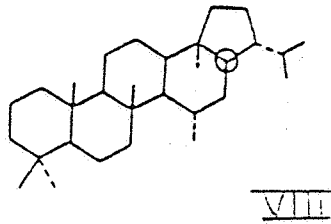
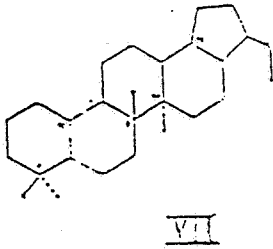
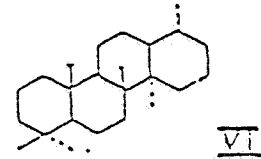
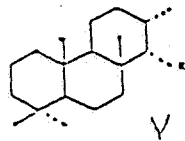
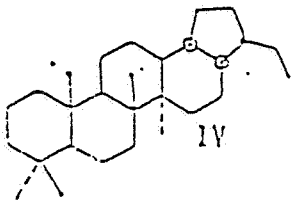
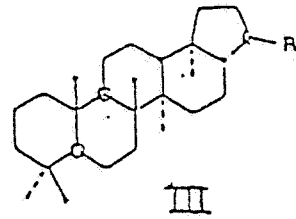
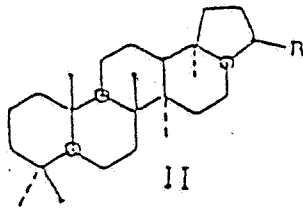
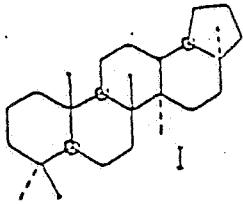
Monoaromatic steranes are detected using the M/Z 253 fragment ion, while the triaromatic steranes are detected using the M/Z 231 fragment ion.

**Mass Fragmentograms representing Terpanes**  
**(M/Z 163, 177, 191, 205, 370, 384, 398, 412 and 426)**

Peak Identification: ( $\alpha$  and  $\beta$  refer to hydrogen atoms at C-17 and C-21 respectively unless indicated otherwise)

|    |  |                                 |  |
|----|--|---------------------------------|--|
| A. | 18 $\alpha$ trisnorneohopane (T <sub>s</sub> ) | C <sub>27</sub> H <sub>44</sub> | ( I )                                      |
| B. | 17 $\alpha$ trisnorhopane (T <sub>m</sub> )    | C <sub>27</sub> H <sub>46</sub> | ( II, R=H )                                |
| Z. | Bisnorhopane                                   | C <sub>28</sub> H <sub>48</sub> | ( IV )                                     |
| C. | $\alpha\beta$ norhopane                        | C <sub>29</sub> H <sub>50</sub> | ( II, R=C <sub>2</sub> H <sub>5</sub> )    |
| D. | $\beta\alpha$ norhopane                        | C <sub>29</sub> H <sub>50</sub> | ( III, R=C <sub>2</sub> H <sub>5</sub> )   |
| E. | $\alpha\beta$ hopane                           | C <sub>30</sub> H <sub>52</sub> | ( II, R=i-C <sub>3</sub> H <sub>7</sub> )  |
| F. | $\beta\alpha$ hopane                           | C <sub>30</sub> H <sub>52</sub> | ( III, R=i-C <sub>3</sub> H <sub>7</sub> ) |
| G. | 22S $\alpha\beta$ homohopane                   | C <sub>31</sub> H <sub>54</sub> | ( II, R=i-C <sub>4</sub> H <sub>9</sub> )  |
| H. | 22R $\alpha\beta$ homohopane                   | C <sub>31</sub> H <sub>54</sub> | ( II, R=i-C <sub>4</sub> H <sub>9</sub> )  |
| I. | $\beta\alpha$ homohopane                       | C <sub>31</sub> H <sub>54</sub> | ( III, R=i-C <sub>4</sub> H <sub>9</sub> ) |
| J. | 22S $\alpha\beta$ bishomohopane                | C <sub>32</sub> H <sub>56</sub> | ( II, R=i-C <sub>5</sub> H <sub>11</sub> ) |
|    | 22R $\alpha\beta$ bishomohopane                | C <sub>32</sub> H <sub>56</sub> | ( II, R=i-C <sub>5</sub> H <sub>11</sub> ) |
| K. | 22S $\alpha\beta$ trishomohopane               | C <sub>33</sub> H <sub>58</sub> | ( II, R=i-C <sub>6</sub> H <sub>13</sub> ) |
|    | 22R $\alpha\beta$ trishomohopane               | C <sub>33</sub> H <sub>58</sub> | ( II, R=i-C <sub>6</sub> H <sub>13</sub> ) |
| L. | 22S $\alpha\beta$ tetrakishomohopane           | C <sub>34</sub> H <sub>60</sub> | ( II, R=i-C <sub>7</sub> H <sub>15</sub> ) |
|    | 22R $\alpha\beta$ tetrakishomohopane           | C <sub>34</sub> H <sub>60</sub> | ( II, R=i-C <sub>7</sub> H <sub>15</sub> ) |
| M. | 22S $\alpha\beta$ pentakishomohopane           | C <sub>35</sub> H <sub>62</sub> | ( II, R=i-C <sub>8</sub> H <sub>17</sub> ) |
|    | 22R $\alpha\beta$ pentakishomohopane           | C <sub>35</sub> H <sub>62</sub> | ( II, R=i-C <sub>8</sub> H <sub>17</sub> ) |
| P. | Tricyclic terpene                              | C <sub>23</sub> H <sub>42</sub> | ( V, R=i-C <sub>4</sub> H <sub>9</sub> )   |
| Q. | Tricyclic terpene                              | C <sub>24</sub> H <sub>44</sub> | ( V, R=i-C <sub>5</sub> H <sub>11</sub> )  |
| R. | Tricyclic terpene (17R, 17S)                   | C <sub>25</sub> H <sub>66</sub> | ( V, R=i-C <sub>6</sub> H <sub>13</sub> )  |
| S. | Tetracyclic terpene                            | C <sub>24</sub> H <sub>42</sub> | ( VI )                                     |
| T. | Tricyclic terpene (17R, 17S)                   | C <sub>26</sub> H <sub>48</sub> | ( V, R=i-C <sub>7</sub> H <sub>15</sub> )  |
| N. | Tricyclic terpene                              | C <sub>21</sub> H <sub>38</sub> | ( V, R=C <sub>2</sub> H <sub>5</sub> )     |
| O. | Tricyclic terpene                              | C <sub>22</sub> H <sub>40</sub> | ( V, R=C <sub>3</sub> H <sub>7</sub> )     |
| Y. | 25,28,30-trisnorhopane/moretane                | C <sub>27</sub> H <sub>46</sub> | ( VII )                                    |
| X. | $\alpha\beta$ diahopane                        | C <sub>30</sub> H <sub>52</sub> | ( VIII )                                   |

STRUCTURES REPRESENTING TERPANES



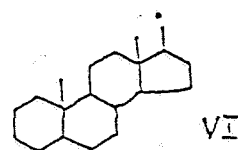
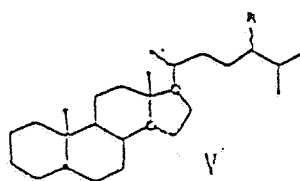
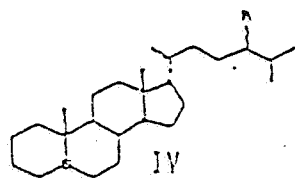
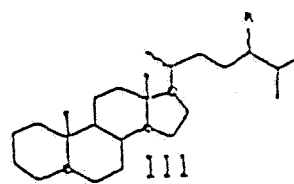
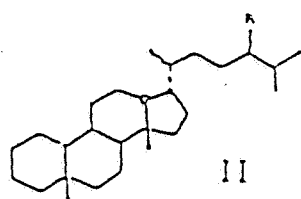
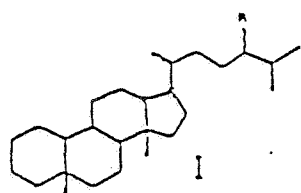
**Mass Fragmentograms representing Steranes**  
(M/Z 149, 189, 217, 218, 259, 372, 386, 400 and 414)

Peak Identifications:  $\alpha$  and  $\beta$  refer to hydrogen atoms at C-5, C-14 and C-17 in regular steranes and at C-13 and C-17 in diasteranes).

|    |   |                |   |
|----|---|----------------|---|
| a. | 20S $\beta\alpha$ diacholestane               | $C_{27}H_{48}$ | ( I, R=H)                               |
| b. | 20R $\beta\alpha$ diacholestane               | $C_{27}H_{48}$ | ( I, R=H)                               |
| c. | 20S $\alpha\beta$ diacholestane               | $C_{27}H_{48}$ | ( II, R=H)                              |
| d. | 20R $\alpha\beta$ diacholestane               | $C_{27}H_{48}$ | ( II, R=H)                              |
| e. | 20S $\beta\alpha$ 24-methyl-diacholestane     | $C_{28}H_{50}$ | ( I, R=CH <sub>3</sub> )                |
| f. | 20R $\beta\alpha$ 24-methyl-diacholestane     | $C_{28}H_{50}$ | ( I, R=CH <sub>3</sub> )                |
| g. | 20S $\alpha\beta$ 24-methyl-diacholestane     | $C_{28}H_{50}$ | ( II, R=CH <sub>3</sub> )               |
|    | + 20S $\alpha\alpha\alpha$ cholestane         | $C_{27}H_{48}$ | (III, R=H)                              |
| h. | 20S $\beta\alpha$ 24-ethyl-diacholestane      | $C_{29}H_{52}$ | ( II, R=C <sub>2</sub> H <sub>5</sub> ) |
|    | + 20R $\alpha\beta\beta$ cholestane           | $C_{27}H_{48}$ | ( IV, R=H)                              |
| i. | 20S $\alpha\beta\beta$ cholestane             | $C_{27}H_{48}$ | ( IV, R=H)                              |
|    | + 20R $\alpha\beta$ 24-methyl-diacholestane   | $C_{28}H_{50}$ | ( II, R=CH <sub>3</sub> )               |
| j. | 20R $\alpha\alpha\alpha$ cholestane           | $C_{27}H_{48}$ | (III, R=H)                              |
| k. | 20R $\beta\alpha$ 24-ethyl-diacholestane      | $C_{29}H_{52}$ | ( I, R=C <sub>2</sub> H <sub>5</sub> )  |
| l. | 20R $\alpha\beta$ 24-ethyl-diacholestane      | $C_{29}H_{52}$ | ( II, R=C <sub>2</sub> H <sub>5</sub> ) |
| m. | 20S $\alpha\alpha\alpha$ 24-methyl-cholestane | $C_{28}H_{50}$ | (III, R=CH <sub>3</sub> )               |
| n. | 20R $\alpha\beta\beta$ 24-methyl-cholestane   | $C_{28}H_{50}$ | ( IV, R=CH <sub>3</sub> )               |
|    | + 20R $\alpha\beta$ 24-ethyl-diacholestane    | $C_{29}H_{52}$ | ( II, R=C <sub>2</sub> H <sub>5</sub> ) |
| o. | 20S $\alpha\beta\beta$ 24-methyl-cholestane   | $C_{28}H_{50}$ | ( IV, R=CH <sub>3</sub> )               |
| p. | 20R $\alpha\alpha\alpha$ 24-methyl-cholestane | $C_{28}H_{50}$ | (III, R=CH <sub>3</sub> )               |
| q. | 20S $\alpha\alpha\alpha$ 24-ethyl-cholestane  | $C_{29}H_{52}$ | (III, R=C <sub>2</sub> H <sub>5</sub> ) |
| r. | 20R $\alpha\beta\beta$ 24-ethyl-cholestane    | $C_{29}H_{52}$ | ( IV, R=C <sub>2</sub> H <sub>5</sub> ) |
| s. | 20S $\alpha\beta\beta$ 24-ethyl-cholestane    | $C_{29}H_{52}$ | ( IV, R=C <sub>2</sub> H <sub>5</sub> ) |
| t. | 20R $\alpha\alpha\alpha$ 24-ethyl-cholestane  | $C_{29}H_{52}$ | (III, R=C <sub>2</sub> H <sub>5</sub> ) |
| u. | 5 $\alpha$ sterane                            | $C_{21}H_{36}$ | ( VI, R=C <sub>2</sub> H <sub>5</sub> ) |
| v. | 5 $\alpha$ sterane                            | $C_{22}H_{38}$ | ( VI, R=C <sub>3</sub> H <sub>7</sub> ) |



## STRUCTURES REPRESENTING STERANES

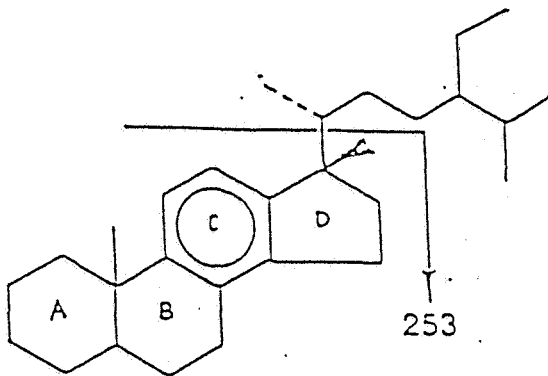


### Mass Fragmentograms representing Monoaromatic Steranes (M/Z 253)

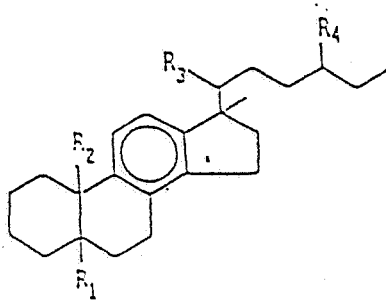
Description of C-ring monoaromatic steroid hydrocarbons

| Peak | R <sub>1</sub>  | Substituents    |                     | R <sub>4</sub>                | Abbreviation<br>of Compound |
|------|-----------------|-----------------|---------------------|-------------------------------|-----------------------------|
|      |                 | R <sub>2</sub>  | R <sub>3</sub>      |                               |                             |
| A1   |                 |                 |                     |                               | C <sub>21</sub> M           |
| B1   |                 |                 |                     |                               | C <sub>22</sub> MA          |
| C1   | β(H)            | CH <sub>3</sub> | S(CH <sub>3</sub> ) | H                             | βSC <sub>27</sub> MA        |
|      | β(H)            | CH <sub>3</sub> | R(CH <sub>3</sub> ) | H                             | βRC <sub>27</sub> MA        |
| D1   | CH <sub>3</sub> | H               | R(CH <sub>3</sub> ) | H                             | RC <sub>27</sub> DMA        |
|      | α(H)            | CH <sub>3</sub> | S(CH <sub>3</sub> ) | H                             | αSC <sub>27</sub> MA        |
| E1   | β(H)            | CH <sub>3</sub> | S(CH <sub>3</sub> ) | CH <sub>3</sub>               | βSC <sub>28</sub> MA        |
|      | CH <sub>3</sub> | H               | S(CH <sub>3</sub> ) | CH <sub>3</sub>               | SC <sub>28</sub> DMA        |
| F1   | α(H)            | CH <sub>3</sub> | R(CH <sub>3</sub> ) | H                             | αRC <sub>27</sub> MA        |
|      | α(H)            | CH <sub>3</sub> | S(CH <sub>3</sub> ) | CH <sub>3</sub>               | αSC <sub>28</sub> MA        |
|      | β(H)            | CH <sub>3</sub> | R(CH <sub>3</sub> ) | CH <sub>3</sub>               | βRC <sub>28</sub> MA        |
| G1   | CH <sub>3</sub> | H               | R(CH <sub>3</sub> ) | CH <sub>3</sub>               | RC <sub>28</sub> DMA        |
|      | β(H)            | CH <sub>3</sub> | S(CH <sub>3</sub> ) | C <sub>2</sub> H <sub>5</sub> | βSC <sub>29</sub> MA        |
|      | CH <sub>3</sub> | H               | S(CH <sub>3</sub> ) | C <sub>2</sub> H <sub>5</sub> | SC <sub>29</sub> DMA        |
|      | α(H)            | CH <sub>3</sub> | R(CH <sub>3</sub> ) | CH <sub>3</sub>               | αRC <sub>28</sub> MA        |
| H1   | β(H)            | CH <sub>3</sub> | R(CH <sub>3</sub> ) | C <sub>2</sub> H <sub>5</sub> | βRC <sub>29</sub> MA        |
|      | CH <sub>3</sub> | H               | R(CH <sub>3</sub> ) | C <sub>2</sub> H <sub>5</sub> | RC <sub>29</sub> DMA        |
| I1   | α(H)            | CH <sub>3</sub> | R(CH <sub>3</sub> ) | C <sub>2</sub> H <sub>5</sub> | αRC <sub>29</sub> MA        |

## STRUCTURES REPRESENTING MONOAROMATIC STERANES



I

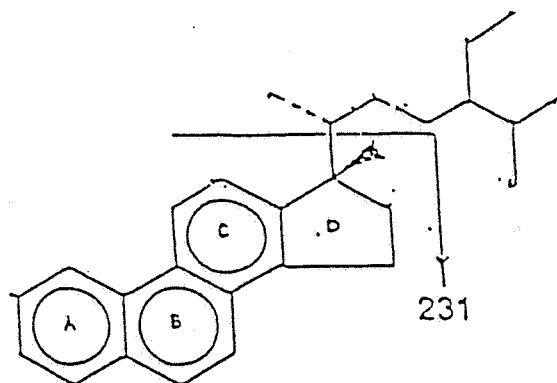


Mass Fragmentograms representing Triaromatic Steranes  
(M/Z 231)

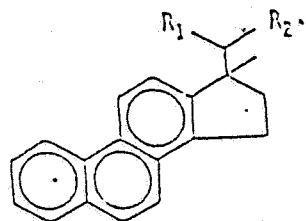
Description of ABC-ring triaromatic steroid hydrocarbons

| Peak | Substituents        |                                 | Abbreviation<br>of Compound |
|------|---------------------|---------------------------------|-----------------------------|
|      | R <sub>1</sub>      | R <sub>2</sub>                  |                             |
| a1   | CH <sub>3</sub>     | H                               | C <sub>20</sub> TA          |
| b1   | CH <sub>3</sub>     | CH <sub>3</sub>                 | C <sub>21</sub> TA          |
| c1   | S(CH <sub>3</sub> ) | C <sub>6</sub> H <sub>1-3</sub> | SC <sub>26</sub> TA         |
| d1   | R(CH <sub>3</sub> ) | C <sub>6</sub> H <sub>13</sub>  | RC <sub>26</sub> TA         |
|      | S(CH <sub>3</sub> ) | C <sub>7</sub> H <sub>15</sub>  | SC <sub>27</sub> TA         |
| e1   | S(CH <sub>3</sub> ) | C <sub>8</sub> H <sub>17</sub>  | SC <sub>28</sub> TA         |
| f1   | S(CH <sub>3</sub> ) | C <sub>7</sub> H <sub>15</sub>  | RC <sub>27</sub> TA         |
| g1   | R(CH <sub>3</sub> ) | C <sub>8</sub> H <sub>17</sub>  | RC <sub>28</sub> TA         |

## STRUCTURES REPRESENTING TRIAROMATIC STERANES



11



## Stable Carbon Isotope Ratio Mass Spectrometry

Carbon isotope analysis is performed on a dual inlet VG SIRA 10 instrument. The combustion of the samples is performed by a Carlo Erba EA 1108 element analyser directly connected to the inlet system of the mass spectrometer.

The combustion temperature is 1020°C and the carrier gas used was Helium. After the combustion H<sub>2</sub>O and CO<sub>2</sub> are trapped in individual cool traps. The CO<sub>2</sub> gas is then heated up before admission into the mass spectrometer. The whole operation is controlled by an IBM PC50 computer system.

### δ-values

The isotope ratios are given as δ-values in ‰ versus the PDB-standard:

$$\delta^{13}\text{C} = (R_{\text{sample}} - R_{\text{standard}}/R_{\text{standard}}) \times 1000$$
$$R = {}^{13}\text{C}/{}^{12}\text{C}$$

The PDB-standard (a marine chalk of the Pee Dee-formation, USA) was created by Craig 1957. All results of <sup>13</sup>C/<sup>12</sup>C-analysis of organic matter today are calculated (Craig correction) against this international standard.

### Reproducibility

The precision of the combustion system and the mass spectrometer is controlled by determination of an international calibrated standard, NBS22 oil and a house standard carbon. Replicate analyses are also performed on samples.

**APPENDIX 1:**  
**TABLES**

Table 1 a: Weight of EOM and Chromatographic Fraction for well NOCS 9/2-1

Depth unit of measure: m

| Depth   | Typ | Lithology                         | Rock<br>Extracted<br>(g) | EOM<br>(mg) | Sat<br>(mg) | Aro<br>(mg) | Asph<br>(mg) | NSO<br>(mg) | HC<br>(mg) | Non-HC<br>(mg) | TOC(e)<br>(%) | Sample  |
|---------|-----|-----------------------------------|--------------------------|-------------|-------------|-------------|--------------|-------------|------------|----------------|---------------|---------|
|         |     | oil DST 3                         | -                        | 78.5        | 48.3        | 19.1        | 5.8          | 5.3         | 67.4       | 11.1           | -             | 0332-0B |
| 3022.00 | cut | Sh/Clst: drk gy to drk brn gy     | 8.0                      | 31.6        | 15.0        | 5.4         | 1.4          | 9.8         | 20.4       | 11.2           | 4.85          | 0202-1L |
| 3520.00 | cut | Sh/Clst: m gy to drk gy to brn gy | 7.3                      | 9.0         | 2.4         | 3.0         | 1.0          | 2.6         | 5.4        | 3.6            | 3.51          | 0258-2L |
| 3655.00 | cut | Sh/Clst: m gy to brn gy           | 2.5                      | 3.3         | 1.2         | 0.5         | 0.3          | 1.3         | 1.7        | 1.6            | 1.75          | 0273-1L |



Depth unit of measure: m

| Depth   | Typ | Lithology                         | EOM  | Sat  | Aro | Asph | NSO  | HC   | Non-HC | Sample  |
|---------|-----|-----------------------------------|------|------|-----|------|------|------|--------|---------|
|         |     | oil DST 3                         | -    | -    | -   | -    | -    | -    | -      | 0332-0B |
| 3022.00 | cut | Sh/Clst: drk gy to drk brn gy     | 3945 | 1872 | 674 | 174  | 1223 | 2546 | 1398   | 0202-1L |
| 3520.00 | cut | Sh/Clst: m gy to drk gy to brn gy | 1224 | 326  | 408 | 136  | 353  | 734  | 489    | 0258-2L |
| 3655.00 | cut | Sh/Clst: m gy to brn gy           | 1346 | 489  | 204 | 122  | 530  | 693  | 653    | 0273-1L |

Table 1c: Concentration of EOM and Chromatographic Fraction (mg/g TOC(e)) for well NOCS 9/2-1

Depth unit of measure: m

| Depth   | Typ | Lithology                         | EOM   | Sat   | Aro   | Asph | NSO   | HC    | Non-HC | Sample  |
|---------|-----|-----------------------------------|-------|-------|-------|------|-------|-------|--------|---------|
|         |     | oil DST 3                         | -     | -     | -     | -    | -     | -     | -      | 0332-0B |
| 3022.00 | cut | Sh/Clst: drk gy to drk brn gy     | 81.34 | 38.61 | 13.90 | 3.60 | 25.23 | 52.51 | 28.83  | 0202-1L |
| 3520.00 | cut | Sh/Clst: m gy to drk gy to brn gy | 34.89 | 9.30  | 11.63 | 3.88 | 10.08 | 20.93 | 13.95  | 0258-2L |
| 3655.00 | cut | Sh/Clst: m gy to brn gy           | 76.97 | 27.99 | 11.66 | 7.00 | 30.32 | 39.65 | 37.32  | 0273-1L |

Depth unit of measure: m

| Depth   | Typ | Lithology                         | Sat   | Aro   | Asph  | NSO   | HC    | Non-HC | Sat    | HC     | Sample  |
|---------|-----|-----------------------------------|-------|-------|-------|-------|-------|--------|--------|--------|---------|
|         |     |                                   | EOM   | EOM   | EOM   | EOM   | EOM   | EOM    | EOM    | Aro    |         |
|         | oil | DST 3                             | 61.53 | 24.33 | 7.39  | 6.75  | 85.86 | 14.14  | 252.88 | 607.21 | 0332-0B |
| 3022.00 | cut | Sh/Clst: drk gy to drk brn gy     | 47.47 | 17.09 | 4.43  | 31.01 | 64.56 | 35.44  | 277.78 | 182.14 | 0202-1L |
| 3520.00 | cut | Sh/Clst: m gy to drk gy to brn gy | 26.67 | 33.33 | 11.11 | 28.89 | 60.00 | 40.00  | 80.00  | 150.00 | 0258-2L |
| 3655.00 | cut | Sh/Clst: m gy to brn gy           | 36.36 | 15.15 | 9.09  | 39.39 | 51.52 | 48.48  | 240.00 | 106.25 | 0273-1L |

Table 2A: Tabulation of carbon isotope data for EOM/EOM - fractions for well NOCS 9/2-1

Depth unit of measure: m

| <u>Depth</u> | <u>Typ</u> | <u>Lithology</u> | <u>EOM</u> | <u>Saturated</u> | <u>Aromatic</u> | <u>NSO</u> | <u>Asphaltenes</u> | <u>Kerogen</u> | <u>Sample</u> |
|--------------|------------|------------------|------------|------------------|-----------------|------------|--------------------|----------------|---------------|
|              | oil        | DST 3            | -          | -29.18           | -28.22          | -27.45     | -                  | -              | 0332-0        |
| 3022.00      | cut        | Sh/Clst          | -          | -28.62           | -28.62          | -28.51     | -                  | -              | 0202-1        |
| 3520.00      | cut        | Sh/Clst          | -          | -28.13           | -25.01          | -25.34     | -                  | -              | 0258-2        |
| 3655.00      | cut        | Sh/Clst          | -          | -27.98           | -27.21          | -27.65     | -                  | -              | 0273-1        |

Depth unit of measure: m

| <u>Depth</u> | <u>Typ</u> | <u>Lithology</u> | <u>Saturated</u> | <u>Aromatic</u> | <u>cv value</u> | <u>Sample</u> |
|--------------|------------|------------------|------------------|-----------------|-----------------|---------------|
|              | oil        | DST 3            | -29.18           | -28.22          | -0.47           | 0332-0        |
| 3022.00      | cut        | Sh/Clst          | -28.62           | -28.62          | -2.78           | 0202-1        |
| 3520.00      | cut        | Sh/Clst          | -28.13           | -25.01          | 4.00            | 0258-2        |
| 3655.00      | cut        | Sh/Clst          | -27.98           | -27.21          | -1.27           | 0273-1        |

Table 3A: Isotope GC of Saturated Fraction, for Well NOCS 9/2-1

Depth unit of measure: m

| <u>Depth</u> | <u>Lithology</u> | <u>nC9</u> | <u>nC10</u> | <u>nC11</u> | <u>nC12</u> | <u>iC13</u> | <u>iC14</u> | <u>nC13</u> | <u>iC15</u> | <u>nC14</u> | <u>Sample</u> |
|--------------|------------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|---------------|
|              | DST 3            | -          | -28.50      | -29.40      | -29.60      | -27.60      | -27.90      | -29.90      | -27.70      | -29.90      | 0332-0        |
| 3022.00      | Sh/Clst          | -          | -           | -           | -31.20      | -27.40      | -27.80      | -30.80      | -27.00      | -30.40      | 0202-1        |
| 3520.00      | Sh/Clst          | -          | -           | -           | -           | -           | -28.30      | -28.30      | -27.70      | -28.90      | 0258-2        |
| 3655.00      | Sh/Clst          | -          | -           | -           | -           | -           | -           | -           | -           | -28.90      | 0273-1        |

Table 3B: Isotope GC of Saturated Fraction, for Well NOCS 9/2-1

Depth unit of measure: m

| <u>Depth</u> | <u>Lithology</u> | <u>iC16</u> | <u>nC15</u> | <u>nC16</u> | <u>iC18</u> | <u>nC17</u> | <u>pristane</u> | <u>nC18</u> | <u>phytane</u> | <u>nC19</u> | <u>Sample</u> |
|--------------|------------------|-------------|-------------|-------------|-------------|-------------|-----------------|-------------|----------------|-------------|---------------|
|              | DST 3            | -28.00      | -29.40      | -29.70      | -27.80      | -30.10      | -28.90          | -29.80      | -28.20         | -28.90      | 0332-0        |
| 3022.00      | Sh/Clst          | -26.10      | -30.50      | -29.90      | -26.70      | -30.20      | -29.80          | -29.80      | -28.20         | -29.20      | 0202-1        |
| 3520.00      | Sh/Clst          | -27.80      | -29.20      | -28.50      | -26.60      | -28.50      | -28.30          | -28.10      | -28.30         | -28.00      | 0258-2        |
| 3655.00      | Sh/Clst          | -27.80      | -29.50      | -29.10      | -27.60      | -29.10      | -29.00          | -28.50      | -28.40         | -28.10      | 0273-1        |

Table 3C: Isotope GC of Saturated Fraction, for Well NOCS 9/2-1

Depth unit of measure: m

| Depth   | Lithology | nC20   | nC21   | nC22   | nC23   | nC24   | nC25   | nC26   | nC27   | nC28   | Sample |
|---------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|         | DST 3     | -29.10 | -28.80 | -29.40 | -29.00 | -28.80 | -28.30 | -28.20 | -28.20 | -28.20 | 0332-0 |
| 3022.00 | Sh/Clst   | -29.20 | -28.90 | -28.70 | -28.40 | -28.30 | -28.00 | -28.20 | -28.10 | -28.30 | 0202-1 |
| 3520.00 | Sh/Clst   | -28.00 | -27.90 | -27.60 | -27.50 | -27.40 | -27.30 | -27.20 | -27.60 | -27.20 | 0258-2 |
| 3655.00 | Sh/Clst   | -27.80 | -27.60 | -27.20 | -27.00 | -27.00 | -26.90 | -27.20 | -27.20 | -27.40 | 0273-1 |



Depth unit of measure: m

| Depth   | Lithology | nC29   | nC30   | nC31   | nC32   | nC33   | nC34 | nC35 | nC36 | Sample |
|---------|-----------|--------|--------|--------|--------|--------|------|------|------|--------|
|         | DST 3     | -28.40 | -28.40 | -28.50 | -28.60 | -      | -    | -    | -    | 0332-0 |
| 3022.00 | Sh/Clst   | -28.40 | -28.70 | -29.00 | -29.10 | -29.30 | -    | -    | -    | 0202-1 |
| 3520.00 | Sh/Clst   | -27.40 | -27.40 | -27.70 | -28.10 | -28.50 | -    | -    | -    | 0258-2 |
| 3655.00 | Sh/Clst   | -27.70 | -28.10 | -28.90 | -      | -      | -    | -    | -    | 0273-1 |

Table 4A: Variation in Triterpane Distribution (peak height) SIR for Well NOCS 9/2-1

Depth unit of measure: m

| Depth   | Lithology | B     |       |       | C/E  | C/C+E | X/E  | Z/E  | Z/C  | Z/Z+E | Q/E  | E/E+F | C+D     |         | J1     |        | Sample |
|---------|-----------|-------|-------|-------|------|-------|------|------|------|-------|------|-------|---------|---------|--------|--------|--------|
|         |           | B/A   | B/B+A | B+E+F |      |       |      |      |      |       |      |       | C+D+E+F | D+F/C+E | J1+J2% |        |        |
| DST 3   | Oil       | 0.50  | 0.33  | 0.08  | 0.39 | 0.28  | 0.09 | 0.01 | 0.03 | 0.01  | 0.05 | 0.91  | 0.28    | 0.10    | 62.23  | 0332-0 |        |
| 3022.00 | Sh/Clst   | 1.10  | 0.52  | 0.14  | 0.52 | 0.34  | 0.05 | 0.01 | 0.03 | 0.01  | 0.04 | 0.86  | 0.34    | 0.16    | 89.12  | 0202-1 |        |
| 3520.00 | Sh/Clst   | 10.88 | 0.92  | 0.30  | 0.79 | 0.44  | 0.04 | 0.01 | 0.01 | 0.01  | 0.03 | 0.80  | 0.42    | 0.20    | 59.21  | 0258-2 |        |
| 3655.00 | Sh/Clst   | 1.93  | 0.66  | 0.25  | 0.68 | 0.40  | 0.05 | 0.02 | 0.03 | 0.02  | 0.16 | 0.83  | 0.40    | 0.20    | 58.20  | 0273-1 |        |

Depth unit of measure: m

| Depth   | Lithology | Ratio1 | Ratio2 | Ratio3 | Ratio4 | Ratio5 | Ratio6 | Ratio7 | Ratio8 | Ratio9 | Ratio10 | Sample |
|---------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|
| DST 3   | Oil       | 0.76   | 48.10  | 71.80  | 1.25   | 0.73   | 0.42   | 0.29   | 0.56   | 0.93   | 2.45    | 0332-0 |
| 3022.00 | Sh/Clst   | 0.40   | 32.75  | 48.60  | 1.33   | 0.59   | 0.28   | 0.20   | 0.32   | 0.49   | 0.70    | 0202-1 |
| 3520.00 | Sh/Clst   | 0.47   | 33.56  | 50.13  | 1.58   | 0.60   | 0.37   | 0.29   | 0.33   | 0.51   | 0.76    | 0258-2 |
| 3655.00 | Sh/Clst   | 0.49   | 33.30  | 48.96  | 1.84   | 0.59   | 0.45   | 0.34   | 0.32   | 0.50   | 0.72    | 0273-1 |

Ratio1:  $a / a + j$ Ratio2:  $q / q + t * 100\%$ Ratio3:  $2(r + s) / (q + t + 2(r + s)) * 100\%$ Ratio4:  $a + b + c + d / h + k + l + n$ Ratio5:  $r + s / r + s + q$ Ratio6:  $u + v / u + v + q + r + s + t$ Ratio7:  $u + v / u + v + i + m + n + q + r + s + t$ Ratio8:  $r + s / q + r + s + t$ Ratio9:  $q / t$ Ratio10:  $r + s / t$

Table 4C: Variation in Triaromatic Sterane Distribution for Well Well NOCS 9/2-1

Depth unit of measure: m

| <u>Depth</u> | <u>Lithology</u> | <u>Ratio1</u> | <u>Ratio2</u> | <u>Ratio3</u> | <u>Ratio4</u> | <u>Ratio5</u> | <u>Sample</u> |
|--------------|------------------|---------------|---------------|---------------|---------------|---------------|---------------|
| DST 3        | Oil              | 0.74          | 0.68          | 0.43          | 0.45          | 0.55          | 0332-0        |
| 3022.00      | Sh/Clst          | 0.39          | 0.31          | 0.11          | 0.15          | 0.15          | 0202-1        |
| 3520.00      | Sh/Clst          | 0.57          | 0.42          | 0.22          | 0.29          | 0.32          | 0258-2        |
| 3655.00      | Sh/Clst          | 0.42          | 0.32          | 0.13          | 0.17          | 0.17          | 0273-1        |

Ratio1:  $a1 / a1 + g1$

Ratio2:  $b1 / b1 + g1$

Ratio3:  $a1 + b1 / a1 + b1 + c1 + d1 + e1 + f1 + g1$

Ratio4:  $a1 / a1 + e1 + f1 + g1$

Ratio5:  $a1 / a1 + d1$

Depth unit of measure: m

| <u>Depth</u> | <u>Lithology</u> | <u>Ratio1</u> | <u>Ratio2</u> | <u>Ratio3</u> | <u>Ratio4</u> | <u>Sample</u> |
|--------------|------------------|---------------|---------------|---------------|---------------|---------------|
| DST 3        | Oil              | 0.54          | 0.40          | 0.41          | 0.35          | 0332-0        |
| 3022.00      | Sh/Clst          | 0.33          | 0.20          | 0.22          | 0.19          | 0202-1        |
| 3520.00      | Sh/Clst          | 0.26          | 0.15          | 0.18          | 0.15          | 0258-2        |
| 3655.00      | Sh/Clst          | 0.26          | 0.16          | 0.17          | 0.15          | 0273-1        |

Ratio1: A1 / A1 + E1  
 Ratio2: B1 / B1 + E1

Ratio3: A1 / A1 + E1 + G1  
 Ratio4: A1+B1 / A1+B1+C1+D1+E1+F1+G1+H1+I1

Table 4E: Aromatisation of Steranes for Well NOCS 9/2-1

Depth unit of measure: m

| <u>Depth</u> | <u>Lithology</u> | <u>Ratio1</u> | <u>Ratio2</u> | <u>Sample</u> |
|--------------|------------------|---------------|---------------|---------------|
| DST 3        | Oil              | 0.52          | 0.90          | 0332-0        |
| 3022.00      | Sh/Clst          | 0.21          | 0.93          | 0202-1        |
| 3520.00      | Sh/Clst          | 0.31          | 0.92          | 0258-2        |
| 3655.00      | Sh/Clst          | 0.31          | 0.92          | 0273-1        |

Ratio1:  $\frac{C1+D1+E1+F1+G1+H1+I1}{C1+D1+E1+F1+G1+H1+I1 + c1+d1+e1+f1+g1}$

Ratio2:  $g1 / g1 + I1$

Depth unit of measure: m

| Depth   | Lithology | p        | q        | r         | s         | t         | a         | b         | z         | c         | Sample |
|---------|-----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------|
|         |           | x        | d        | e         | f         | g         | h         | i         | j1        |           |        |
|         |           | j2       | k1       | k2        | l1        | l2        | m1        | m2        |           |           |        |
| DST 3   | Oil       | 91089.7  | 47421.5  | 28148.7   | 66018.3   | 19362.3   | 189919.2  | 94015.1   | 12331.7   | 387134.3  | 0332-0 |
|         |           | 85469.0  | 36525.8  | 1004485.9 | 98304.0   | 422752.0  | 270042.1  | 52134.4   | 281898.0  |           |        |
|         |           | 171101.5 | 226313.4 | 146540.5  | 130992.2  | 83315.1   | 91571.9   | 62219.3   |           |           |        |
| 3022.00 | Sh/Clst   | 443832.9 | 174852.0 | 110763.5  | 351200.0  | 65419.6   | 686291.0  | 754030.8  | 55115.0   | 2087488.0 | 0202-1 |
|         |           | 210996.8 | 360517.0 | 4014863.5 | 644908.3  | 1748352.8 | 1166903.9 | 342371.0  | 882364.0  |           |        |
|         |           | 107730.7 | 840496.8 | 602255.2  | 520718.0  | 360716.3  | 408019.5  | 300886.3  |           |           |        |
| 3520.00 | Sh/Clst   | 406325.8 | 162174.7 | 72535.1   | 731784.8  | 39478.1   | 295303.5  | 3213027.5 | 47516.4   | 4717300.0 | 0258-2 |
|         |           | 232184.0 | 638228.2 | 5936930.0 | 1478035.3 | 3224836.5 | 2225164.0 | 682809.3  | 1317595.4 |           |        |
|         |           | 907862.0 | 664698.8 | 478788.8  | 333319.0  | 233476.0  | 136985.7  | 103236.0  |           |           |        |
| 3655.00 | Sh/Clst   | 469729.2 | 207187.8 | 93184.5   | 358051.9  | 54223.9   | 260167.3  | 502606.8  | 26424.2   | 867836.6  | 0273-1 |
|         |           | 64582.4  | 166930.4 | 1281187.6 | 254861.4  | 587655.4  | 407249.3  | 131115.0  | 238819.0  |           |        |
|         |           | 171534.4 | 181391.2 | 140103.3  | 92143.2   | 72299.4   | 64108.3   | 42654.8   |           |           |        |

Depth unit of measure: m

| Depth   | Lithology | u        | v        | a         | b        | c         | d        | e        | f        | g        | Sample |
|---------|-----------|----------|----------|-----------|----------|-----------|----------|----------|----------|----------|--------|
|         |           | h        | i        | j         | k        | l         | m        | n        | o        |          |        |
|         |           | p        | q        | r         | s        | t         |          |          |          |          |        |
| DST 3   | Oil       | 182222.7 | 81800.6  | 330230.2  | 199970.0 | 77706.0   | 79555.0  | 139492.5 | 82708.8  | 103302.6 | 0332-0 |
|         |           | 267782.6 | 139351.0 | 101498.7  | 131120.0 | 45358.8   | 43022.8  | 104846.8 | 104526.8 |          |        |
|         |           | 49564.2  | 76187.3  | 110314.5  | 91301.1  | 82221.3   |          |          |          |          |        |
| 3022.00 | Sh/Clst   | 737168.8 | 247464.8 | 1062341.9 | 699468.8 | 295266.3  | 346371.1 | 490830.8 | 401574.8 | 947556.8 | 0202-1 |
|         |           | 654556.3 | 471137.1 | 1601317.8 | 479187.5 | 249821.7  | 472413.7 | 429946.3 | 385198.2 |          |        |
|         |           | 799716.9 | 576085.5 | 503913.3  | 327910.8 | 1183060.5 |          |          |          |          |        |
| 3520.00 | Sh/Clst   | 453290.7 | 144101.6 | 501361.3  | 315550.9 | 139637.4  | 163025.6 | 198230.0 | 148982.2 | 326723.3 | 0258-2 |
|         |           | 282051.3 | 203843.3 | 573358.2  | 210862.2 | 99517.4   | 143376.5 | 115216.5 | 118224.5 |          |        |
|         |           | 229660.5 | 222640.9 | 196532.1  | 136942.3 | 440797.1  |          |          |          |          |        |
| 3655.00 | Sh/Clst   | 383099.6 | 140119.4 | 461357.7  | 310450.3 | 128604.8  | 143823.7 | 166963.8 | 134445.7 | 290606.1 | 0273-1 |
|         |           | 220560.7 | 164989.1 | 480685.4  | 169326.9 | 77328.0   | 112572.3 | 101595.3 | 92662.6  |          |        |
|         |           | 183160.9 | 146423.4 | 129494.1  | 81398.5  | 293319.3  |          |          |          |          |        |



Depth unit of measure: m

| Depth   | Lithology | a1        | b1        | c1        | d1         | e1        | f1        | g1        | Sample |
|---------|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|--------|
| DST 3   | Oil       | 2557250.5 | 1873711.3 | 588028.0  | 2122625.0  | 1351742.6 | 902244.9  | 895715.8  | 0332-0 |
| 3022.00 | Sh/Clst   | 2168100.0 | 1472068.0 | 4727181.0 | 12632790.0 | 3631937.0 | 5182283.5 | 3338496.0 | 0202-1 |
| 3520.00 | Sh/Clst   | 450165.1  | 243485.5  | 389955.5  | 948315.8   | 387720.5  | 391585.5  | 334233.5  | 0258-2 |
| 3655.00 | Sh/Clst   | 460095.0  | 306763.5  | 840844.0  | 2235265.5  | 691399.3  | 934145.4  | 640392.2  | 0273-1 |

Table 4I: Raw GCMS monoaromatic sterane data (peak height) for Well NOCS 9/2-1

Depth unit of measure: m

| Depth   | Lithology | a1        | b1        | c1        | d1       | e1        | f1       | g1        | h1       | i1       | Sample |
|---------|-----------|-----------|-----------|-----------|----------|-----------|----------|-----------|----------|----------|--------|
| DST 3   | Oil       | 2163752.5 | 1213947.0 | 1228289.4 | 784886.3 | 1840893.3 | 419570.5 | 1308716.0 | 648228.6 | 103162.0 | 0332-0 |
| 3022.00 | Sh/Clst   | 1161111.1 | 598451.3  | 1214048.1 | 947157.0 | 2368897.5 | 439589.5 | 1632973.0 | 831892.5 | 238802.3 | 0202-1 |
| 3520.00 | Sh/Clst   | 131447.5  | 68332.2   | 188024.6  | 121108.9 | 378194.7  | 75150.5  | 206514.5  | 126418.3 | 27954.6  | 0258-2 |
| 3655.00 | Sh/Clst   | 262447.6  | 144567.4  | 358361.2  | 287678.8 | 765088.7  | 159583.9 | 495655.2  | 262769.6 | 54838.0  | 0273-1 |