

# Geochemical Report for Well NOCS 6608/11-1

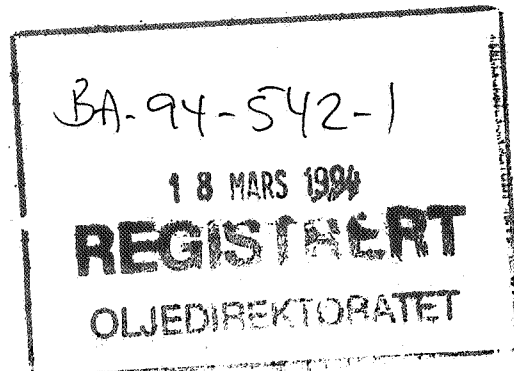
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## Chapter 1

# INTRODUCTION

### 1.1 General Comments

The samples were collected at the Norwegian Petroleum Directorate (NPD) in Stavanger. The cutting samples were washed, described and picked before analysis commenced, while the core chips were analysed after cleansing of any superficial contamination. Both screening and follow-up analyses were performed in the depth range 1001 - 1616 m, covered by 77 cuttings samples.

## 1.2 Analytical Program

Based on the samples availability and the screening analyses results, the following analytical programme was executed for well 6608/11-1 in the section 1001 - 1616 m:

<u>Analysis type</u>	<u>No of samples</u>	<u>Figures</u>	<u>Tables</u>
Lithology description	77	1	1
TOC	27	1	1,2
Rock-Eval pyrolysis	27	2,3,4	2
Thermal extraction GC (GHM, S <sub>1</sub> )	3	5	
Pyrolysis GC (GHM, S <sub>2</sub> )	3	6,7a-b	3
Vitrinite reflectance	14	8	4
Visual kerogen microscopy	10	9	7,8

## ***Experimental Procedures***

### **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.



Fluorescence Colour	Colour	Corresp. Vitrinite
	Index	Reflectance
Green	1	0.2 %
Green/yellow	2	0.2-0.3 %
Yellow	3	0.3 %
Yellow/orange	4	0.4 %
Light orange		50.5 %
Moderate-orange	6	0.6 %
Dark orange		70.8 %
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 catenagenic 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

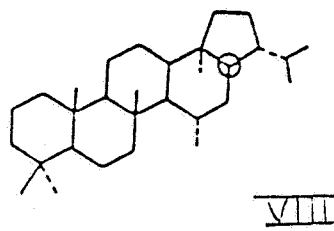
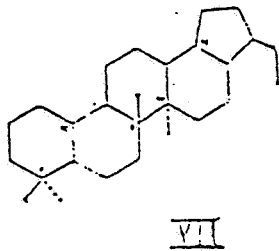
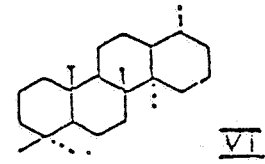
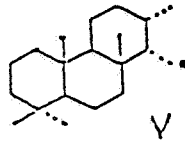
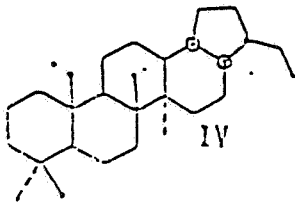
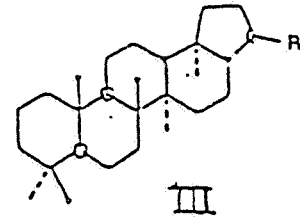
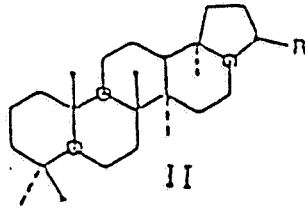
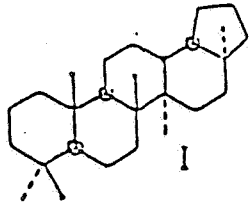
Monoaromatic steranes are detected using the M/Z 253 fragment ion, while the triaromatic steranes are detected using the M/Z 231 fragment ion.

**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 terpane	C <sub>23</sub> H <sub>42</sub>	( V, R=i-C <sub>4</sub> H <sub>9</sub> )
Q.	Tricyclic terpane	C <sub>24</sub> H <sub>44</sub>	( V, R=i-C <sub>5</sub> H <sub>11</sub> )
R.	Tricyclic terpane (17R, 17S)	C <sub>25</sub> H <sub>66</sub>	( V, R=i-C <sub>6</sub> H <sub>13</sub> )
S.	Tetracyclic terpane	C <sub>24</sub> H <sub>42</sub>	( VI )
T.	Tricyclic terpane (17R, 17S)	C <sub>26</sub> H <sub>48</sub>	( V, R=i-C <sub>7</sub> H <sub>15</sub> )
N.	Tricyclic terpane	C <sub>21</sub> H <sub>38</sub>	( V, R=C <sub>2</sub> H <sub>5</sub> )
O.	Tricyclic terpane	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

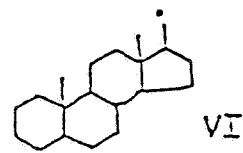
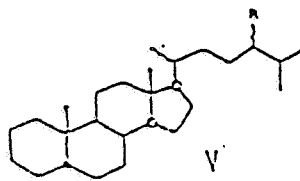
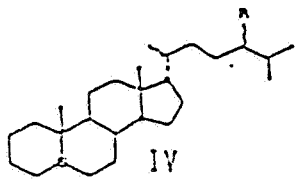
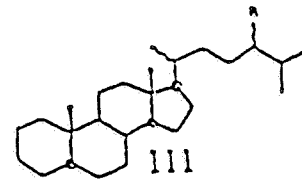
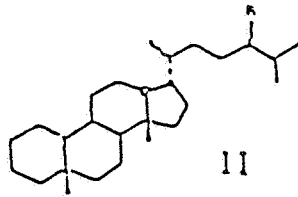
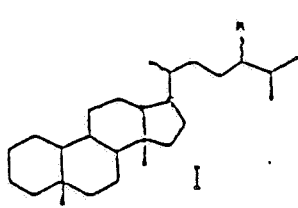


**Mass Fragmentograms representing Steranes**  
(M/Z 149, 189, 217, 218, 259, 372, 386, 400 and 414)

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 + 20S $\alpha\alpha\alpha$ cholestane	$C_{28}H_{50}$ $C_{27}H_{48}$	( II, R=CH <sub>3</sub> ) ( III, R=H)
h.	20S $\beta\alpha$ 24-ethyl-diacholestane + 20R $\alpha\beta\beta$ cholestane	$C_{29}H_{52}$ $C_{27}H_{48}$	( II, R=C <sub>2</sub> H <sub>5</sub> ) ( IV, R=H)
i.	20S $\alpha\beta\beta$ cholestane + 20R $\alpha\beta$ 24-methyl-diacholestane	$C_{27}H_{48}$ $C_{28}H_{50}$	( IV, R=H) ( 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 + 20R $\alpha\beta$ 24-ethyl-diacholestane	$C_{28}H_{50}$ $C_{29}H_{52}$	( IV, R=CH <sub>3</sub> ) ( 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



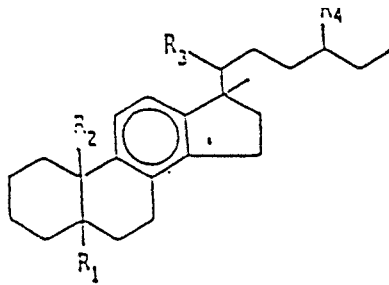
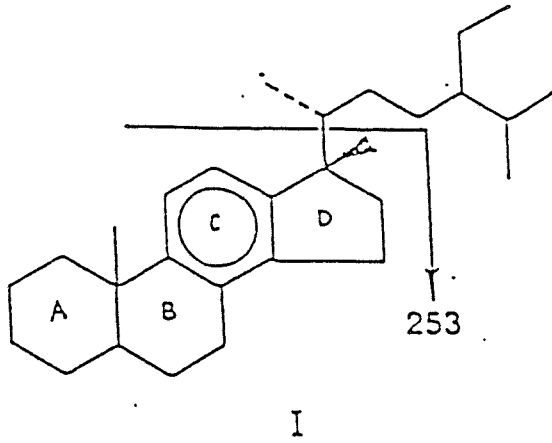


## Mass Fragmentograms representing Monoaromatic Steranes (M/Z 253)

Description of C-ring monoaromatic steroid hydrocarbons

Peak	R <sub>1</sub>	Substituents		R <sub>4</sub>	Abbreviation of Compound
		R <sub>2</sub>	R <sub>3</sub>		
A1					C <sub>21</sub> M
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B1					C <sub>22</sub> MA
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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
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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

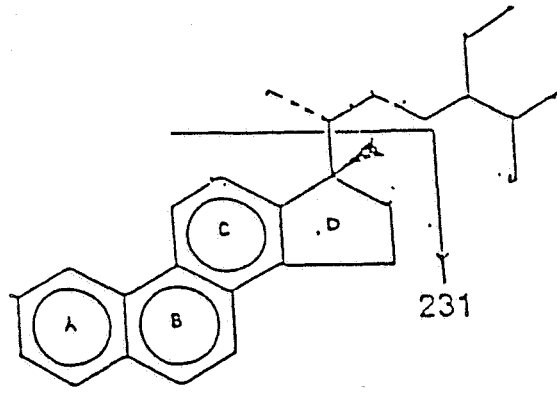


**Mass Fragmentograms representing Triaromatic Steranes  
(M/Z 231)**

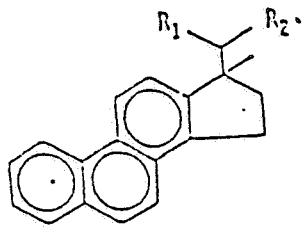
Description of ABC-ring triaromatic steroid hydrocarbons

Peak	Substituents		Abbreviation 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



II



## 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:

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

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**

- 1 -

Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int	Cvd	TOC%	%	Lithology description		
1001.00						0001
				70 S/Sst : w to lt gy to pl pi to dsk pi to lt or, fos, glauc, f, rnd, ang, crs, ang, l		0001-2L
				30 Sh/Clst: lt gy to m gy to lt ol gy, calc, pyr, slt, mic, fos, glauc, hd, br		0001-1L
1022.00						0002
	0.08			80 S/Sst : w to lt gy to pl pi to dsk pi to lt or, mic, fos, glauc, f, rnd, crs, rnd, ang, l, sil		0002-2L
				20 Sh/Clst: lt gy to y gy to lt ol gy, calc, pyr, slt, s, mic, fos, hd, br		0002-1L
1040.00						0003
				40 Sh/Clst: y gy to lt ol gy to m gy, calc, slt, mic, fos, glauc, hd, br		0003-1L
				40 S/Sst : w to lt gy, mic, fos, glauc, f, crs, rnd, ang, l		0003-2L
				20 Cont : dd		0003-3L
1061.00						0004
	0.09			70 S/Sst : w to lt gy, mic, fos, glauc, f, crs, rnd, ang, l		0004-2L
				25 Sh/Clst: y gy to lt ol gy to m gy, calc, slt, s, mic, fos, glauc, hd		0004-1L
				5 Cont : Mica-ad, dd		0004-3L

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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int	Cvd	TOC%	%	Lithology description		
1082.00						0005
			65	S/Sst	: w to lt gy, mic, fos, glauc, f, crs, rnd, ang, l, sil	0005-2L
			35	Sh/Clst:	y gy to lt ol gy to m gy, calc, slt, s, mic, fos, glauc, hd	0005-1L
				tr Cont	: Mica-ad, prp, dd	0005-3L
1100.00						0006
			50	Sh/Clst:	y gy to lt ol gy to m gy, calc, slt, s, mic, fos, glauc, hd	0006-1L
			50	S/Sst	: w to lt gy to lt or to dsk pi, mic, fos, glauc, f, crs, rnd, ang, l, sil	0006-2L
				tr Cont	: prp	0006-3L
1118.00						0007
			50	Sh/Clst:	y gy to m gy to m brn to brn gy, calc, slt, s, mic, fos, glauc, hd	0007-1L
			50	S/Sst	: w to lt gy to lt or to pl pi, mic, fos, glauc, f, crs, rnd, ang, l, sil	0007-2L
				tr Cont	: prp	0007-3L
1133.00						0008
	0.05		55	S/Sst	: w to lt gy to lt or to pl pi, cly, mic, fos, glauc, f, crs, rnd, ang, l, sil	0008-2L
			40	Sh/Clst:	y gy to m gy to m brn to brn gy, calc, slt, s, mic, fos, glauc, hd	0008-1L
			5	S/Sst	: w to lt gy, carb, mic, glauc, f, ang, hd, cem	0008-3L
				tr Cont	: Mica-ad, prp	0008-4L



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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int Cvd	TOC%	%	Lithology description			
1151.00						0009
	0.06	80	S/Sst	: w to lt gy to m or to pl pi to dsk pi, cly, mic, fos, glauc, f, crs, rnd, ang, l, sil		0009-2L
		20	Sh/Clst:	y gy to m gy to m brn to brn gy, calc, slt, s, mic, fos, glauc, hd		0009-1L
			tr S/Sst	: w to lt gy, carb, mic, glauc, f, ang, hd, cem		0009-3L
			tr Cont	: Mica-ad, prp		0009-4L
1172.00						0010
		65	S/Sst	: w to lt gy to m or to pl pi to dsk pi, mic, fos, glauc, f, crs, rnd, ang, l, sil		0010-2L
	0.71	35	Sh/Clst:	y gy to m gy, calc, slt, s, mic, fos, glauc, hd		0010-1L
			tr S/Sst	: w to lt gy, carb, mic, f, ang, hd, cem		0010-3L
			tr Cont	: prp		0010-4L
1190.00						0011
		85	Sh/Clst:	pl gn y to y gy to gy y, calc, slt, mic, glauc, sft		0011-1L
		15	S/Sst	: w to m or to pl pi, mic, glauc, f, crs, rnd, ang, l, sil		0011-2L
			tr Cont	: prp		0011-3L
1211.00						0012
	0.34	100	Sh/Clst:	drk y brn to dsk y brn to dsk y, slt, mic, glauc, sft, tuf		0012-1L
			tr S/Sst	: w to m or to pl pi, f, crs, rnd, ang, l		0012-2L
			tr Cont	: prp, fib		0012-3L

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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int	Cvd	TOC%	%	Lithology description		
1217.00						0013
			100	Sh/Clst: drk y brn to dsk y brn to dsk y, slt, mic, glauc, sft, tuf		0013-1L
				tr S/Sst : w to m or to pl pi, f, crs, rnd, ang, l		0013-2L
				tr Cont : prp, fib		0013-3L
1223.00						0014
			100	Sh/Clst: y gy to ol gy to w to lt gy, slt, mic, glauc, lam, sft, tuf		0014-1L
				tr S/Sst : w to m or to pl pi, f, crs, rnd, ang, l, sil		0014-2L
				tr Cont : Mica-ad, prp, bar, fib		0014-3L
1229.00						0015
	0.39		100	Sh/Clst: gy brn to pl y brn to lt ol gy to lt ol brn to m gy, slt, mic, glauc, wx, lam, sft		0015-1L
				tr S/Sst : w, crs, ang, l, sil		0015-2L
				tr Cont : bar, fib		0015-3L
1235.00						0016
			60	Sh/Clst: gy brn to m brn to pl y brn to lt ol gy to lt ol brn to m gy, calc, slt, mic, fos, glauc, sft		0016-1L
			40	S/Sst : m or y to lt y to m y brn to w, mic, f, crs, rnd, ang, l		0016-2L
				tr Cont : Mica-ad, bar, fib		0016-3L

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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample	
Int Cvd	TOC%	%	Lithology description				
1241.00						0017	
	0.29	80	S/Sst	: m or y to lt y to m y brn to w, mic, f, crs, rnd, ang, l		0017-2L	
		20	Sh/Clst:	gy brn to pl y brn to lt ol gy to m brn, calc, slt, mic, fos, glauc, hd, br		0017-1L	
			tr Cont	: Mica-ad, fib		0017-3L	
1247.00						0018	
		65	S/Sst	: m or y to lt y to m y brn to w, mic, f, crs, rnd, ang, l		0018-2L	
		35	Sh/Clst:	m brn to m y brn to lt ol gy to lt or, slt, mic, glauc, sft		0018-1L	
			tr Cont	: Mica-ad, fib		0018-3L	
1253.00						0019	
		80	S/Sst	: w to m y brn to pl pi, mic, f, crs, rnd, ang, l		0019-2L	
	2.58	20	Sh/Clst:	lt gy to m gy to brn blk to m brn to y gy, carb, slt, mic, sft		0019-1L	
			tr Cont	: Mica-ad		0019-3L	
1259.00						0020	
		90	S/Sst	: w to m y brn to pl pi, mic, f, ang, crs, rnd, ang, l		0020-2L	
		10	Sh/Clst:	lt gy to m gy to brn blk to m brn to y gy, carb, slt, mic, sft		0020-1L	
			tr Cont	: Mica-ad		0020-3L	

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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int	Cvd	TOC%	%	Lithology description		
1265.00						0021
			90	S/Sst	: w to lt gy to lt pi, pyr, mic, f, ang, crs, rnd, l, sil	0021-2L
			10	Sh/Clst:	lt gy to m gy to brn blk to y gy, carb, pyr, slt, mic, hd	0021-1L
				tr Cont	: Mica-ad	0021-3L
1271.00						0022
		0.13	85	S/Sst	: w to lt gy to lt pi, f, ang, hd, pyr, cem, f, crs, rnd, l, sil	0022-2L
			15	Sh/Clst:	lt gy to m gy to brn blk to y gy, carb, pyr, slt, mic, hd	0022-1L
				tr Cont	: Mica-ad	0022-3L
1277.00						0023
			80	S/Sst	: w to lt gy to lt pi, f, rnd, hd, pyr, cem, f, crs, rnd, l, sil	0023-2L
			15	Sh/Clst:	lt gy to m gy to brn blk to y gy, carb, pyr, slt, mic, hd	0023-1L
			5	Coal	: dsk brn, carb, sft, br	0023-3L
				tr Cont	: Mica-ad	0023-4L
1286.00						0024
			80	S/Sst	: w to lt gy, f, rnd, hd, pyr, cem, f, crs, rnd, l, sil	0024-2L
		2.49	20	Sh/Clst:	lt gy to m gy to lt ol gy to brn blk, carb, pyr, slt, mic, hd	0024-1L
				tr Coal	: dsk brn, carb, pyr, sft, br	0024-3L
				tr Cont	: Mica-ad, prp	0024-4L

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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int	Cvd	TOC%	%	Lithology description		
1289.00						0025
			60	S/Sst : w to lt gy, f, ang, hd, pyr, cem, f, crs, rnd, l, sil		0025-2L
			35	Sh/Clst: lt gy to m gy to lt brn gy to brn blk, carb, pyr, slt, mic, fos, sft		0025-1L
			5	Coal : dsk brn to brn blk, carb, pyr, sft, br		0025-3L
			tr	Cont : Mica-ad		0025-4L
1295.00						0026
			60	S/Sst : w to lt gy, f, ang, hd, pyr, cem, f, crs, rnd, ang, l		0026-2L
	1.15		40	Sh/Clst: lt gy to m gy to lt brn gy to brn blk, carb, pyr, slt, mic, fos, sft		0026-1L
			tr	Coal : dsk brn to brn blk, carb, pyr, sft, br		0026-3L
			tr	Cont : Mica-ad		0026-4L
1301.00						0027
			55	S/Sst : w to lt gy, pyr, mic, fos, glauc, f, crs, rnd, ang, l		0027-2L
			45	Sh/Clst: lt gy to m gy to lt ol gy, slt, mic, fos, glauc, hd, br		0027-1L
			tr	Ca : w, calc, fos, glauc, f, sft, chk		0027-3L
			tr	Cont : Mica-ad, prp		0027-4L
1307.00						0028
	0.56		65	Sh/Clst: lt gy to m gy to lt ol gy to gy brn, slt, s, mic, fos, glauc, hd, br		0028-1L
			25	S/Sst : w to lt gy, pyr, mic, fos, glauc, f, crs, ang, l		0028-2L
			10	Ca : w, calc, s, glauc, f, hd, br		0028-3L
			tr	Cont : Mica-ad, prp		0028-4L

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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int	Cvd	TOC%	%	Lithology description		
1313.00						0029
			70	Sh/Clst: lt gy to m gy to lt ol gy to gy brn, carb, slt, s, mic, glauc, hd, br		0029-1L
			20	S/Sst : w to lt gy to lt pi, pyr, mic, glauc, f, crs, ang, l, sil		0029-2L
			10	Ca : w, calc, s, glauc, f, hd, br		0029-3L
			tr	Cont : Mica-ad, prp		0029-4L
1319.00						0030
			65	S/Sst : w to lt gy to lt pi, pyr, mic, f, crs, ang, l, sil		0030-2L
			30	Sh/Clst: lt gy to lt ol gy to lt ol brn to gy brn to pl red pu, carb, pyr, slt, mic, hd, br		0030-1L
			5	Ca : w, calc, s, glauc, f, hd, br		0030-3L
			tr	Cont : Mica-ad, prp		0030-4L
1325.00						0031
	0.07		70	S/Sst : w to lt gy to lt pi, pyr, mic, f, crs, rnd, ang, l		0031-2L
			25	Sh/Clst: lt gy to lt ol gy to pl red pu, carb, slt, mic, hd, br		0031-1L
			5	Ca : w, calc, slt, s, sft, br		0031-3L
			tr	Coal : brn blk, carb, pyr, hd, br		0031-4L
			tr	Cont : Mica-ad		0031-5L
1331.00						0032
			80	S/Sst : w to lt gy to lt pi, pyr, f, crs, rnd, ang, l		0032-2L
			15	Sh/Clst: lt gy to lt ol gy to pl red pu, slt, mic, hd, br		0032-1L
			5	Ca : w, calc, slt, sft, br		0032-3L
			tr	Cont : Mica-ad		0032-4L

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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int Cvd	TOC%	%	Lithology description			
1337.00						0033
		85	S/Sst	: w to lt gy to pl pi, pyr, mic, f, ang, crs, rnd, l		0033-2L
		10	Sh/Clst:	lt gy to m gy to lt ol gy to pl brn, slt, mic, glauc, hd, br		0033-1L
		5	Ca	: w, calc, slt, glauc, f, sft, br		0033-3L
			tr Cont	: Mica-ad, prp		0033-4L
1343.00						0034
		80	S/Sst	: w to lt gy to pl pi, pyr, mic, f, rnd, ang, crs, rnd, l		0034-2L
		15	Sh/Clst:	lt gy to m gy to lt ol gy to pl brn, pyr, slt, mic, glauc, hd, br		0034-1L
		5	Ca	: w, calc, slt, glauc, f, sft, br		0034-3L
			tr Cont	: Mica-ad, prp		0034-4L
1349.00						0035
	0.07	75	S/Sst	: w to lt gy to pl pi, pyr, mic, glauc, f, crs, rnd, ang, l		0035-2L
		20	Sh/Clst:	lt gy to m gy to lt ol gy to pl brn, pyr, slt, mic, glauc, hd, br		0035-1L
		5	Ca	: w, calc, slt, glauc, f, sft, br, chk		0035-3L
			tr Cont	: Mica-ad, prp		0035-4L
1355.00						0036
		45	Sh/Clst:	lt gy to m gy to lt ol gy to pl brn, calc, slt, mic, glauc, hd, br		0036-1L
		40	S/Sst	: w to lt gy to pl pi, pyr, mic, f, crs, rnd, ang, l		0036-2L
		15	Ca	: w, calc, slt, f, sft, br		0036-3L
			tr Cont	: prp		0036-4L

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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int	Cvd	TOC%	%	Lithology description		
1361.00						0037
			35	Sh/Clst: lt gy to m gy to lt ol gy to pl brn, calc, pyr, slt, mic, glauc, hd, br		0037-1L
		0.17	35	Ca : w, calc, slt, s, glauc, f, sft, br		0037-3L
			30	S/Sst : w to lt gy, pyr, mic, f, crs, rnd, ang, l		0037-2L
			tr	Cont : Mica-ad		0037-4L
1367.00						0038
			40	S/Sst : w to lt gy to pl pi, pyr, mic, f, crs, rnd, ang, l		0038-2L
			35	Sh/Clst: lt gy to gn gy to pl brn, calc, mic, hd, br, mrl		0038-1L
			25	Ca : w, calc, f, sft, br		0038-3L
			tr	Cont : Mica-ad		0038-4L
1373.00						0039
		0.28	65	Sh/Clst: lt gy to gn gy to pl brn to pl red pu, calc, mic, hd, br, mrl		0039-1L
			25	S/Sst : w to lt gy to pl pi, f, ang, hd, pyr, cem, f, crs, rnd, ang, l		0039-2L
			10	Ca : w, calc, f, sft, br		0039-3L
			tr	Cont : Mica-ad, prp		0039-4L
1379.00						0040
			65	Sh/Clst: lt gy to gn gy to pl brn to pl red pu, calc, pyr, slt, mic, hd, br, mrl		0040-1L
			35	S/Sst : w to lt gy to pl pi, pyr, mic, f, crs, rnd, ang, l		0040-2L
			tr	Ca : w, calc, slt, f, sft, br		0040-3L
			tr	Cont : Mica-ad, prp, fib		0040-4L



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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int	Cvd	TOC%	%	Lithology description		
1385.00						0041
				50 Sh/Clst: lt gy to gn gy to pl brn to pl red pu, calc, pyr, slt, mic, hd, br, mrl		0041-1L
				50 S/Sst : w to lt gy to m y, mic, f, crs, rnd, ang, l		0041-2L
				tr Ca : w, calc, slt, f, sft, br		0041-3L
				tr Cont : Mica-ad, prp, fib		0041-4L
	cvd			tr S/Sst : w to lt gy, carb, pyr, mic, f, ang, cem		0041-5L
	cvd			tr Coal : brn blk, carb, pyr, sft, br		0041-6L
1391.00						0042
				55 S/Sst : w to lt gy to m y, pyr, mic, f, crs, rnd, ang, l		0042-2L
				45 Sh/Clst: gn gy to pl brn to pl red pu, calc, slt, mic, hd, br, mrl		0042-1L
				tr Ca : w, calc, slt, f, sft, br		0042-3L
				tr Cont : Mica-ad, prp, fib, tar-ad		0042-4L
1397.00						0043
				60 S/Sst : w to lt gy to m y to m or, pyr, mic, glauc, f, crs, rnd, ang, l		0043-2L
				40 Sh/Clst: gn gy to pl brn to brn gy to pl red pu, calc, slt, mic, hd, br, mrl		0043-1L
				tr Ca : w, calc, slt, f, sft, br		0043-3L
				tr Cont : Mica-ad, prp, fib, tar-ad		0043-4L
1403.00						0044
		0.16		85 Sh/Clst: gn gy to lt gn gy to gy pi to brn gy, calc, slt, mic, hd, br, mrl		0044-1L
				15 S/Sst : w to lt gy to m y to m or, pyr, mic, glauc, f, crs, rnd, ang, l		0044-2L
				tr Ca : w, calc, slt, f, sft, br		0044-3L
	cvd			tr Coal : brn blk to dsk brn, carb, pyr, sft, br		0044-4L
				tr Cont : Mica-ad, prp, tar-ad		0044-5L

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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int	Cvd	TOC%	%	Lithology description		
1409.00						0045
				90 Sh/Clst: gn gy to lt gn gy to gy pi to brn gy, calc, slt, mic, hd, br, mrl		0045-1L
				10 S/Sst : w to lt gy to m y to m or, pyr, mic, glauc, f, rnd, ang, l		0045-2L
				tr Ca : w, calc, f, sft, br		0045-3L
	cvd			tr Coal : brn blk to dsk brn, carb, pyr, sft, br		0045-4L
				tr Cont : Mica-ad, prp, fib, tar-ad		0045-5L
1418.00						0046
				85 Sh/Clst: gn gy to lt gn gy to gy pi to lt brn, calc, mic, hd, br, mrl		0046-1L
				15 S/Sst : w to lt gy to pl pi, pyr, mic, f, ang, l		0046-2L
				tr Ca : w, calc, f, sft, br		0046-3L
				tr Cont : Mica-ad, prp, fib, tar-ad		0046-4L
1424.00						0047
				90 Sh/Clst: gn gy to lt gn gy to gy pi to lt brn, calc, mic, hd, br, mrl		0047-1L
				10 S/Sst : w to lt gy to pl pi, pyr, mic, f, ang, l		0047-2L
				tr Ca : w, calc, f, sft, br		0047-3L
				tr Cont : Mica-ad, prp, fib, tar-ad		0047-4L
1430.00						0048
	0.15			90 Sh/Clst: gn gy to lt gn gy to gy pi to lt brn, calc, mic, hd, br, mrl		0048-1L
				10 S/Sst : w to lt gy to pl pi, pyr, mic, f, rnd, ang, crs, rnd, l		0048-2L
				tr Ca : w, calc, f, sft, br		0048-3L
				tr Cont : Mica-ad, prp, fib, tar-ad		0048-4L

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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int	Cvd	TOC%	%	Lithology description		
1439.00						0049
				90 Sh/Clst: gn gy to lt gn gy to gy pi to lt brn, calc, mic, hd, br, mrl		0049-1L
				10 S/Sst : w to lt gy, pyr, mic, f, crs, rnd, ang, l		0049-2L
				tr Ca : w, calc, f, sft, br		0049-3L
				tr Cont : Mica-ad, prp, fib, tar-ad		0049-4L
1448.00						0050
				95 Sh/Clst: gn gy to gy pi to lt brn, calc, mic, hd, br, mrl		0050-1L
				5 S/Sst : w, mic, f, crs, rnd, ang, l		0050-2L
	cvd			tr Ca : w, calc, f, sft, br		0050-3L
				tr Cont : Mica-ad, prp, fib, tar-ad		0050-4L
1454.00						0051
				95 Sh/Clst: gn gy to gy pi to lt brn, calc, mic, hd, br, mrl		0051-1L
				5 S/Sst : w, mic, f, crs, rnd, ang, l		0051-2L
	cvd			tr Ca : w, calc, f, sft, br		0051-3L
				tr Cont : prp, fib, tar-ad		0051-4L
1460.00						0052
		0.15		100 Sh/Clst: gn gy to gy pi to lt brn, calc, mic, hd, br, mrl		0052-1L
				tr S/Sst : w, mic, f, ang, l		0052-2L
				tr Ca : w, calc, slt, f, sft, br		0052-3L
				tr Cont : Mica-ad, prp, fib		0052-4L

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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int	Cvd	TOC%	%	Lithology description		
1469.00						0053
			100	Sh/Clst: gn gy to gy pi to lt brn, calc, mic, hd, br, mrl		0053-1L
				tr S/Sst : w, mic, f, crs, ang, l		0053-2L
				tr Ca : w, calc, s, f, sft, br		0053-3L
				tr Cont : fib		0053-4L
1475.00						0054
			95	Sh/Clst: gn gy to gy pi to lt brn to lt ol brn, calc, mic, hd, br, mrl		0054-1L
				5 S/Sst : w, mic, f, crs, rnd, ang, l		0054-2L
				tr Ca : w, calc, s, f, sft, br		0054-3L
				tr Cont : fib		0054-4L
1481.00						0055
			95	Sh/Clst: gn gy to gy pi to lt brn to lt ol brn, calc, mic, hd, br, mrl		0055-1L
				5 S/Sst : w, pyr, mic, f, crs, rnd, ang, l		0055-2L
	cvd			tr Ca : w, calc, slt, f, sft, br		0055-3L
				tr Cont : fib		0055-4L
1487.00						0056
		0.23	100	Sh/Clst: gn gy to gy pi to lt brn to lt ol brn, calc, mic, hd, br, mrl		0056-1L
				tr S/Sst : w, pyr, mic, f, crs, rnd, ang, l		0056-2L
	cvd			tr Ca : w, calc, slt, f, sft, br		0056-3L
1493.00						0057
			100	Sh/Clst: gn gy to gy pi to lt brn to lt ol brn, calc, mic, hd, br, mrl		0057-1L
				tr S/Sst : w, pyr, mic, f, ang, l		0057-2L
	cvd			tr Ca : w, calc, slt, f, sft, br		0057-3L
				tr Cont : fib		0057-4L

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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int	Cvd	TOC%	%	Lithology description		
1499.00						0058
			100	Sh/Clst: gn gy to gy pi to lt ol brn to dsk y, calc, mic, hd, br, mrl		0058-1L
	cvd			tr S/Sst : w, pyr, mic, f, crs, rnd, ang, l		0058-2L
				tr Ca : w, calc, f, sft, br		0058-3L
				tr Cont : fib		0058-4L
1508.00						0059
			90	Sh/Clst: gn gy to gy pi to lt ol brn to dsk y, calc, mic, hd, br, mrl		0059-1L
			10	S/Sst : w, mic, f, crs, rnd, ang, l		0059-2L
				tr Cont : fib		0059-3L
1511.00						0060
			95	Sh/Clst: gn gy to gy pi to lt ol brn, calc, mic, hd, br, mrl		0060-1L
			5	S/Sst : w, mic, f, crs, rnd, ang, l		0060-2L
				tr Cont : fib		0060-3L
				tr Ca : w to lt gy, calc, f, hd, br, crs, rnd, ool		0060-4L
1517.00						0061
		0.26	100	Sh/Clst: lt gy to gn gy to gy pi to lt ol brn, calc, mic, hd, br, mrl		0061-1L
				tr S/Sst : w, pyr, mic, f, crs, ang, l		0061-2L
				tr Cont : prp, fib, tar-ad		0061-3L
				tr Ca : w to lt gy, calc, f, hd, br, crs, rnd, ool		0061-4L

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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int	Cvd	TOC%	%	Lithology description		
1523.00						0062
			95	Sh/Clst: lt gy to gn gy to gy pi to lt ol brn to dsk y, calc, mic, hd, br, mrl		0062-1L
			5	Ca : w, calc, f, hd, br, crs, rnd, ool		0062-3L
			tr	S/Sst : w, f, crs, ang, l		0062-2L
			tr	Cont : prp, fib		0062-4L
1529.00						0063
			80	Sh/Clst: gn gy to gy pi to lt brn to dsk y, calc, mic, hd, br, mrl		0063-1L
			10	S/Sst : w, f, crs, rnd, ang, l, sil		0063-2L
			10	Ca : w, calc, f, hd, br, crs, rnd, ool		0063-3L
1532.00						0064
			80	Sh/Clst: gn gy to gy pi to lt brn to dsk y, calc, mic, hd, br, mrl		0064-1L
			10	S/Sst : w, pyr, f, crs, rnd, ang, l		0064-2L
			10	Ca : w, calc, slt, f, hd, br, crs, rnd, ool		0064-3L
1538.00						0065
			85	Sh/Clst: gn gy to gy pi to lt brn to dsk y, calc, mic, hd, br, mrl		0065-1L
			10	S/Sst : w, pyr, f, crs, rnd, ang, l		0065-2L
			5	Ca : w to lt gy to m gy, calc, slt, f, hd, br, crs, rnd, ool		0065-3L
1544.00						0066
	0.17		90	Sh/Clst: lt gn gy to gn gy to gy pi to m red brn to m brn to dsk y, calc, mic, hd, br, mrl		0066-1L
			5	S/Sst : w, pyr, f, crs, rnd, ang, l		0066-2L
			5	Ca : w to lt gy to m gy, calc, slt, f, hd, br, crs, rnd, ool		0066-3L

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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int	Cvd	TOC%	%	Lithology description		
1553.00						0067
			80	Sh/Clst: lt gn gy to gn gy to gy pi to m red brn to m brn to dsk y, calc, mic, hd, br, mrl		0067-1L
			15	S/Sst : w to or gy, pyr, f, ang, calc, cem, f, crs, rnd, ang, l		0067-2L
			5	Ca : w to lt gy, calc, slt, f, hd, br, crs, rnd, ool		0067-3L
1559.00						0068
			85	Sh/Clst: lt gn gy to gn gy to m red brn to lt brn to dsk y to y gy, calc, mic, hd, br, mrl		0068-1L
			10	S/Sst : w to or gy, f, ang, calc, cem, f, crs, rnd, ang, l		0068-2L
			5	Ca : w to lt gy, calc, slt, f, hd, br, crs, rnd, ool		0068-3L
			tr	Cont : tar-ad		0068-4L
1568.00						0069
			65	Sh/Clst: lt gn gy to gn gy to m red brn to lt brn to dsk y to y gy, calc, mic, hd, br, mrl		0069-1L
			35	S/Sst : w to or gy, pyr, f, ang, calc, cem, f, crs, rnd, ang, l		0069-2L
			tr	Ca : w to lt gy, calc, f, hd, br, f, crs, rnd, ool		0069-3L
			tr	Cont : tar-ad		0069-4L
1571.00						0070
	0.10		80	S/Sst : w to or gy to dsk y, mic, f, ang, calc, cem, f, crs, rnd, ang, l		0070-2L
			20	Sh/Clst: lt gn gy to gn gy to m red brn to lt brn to dsk y to y gy, calc, pyr, slt, mic, hd, br, mrl		0070-1L
			tr	Ca : w to lt gy, calc, f, crs, rnd, ool, hd, br		0070-3L
			tr	Cont : tar-ad		0070-4L

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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample
Int	Cvd	TOC%	%	Lithology description		
1574.00						0071
			85	S/Sst	: w to or gy to dsk y, pyr, f, ang, calc, cem, f, crs, rnd, ang, l	0071-2L
			15	Sh/Clst:	lt gn gy to gn gy to lt brn to m brn to gy y, calc, slt, mic, hd, br, mrl	0071-1L
			tr	Ca	: w to lt gy, calc, f, crs, rnd, ool, hd, br	0071-3L
			tr	Cont	: prp, tar-ad	0071-4L
1580.00						0072
			65	S/Sst	: w to or gy to dsk y, pyr, f, ang, calc, cem, f, crs, rnd, ang, l	0072-2L
			35	Sh/Clst:	lt gn gy to gn gy to lt brn to m brn to gy y, calc, slt, mic, hd, br, mrl	0072-1L
			tr	Ca	: w to lt gy, calc, f, hd, br	0072-3L
			tr	Cont	: prp, tar-ad	0072-4L
1586.00						0073
			70	S/Sst	: w to lt or to lt pi, pyr, f, rnd, calc, cem, f, crs, rnd, ang, l	0073-2L
			30	Sh/Clst:	lt gn gy to gn gy to lt brn to m brn to gy y, calc, slt, mic, hd, br, mrl	0073-1L
			tr	Ca	: w to lt gy, calc, f, hd, br	0073-3L
1592.00						0074
	0.21		60	S/Sst	: w to lt or to lt pi, f, ang, calc, cem, f, crs, pyr, glauc, ang, l	0074-2L
			35	Sh/Clst:	lt gn gy to gn gy to lt brn to lt gy to gy y, calc, pyr, slt, mic, hd, br, mrl	0074-1L
			5	Ca	: w to lt gy, calc, pyr, mic, f, hd, br	0074-3L
			tr	Cont	: Mica-ad, prp	0074-4L



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Table 1 : Lithology description for well 6608/11-1

Depth unit of measure: m

Depth	Type	Grp	Frm	Age	Trb	Sample	
Int Cvd	TOC%	%	Lithology description				
1598.00						0075	
		60	S/Sst	:	w to lt or to lt pi, f, ang, calc, cem, pyr, f, crs, ang, l	0075-2L	
		30	Sh/Clst:		lt gn gy to gn gy to lt brn to m brn to lt gy to gy y, calc, pyr, slt, mic, hd, br, mrl	0075-1L	
		10	Ca	:	w to lt gy to pl y brn, calc, pyr, slt, mic, f, hd, br	0075-3L	
		tr	Cont	:	Mica-ad, prp	0075-4L	
1610.00						0076	
		80	S/Sst	:	w to lt brn gy, f, rnd, calc, cem, mic, f, crs, rnd, ang, l	0076-2L	
		15	Sh/Clst:		lt gn gy to gn gy to lt brn to m brn to lt gy to gy y, calc, slt, mic, hd, br, mrl	0076-1L	
		5	Ca	:	w to lt gy to pl y brn, calc, slt, mic, f, hd, br	0076-3L	
		tr	Cont	:	Mica-ad	0076-4L	
1616.00						0077	
	0.08	90	S/Sst	:	w to lt brn gy, f, calc, cem, pyr, mic, f, crs, rnd, ang, l	0077-2L	
		10	Sh/Clst:		lt gn gy to gn gy to lt brn to m brn to lt gy to gy y, calc, slt, mic, hd, br, mrl	0077-1L	
		tr	Ca	:	w to lt gy to pl y brn, calc, mic, f, hd, br	0077-3L	
		tr	Cont	:	Mica-ad, prp	0077-4L	

Table 2 : Rock-Eval table for well 6608/11-1

Depth unit of measure: m

Depth	Typ	Lithology	S1	S2	S3	S2/S3	TOC	HI	OI	PP	PI	Tmax	Sample
1022.00	cut	S/Sst : w to lt gy to pl pi to dsk pi to lt or	0.02	-	0.10	-	0.08	-	125	-	1.00	-	0002-2L
1061.00	cut	S/Sst : w to lt gy	0.01	-	0.14	-	0.09	-	156	-	1.00	-	0004-2L
1133.00	cut	S/Sst : w to lt gy to lt or to pl pi	0.01	-	0.18	-	0.05	-	360	-	1.00	-	0008-2L
1151.00	cut	S/Sst : w to lt gy to m or to pl pi to dsk pi	-	-	0.12	-	0.06	-	200	-	-	-	0009-2L
1172.00	cut	Sh/Clst: y gy to m gy	0.39	0.66	1.26	0.52	0.71	93	177	1.1	0.37	412	0010-1L
1211.00	cut	Sh/Clst: drk y brn to dsk y brn to dsk y	0.05	0.04	1.06	0.04	0.34	12	312	0.1	0.56	421	0012-1L
1229.00	cut	Sh/Clst: gy brn to pl y brn to lt ol gy to lt ol brn to m gy	0.05	0.14	1.78	0.08	0.39	36	456	0.2	0.26	398	0015-1L
1241.00	cut	S/Sst : m or y to lt y to m y brn to w	0.03	0.06	0.69	0.09	0.29	21	238	0.1	0.33	335	0017-2L
1253.00	cut	Sh/Clst: lt gy to m gy to brn blk to m brn to y gy	0.29	3.71	3.06	1.21	2.58	144	119	4.0	0.07	430	0019-1L
1271.00	cut	S/Sst : w to lt gy to lt pi	0.01	0.02	0.25	0.08	0.13	15	192	-	0.33	423	0022-2L
1286.00	cut	Sh/Clst: lt gy to m gy to lt ol gy to brn blk	0.36	4.04	2.53	1.60	2.49	162	102	4.4	0.08	433	0024-1L

Table 2 : Rock-Eval table for well 6608/11-1

Depth unit of measure: m

Depth	Typ	Lithology	S1	S2	S3	S2/S3	TOC	HI	OI	PP	PI	Tmax	Sample
1295.00	cut	Sh/Clst: lt gy to m gy to lt brn gy to brn blk	0.24	1.04	1.44	0.72	1.15	90	125	1.3	0.19	430	0026-1L
1307.00	cut	Sh/Clst: lt gy to m gy to lt ol gy to gy brn	0.08	0.14	1.37	0.10	0.56	25	245	0.2	0.36	392	0028-1L
1325.00	cut	S/Sst : w to lt gy to lt pi	0.01	-	0.11	-	0.07	-	157	-	1.00	-	0031-2L
1349.00	cut	S/Sst : w to lt gy to pl pi	0.01	-	0.19	-	0.07	-	271	-	1.00	-	0035-2L
1361.00	cut	Ca : w	0.07	0.06	0.93	0.06	0.17	35	547	0.1	0.54	355	0037-3L
1373.00	cut	Sh/Clst: lt gy to gn gy to pl brn to pl red pu	0.24	0.20	1.37	0.15	0.28	71	489	0.4	0.55	354	0039-1L
1403.00	cut	Sh/Clst: gn gy to lt gn gy to gy pi to brn gy	0.13	0.08	0.64	0.13	0.16	50	400	0.2	0.62	347	0044-1L
1430.00	cut	Sh/Clst: gn gy to lt gn gy to gy pi to lt brn	0.12	0.09	0.43	0.21	0.15	60	287	0.2	0.57	331	0048-1L
1460.00	cut	Sh/Clst: gn gy to gy pi to lt brn	0.12	0.10	0.46	0.22	0.15	67	307	0.2	0.55	318	0052-1L
1487.00	cut	Sh/Clst: gn gy to gy pi to lt brn to lt ol brn	0.10	0.16	0.41	0.39	0.23	70	178	0.3	0.38	426	0056-1L
1517.00	cut	Sh/Clst: lt gy to gn gy to gy pi to lt ol brn	0.18	0.30	0.48	0.63	0.26	115	185	0.5	0.38	396	0061-1L

Table 2 : Rock-Eval table for well 6608/11-1

Depth unit of measure: m

Depth	Typ	Lithology	S1	S2	S3	S2/S3	TOC	HI	OI	PP	PI	Tmax	Sample
1532.00	com	bulk	0.02	0.03	0.50	0.06	0.11	27	455	0.1	0.40	-	0078-0B
1544.00	cut	Sh/Clst: lt gn gy to gn gy to gy pi to m red brn to m brn to dsk y	0.11	0.11	0.41	0.27	0.17	65	241	0.2	0.50	418	0066-1L
1571.00	cut	S/Sst : w to or gy to dsk y	-	-	0.24	-	0.10	-	240	-	-	-	0070-2L
1592.00	cut	S/Sst : w to lt or to lt pi	0.10	0.09	0.36	0.25	0.21	43	171	0.2	0.53	379	0074-2L
1616.00	cut	S/Sst : w to lt brn gy	0.01	-	0.21	-	0.08	-	263	-	1.00	-	0077-2L

Table 3 : Pyrolysis GC Data (S2 peak) as Percentage of Total Area for Well 6608/11-1

Depth unit of measure: m

Depth	Typ	Lithology	C1	C2-C5	C6-C14	C15+	S2 from Rock-Eval	Sample
1253.00	cut	Sh/Clst: lt gy to m gy to brn blk to m brn to y gy	5.28	19.70	51.88	23.14	3.71	0019-1L
1286.00	cut	Sh/Clst: lt gy to m gy to lt ol gy to brn blk	5.47	17.05	49.29	28.19	4.04	0024-1L
1295.00	cut	Sh/Clst: lt gy to m gy to lt brn gy to brn blk	3.58	23.30	60.83	12.29	1.04	0026-1L

Table 4 : Thermal Maturity Data for well 6608/11-1 Vitrinite Reflectance Maturity Data

Depth-unit of measure: m

Depth Typ Lithology	Vitrinite Reflectance (%)	Number of Readings	Standard Deviation	Spore Fluorescence Colour	SCI	T <sub>max</sub> (°C)	Sample
1001.00 cut bulk	5.82	5	0.85	-	-	-	0001-0B
1040.00 cut bulk	0.32	7	0.04	2	-	-	0003-0B
1151.00 cut bulk	0.42	17	0.01	-	-	-	0009-0B
1172.00 cut bulk	0.38	10	0.05	3	-	-	0010-0B
1211.00 cut bulk	0.25	6	0.03	3	-	-	0012-0B
1247.00 cut bulk	0.34	20	0.03	3+4	-	-	0018-0B
1289.00 cut bulk	0.34	20	0.04	3-4	-	-	0025-0B
1295.00 cut bulk	0.36	20	0.05	3+4	-	-	0026-0B
1355.00 cut bulk	0.44	20	0.04	3-4	-	-	0036-0B
1409.00 cut bulk	NDP	-	-	-	-	-	0045-0B
1448.00 cut bulk	NDP	-	-	3	-	-	0050-0B
1499.00 cut bulk	0.34	2	0.04	3-4	-	-	0058-0B
1553.00 cut bulk	0.38	1	0.00	3-4	-	-	0067-0B
1598.00 cut bulk	0.40	5	0.03	3+4	-	-	0075-0B

Table 4 : Thermal Maturity Data for well NOCS 6608/11-1 Visual Kerogen Maturity Data

Depth unit of measure: m

Depth	Typ Lithology	Vitrinite Reflectance (%)	Number of Readings	Standard Deviation	Spore Fluorescence Colour	SCI	T <sub>max</sub> (°C)	Sample
1172.00	cut bulk	-	-	-	-	3.0-3.5	-	0001-0B
1211.00	cut bulk	-	-	-	-	3.0-3.5	-	0002-0B
1229.00	cut bulk	-	-	-	-	3.5	-	0003-0B
1253.00	cut bulk	-	-	-	-	3.0-3.5	-	0004-0B
1286.00	cut bulk	-	-	-	-	3.5	-	0005-0B
1373.00	cut bulk	-	-	-	-	NDP	-	0006-0B
1487.00	cut bulk	-	-	-	-	3.5(?)	-	0007-0B
1517.00	cut bulk	-	-	-	-	4.0-4.5(?)	-	0008-0B
1544.00	cut bulk	-	-	-	-	4.0-4.5	-	0009-0B
1592.00	cut bulk	-	-	-	-	4.0(?)	-	0010-0B

Table 5 : Visual Kerogen Composition Data for well NOCS 6608/11-1

Depth unit of measure: m

Depth	Typ	Lithology	L I P T %	A m p r e l %	L o p p o l %	S p / P o l %	C u t p i c l n e %	R e s i d u a l %	D i n o r t %	A B i t L	I N E R T %	F u s i n %	S e n s i t i v e %	M e t h o d %	S c r e e n %	B i t u m %	V I T R %	T e l l u r i t %	C o l l o i d %	V o l u m e %	A r o m a t i c %	B i o g e n i c %	Sample
1172.00	cut	bulk	50	**	*	*	*				35	*	**	**				15	*	**			0001-0B
1211.00	cut	bulk	85	**	**		*	*			15		*					TR		*			0002-0B
1229.00	cut	bulk	40	**	*	*	*				20	*						40	**	*			0003-0B
1253.00	cut	bulk	50	**	**	*	*	*			20	*	**					30	*	**			0004-0B
1286.00	cut	bulk	65	*	**	**	*	*	*		25	*	**					10	*	**			0005-0B
1373.00	cut	bulk	NDP								NDP							NDP					0006-0B
1487.00	cut	bulk	NDP	**	*						NDP		*					NDP		*			0007-0B
1517.00	cut	bulk	90	**	**	*	*				10		*					TR		*			0008-0B
1544.00	cut	bulk	NDP	*	*						NDP							NDP					0009-0B
1592.00	cut	bulk	NDP		*		*				NDP	*						NDP	**	*			0010-0B