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O&E Research Centre Bergen

Title:	**Well 7220/6-1 Petroleum geochemistry**	No.	:	NH-01351009
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		Page	:	1 of 42
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CONTENTS

2 ANALYTICAL PROCEDURES

For the realtime gas analysis performed by Geoservices on the rig is referred to the manual for the "RESERVAL" - GC gas detection (Geoservices 2004).

Delta 13 C isotope analysis of gas sampled in polythene bags above mud flowline were sent onshore and analysed at the Norsk Hydro Reseach Centre in Bergen by standard procedures for gaseous hydrocarbon samples.

Standard GC and GCMS- measurements at the Hydro Reseach Centre are based are based on quantitative measurements. The analytical methods are in accordance with the guidelines in the Norwegian Industry Guide to Organic Geochemical Analyses (NIGOGA 2000, edition 4.0). There are some deviation from this guide, however:

- Extract and asphaltene workup by centrifugation
- Internal standard compound mixture added for quality control and quantitative measurements
- GC analysis of aromatic fractions by 5% phenyl methyl- silicone stationary phase
- GC- MSD detection of the aromatic hydrocarbons (not by FID)
- Some limitations on the reporting of compounds relative to the NIGOGA guide due to known co- elutions or disputable compound identities

The data quality control is according to laboratory procedures and NIGOGA, available on request. Samples annotated "NSO1" represent the North Sea reference oil and reflect the analytical repeatability.

The data generated on the basis of the 7220/6-1 well material in this report has according to standard routines been reported digitally to Petrobank.

Depth	Delta 13C- isotope values (o/oo PDB)				
(mD)	C1	C2	C3	iC4	nC4
490	-69,52				
500	-69,94				
510	-66,47				
560	-62,44				
600	**-61,31**	-36,51			
650	-59,92	-36,27			
710	-59,04				
740	**-58,76**				
750	-59,52				
820	-59,89				
890	-60,59	-39,10	-30,31		
950	-59,62	-37,27	-28,63		
980	-58,93	-37,66	-29,65		
1000	**-56,86**	**-34,07**	**-29,48**	**-29,64**	**-29,39**
1020	**-54,65**	**-33,51**	**-29,99**	**-30,09**	**-29,84**
1050	**-52,05**	**-33,17**	**-30,14**	**-30,61**	**-29,90**
1080	**-50,58**	**-32,69**	**-30,26**	-30,26	**-29,69**
1100	**-49,52**	**-32,56**	**-30,09**	**-30,67**	**-29,83**
1120	**-49,30**	**-33,05**	**-29,87**	**-30,78**	**-30,26**
1130	**-49,46**	**-33,60**	**-30,24**	**-31,24**	**-30,02**
1140			-34,80		
1150			-35,40		-33,22
1160	-51,19	**-36,53**	**-34,78**	**-33,79**	**-33,24**
1165	-50,22	**-36,57**	-34,54	**-33,86**	**-33,29**
1170	-51,39	**-36,24**	**-34,36**	**-33,80**	**-33,32**
1180	-51,23	**-35,95**	**-34,33**	**-33,98**	**-33,26**
1190	-51,32	-34,55	-32,84	-33,67	-33,27
1205					
1220	**-51,48**	-32,25	-27,46	-33,48	
1240	-50,65	**-31,75**	**-26,32**	**-33,29**	-32,23
1255	-50,24	**-31,56**	**-26,09**	**-33,20**	-31,93
1270	-50,10	**-31,58**	**-25,43**	**-33,37**	-31,67
1285	-49,82	**-31,62**	**-25,53**	**-33,34**	**-31,33**
1305	-49,65	**-31,42**	**-24,72**	**-33,41**	**-30,80**
1320	-50,08	**-31,25**	**-24,50**	**-33,26**	**-30,43**
1340	-49,96	**-31,26**	**-24,55**	**-33,31**	**-30,51**
1365	-49,19	**-31,30**	**-24,47**	**-33,23**	-30,39
1380	-49,69	**-32,05**	**-25,04**	**-33,27**	-29,92
1400	-50,41	**-32,37**	**-26,33**	**-33,26**	**-30,72**
1415	-49,99	**-32,29**	**-26,25**	**-33,14**	**-30,88**
1425	**-50,12**	-32,33	-26,68	-33,28	-30,85

Table 3-1: Delta 13C isotope analysis of C1- nC4 gas sampled in polythene bags. (Figures in bold typing are averages of more than one parallel analysis)

Depth (mD)	C1 (mol %)	C2 (mol %)	C3 (mol %)	iC4 (mol %)	nC4 (mol %)	iC5 (mol %)	nC5 (mol %)	Sum
490	**99,873**	**0,045**	**0,048**	**0,007**	**0,010**	**0,004**	**0,014**	100,000
510	99,788	0,058	0,079	0,064	0,003	0,005	0,003	100,000
560	98,789	0,582	0,264	0,338	0,009	0,012	0,005	100,000
600	97,856	1,259	0,308	0,174	0,131	0,153	0,118	100,000
650	97,457	1,646	0,355	0,194	0,119	0,133	0,095	100,000
710	98,457	0,623	0,258	0,253	0,093	0,212	0,105	100,000
740	99,103	0,363	0,158	0,131	0,068	0,113	0,065	100,000
750	**98,607**	**0,749**	**0,292**	**0,172**	**0,051**	**0,084**	**0,046**	**100,000**
820	98,543	0,679	0,271	0,166	0,011	0,182	0,149	100,000
890	98,052	1,127	0,297	0,223	0,083	0,144	0,074	100,000
950	97,964	0,718	0,436	0,341	0,187	0,221	0,133	100,000
980	96,006	1,507	0,811	0,631	0,398	0,398	0,249	100,000
1000	91,484	3,148	1,862	0,935	1,148	0,772	0,650	100,000
1020	89,530	3,359	2,132	1,173	1,756	1,110	0,940	100,000
1050	89,003	3,325	2,109	1,368	2,060	1,141	0,993	100,000
1080	86,710	3,819	2,399	1,805	2,598	1,475	1,195	100,000
1100	81,422	4,598	3,136	2,734	3,762	2,316	2,032	100,000
1120	83,126	5,285	2,639	2,391	2,901	1,974	1,683	100,000
1130	**85,360**	**8,513**	**2,838**	**1,378**	**0,837**	**0,619**	**0,455**	**100,000**
1140	**56,530**	**10,059**	**13,944**	**5,250**	**8,553**	**3,273**	**2,389**	**100,000**
1150	**31,853**	**8,597**	**17,747**	**8,463**	**16,198**	**9,079**	**8,063**	**100,000**
1160	**28,080**	**8,146**	**18,324**	**9,735**	**18,224**	**9,172**	**8,317**	**100,000**
1165	**45,246**	**12,189**	**16,978**	**6,825**	**10,626**	**4,386**	**3,750**	**100,000**
1170	**35,212**	**8,272**	**15,065**	**9,691**	**14,662**	**9,017**	**8,081**	**100,000**
1180	**38,050**	**8,284**	**13,950**	**10,250**	**13,329**	**8,916**	**7,221**	**100,000**
1190	**45,518**	**8,329**	**10,259**	**11,481**	**9,108**	**9,216**	**6,088**	**100,000**
1205	52,595	8,334	6,885	11,228	5,407	10,349	5,202	100,000
1220	53,026	8,049	6,321	15,174	3,414	11,013	3,004	100,000
1240	48,275	9,538	8,058	17,473	3,271	10,993	2,392	100,000
1255	42,349	7,367	7,137	18,670	3,803	16,606	4,069	100,000
1270	54,639	9,330	6,863	13,708	2,742	10,184	2,534	100,000
1285	51,887	8,290	7,683	14,231	3,440	11,201	3,267	100,000
1305	47,333	8,449	7,955	14,945	4,313	12,966	4,038	100,000
1320	49,038	8,516	7,496	13,502	4,469	12,458	4,519	100,000
1340	42,872	7,887	8,625	14,251	5,785	14,158	6,424	100,000
1365	52,335	6,426	6,941	11,548	5,264	12,151	5,335	100,000
1380	32,862	5,683	8,638	15,407	7,190	20,973	9,247	100,000
1400	47,935	6,565	8,682	12,424	4,655	14,432	5,307	100,000
1415	54,469	5,924	7,166	10,928	4,324	12,524	4,666	100,000
1425	55,374	5,423	5,952	9,638	4,160	13,874	5,580	100,000
1430	51,850	5,121	5,329	9,275	4,206	16,846	7,374	100,000
1440	69,593	5,561	4,538	4,363	3,108	8,841	3,997	100,000
1455	60,241	6,990	6,132	5,855	3,945	11,234	5,602	100,000
1460	79,256	4,429	2,996	2,884	1,743	5,866	2,825	100,000
1465	77,870	3,874	2,797	3,529	1,981	6,741	3,209	100,000
1480	72,180	8,828	4,353	0,833	0,868	8,307	4,631	100,000
1490	66,798	5,419	4,497	5,913	2,977	9,750	4,646	100,000
1505	63,312	5,693	4,921	6,439	3,315	11,055	5,265	100,000
1525	51,382	7,596	6,313	8,610	4,322	14,890	6,887	100,000

Table 3-2: Normalised gas composition C1- nC5 gas sampled in polythene bags. (Figures in bold typing are averages of more than one parallel analysis)

4.2 C5-C20 gas chromatography of the MDT- oil and reference samples

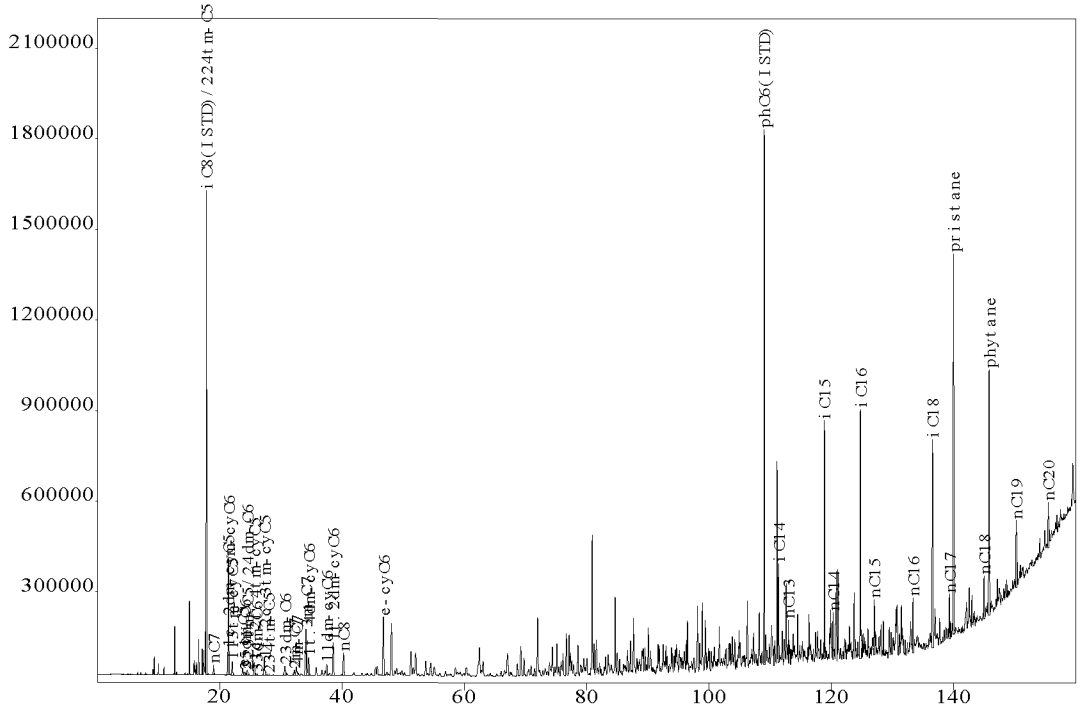

Figure 4-1: C5-C20 gas chromatogram of oil in MDT- water sample at 1184.5 mRKB

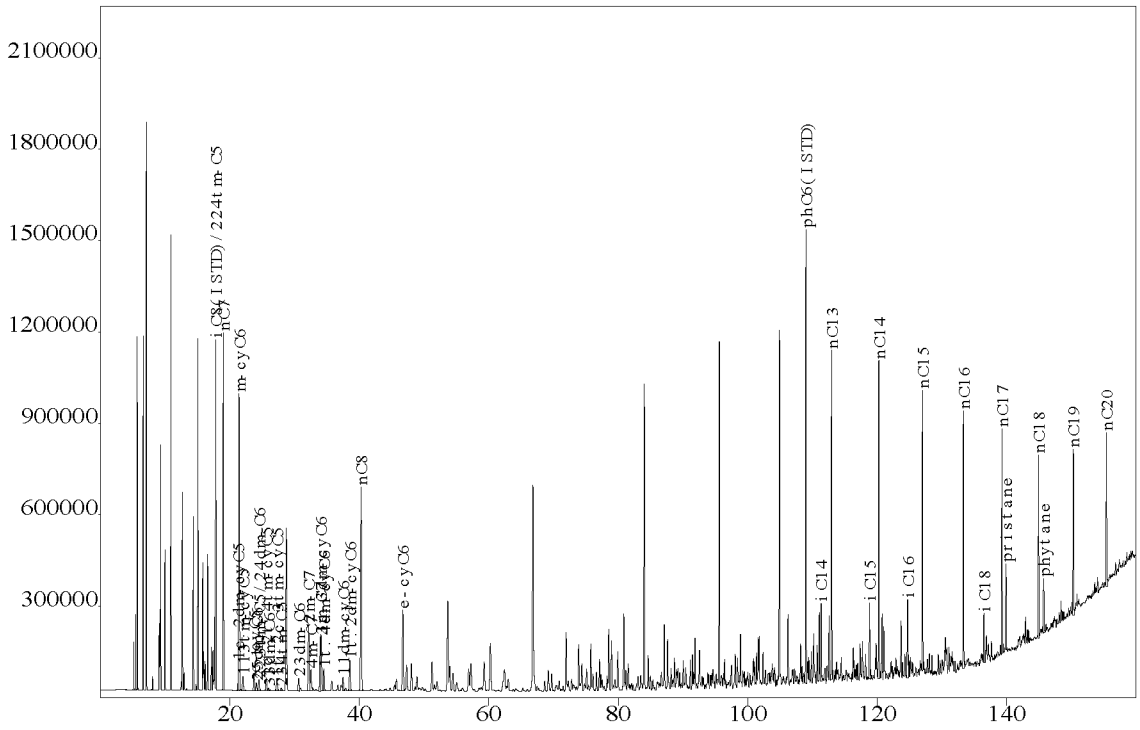

Figure 4-2: C5-C20 gas chromatogram of NSO1 oil (Oseberg, well 30/9-B 18)

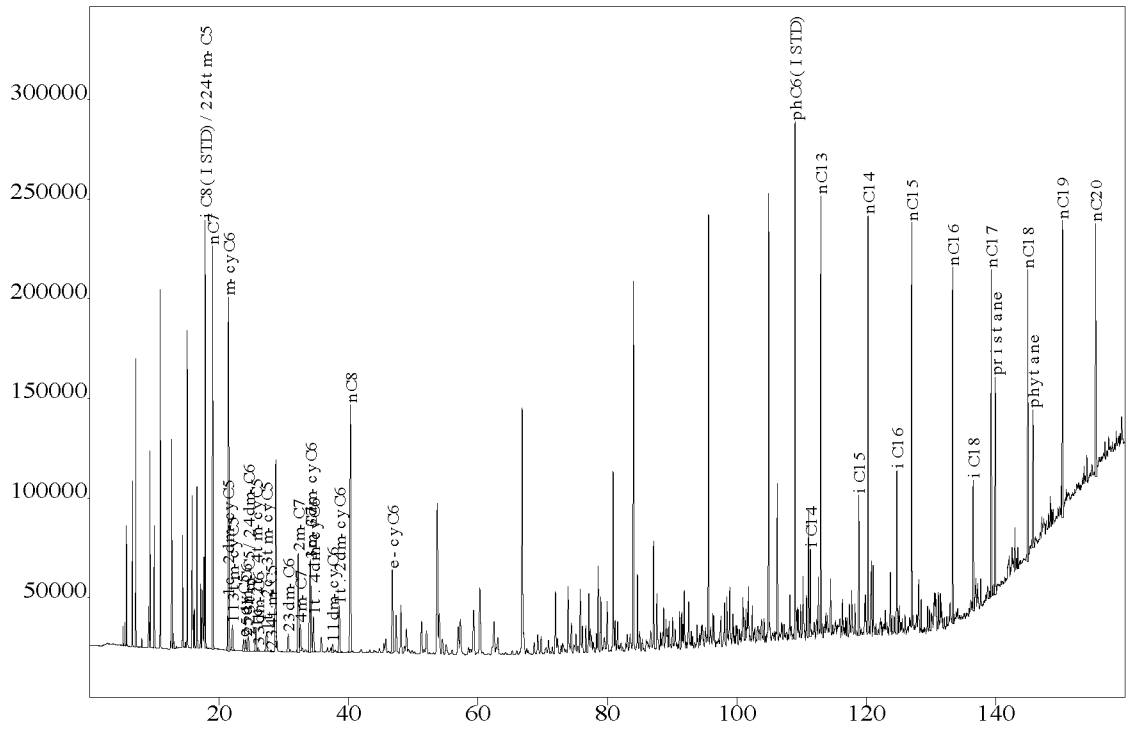

Figure 4-3: C5-C20 gas chromatogram of oil in DST4- water sample well 7120/2-1 (1945- 2031 mRKB)

4.3 Gas chromatography of EOM- fractions (C15+)

A FID gas chromatogram of the C15+ saturate fraction of the MDT- oil from 1184.5 mRKB is shown in Figure 4-5. The depletion of n- alkanes compared to the Pristane- and Phytane- isoprenoids is very evident here. The Pristane/Phytane- ratio, the Pristane/nC17- ratio and the Phytane/nC18- ratio are 1.41, 10.8 and 7.4, respectively.

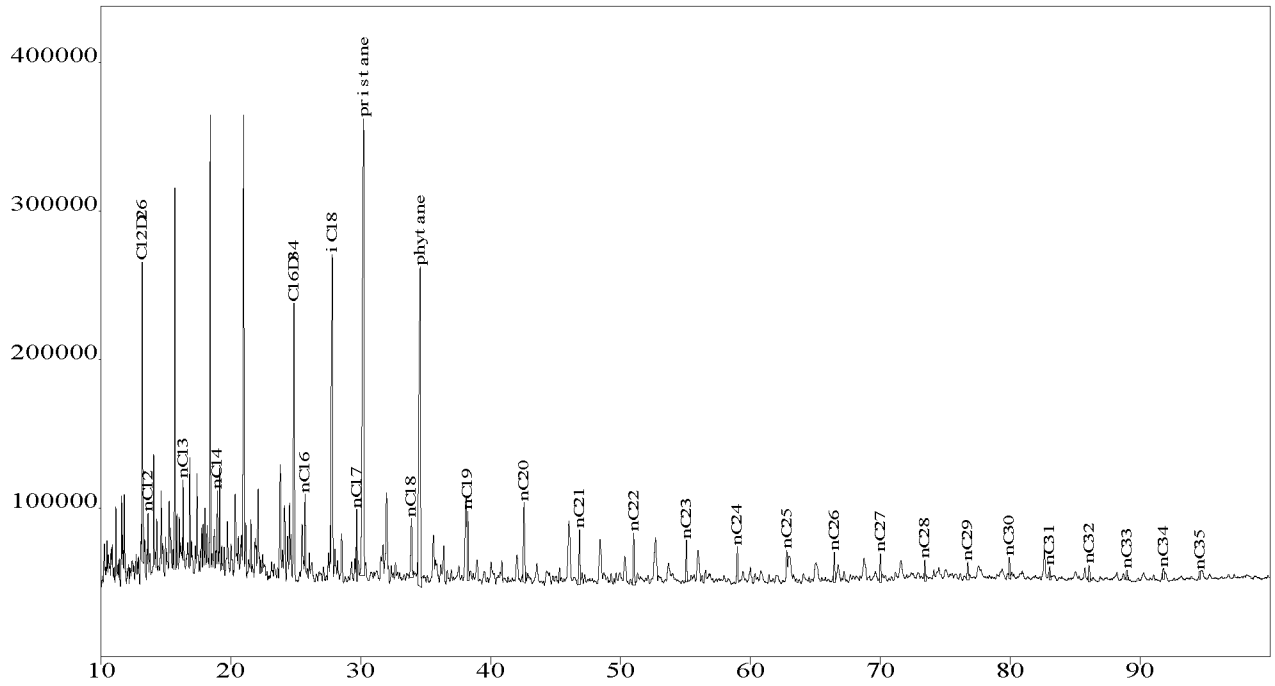

Figure 4-5: GC FID of C15+ saturate fraction of MDT-oil from 1184.5mRKB in well 7220/6-1

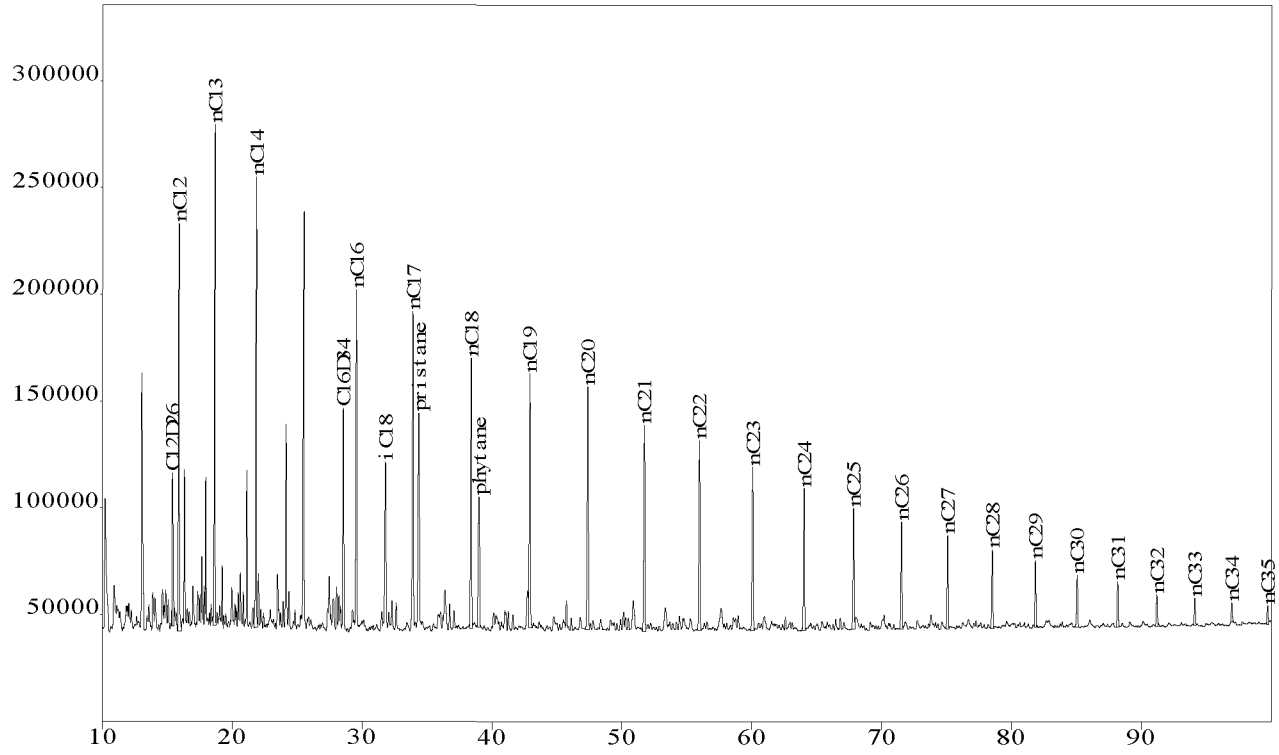

Figure 4-6: GC FID of C15+ saturate fraction of DST4- oil from 1945- 2031 mRKB in well 7120/2-1

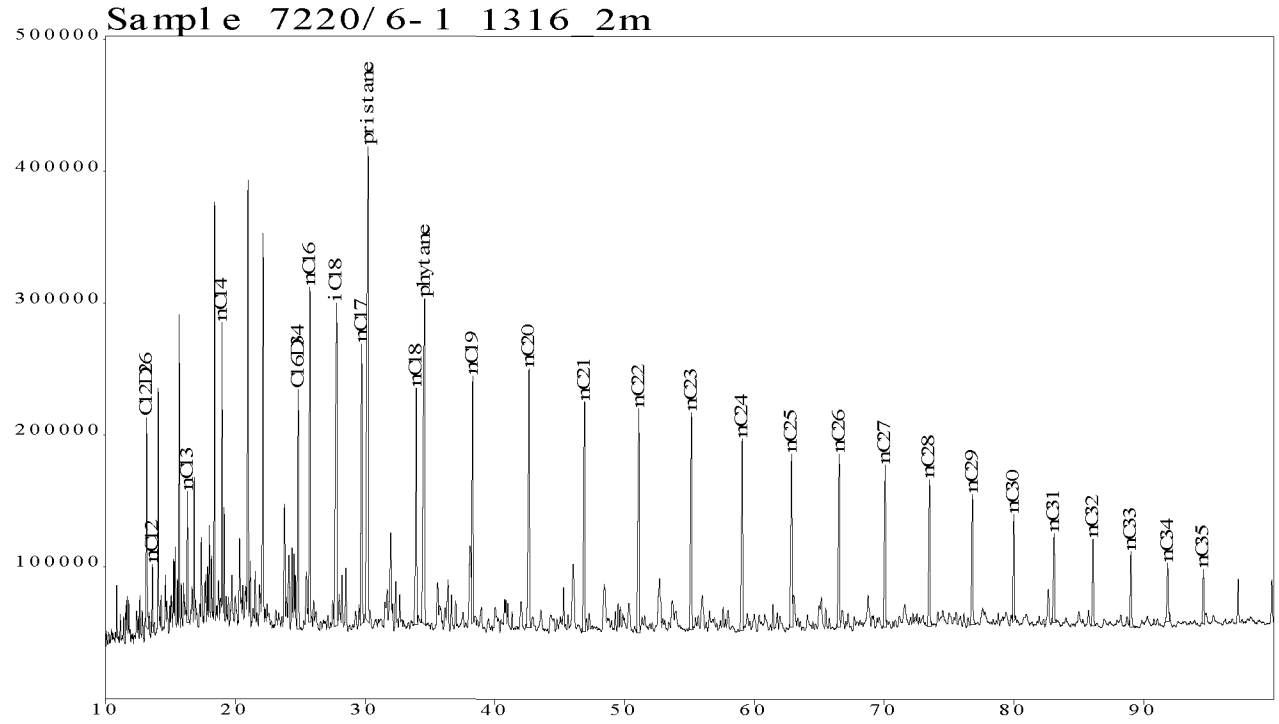

Figure 4-7: GC FID of C15+ saturate fraction of EOM from SWC at 1316.2 mRKB

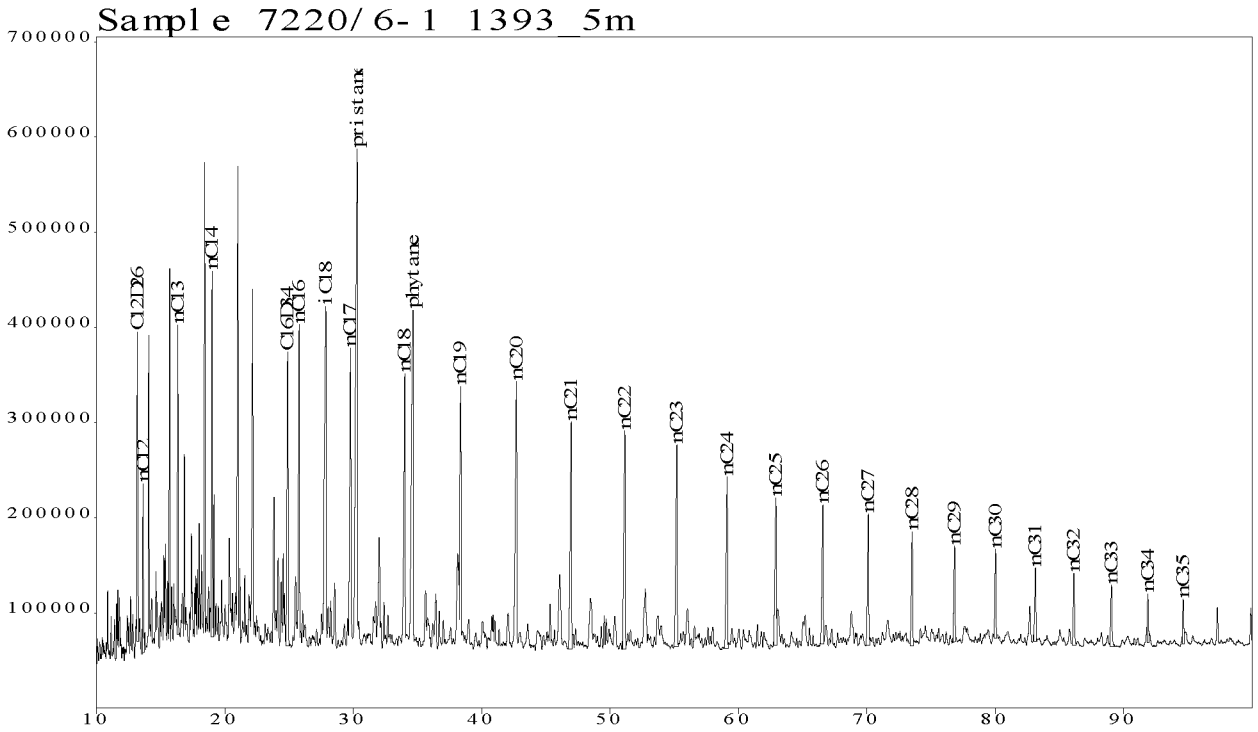

Figure 4-8: GC FID of C15+ saturate fraction of EOM from SWC at 1393.5 mRKB

4.4 Results from the GCMS- analysis

The MDT- oil from 1184.5 mRKB, SWCs from 1316.2 mRKB and 1393.5 mRKB were analysed with respect to biomarkers in both the saturate and aromatic fractions. In Figures 4-9 to 4-11 are shown the terpane saturate biomarkers (m/z=191) and in Figures 4-12- to 4-14 the steranes (m/z=217, m/z=218).

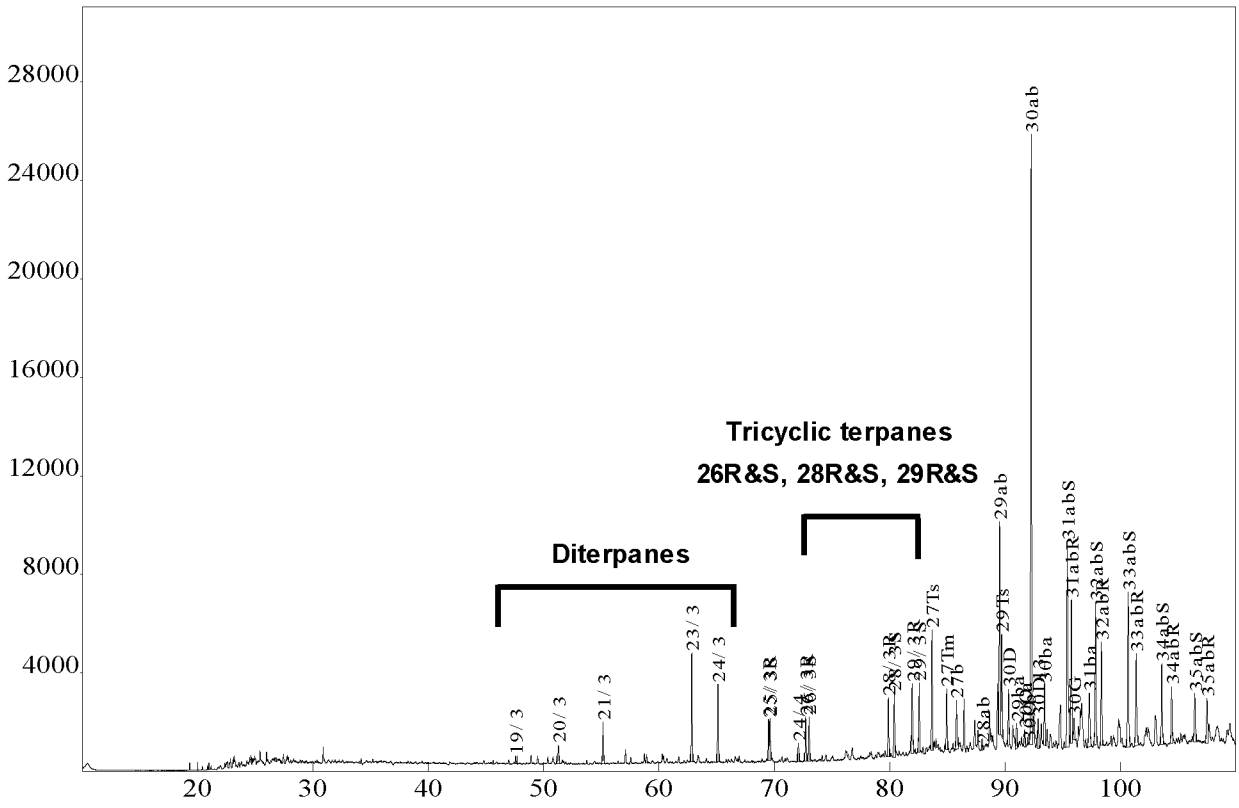

Figure 4-9: m/z=191 MSD- massfragmentograms of saturate fraction of MDT-oil from 1184.5mRKB

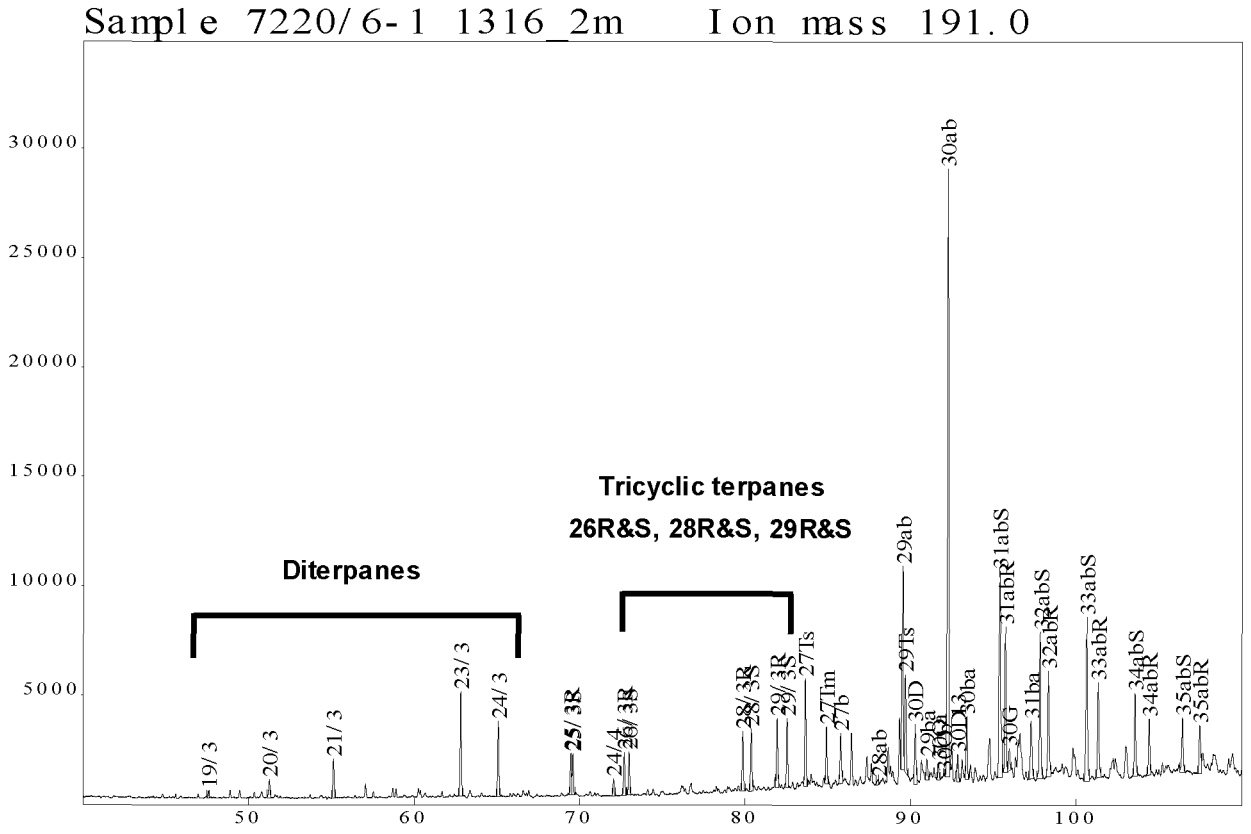

Figure 4-10:m/z=191 MSD- massfragmentograms of saturate fraction of SWC from 1316.2 mRKB

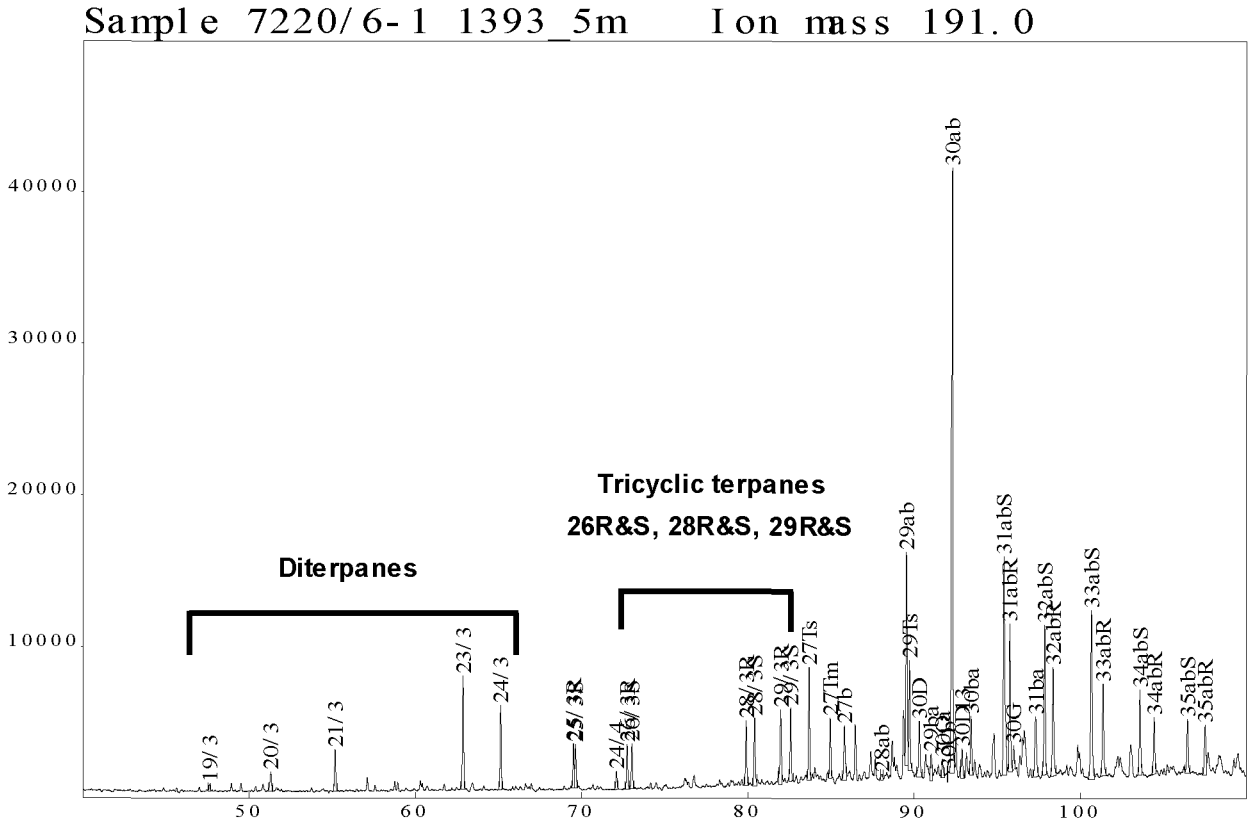

Figure 4-11:m/z=191 MSD- massfragmentograms of saturate fraction of SWC from 1393.5 mRKB

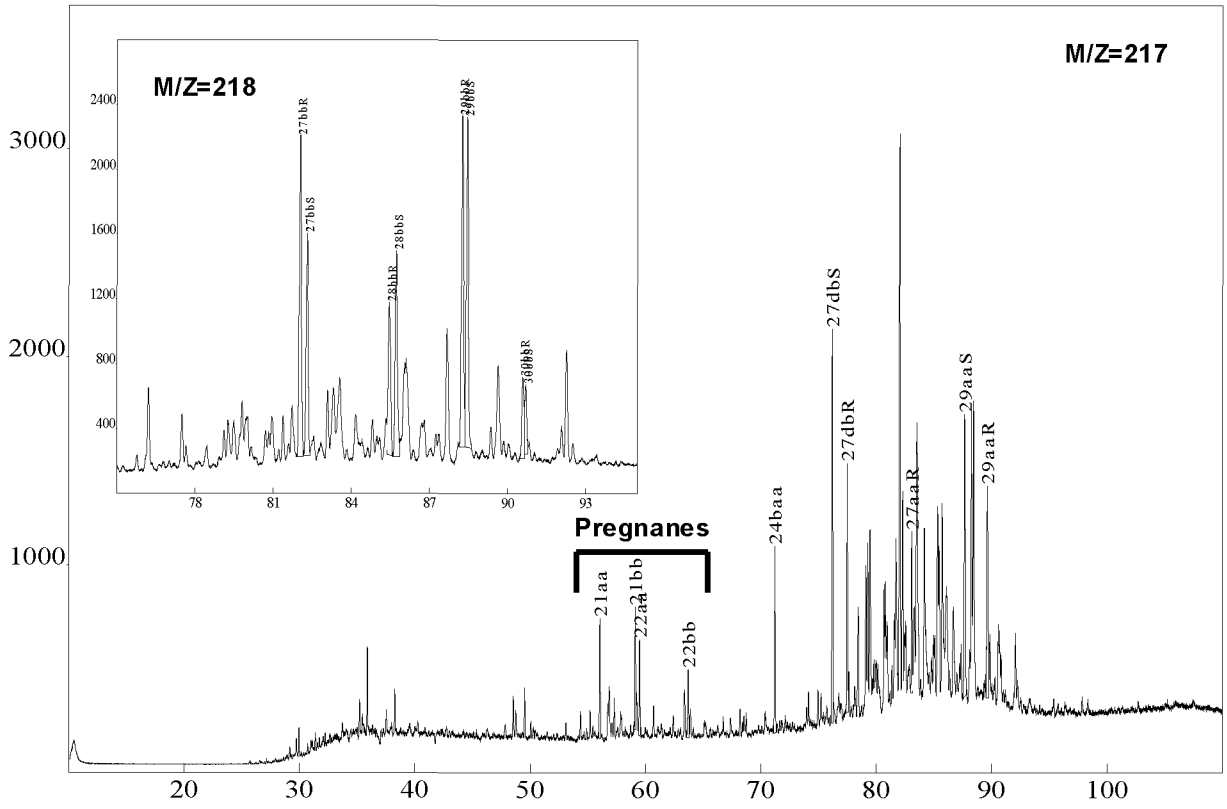

Figure 4-12:m/z=217 and m/z=218 MSD- fragmentograms of sat. fraction of MDT-oil from 1184.5mRKB

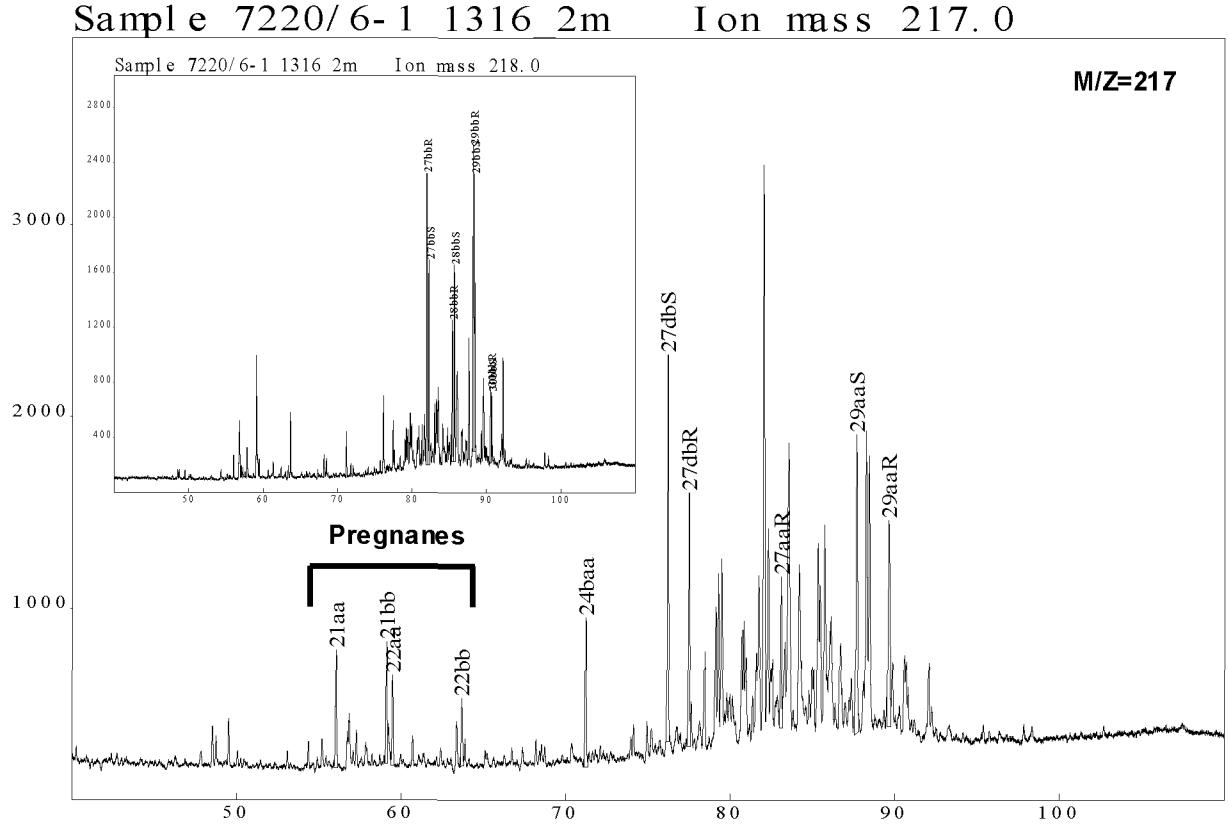

Figure 4-13:m/z=217 and m/z=218 MSD- fragmentograms of sat. fraction of SWC from 1316.2 mRKB

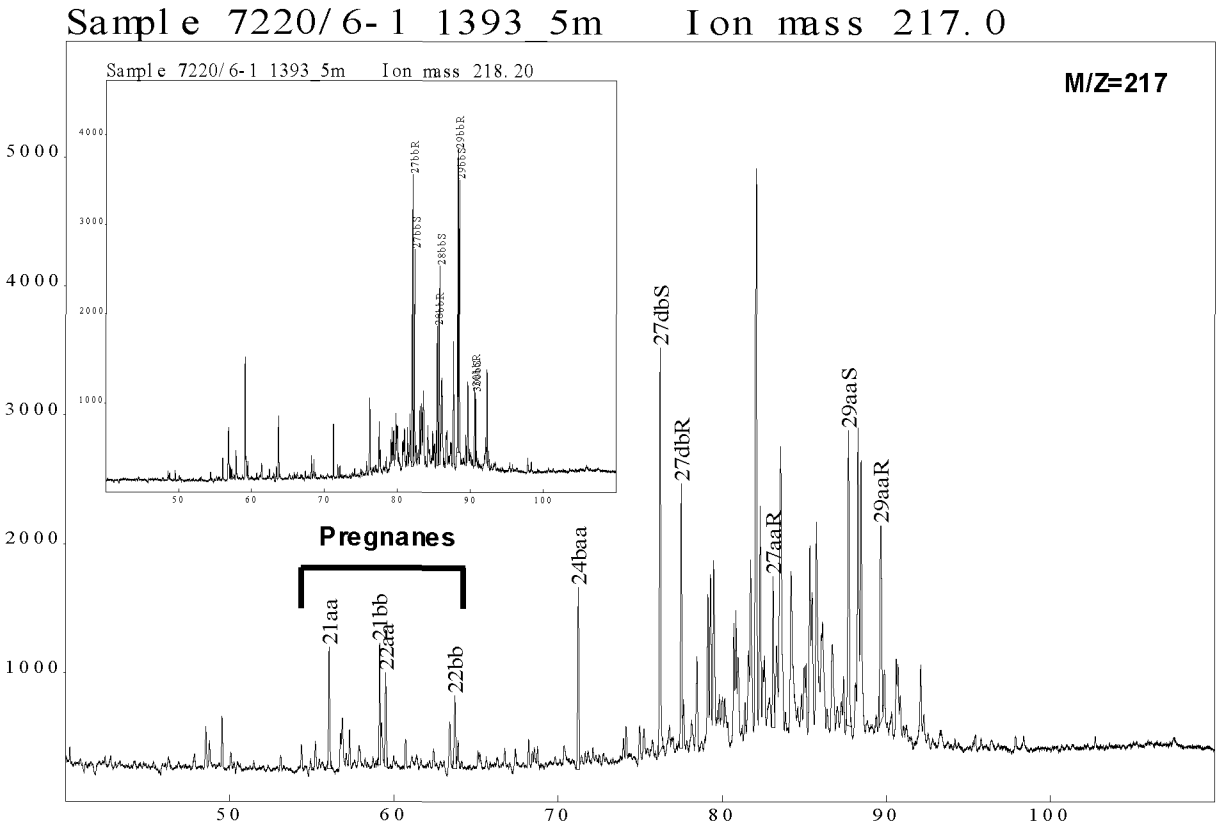

Figure 4-14:m/z=217 and m/z=218 MSD- fragmentograms of sat. fraction of SWC from 1393.5 mRKB

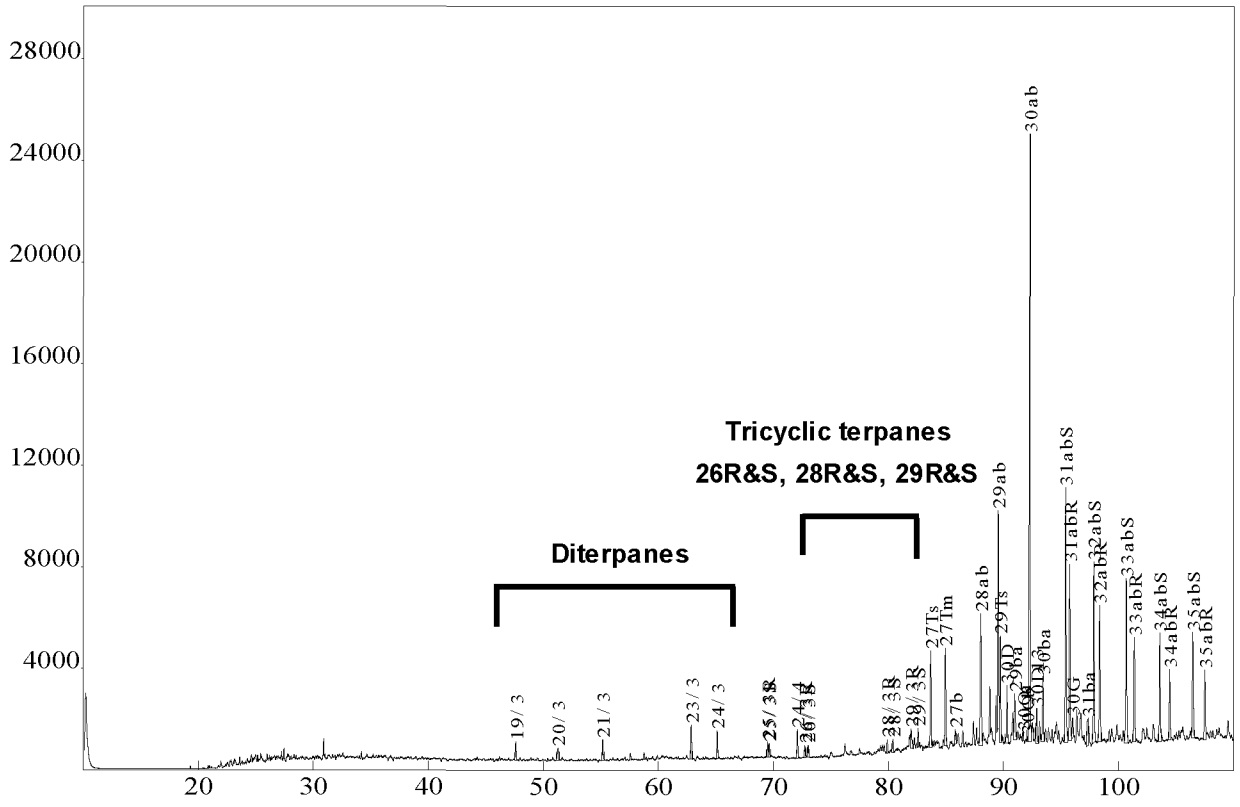

Figure 4-15:m/z=191 MSD- massfragmentograms of saturate fraction of NSO1 oil

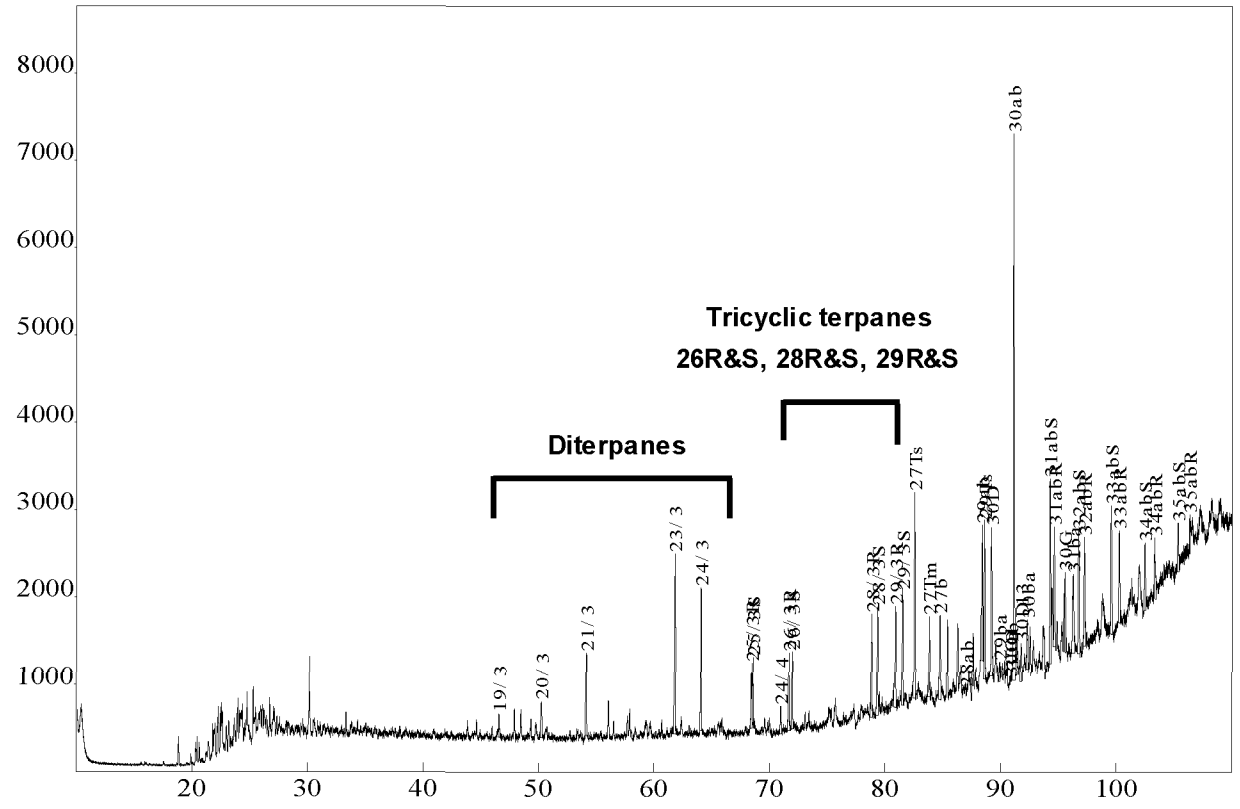

Figure 4-16:m/z=191 MSD- massfragmentograms of saturate fraction of DST4- oil, well 7120/2-1

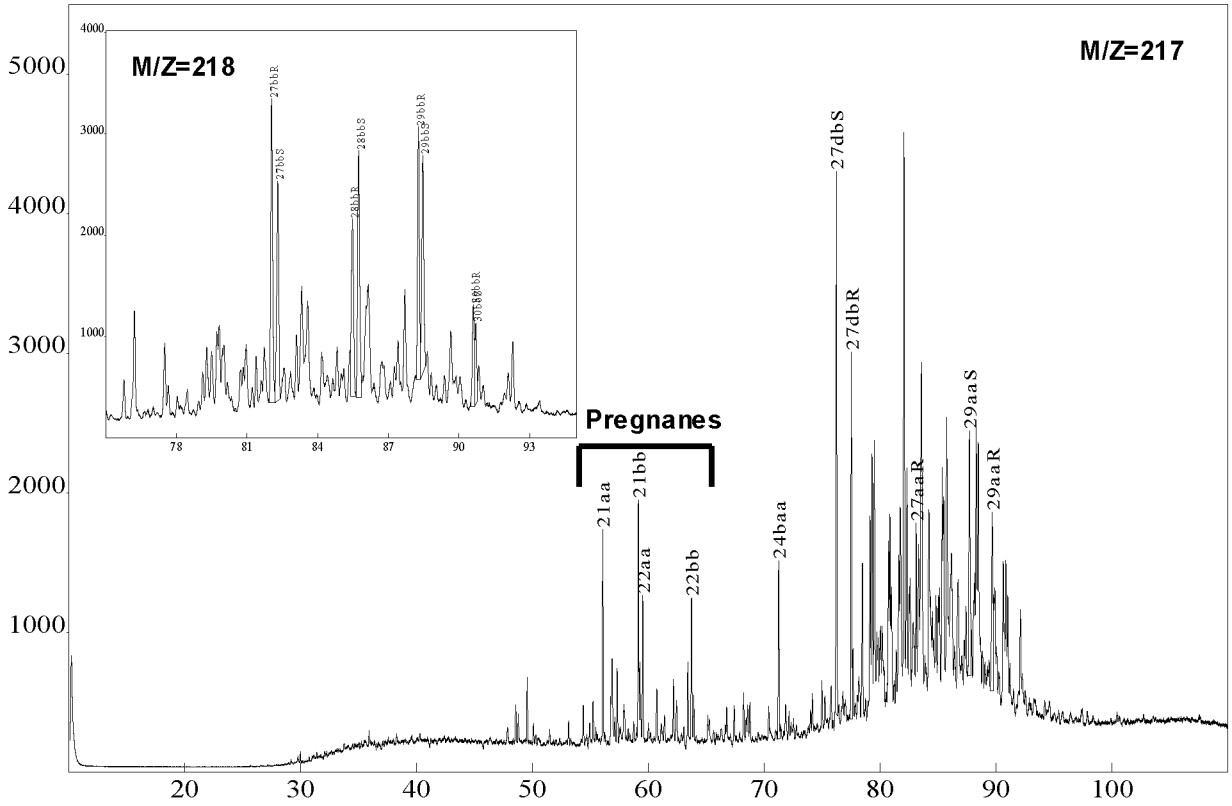

Figure 4-17:m/z=217 and m/z=218 MSD- fragmentograms of sat. fraction of NSO1 oil

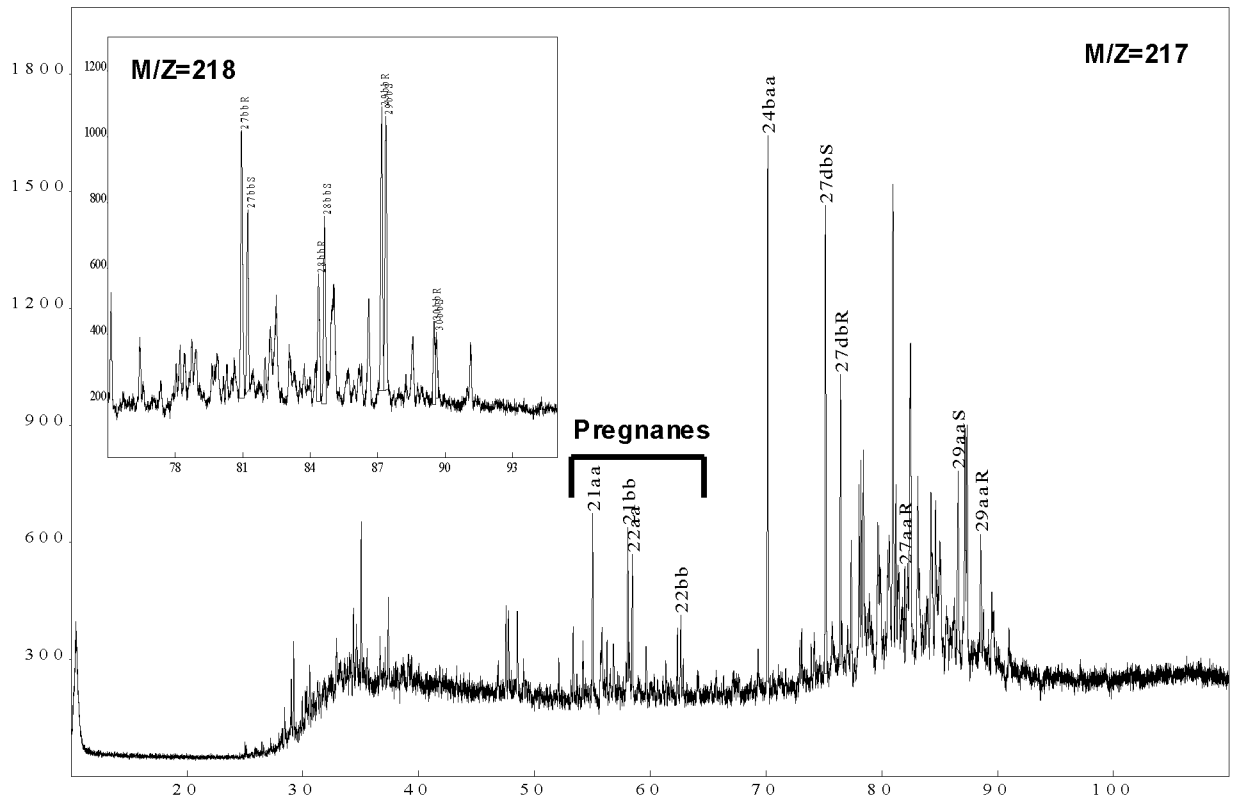

Figure 4-18:m/z=217 and m/z=218 MSD- fragmentograms of sat. fraction of DST4- oil, well 7120/2-1

4.5 Delta 13C- analysis of EOM- fractions

Delta 13C- isotope values of EOM- fractions of the Obelix- oils have been analysed by APT, Kjeller. The results are shown in Table 4-3.

Well	Samples	EOM (o/oo)	Saturate (o/oo)	Aromatic (o/oo)	NSO (o/oo)	Asphaltenes (o/oo)
7220/6-1 (Obelix)	MDT 1184,5m		-31,3	-31,0	-30,7	-29,6
	SWC 1316,2m	-31,2	-31,4	-30,9	-30,5	-29,4
	SWC 1393,5m	-31,1	-31,4	-30,8	-30,7	-30,6
7120/2-1 (Senilix)	DST4 1944-2031m		-31,4	-30,6		

Table 4-3: Delta 13C- values of EOM fractions of Obelix MDT- oil and SWCs at 1316.2 mRKB and 1393.5 mRKB

6 SOURCE ROCK SCREENING

GR- interval (mD)		Sample	Sample interval (mD)		Tmax (oC)	TOC (%)	S1 (kg/t)	S2 (kg/t)	S3 (kg/t)	HI
1183	1186	COCH	1183,90	1183,90	412	0,69	0,54	0,72	0,67	104
1224	1228	DC	1225	1227	401	0,35	1,12	0,88	0,88	251
1444	1453	DC	1444	1447	*	0,27	0,07	0,09	0,67	33

Table 6-1: Rock Eval pyrolysis of samples from intervals of high gammay responses

Sample type	Lower depth (m)	APT ID	Sample prep.	Lithology	Ro (%)	Std. dev.	No. of meas.	Quality rating	Overall quality
DC	500	26351	HF	clyst/sst	0,23	0,03	14	-oo--o	P
DC	530	26352	HF	clyst	0,31	0,06	28	ooo--o	M
DC	560	26353	HF	clyst	0,33	0,05	19	ooo--o	M
DC	590	26354	HF	clyst	0,34	0,04	15	-oo--o	M
DC	610	26355	HF	clyst	0,35	0,06	23	ooo--o	M/G
DC	650	26356	HF	clyst	0,42	0,05	20	ooo--o	M/G
DC	680	26357	HF	clyst	0,47	0,07	23	ooo--o	M/G
DC	700	26358	HF	clyst	0,44	0,05	21	ooo-oo	M/G
DC	730	26359	HF	clys/sst	0,44	0,05	20	ooo-oo	M/G
DC	740	26360	HF	clyst/sst	0,46	0,05	21	ooo-oo	G
DC	770	26361	HF	clyst/sst	0,44	0,06	21	ooo-oo	M
DC	790	26362	HF	clyst	0,42	0,06	22	ooo-oo	M
DC	840	26363	HF	clyst	0,50	0,07	21	ooo-oo	M
DC	860	26364	HF	clyst	0,45	0,08	23	ooo-oo	M
DC	890	26365	HF	clyst/sst	0,48	0,07	20	ooo--o	M
DC	910	26366	HF	clyst/sst	0,50	0,07	20	ooo--o	M
DC	930	26367	HF	clyst/sst	0,52	0,07	21	ooo--o	M
DC	950	26368	HF	clyst	0,48	0,06	20	ooo--o	M
DC	990	26369	HF	clyst	0,49	0,06	22	ooo--o	M
DC	1000	26370	HF	clyst	0,52	0,06	21	ooo--o	M
DC	1020	26371	HF	clyst	0,51	0,06	21	ooo--o	M
DC	1040	26372	HF	clyst	0,53	0,06	20	ooo--o	M
DC	1060	26373	HF	clyst	0,55	0,06	20	ooo--o	M
DC	1080	26374	HF	clyst	0,54	0,06	16	-oo--o	M
DC	1100	26375	HF	clyst	0,56	0,05	20	ooo-o+	M
DC	1130	26376	HF	clyst	0,57	0,06	20	ooo--+	M
COCH	1184	26377	HF	clyst	0,51	0,05	6	-oo-o+	P
DC	1220	26378	HF	clyst/lst	barren				
DC	1227	26379	HF	clyst/lst	0,57	0,06	5	-oo-oo	P
DC	1232	26380	HF	clyst	0,55	0,19	2	-±±-o+	barren
DC	1275	26381	HF	clyst	barren				
DC	1282	26382	HF	clyst	barren				
DC	1295	26383	HF	clyst	0,54	0	1	-oo-oo	P
DC	1315	26384	HF	clyst	barren				
DC	1335	26385	HF	clyst	0,58	0,06	6	-oo-o+	P
DC	1352	26386	HF	clyst	0,61	0,05	4	-oo-oo	P
DC	1382	26387	HF	clyst	0,52	0,03	6	-oo--o	P
DC	1397	26388	HF	clyst	0,59	0,06	7	-±o--o	P
DC	1412	26389	HF	clyst	0,61	0,06	13	-oo--o	M
DC	1440	26390	HF	clyst	barren				
DC	1452	26391	HF	clyst	0,47	0,03	4	-o--oo	P
DC	1477	26392	HF	clyst/lst	barren				
DC	1500	26393	HF	clyst/lst	0,54	0,08	2	-±±-oo	P
DC	1525	26394	HF	clyst/lst	0,56	0,01	3	-oo--o	P

Table 7-1 Vitrinite reflectance in samples from well 7220/6-1. Data contained by red frames are probably representing measurements on primary vitrinite in sediments