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REPORT TITLE/ TITTEL

COMPARISON OF WELLS 7120/8-1 and 7120/8-2

CLIENT/ OPPDRAGSGIVER

Statoil

RESPONSIBLE SCIENTIST/ PROSJEKTANSVARLIG

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SUMMARY/ SAMMENDRAG

There are many similarities in the organic facies of the two wells. A fairly close correlation can be made with TOC data and saturated hydrocarbon gas chromatogram traces. This allows a division into seven zones. The pyrolysis data is less amenable to comparison, since experimental conditions used by the two laboratories are quite different. However, kerogen types, for zones 4 and 5-7, which correspond fairly closely to the Lower Cretaceous and Jurassic sequences respectively, are comparable. Zones 4 and 6 and 7 contain type III kerogen, and zone 5 (the Upper Jurassic) type III and mixed type II/III kerogen.

KEY WORDS/ STIKKORD

Lithology/TOC | Pyrolysis

Saturated Hydrocarbons | Comparison

Skipnes Offsettrykkeri A/S

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Zone 6. 2095 - 2270m. (7120/8-1)
2085 - 2200m. (7120/8-2)

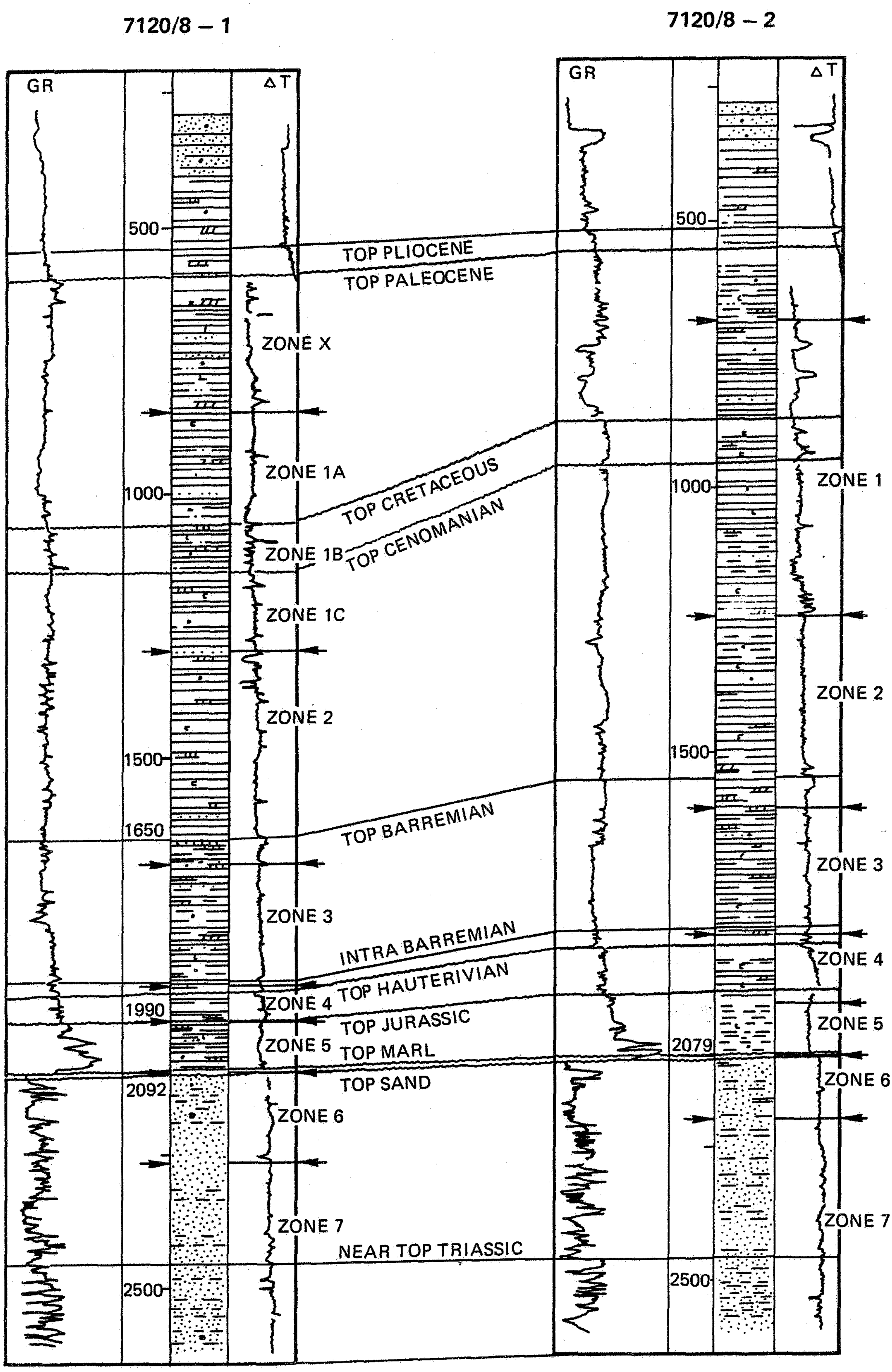
Dark grey to dark brownish-grey silty shales in 7120/8-1 and dark grey claystones in 7120/8-2 are found in this zone. TOC values vary from 4-7% in 7120/8-1 and from 2-4% in 7120/8-2. In both wells sandstones dominate, these are fluorescent in ultraviolet light and have a slight whitish cut.

Zone 7. 2270 - 2615m. (7120/8-1)
2200 - 2501m.

Mixed lithology of interbedded sandstones, coaly or carbonaceous shales, coals and siltstones in 7120/8-1, and sandstones, carbonaceous claystones and coals in 7120/8-2. TOC values for the shales/claystones in this section of the two wells varies from 3-40% in 7120/8-1 and from 2-10% in 7120/8-2. The extreme variations in TOC values are probably due to variable amounts of coal stringers and veins in the shales/claystones.

Sandstones show yellow fluorescence in ultra-violet light and both sandstones and carbonaceous claystones show a cut (milky in 7120/8-1, yellow-white in 7120/8-2).

Figure 1.


7120/8 – 1
7120/8 – 2
GR
ΔT
500
1000
1500
1650
1990
2092
2500
2079
TOP PLIOCENE
TOP PALEOCENE
ZONE X
ZONE 1A
TOP CRETACEOUS
TOP CENOMANIAN
ZONE 1B
ZONE 1C
ZONE 2
TOP BARREMIAN
ZONE 3
INTRA BARREMIAN
TOP HAUTERIVIAN
ZONE 4
TOP JURASSIC
ZONE 5
TOP MARL
TOP SAND
ZONE 6
ZONE 7
NEAR TOP TRIASSIC
ZONE 1

MATURITY

Thermal Alteration Index

Staplins colour scale is used at IKU and is presumed to be the one used in the other report. The range of values observed in both wells is from 1+ to 2- indicating a range from immature to moderate mature.

The change to moderate maturity occurs approximately in zone 7 of 7120/8-1 (at 2300m approximately) and indicated to be in zone 4 of 7120/8-2 (at 1400m approximately).

Vitrinite Reflectance Data

In 7120/8-1 the high values in the vitrinite populations above 2000 metres (> 0.5% Ro) are probably due to measurements on reworked organic material. The low values between 2200 - 2500 metres (<0.4%) are probably due to heavy bitumen staining particularly in zones 5 and 7. The analysed sequence is within the top part of the oil window below 2300 metres and moderate mature - early mature between 1300m and 2300m.

In 7120/8-2 the sequence is moderate mature - early mature between 1000 and 2200 metres approximately and within the top of the oil window below 2200 metres.

Kerogen Composition

Examination in Transmitted Light

There are two major differences in the visual kerogen data of the two wells. In zones 4 and 5 of 7120/8-1 the major organic residues contain abundant algal/amorphous material (whereas in the same zones in 7120/8-2 cuticles appear to be dominant). This appears to contradict the pyrolysis data (see pyrolysis discussion) where the kerogens are mostly type III in 7120/8-1 (type III and mixed type II/III in 7120/8-2). However the description "amorphous" tends to be rather vague. In zones 4 and 5 of 7120/8-2 the Rock-Eval and visual kerogen data plus information from the pyrolysis - gas chromatograms and extraction data indicates that the kerogens have a large terrestrial input - probably of cuticles and spores and pollen. This possibly also applies to 7120/8-1, (this problem could, perhaps, be solved by having Rock-Eval pyrolysis performed on samples from 7120/8-1).

Kerogen type

Pyrolysis

When an attempt is made to correlate the pyrolysis results from the two wells we run into two problems:

i) The difficulties in making a direct comparison between data from screening pyrolysis techniques other than Rock-Eval and the Rock-Eval pyrolysis data. Perhaps if samples were pyrolysed using both instruments then a comparison can be made.

ii) Similar to a) Difficulties in comparison of pyrolysis-gas chromatograms from different laboratories without knowing the conditions used in pyrolysis.

a) Screening Pyrolysis

For 7120/8-1 we have calculated approximate Rock-Eval equivalents for S1, S2, hydrogen indices, petroleum potential and production indices based on the pyrolysis values given, these are shown in table 1 in the appendix.

In zone 1 of 7120/8-1 grey mudstones between 850-1045 metres (and above 850 metres in zone x) have hydrogen indices which indicate mixed type II/III or even type II kerogens. Rock-Eval data for the approximate equivalent section in 7120/8-2 (grey claystones from 700-1000 metres) have type III kerogens, but the high oxygen indices (not carbonates) suggest poor type III kerogen at best.

The high S2 values in zone 1 of 7120/8-1 may be due to the pyrolysis conditions employed (i.e. the S2 peak might include more asphaltic material than would be found in the Rock-Eval S2 of the same samples). In 7120/8-1, visual kerogen data suggests that kerogens consist mostly of amorphous material plus herbaceous material and inertinites above 700 metres. Between 700-1045 metres, kerogens mostly consist of inertinites and woody material, which does not fit in well with a mixed type II/III or type II for this section. Visual kerogen analysis of one sample from 7120/8-2 in zone 1 indicates mostly woody and reworked woody material, supporting the Rock-Eval pyrolysis data which indicates mostly type IV kerogen for zone 1, except perhaps for the section from 700-1000 metres where there is some type III kerogen. It is probable that zone 1 in 7120/8-1 is the same as in 7120/8-2. Petroleum potentials for this zone in both wells suggest poor potential for gas except for the upper sections of the zone as discussed above.

In zone 2 of 7120/8-1 type III kerogens dominate, however, from 1570-1690 metres, calculated hydrogen indices indicate mixed type II/III kerogens; The whole of zone 2 in 7120/8-2 consists of type IV kerogen; a conclusion which is backed up by the visual kerogen analysis (mostly woody and reworked woody material). Again it is possible that the S2 values are high in 7120/8-1 due to material remaining with the kerogen instead of being removed during thermal extraction of the soluble material for the S1 peak.

In zones 3 and 4 the calculated hydrogen indices for 7120/8-1 indicate type III kerogens (hydrogen indices of 40-126), whereas in 7120/8-2 the Rock-Eval combined hydrogen and oxygen indices indicate mostly type IV or poor type III kerogens at best (hydrogen indices 12-150, oxygen indices 46-723) from 1605-1950 metres. In 7120/8-2 below 1950 metres and into zone 5, there appears to be a gradual increase in the hydrogen indices changing from type III to mixed type II/III (90 - 291). In 7120/8-1 there is a slight change from type III kerogens (hydrogen indices 75-180) in zone 4, to type III kerogen and mixed type II/III kerogens (hydrogen indices 66-247) in zone 5.

In zone 5 of 7120/8-2 which contains the organic-rich claystones, Rock-Eval data indicates mostly mixed type II/III kerogens between 2000 and 2085 metres, with good-rich potentials for gas and oil. In zone 5 of 7120/8-1 the calculated hydrogen indices suggest mostly type III kerogen with one sample from 2005-2020m of probable mixed type II/III kerogen, which indicates mainly fair to good source potential for gas and perhaps minor oil.

In zones 6 and 7 in both wells there are carbonaceous shales/claystones and coals which from the Rock-Eval data contain type III kerogens with a good-rich potential for gas only.

Pyrolysis - gas chromatography

The maturity data indicates that oil window maturity is reached in the bottom zone of the wells (such that the coals have begun to yield gas). However, there are indications of oil staining in the main source rock section (zone 5) and in sandstones below this. This material has probably migrated from a sequence where zones 5-7 (the Jurassic sequence) has reached peak oil generation. This migrated material will have considerable effects on the Rock-Eval production indices and on pyrolysis gas chromatograms done on unextracted whole rock powder.

A technique of thermal evaporation or extraction (equivalent to extraction) was employed before pyrolysis for samples from the 7120/8-2 well. Thermal extractiongas chromatograms were obtained for each sample. These chromatograms can be considered to represent the total soluble material in a rock sample. A pyrolysis-gas chromatogram (or pyrogram for short) was then obtained of the insoluble organic material or kerogen. Examples of the two different types of gas chromatograms for 7120/8-2 are shown in figure 2a and 2b. The peak marked S1 on the gas chromatograms is the same as the Rock-Eval S1 peak (roughly) and indicates by its size (area) the abundance (approximately 100 milligram of sample is used). The gas chromatogram follows the S1 peak. The S2 peak which represents the abundance of the kerogen pyrolysate (equivalent to the Rock-Eval S2) is followed by the gas chromatogram of that peak.

Comparable pyrogram from 7120/8-1 to the pyrogram in figure 2a is shown in figure 3. The pyrograms of 7120/8-1 have been done on whole rock and they appear to be similar to the thermal extracts of 7120/8-2, since the bulk of the material in many samples from 7120/8-1 which were pyrolysed has a retention time less than nC_{20}. A large part of this material could probably be thermally extracted. Figure 4 shows a thermal extraction gas chromatogram for a sample from zone 3 of 7120/8-2. This can be compared with the pyrogram for the same sample in figure 8. S1 peak area is not much less than the S2 peak area and in this case the pyrogram trace would have been masked by the thermally extractable material if a whole rock pyrolysis-gas chromatogram had been done.

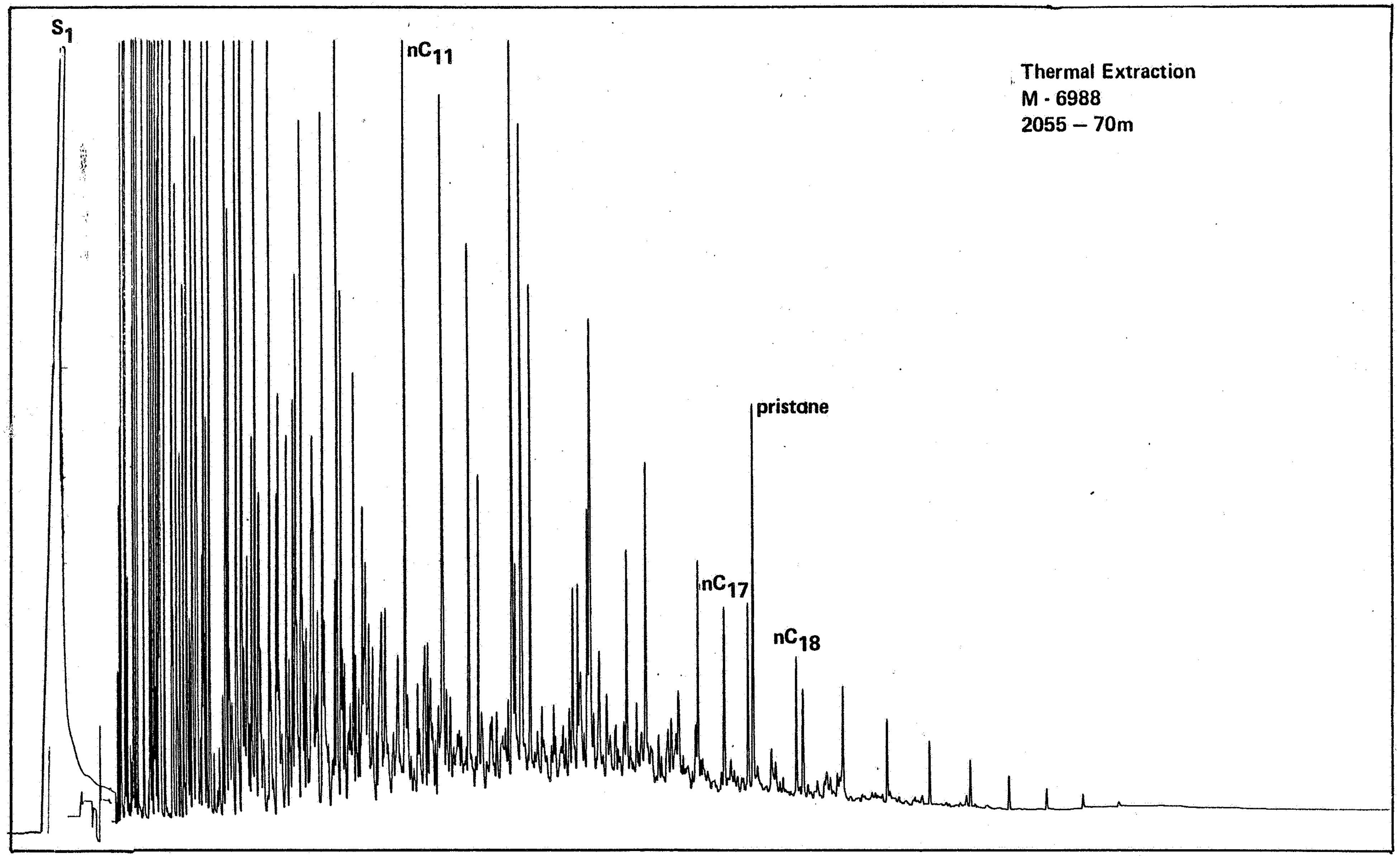


Figure 2a Thermal extraction gas chromatogram of a sample from zone 5 of 7120/8–2

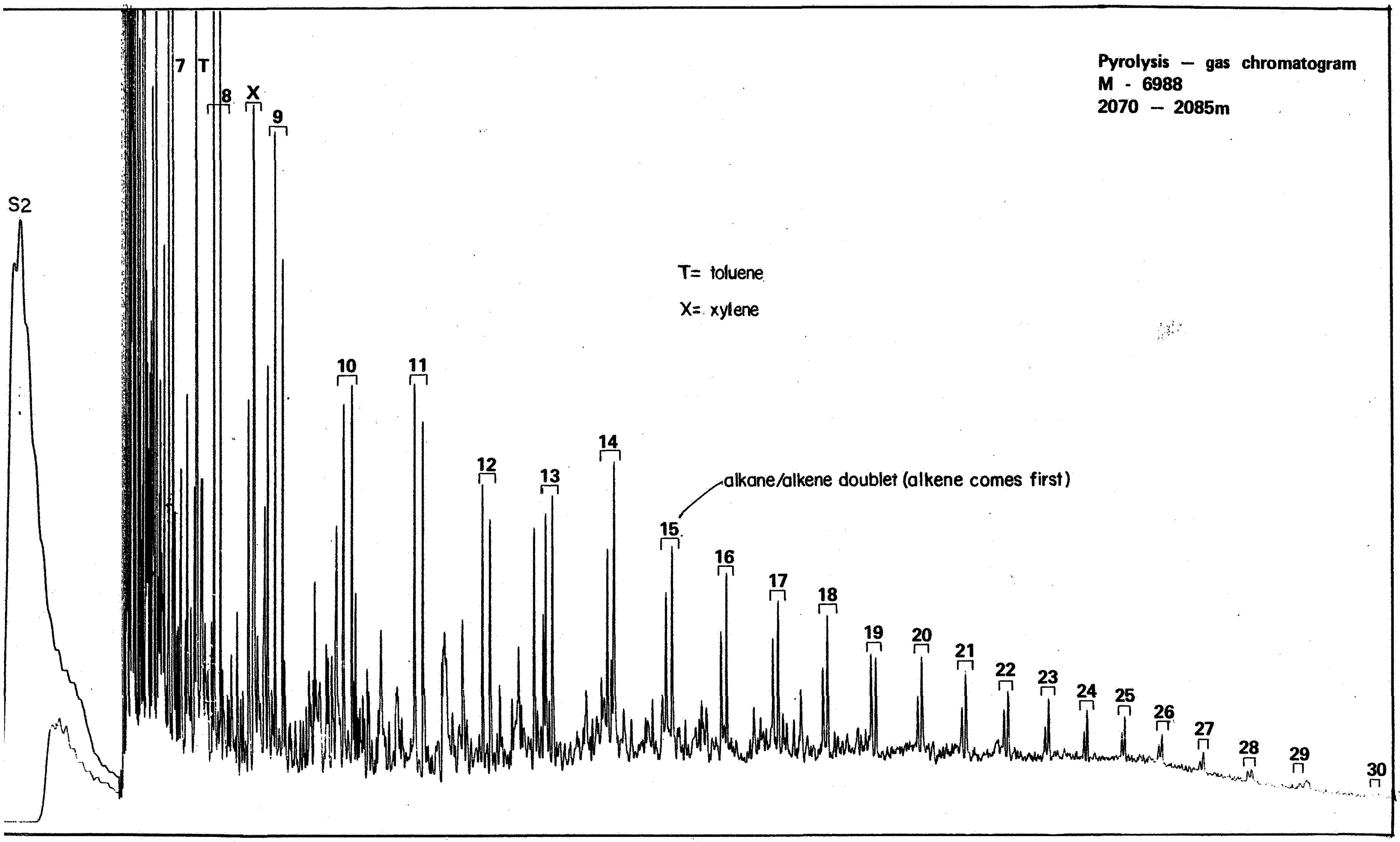


Figure 2b Pyrogram of sdmple from zone 5 of 7120/8-2

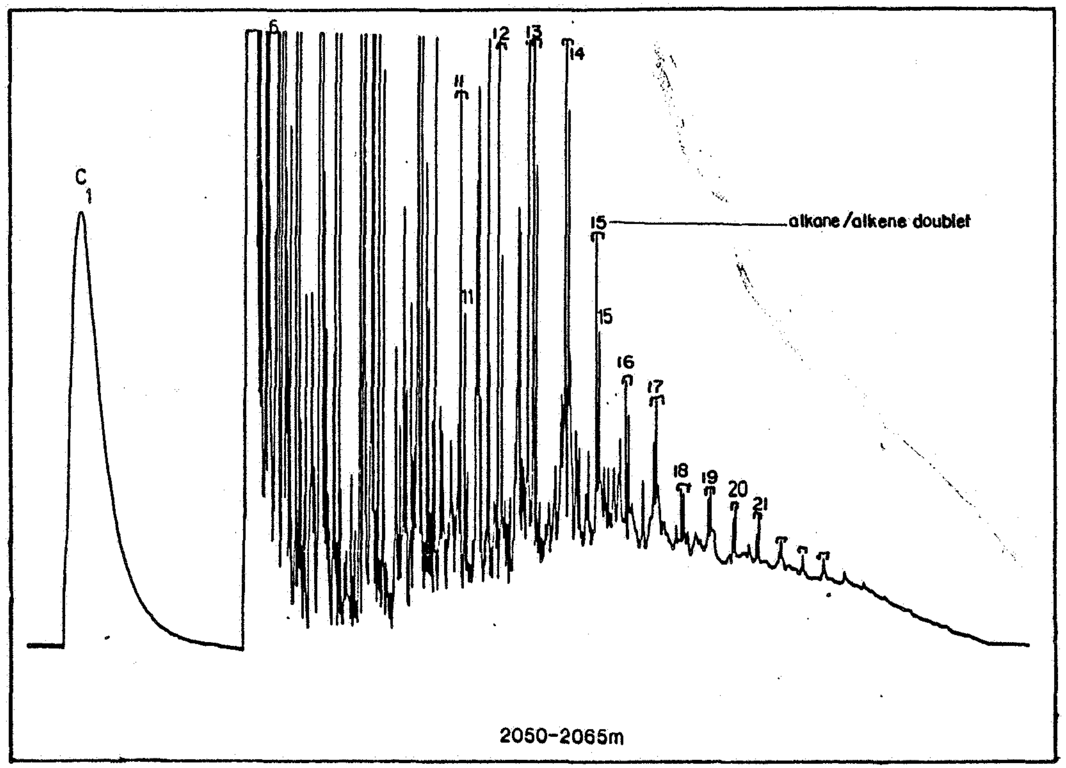


Figure 3. Pyrogram of sample from zone 5 of 7120/8-1

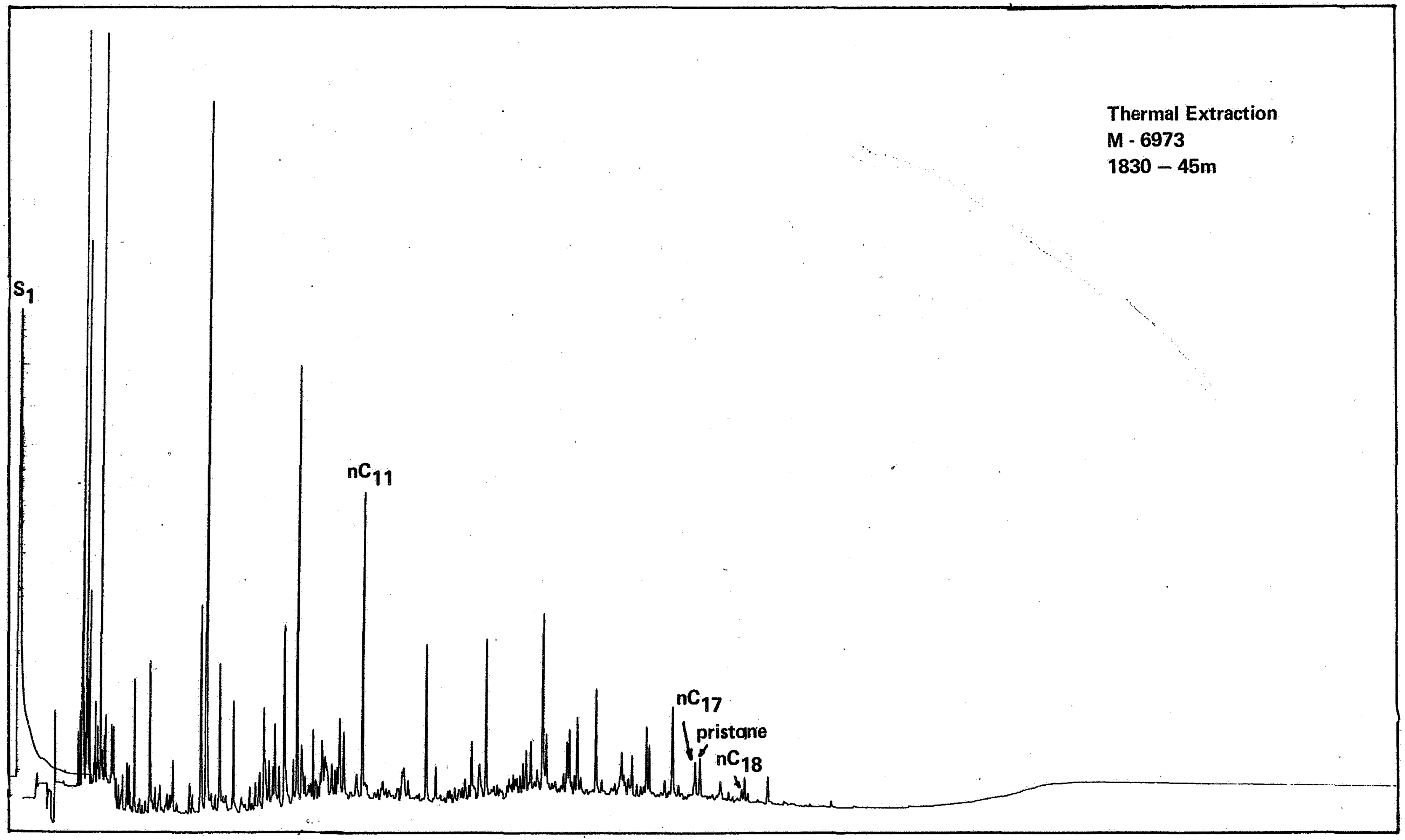


Figure 4 Thermal extraction gas chromatogram of a sample from zone 3 of 7120/8-2

Pyrograms of two of the cuttings samples from the promising source rock (zone 5) sequence of 7120/8-1, show some similarity to the pyrograms obtained for zone 5 in 7120/8-2. Thus a prominent n-alkane/alkene homology is developed up to at least nC_{25} (figures 5 and 6 from 7120/8-1 and 7120/8-2).

The difference between the pyrograms from the cuttings (figures 5 and 6) and the sidewall cores (figure 7) in zone 5 of 7120/8-1 is difficult to explain. Two possibilities (at least) can be suggested:

a) The kerogen in the sidewall cores is poorer in straight chain material than is general for the section.

b) Migrated hydrocarbons (capable of thermal extraction) mask the kerogen pyrolysis products.

Generally the pyrograms of zones 1-4 in 7120/8-1 (eg. figure 8) appear to consist of much material with a shorter retention time than nC_{20}. In the same zones for 7120/8-2 the pyrograms (e.g. figure 8) are characteristic for kerogens with a poor hydrocarbon potential producing mostly aromatic hydrocarbons and heterocyclic, compounds, unlike the promising source rock section (zone 5) which shows an abundance of straight chain material up to C_{30} (figures 5 and 6).

Carbonaceous claystones/shales and coals from both wells, which were pyrolysed (figure 9), show certain similarities although, again, thermally extractable material appears to mask the pyrogram patterns in the samples from 7120/8-1. However, in pyrogram of the carbonaceous claystones from 7120/8-1, abundant material occurs above nC_{20}, mostly in the form of an unresolved hump (marked U.H.), but also n-alkanes above nC_{20}. Where n-alkanes (the second of the n-alkane/alkene doublet see figures 3, 5 and 6) are much more abundant than the alkene, then the origin of the alkanes is probably not from a polymer requiring carbon-carbon bond cleavage, but from material with relatively weak bonding i.e. to a heterocyclic group or from free hydrocarbons or acids. In this case the n-alkanes in the carbonaceous claystones are probably derived from plant wax sources. In zone 5 (figures 5 and 6), the peak heights of alkanes and alkenes are approximately equal and in this zone the material is probably derived from some biopolymer such as sporopollenin or cutin, found in spores and pollen and cuticles.

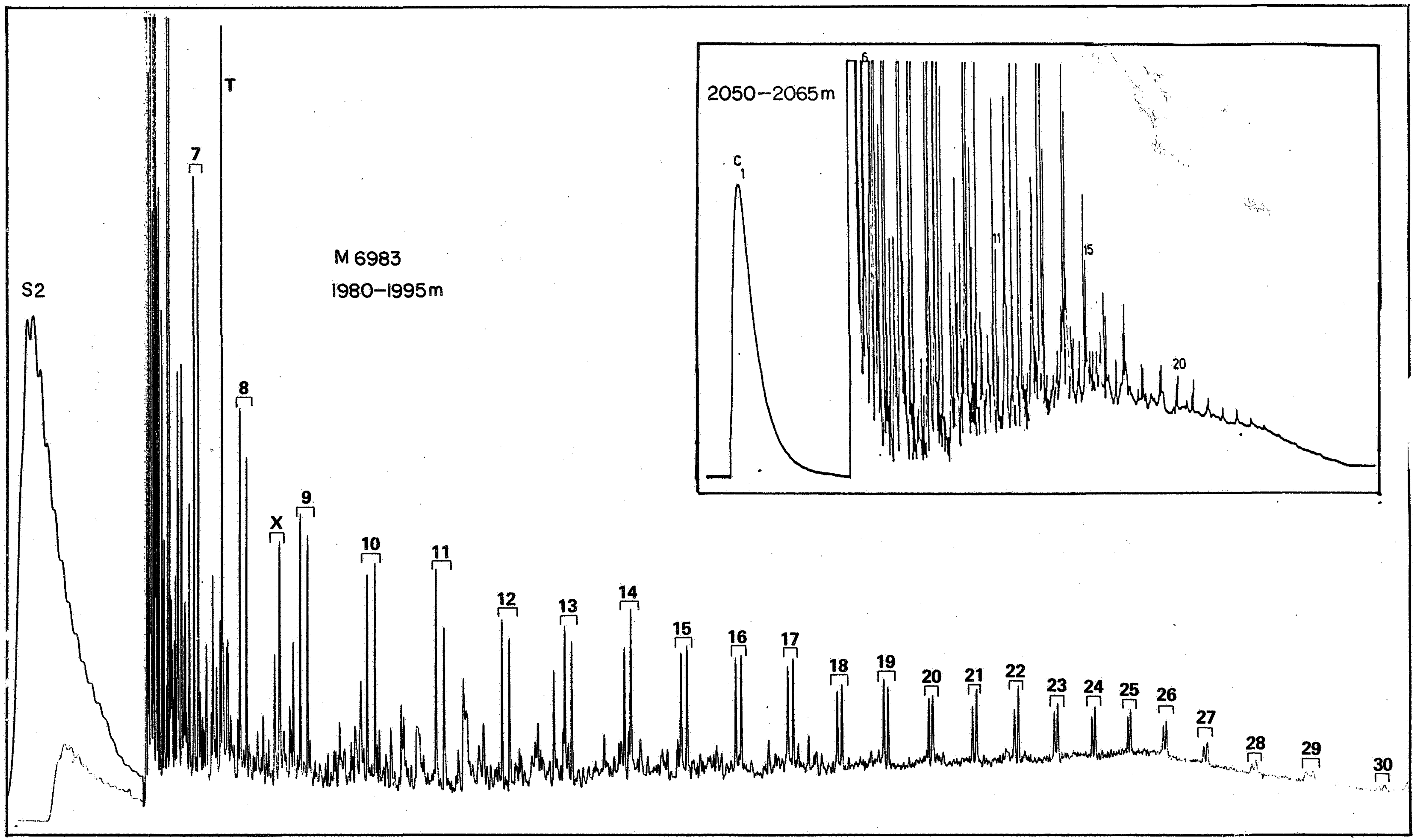


Figure 5 Pyrolysis-gas chromatograms from zone 5 (Upper Jurassic) of 7120/8–1 (inset) and 7120/8–2

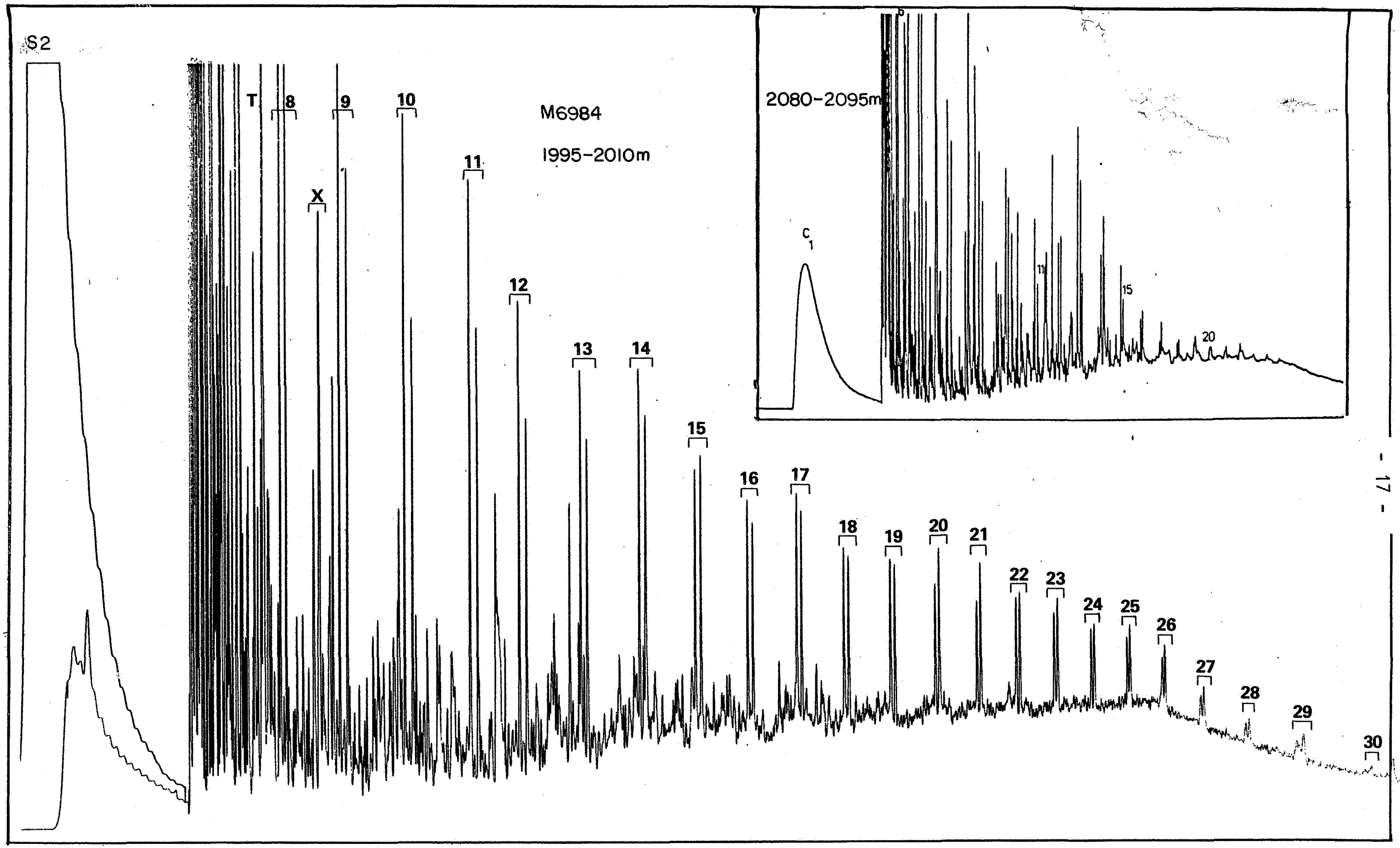


Figure 6 Pyrolysis-gas chromatograms from zone 5 (Upper Jurassic) of 7120/8-1 (inset) and 7120/8-2

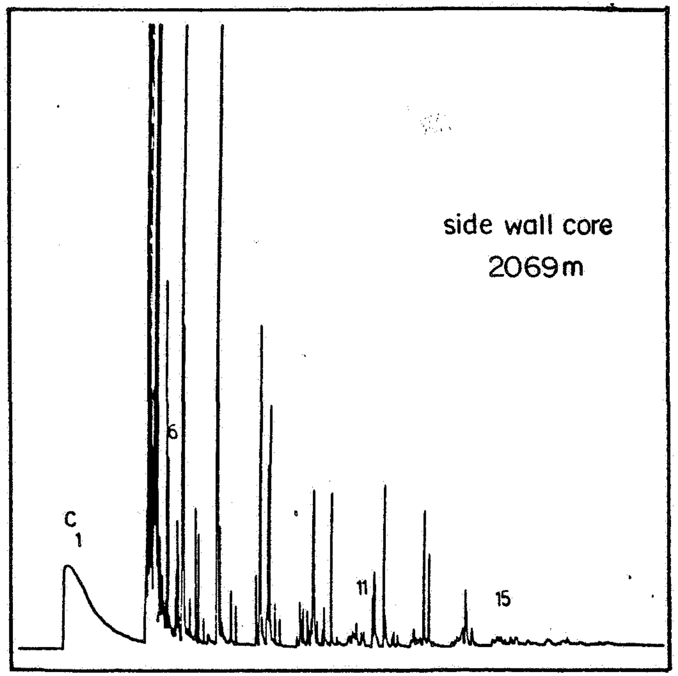


Figure 7 Pyrolysis–gas chromatogram of a side wall core sample from zone 5 of 7120/8–1

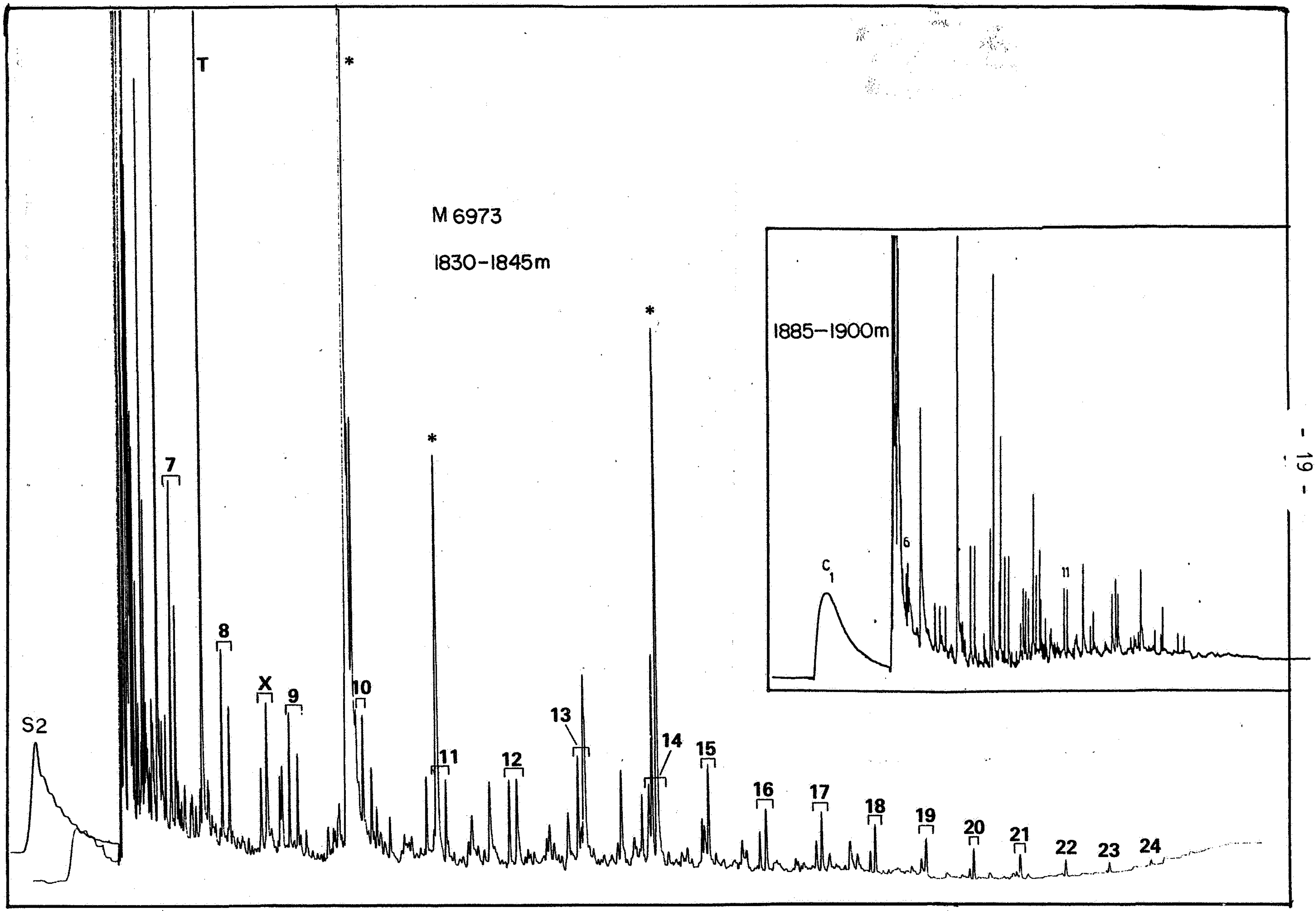


Figure 8 Pyrolysis-gas chromatograms of zone 3 (Barremian) of 7120/8-1 (inset) and 7120/8-2

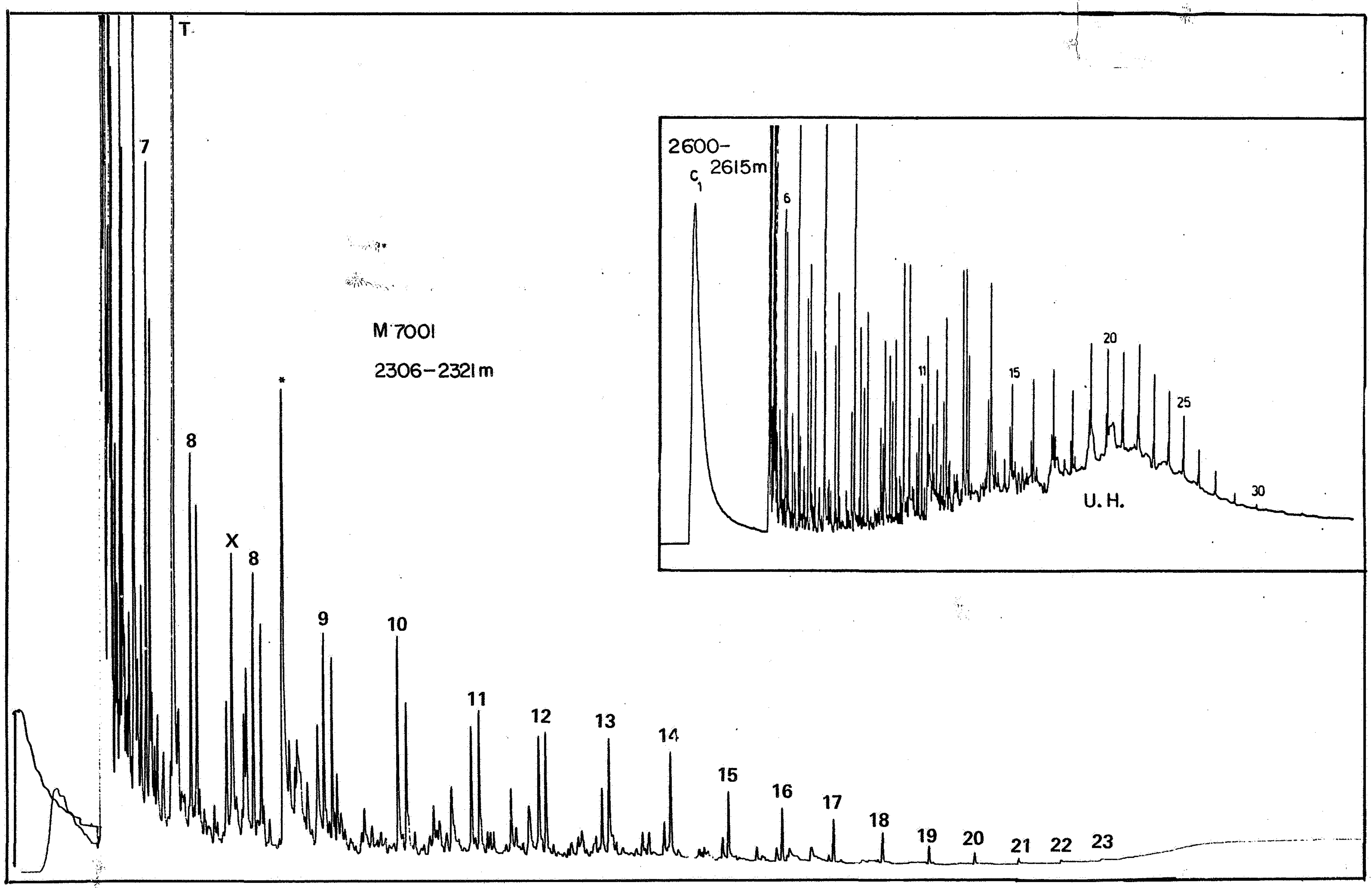


Figure 9 Pyrolysis-gas chromatograms of carbonaceous claystones from zone 7 of 7120/8-1 (inset) and 7120/8-2

Light Hydrocarbon Data

Most of the trends seen in the two wells are similar. Thus towards the base of zone 1 in both wells C_5+ hydrocarbon abundances are good and increasing percentage wetness towards the base of zone. In zone 2, C_5+ hydrocarbon abundances are lower than in zone 1 (only the lower half of zone 1 in 7120/8-1). In zone 3, C_5+ hydrocarbons increase and good abundances are seen in siltstones in 7120/8-1 and in sandstones in 7120/8-2.

The limestone in zone 4 of both wells is poor in C_5+ hydrocarbons in both zones. There are good abundances of C_1 - C_4 and C_5+ hydrocarbon in both wells in zone 5 which contains organic-rich silty shales/claystones. The C_1 - C_4 and C_5+ hydrocarbon abundances decrease in zone 6. At the top of zone 7 there is a slight increase in C_5+ hydrocarbons (to fair in 7120/8-1 and good in 7120/8-2) which may mark reservoired hydrocarbons in the sandstone-rich sequence.

C_{15}+ Extraction Data

Comparison of the extraction data and the composition of extractable organic matter (EOM for short) for the two wells is difficult:

a) Because the method of extraction used is different.

b) Pentane is used to remove asphaltenes before fractionation into saturated and aromatic hydrocarbons and NSO compounds.

c) The method of fractionation is not indicated.

However, some general trends can be distinguished, and the saturated hydrocarbon gas chromatograms of the two wells show many similarities in distribution of components.

In zones 1, 2 and 3 the n-alkane distributions of extracted samples from both wells, are generally front-end biased with a maximum occurring between nC_{15} and nC_{17} (fig. 10). These are probably indicative of migrated hydrocarbons in what is an immature sequence containing type III or type IV kerogens. There are some samples below 900 metres in 7120/8-1 (a larger sampling frequency was used on this well) in which in addition to the front-end bias there is a narrow envelope of high molecular weight n-alkanes from nC_{20}-nC_{30} (maximum at nC_{25}) (fig. 11). This distribution is also noticeable in sandstones below 2200 metres, and is probably due to migrated hydrocarbons.

In 7120/8-2 the few samples analysed in zones 1-3 show front-end bias maximum between nC_{14}-nC_{17} (figure 10) with only one sample M-6949 (1470-1485m) having an appreciable, high molecular weight n-alkane component (figure 11). The oil stained limestone sample M-6980 in zone 4 also has a prominent high molecular weight component with a maxima at nC_{18} and nC_{28}.

Pristane/nC_{17} ratios in zones 1-3 of both wells are generally less than 1 and CPI values less than 1.5.

There is a marked change in zones 4 and 5 in both wells where the hydrocarbon distributions become more representative for the indigenous kerogens (figure 12 and 13). There is a broader n-alkane envelope ranging from nC_{15}-nC_{35} with maxima at nC_{15} and nC_{25}, pristane is the dominant alkane (pristane/nC_{17} ratio >2). Also in 7120/8-2 in zone 5 there is more evidence of geochemical fossils (i.e. in the region from nC_{25}-nC_{35}). Pristane/phytane ratios are also noticeably higher in zone 4 indicating perhaps mainly terrestrial material deposited in mildly anoxic environments.

A sandstone analysed in zone 6 of 7120/8-2 shows the same characteristics to one from zone 7 in 7120/8-1, dominated by high molecular weight n-alkanes between nC_{20}-nC_{40} with maximum at nC_{25}-nC_{27} (figure 14). Claystones analysed below zone 5 show front-end n-alkane bias probably due to migrated hydrocarbons (figure 15). The coal in zone 7 of 7120/8-2 which was analysed shows an unusual distribution, with a low CPI and a maximum at nC_{23} (figure 16). This coal was oil stained and gave a yellow cut.

The increased abundance of C_5+ hydrocarbons at the top of zone 7 plus the visible 'cut', plus the large amounts of paraffinic hydrocarbons in sandstones and also in coals and claystones in zones 6 and 7 (particularly zone 7), suggests the presence of reservoired hydrocarbons or at least residual migrated hydrocarbons in these two zones.

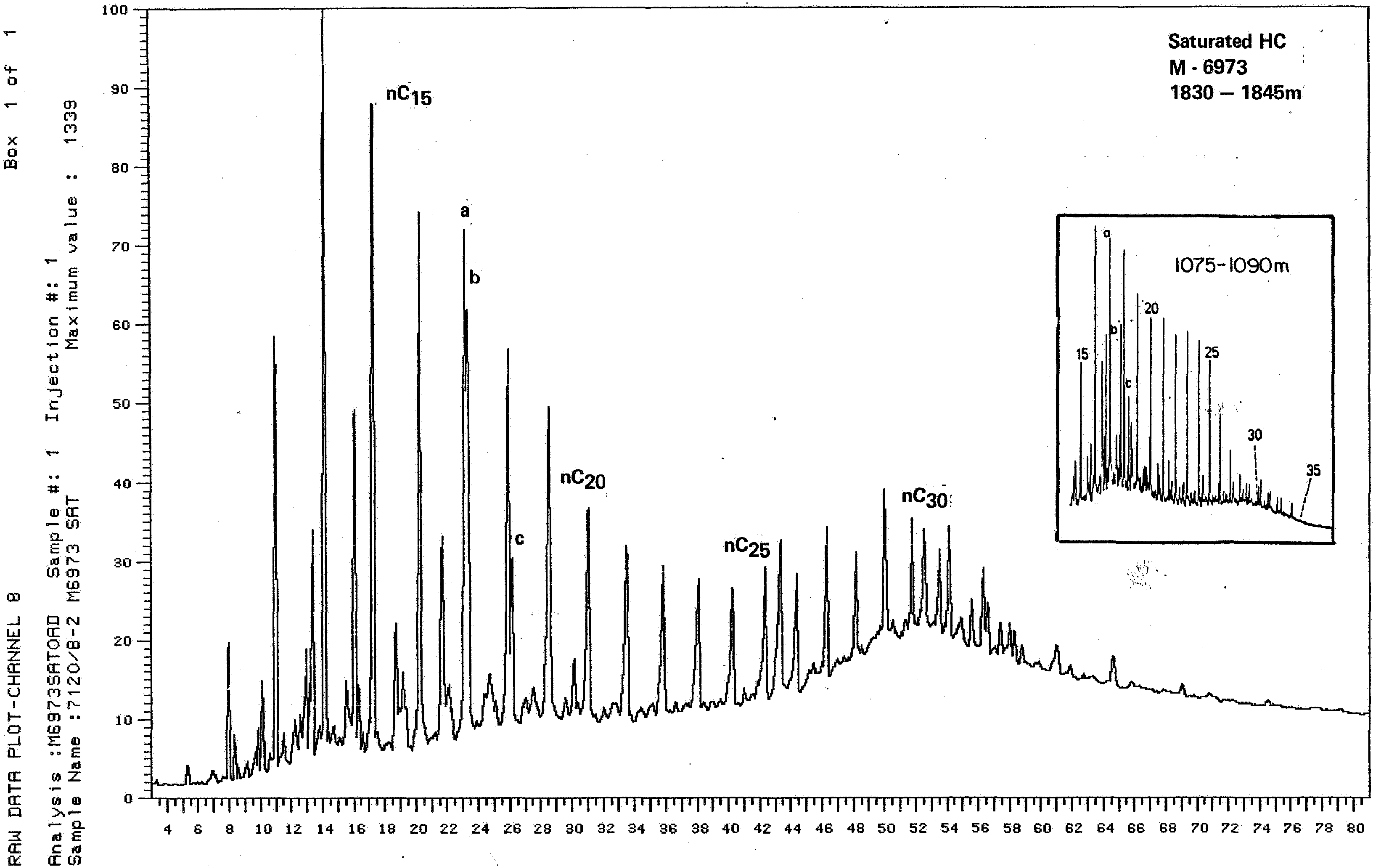


Figure 10 Saturated hydrocarbon gas chromatograms from zone 3 (Barremian) of 7120/8-1 (inset) and 7120/8-2

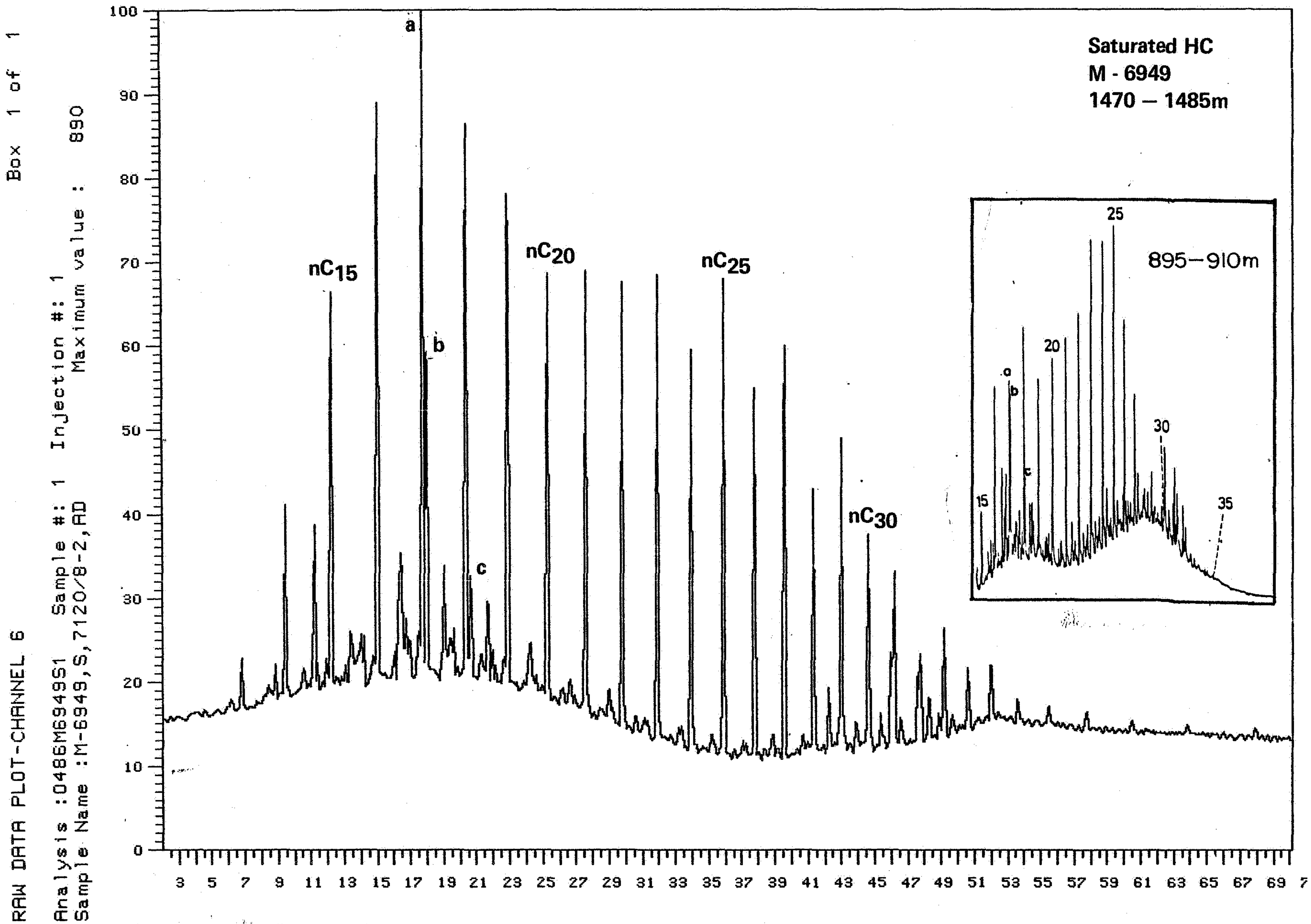


Figure 11 Saturated hydrocarbon gas chromatograms of zone I of 7120/8-I (inset) and zone 2 of 7120/8-2, illustrating maximum at nC_{25}

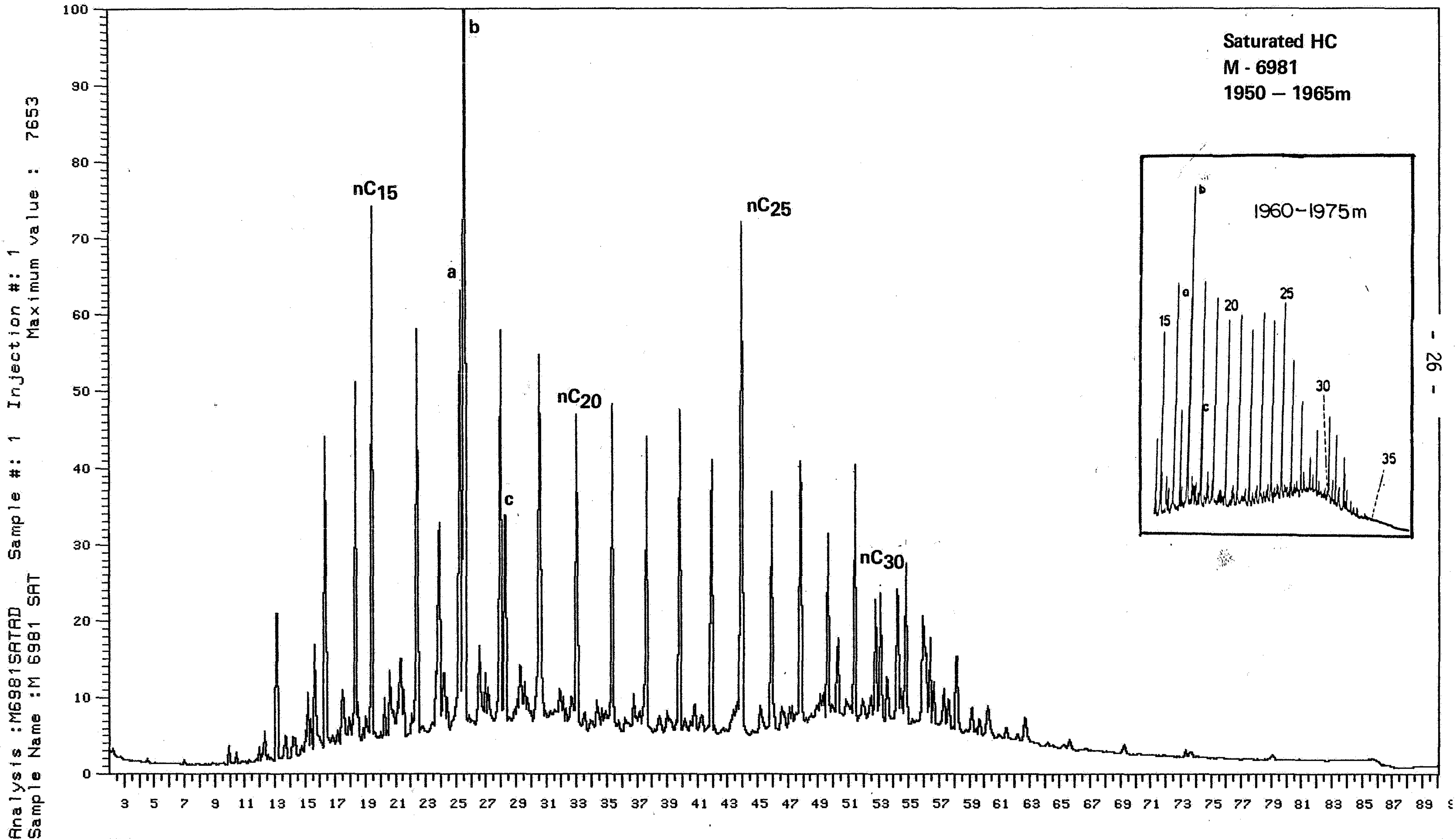


Figure 12 Saturated hydrocarbon gas chromatograms of zone 4 of 7120/8-1 (inset) and 7120/8-2 (L.Cretaceous)

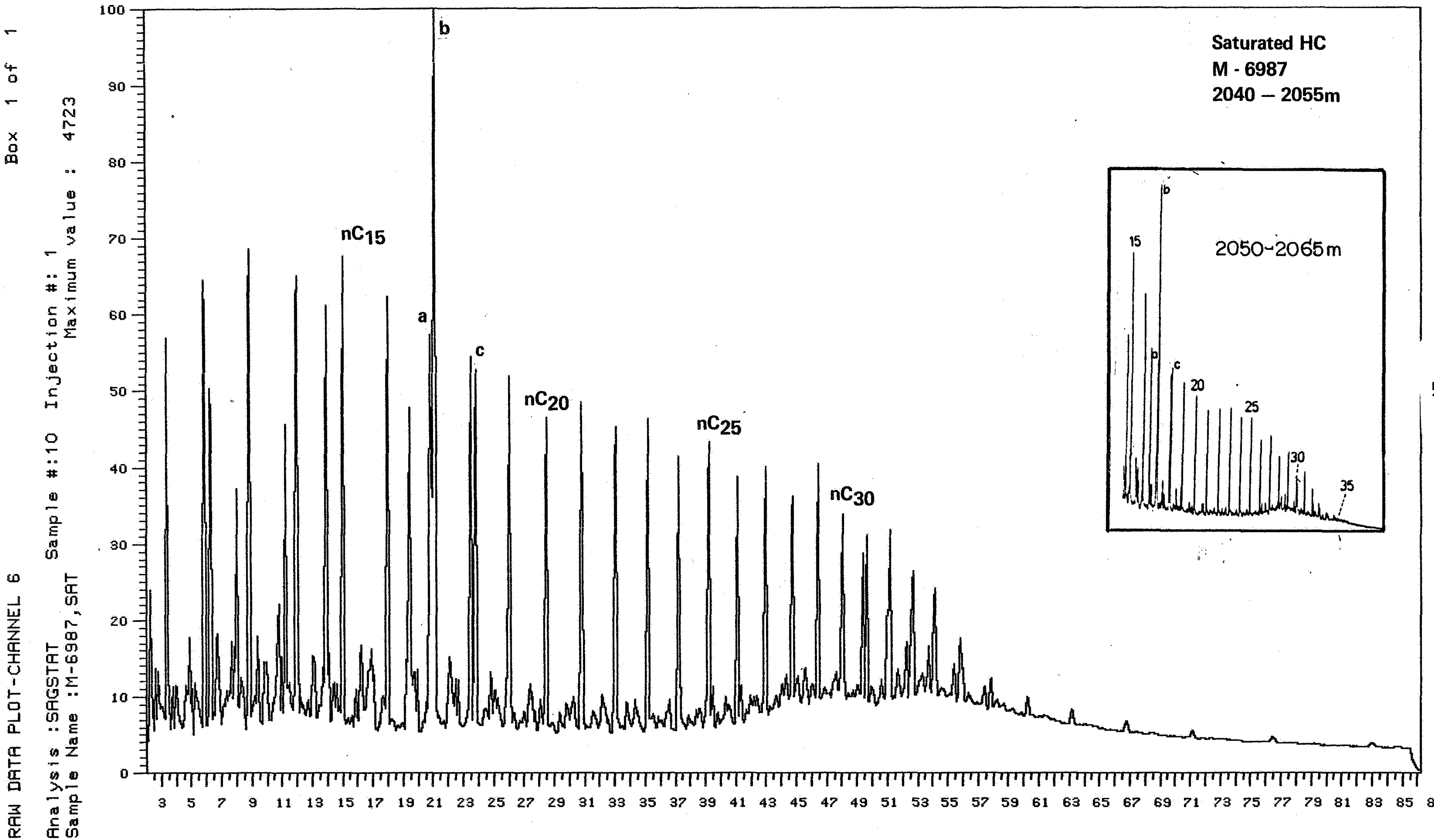


Figure 13 Saturated hydrocarbon gas chromatograms of zone 5 (Upper Jurassic) of 7120/8-1 (inset) and 7120/8-2

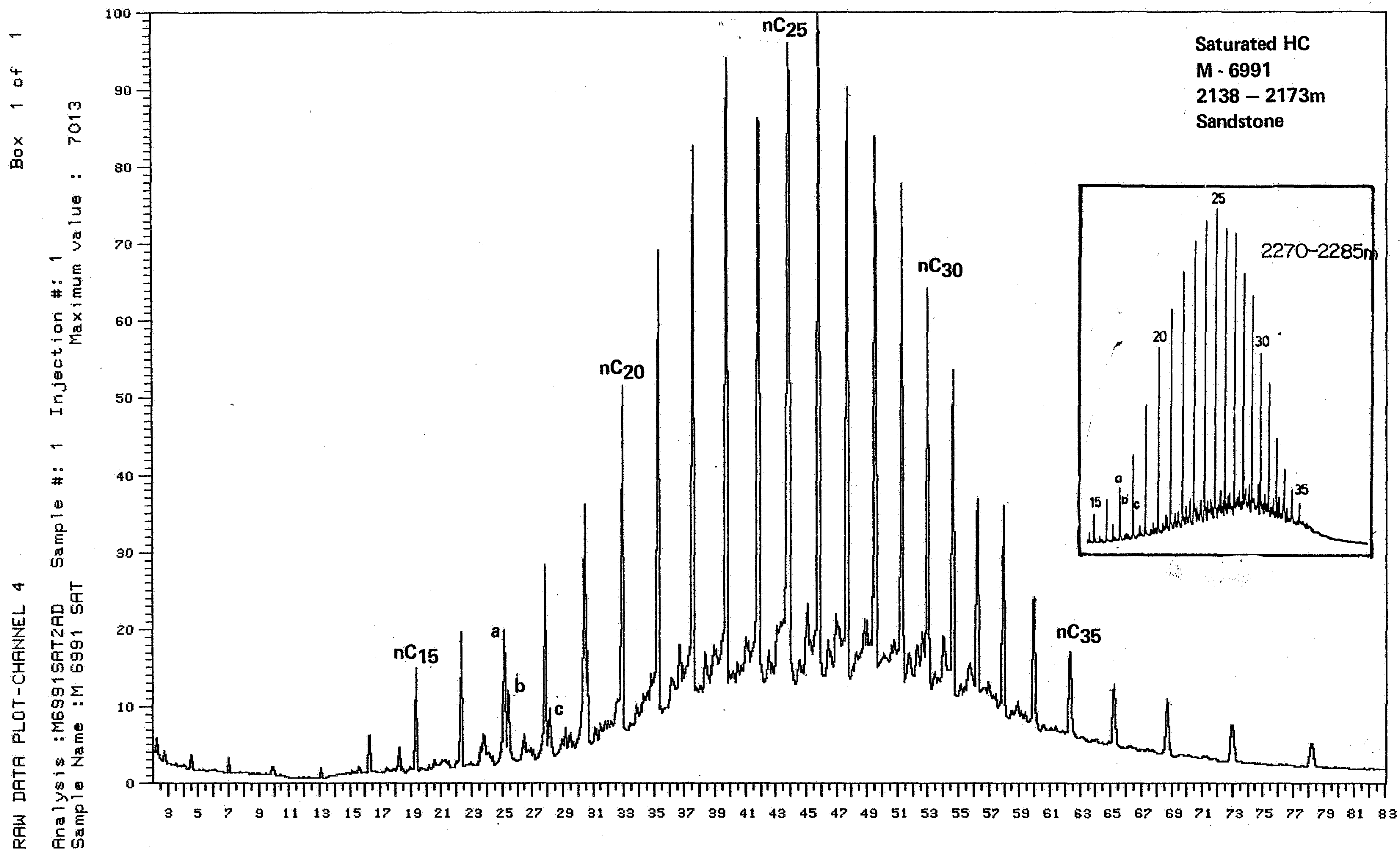


Figure 14 Saturated hydrocarbon gas chromatograms of zone 7 (7120/8–1) and zone 6 (7120/8–2) sandstones
inset

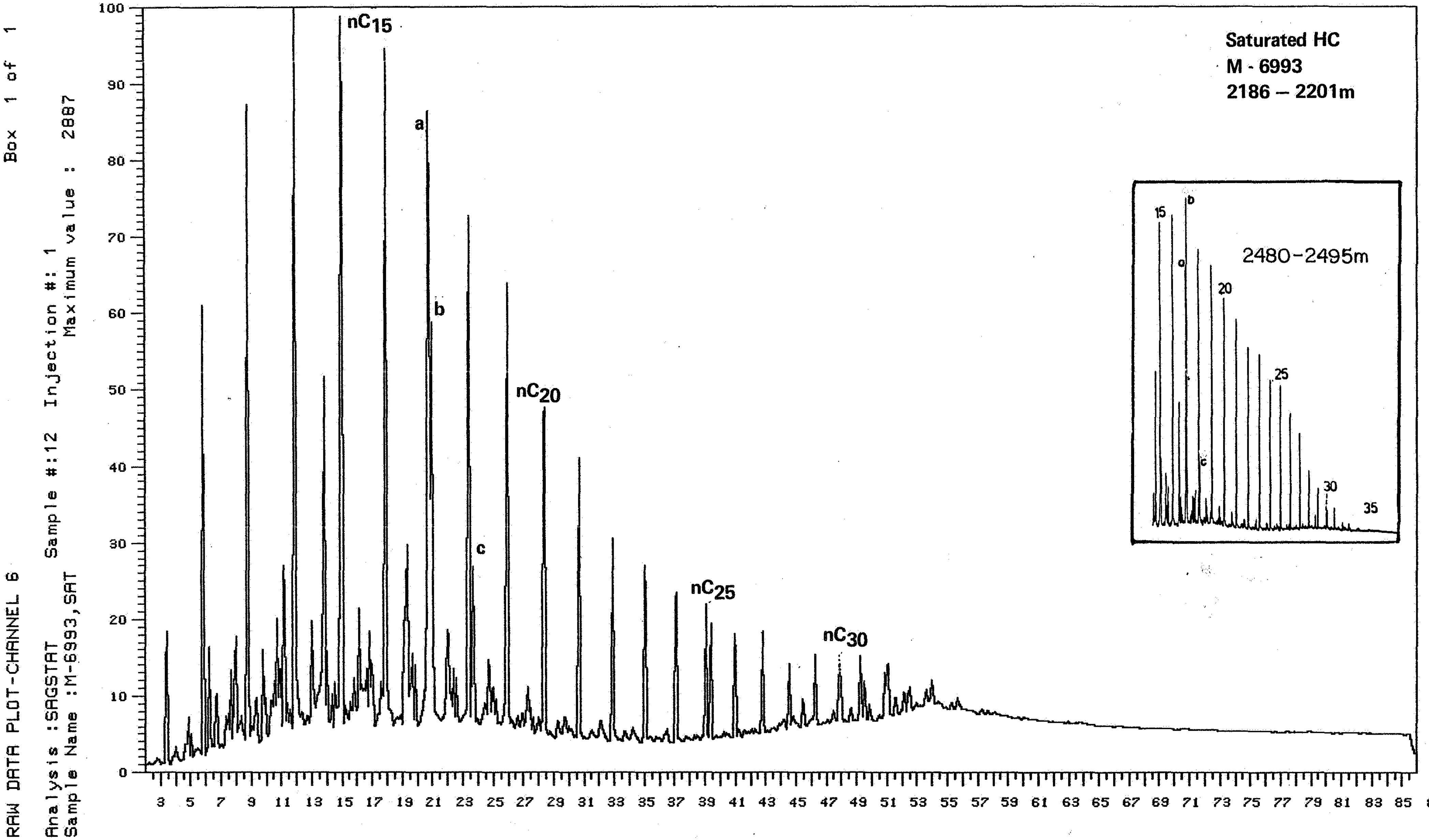


Figure 15 Saturated hydrocarbon gas chromatograms of carbonaceous claystones from zone 7(7120/8-1, inset) and zone 6 (7120/8-2)

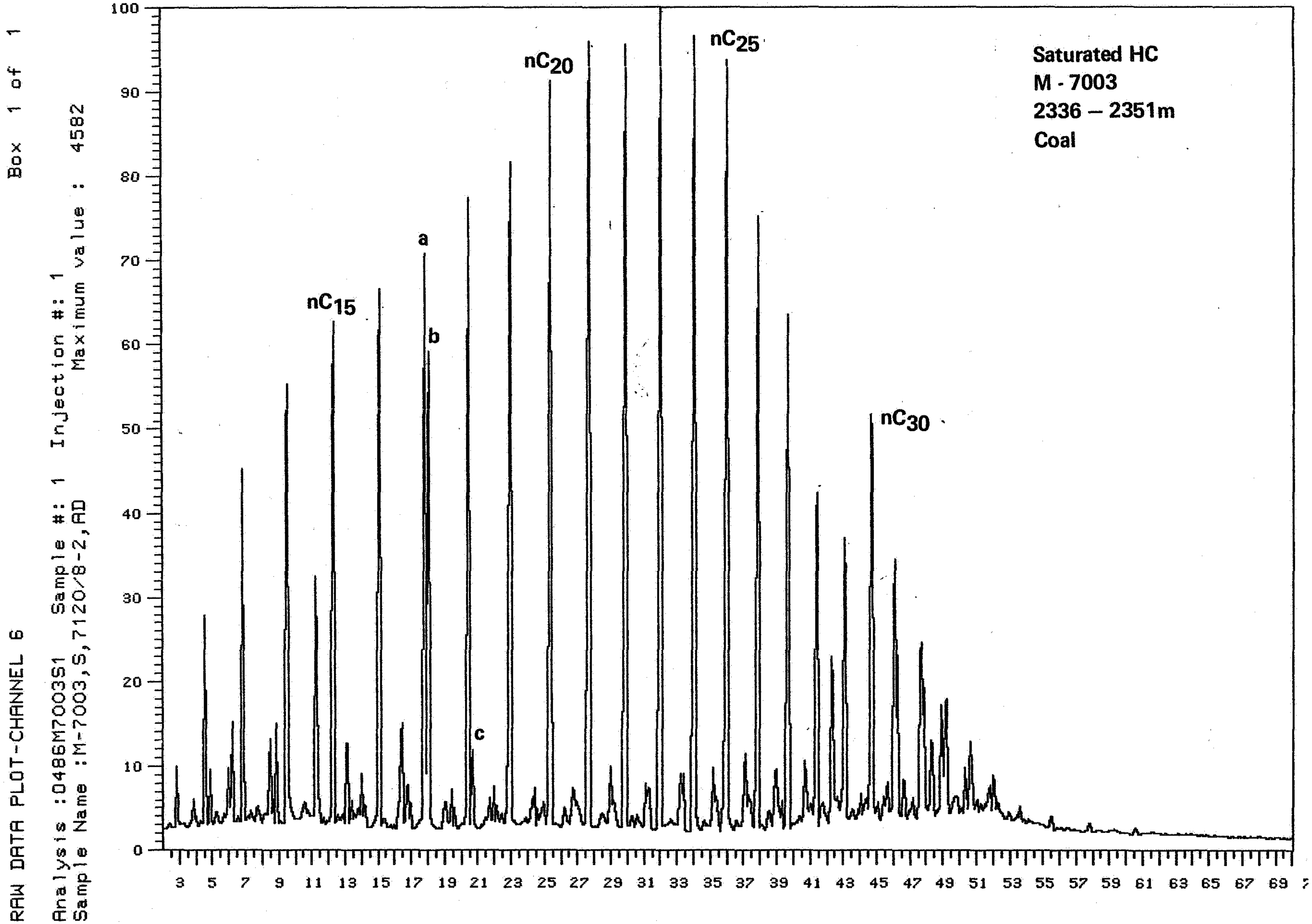

RAW DATA PLOT-CHANNEL 6
Analysis :0486M7003S1 Sample #: 1 Injection #: 1 Box 1 of 1
Sample Name :M-7003,S,7120/8-2,AD Maximum value : 4582
Saturated HC
M - 7003
2336 – 2351m
Coal
nC15
nC20
nC25
nC30
a
b
c

Figure 16

CONCLUSIONS

A few observations can be made on the zonation in comparison with the stratigraphic zonation:

a) The zonation in the Tertiary and Cretaceous (zones 1-4) is only very approximate in 7120/8-2 based on a much lower sampling frequency than in 7120/8-1.

b) In zone 1 the Tertiary-Cretaceous boundary is marked (approximately) in 7120/8-1 by an increase in C_1-C_4 and C_5+ hydrocarbon abundances and by increase in TOC (i.e. at about 1150 metres - zone 1B/1C in 7120/8-1). A slight change in C_5+ hydrocarbon abundances in 7120/8-2 at approximately 950 metres may mark the boundary but since no definite boundary can be marked the zone has not been subdivided.

c) The rest of the Cretaceous in both wells is divided into 3 zones; 2, 3 and 4 based on a combination of lithology and TOC differences plus changes in light hydrocarbon trends.

d) The boundary between zones 2 and 3 correlates approximately with the top of the Barremian. The difference is that the TOC and light hydrocarbon trend show a more marked change slightly lower in the sequence.

e) The zonation in both wells approximate to the stages for the Lower Cretaceous and the Upper Jurassic but not for the Upper Cretaceous and Middle and Lower Jurassic. This is mainly because of better sampling frequency and the relative uniform nature of the lithologies (particularly when compared with the Middle and Lower Jurassic).

f) In 7120/8-2 there is a clearer distinction using pyrolysis data for zones 4, 5 and 6 than in 7120/8-1. This may be due not only to pyrolysis techniques, but to changes in the kerogen quality.

The main correlatable horizons are zones 4-7. Generally zones 1-3 of both wells are dominated by shale lithologies which have poor-fair TOC values (less than 1%) increasing to good TOC values in the lower part of zone 3. The kerogens consist mostly of inertinite, woody and reworked woody material - type III or type IV kerogen with a poor source rock potential for gas. Above 1000 metres and between 1500-1700 metres in 7120/8-1 in particular the pyrolysis data suggests that kerogens vary from type III to type II and have a fair to good potential for gas and oil. However, it is possible that the amount of pyrolysate (S2 peak) is supplemented by migrated hydrocarbons which have not been included with the bitumen (or S1 peak). If so, then the calculated hydrogen indices are high. However, certainly between 700-1000 metres, in both wells the shales have a fair potential for gas.

Zone 4 consists of good to rich TOC-claystone/shales with type III kerogens which have a fair to good potential for gas.

Zone 5 (2005-2095m in 7120/8-1, 1980-2085m in 7120/8-2) is marked in both wells by organic-rich shales (silty in 7120/8-1) or claystones (7120/8-2) which are oil stained in both wells. TOC values vary from 3-12% with a maximum towards the base of the zone in 7120/8-2. It appears that a limestone (poor TOC, 0.2-0.5%) which is developed in both wells probably marks the top of this promising source rock in both wells. The limestone is found in 7120/8-1 from 1975-1990 metres and from 1920-1980 metres in 7120/8-2. This limestone is slightly oil stained in 7120/8-2.

The kerogen type in zone 5 of both wells is at best mixed type II/III kerogen, and it is possible that the kerogen is less hydrogen-rich in 7120/8-1 than in 7120/8-2 (see suggestions below).

Zone 6 (2095-2270 metres in 7120/8-1, 2085-2200 metres in 7120/8-2) consists mostly of sandstones; dark grey shales/claystones have lower TOC values than zone 5 (2-7% range) with only type III kerogens, and therefore have only a fair-good potential for gas (perhaps better in 7120/8-1 than 7120/8-2). The lower limit of zone 6 in 7120/8-1 was taken at the base of the non-sampled section (cored interval?).

Zone 7 contains carbonaceous shales/claystones which have rich TOC values (3-40%) and a good potential for gas whilst the coals have a rich potential for gas.

Zone 7 in both wells is oil window mature, zones 2-6 are moderate mature to oil window mature, zone 1 is immature in both wells.

Zones 5-7 in both wells show indications of migrated hydrocarbons, with abundant low molecular weight (nC_{15}-nC_{20}) hydrocarbons in shales from zone 5 and 7, and heavy residual paraffinic hydrocarbons in sandstones of zones 6 and 7. This material has probably not been derived from source rocks in zones 5-7 of this well, but most likely from the same horizons buried to greater depth.

Suggestions for further work (including oil show/source rock correlation work proposed in IKU quotation for 7120/8-2).

1) Rock-Eval analysis of selected samples from 7120/8-1 particularly zones 4, 5 and 6.

2) Examination of shows in sandstones from both wells, by extraction of further samples of sandstones from zones 6 and 7 for comparison, by gas chromatography and gc-ms.

3) * 'Light' extraction of material giving the 'cut' in shale lithologies in zone 5 of both wells for comparison with sandstone extracts.

4) Extraction and analysis of extracts (gc and gc/ms) from shale lithologies in zone 5 of both wells after 'light' extraction for comparison/correlation with shows in sandstones.

5) Extraction and analysis of extracts of carbonaceous claystones (preferably after pre-extraction) in zone 7 and correlation with extracts from sandstones.

*'Light' extraction - careful washing of cuttings with dichloromethane until the samples show negligible 'cut' under ultra-violet light.

7120/8-1

TABLE 1

IKU

ROCK-EVAL PYROLYSIS DATA (calculated) BA-83-6256-1

A

IKU No.	DEPTH m/ft	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	OIL OF GAS CONTENT S1+S2	PROD. INDEX S1/(S1+S2)	TEMP. MAX (C)
	370	1.49	3.48		2.84	123		4.97	0.30	
	415	0.17	2.19		0.66	332		2.37	0.07	
	490	0.26	2.92		0.66	442		3.18	0.08	
	565	0.33	2.91		1.06	274		3.24	0.10	
	595	0.21	1.44		1.58	91		1.65	0.13	
	610	0.07	6.41		3.51	183		6.48	0.01	
	640	0.19	4.98		1.57	317		5.17	0.04	
	670	0.80	0.89		0.94	95		1.69	0.47	
	700	0.03	5.83		2.21	264		5.87	0.01	
	730	0.09	3.08		1.06	291		3.17	0.03	
	760	0.93	5.66		3.16	179		6.59	0.14	
	820	0.04	2.25		2.74	82		2.29	0.02	
	850	0.17	2.65		1.18	225		2.83	0.06	
	895	0.03	2.20		0.80	275		2.22	0.01	
	970	0.03	3.09		0.73	423		3.12	0.01	
	1015	0.08	0.74		0.53	141		0.83	0.10	
	1060	0.05	0.90		0.72	126		0.96	0.05	
	1105	0.13	1.65		0.96	172		1.78	0.07	
	1150	0.04	1.00		0.87	114		1.03	0.04	
	1195	0.24	1.62		1.48	110		1.86	0.13	
	1240	0.00	2.74		1.17	234		2.74	0.00	
	1300	0.37	2.23		1.27	176		2.60	0.14	
	1330	0.04	1.40		1.11	126		1.44	0.03	

IKU

TABLE 1

ROCK-EVAL PYROLYSIS DATA (calcuated)

B

IKU No.	DEPTH m/ft	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	OIL OF GAS CONTENT S1+S2	PROD. INDEX S1/S1+S2	TEMP. MAX (C)
	1360	0.17	1.00		0.96	104		1.17	0.15	
	1405	0.06	1.64		1.14	144		1.70	0.03	
	1435	0.08	1.74		0.95	183		1.81	0.04	
	1480	0.08	0.67		1.15	58		0.75	0.11	
	1525	0.09	1.73		1.12	155		1.82	0.05	
	1585	0.16	3.12		0.98	318		3.28	0.05	
	1630	0.01	3.57		1.21	295		3.58	0.00	
	1660	0.06	0.82		1.26	65		0.88	0.07	
	1690	0.47	4.18		1.18	354		4.65	0.10	
	1720	0.08	1.41		1.49	95		1.50	0.05	
	1780	0.12	1.30		1.77	73		1.42	0.08	
	1825	0.27	1.64		2.19	75		1.91	0.14	
	1855	0.14	0.89		2.22	40		1.03	0.14	
	1900	0.07	2.00		1.59	126		2.07	0.04	
	1943	0.75	6.84		6.88	99		7.59	0.10	
	1945	0.17	2.32		3.09	75		2.49	0.07	
	1975	0.24	6.55		3.46	189		6.80	0.04	
	1993	0.56	2.69		2.11	127		3.25	0.17	
	2008	0.69	3.33		5.07	66		4.02	0.17	
	2020	1.35	9.94		4.02	247		11.29	0.12	
	2065	2.37	13.62		7.30	187		15.99	0.15	
	2069	0.96	7.63		11.30	68		8.59	0.11	
	2089.50	0.53	1.33		1.76	75		1.86	0.29	

TABLE 1

IKU

ROCK-EVAL PYROLYSIS DATA (calculated)

C

IKU No.	DEPTH m/ft	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	OIL OF GAS CONTENT S1+S2	PROD. INDEX S1/S1+S2	TEMP. MAX (C)
	2095	0.64	8.82		8.26	107		9.46	0.07	
	2140	0.57	2.91		5.90	49		3.48	0.17	
	2170	0.33	3.08		7.39	42		3.41	0.10	
	2285	1.22	3.84		2.48	155		5.05	0.24	
	2330	1.63	7.59		9.29	82		9.22	0.18	
	2360	4.95	19.64		40.56	48		24.60	0.20	
	2390	0.13	0.89		3.80	24		1.02	0.13	
	2435	0.47	4.20		9.25	45		4.68	0.10	
	2495	3.43	35.98		21.60	167		39.41	0.09	
	2555	1.35	3.72		2.65	140		5.07	0.27	
	2615	3.05	19.19		42.69	45		22.24	0.14	

DATE : 9 - 12 - 82.

TABLE 1

IKU

ROCK-EVAL PYROLYSIS DATA

A

IKU No.	DEPTH m/ft	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	OIL OF GAS CONTENT S1+S2	PROD. INDEX S1 / S1+S2	TEMP. MAX (C)
M 6897	720	0.22	0.26	0.60	0.90	29	67	0.48	0.46	423
M 6909	885	0.85	1.73	1.25	1.17	148	107	2.58	0.33	346
M 6913	945	1.08	2.08	1.09	1.03	202	106	3.16	0.34	353
		Clst	sY - sn - sY							
M 6917	1005	0.42	0.74	0.60	0.84	88	71	1.16	0.36	361
M 6937	1305	0.16	0.35	0.51	1.02	34	50	0.51	0.31	428
M 6941	1365	0.13	0.26	3.96	0.89	29	445	0.39	0.33	433
M 6945	1425	0.24	0.33	1.47	1.09	30	135	0.57	0.42	433
M 6953	1545	0.16	0.28	0.66	1.12	25	59	0.44	0.36	450
M 6957	1605	0.16	0.14	0.54	1.17	12	46	0.30	0.53	363
		Clst	dk - sY							
M 6961	1665	0.18	0.39	0.76	1.56	25	49	0.57	0.32	439
		Clst	dk - sY							
M 6961	1665	0.31	0.37	7.45	1.03	36	723	0.68	0.46	465
		Ls								
M 6965	1725	0.51	1.34	2.11	2.18	61	97	1.85	0.28	435
		Clst	dk - sY							
M 6965	1725	0.41	0.63	8.49	1.59	40	534	1.04	0.39	441
		Ls								
M 6973	1845	0.30	1.63	4.77	2.28	71	209	1.93	0.16	383
		Clst	dk - sY							
M 6973	1845	0.23	1.44	4.77	0.96	150	497	1.67	0.14	436
		Ls								
M 6977	1905	0.10	0.35	0.79	1.74	20	45	0.45	0.22	446
M 6978	1920	0.17	0.39	0.63	1.47	27	43	0.56	0.30	437
M 6979	1935	0.11	0.75	0.92	2.56	29	36	0.86	0.13	442
M 6980	1950	0.13	0.51	0.90	1.67	31	54	0.64	0.20	440
M 6981	1965	0.45	2.06	1.05	2.29	90	46	2.51	0.18	435
M 6982	1980	0.24	1.69	0.77	2.18	78	35	1.93	0.12	436
M 6983	1995	0.58	4.87	0.67	3.41	143	20	5.45	0.11	434
M 6984	2010	1.37	11.87	0.32	4.08	291	8	13.24	0.10	431

7120/8-2

IKU

TABLE 1

ROCK-EVAL PYROLYSIS DATA

B

IKU No.	DEPTH m/ft	S1	S2	S3	TOC (%)	HYDR. INDEX	OXYGEN INDEX	OIL OF GAS CONTENT S1+S2	PROD. INDEX S1 / S1+S2	TEMP. MAX (C)
M 6985	2025	1.38	12.85	0.32	4.28	300	7	14.23	0.10	431
M 6986	2040	1.83	14.06	0.44	4.84	290	9	15.89	0.12	432
M 6987	2055	3.09	19.25	0.57	7.92	243	7	22.34	0.14	432
M 6988	2070	3.22	21.23	0.69	9.62	221	7	24.45	0.13	431
M 6989	2085	7.70	23.77	0.65	10.40	229	6	31.47	0.24	430
M 6990	2138	0.50	2.87	1.08	3.41	84	32	3.37	0.15	434
M 6991	2173	0.67	1.87	1.10	3.00	62	37	2.54	0.26	438
M 6992	2186	0.69	2.32	0.65	2.95	79	22	3.01	0.23	436
M 6993	2201	0.34	1.54	0.43	2.70	57	16	1.88	0.18	438
M 6994	2216	0.21	0.93	0.58	2.38	39	24	1.14	0.18	438
		Clst	dk - gy							
M 6995	2231	0.69	2.15	0.40	2.38	90	17	2.84	0.24	433
M 6996	2246	2.01	10.23	0.26	4.35	235	6	12.24	0.16	439
M 6998	2276	0.66	2.79	0.40	2.90	96	14	3.45	0.19	440
M 7001	2321	0.64	2.01	0.55	2.08	97	26	2.65	0.24	436
M 7002	2336	0.28	1.18	0.44	1.80	66	24	1.46	0.19	435
M 7003 COAL	2351	12.03	104.63	1.42	62.09	169	2	116.66	0.10	440
M 7004	2366	0.59	3.19	0.82	3.89	82	21	3.78	0.16	437
M 7005	2381	0.95	13.34	0.79	9.17	145	9	14.29	0.07	437
M 7010	2456	1.59	9.09	0.81	7.42	123	11	10.68	0.15	441
M 7013	2501	0.41	1.25	1.25	2.05	61	61	1.66	0.25	440

DATE : 8 - 11 - 82.