PROSPECT DESCRIPTION
AND
PROGNOSIS
31/3-2

Norsk Hydro

PROSPECT DESCRIPTION

AND

PROGNOSIS

31/3-2

jeb831101kn1

PROSPECT DESCRIPTION AND PROGNOSIS 31/3-2

1. LOCATION

AREA	NORWEGIAN NORTH SEA	
LICENCE	PL 085	
BLOCK	31/3	
WELL NO	31/3-2	
GROUP	NORSK HYDRO PRODUKSJON A.S., STATOIL, SAGA PETROLEUM	
OPERATOR	NORSK HYDRO PRODUKSJON A.S.	
CLASSIFICATION	APPRAISAL	
GEOGRAPHICAL COORDINATES	60°52' 11.5"N	
	3°40'42.8"E	Sone 31
UTM COORDINATES	6,748,643m N	C. Meridian 3°E
	536,851m E	ED 50
SEISMIC LOCATION	ST 8007-338A, SP 204.5	
DRILLING RIG	*TREASURE SEEKER*	
WATER DEPTH	340 m	
RKB-MSL	25 m	
PROJECTED TOTAL DEPTH	2050m RKB (Alt.1)/2130 m RKB (Alt.2)	

2. SUMMARY OF OBJECTIVES

31/3-2 is an appraisal well located immediately to the southeast of the Troll-West/Troll-East 'boundary fault'. The well may record the 'boundary fault' zone in the lower FENSFJORD FM (Alternative 1) or drill a complete UPPER-MIDDLE JURASSIC section (Alternative 2).

The objectives of 31/3-2 will be:

A: To determine if hydrocarbons are present on the downthrown side close to the 'boundary fault' and determine the contacts.

B: To obtain data for evaluating the degree and capacity of communication between Troll-West and Troll-East.

C: To determine the depth to the top reservoir in the area of unreliable seismic mapping.

D: If moveable hydrocarbons are found, to perform testing for observation of 'boundary effects' where the pay-zone is narrow and thin.

E: To obtain a new sedimentological datapoint between 31/2-6 and 31/3-1, with different evolution of the main reservoir sand.

F: To try to determine whether sands with different capillary pressure properties are in contact across the 'boundary fault'.

The well will be drilled into the LOWER JURASSIC, DRAKE FM with a T.D. around 2050m RKB drilling through the boundary fault zone (Alternative 1). The possibility of the well to be drilled entirely in the downthrown block is covered by alternative 2. In this case, T.D. will be 2130 m RKB.

The MIDDLE JURASSIC sandstones penetrated by the well are not considered to be hydrocarbon-bearing based on the 31/3-1 results.

3. INTRODUCTION

Brief regional framework

Block 31/3 covers parts of the Sogn Spur on the Horda Platform east of the Viking Graben axis and south of Sogn Graben (Fig. 1).

A large tilted fault block covering the major part of block 31/6, extends into block 31/3. The well is located very near the junction of the western master fault and the fault bounding the 31/2-6 block to the southeast (Fig. 2, Encl. 1).

Data base

Seismic:
The two surveys ST 8007 and ST 8116, making up a north-south/east-west, 1 x 1 km grid, have been interpreted in the area.

A specially designed site-survey (250 m line spacing) applying a water gun source has been interpreted for optimal location of 31/3-2 (Encl. 7,8,9).

Wells:

The results from wells
31/6-1 (T.D.: 4070m RKB, Crystalline basement),
31/3-1 (T.D.: 2374m RKB, HEGRE GRP) and
31/6-2 (T.D.: 1760m RKB, FENSFJORD FM) have been used for seismic calibration and prediction of geology. Velocity information has been extracted from wells 31/2-1 to -10 and 31/3-1.

It should be noted that a revised map (Encl. 7) and well location (ST 8007-338 sp 204.5) may change the top SOGNEFJORD.

4. PROSPECT DEFINITION

The predominantly N-S striking master fault running through blocks 31/8,5,6 and 3 turns progressively more to the NW in 31/3 (Fig. 2, Encl. 1). Near the 31/3-2 location it also accommodates the movement at the 'boundary fault' and continues into block 31/2.

The areal extent of the seismic anomaly gradually narrows approaching the 'boundary fault'. It is presently mapped (Encl. 7) to terminate immediately to the south of the 'boundary fault'. Hence the seismic interpretation shows that no direct communication exists in the gas phase.

The contacts recorded so far are (m MSL):

	31/2-6	31/3-1	31/6-1
GOC	1546.4	1548	1547
OWC	1557.2	1551-1553	1549

Furthermore, the pressure recordings indicate the pressure regime to be the same in Troll-West and Troll-East. This fact and the similar GOC's suggest communication in the gas and accordingly in the oil phase. A second communication between Troll-West and Troll-East is, however, mapped southeast of 31/2-3. This may also account for the similar pressure recording and fluid contacts.

The sandstones containing the contacts on both sides of the fault belong to the SOGNEFJORD FM (Encl. 2).

The OWC in 31/3-1 is uncertain. The deeper OWC in 31/2-6 may be due to juxtaposition against sandstones with higher displacement pressure on the downthrown side of the 'boundary fault'. In this case the GOC should be slightly higher in 31/2-6 than in Troll-East as observed in the wells drilled so far.

Although the seismic interpretation favours lack of communication in the gas phase, the narrow zone around 31/3-2 is considered the path of secondary migration of hydrocarbons from Troll-West to Troll-East.

The observations and interpretations made so far are not conclusive to the degree of communication between Troll-West and Troll-East, and it is absolutely required to pursue the objectives listed in chapter 2.

5. STRATIGRAPHY

Reference is made to the Geological Prognosis (Encl. 5, 6), figures 3-5 and tables 1 and 2.

JURASSIC

TOARCIAN-BAJOCIAN SEQUENCES

DUNLIN and BRENT GRPS (Alt. 1: 1900m RKB)
(Alt. 2: 1980m RKB)

The DRAKE FM of the DUNLIN GRP (TOARCIAN) and the BRENT GRP (UPPER TOARCIAN/AALENIAN/BAJOCIAN) are treated basically as one sequence. Of the two wells, 31/2-6 and 31/3-1, used as references for this prognosis, only 31/3-1 penetrated the DRAKE FM. The lithology fits into an overall progradational cycle: marine claystones (DRAKE FM) - intercalated clay-/silt-/sandstones (DRAKE FM transitional facies), fine to coarse sandstone (ETIVE FM, 30m) - interbeds of sand-/siltstones, shales and coals of deltaic facies (NESS FM, 45m). We expect the same thickness relationships for NESS and ETIVE FMS in 31/3-2 as in 31/3-1.

BATHONIAN-BERRIASIAN SEQUENCES

This MIDDLE-UPPER JURASSIC/lowermost CRETACEOUS interval is divided into five lithostratigraphic units. The thicknesses in 31/3-2 are based on relative thickness considerations between 31/3-1 and 31/2-6 within the frame-work of the top reservoir and the top NESS coal reflectors (Fig. 5).

LOWER HEATHER FM (Alt. 1: 1865m RKB, 35m, Alt. 2: 1885m RKB, 95m) AND KROSSFJORD FM (Alt. 1: faulted out, Alt. 2: 1870m RKB, 15m)

A map showing the relative thickness between the KROSSFJORD FM and the total thickness (LOWER HEATHER FM + KROSSFJORD FM) has been used to predict the thicknesses of the two formations in 31/3-2. The two formations make up a prograding sequence (Fig. 5) of offshore silt-/claystones (LOWER HEATHER FM) coarsening up to shoreline sandstones (KROSSFJORD FM).

FENSFJORD FM (1740 m RKB, Alt. 1: 125 m, Alt. 2: 130 m)

The FENSFJORD FM consists of alternating sequences up to 20 m thick of fine to coarse sandstones and micaceous siltstones. The depositional environment was probably offshore to shallow marine.

UPPER HEATHER FM (1725 m RKB, 15 m)
The UPPER HEATHER FM consists of very fine grained sandstones and siltstones deposited in an offshore environment.

SOGNEFJORD FM (1575 m RKB, 150 m)
The SOGNEFJORD FM (OXFORDIAN-KIMMERIDGIAN/EARLY PORTLANDIAN) being the reservoir interval is expected to consist of medium to coarse sandstones with finer intervals. The general assumption is that the grainsize will be closer to that of 31/2-6 (mainly coarse grained)

than 31/3-1 (mainly fine-medium grained). The depositional environment was probably shallow marine. A net/gross ratio within the range of 0.75-0.90 and porosities around 30% are expected.

Due to the revised map (Encl. 7) and the change in location; the top SOGNEFJORD FM may be at 1600 m RKB.

DRAUPNE FM (1550 m RKB, 25 m)
The DRAUPNE FM (LATE PORTLANDIAN-BERRIASIAN) consists of dark grey to greybrown carbonaceous claystones.

CRETACEOUS

The CRETACEOUS is not considered prospective in the area, and is expected to be 75 m thick, of which 20 m is LOWER CRETACEOUS.

CROMER KNOLL GRP (1530 m RKB, 20 m).
The group includes marine marls, limestones and claystones.

SHETLAND GRP (1475 m RKB, 55 m)
Marine marls, limestones and claystones are expected.

TERTIARY, QUATERNARY

ROGALAND GRP (1050 m RKB, 425 m)
No reservoir sands are present and the interval is not considered prospective. The dominating lithology is claystone. Some 15 m of limestone and marl of the MAUREEN FM is expected at the base of the interval.

HORDALAND GRP (545 m RKB, 505 m)
The lithology is mainly claystone with some 55 m of sand in the uppermost part (OLIGOCENE).

NORDLAND GRP (365 m RKB, 180 m)

The NORDLAND GRP is some 180 m thick and clearly separated from the underlaying sediments by an angular discordance which is a regional erosional surface. The upper zone can be divided into four units, as inferred from the reflection patterns on the shallow seismic (Fig. 4).

6. DEPTH CONVERSION AND SEISMIC PROGNOSIS

Method of depth conversion

The method used for depth conversion of the seismic picks is based upon the assumption that the seismic interval velocity in a given lithological sequence is homogeneous and linearly proportional to two-way reflection time. This is an oversimplification, but to take account of all the possible factors influencing the interval velocity is clearly impossible. In an area of relatively flat reflectors without extreme lateral changes in lithology, it is felt that the assumptions made in this method are justified.

In practice, the two-way reflection times and the depths (relative to MSL) of major seismic reflectors are obtained from the velocity logs of a number of Troll wells. For the purposes of the present prognosis, wells 31/2-1 to 31/2-10 and 31/3-1 were used. The velocity in each interval is then calculated, and a graph of interval velocity against two-way reflection time to the centre of the interval is plotted. A 'best fit' straight line can then be drawn through the plotted points, and this line represents the function:

$$V_i = At + B$$

where V_i = interval velocity
t = two way time to centre of interval
A = gradient of 'best fit' line
B = constant

In practice, it is most convenient to calculate the constants A and B using a suitable programme for linear regression. By calculating the standard error of the mean for V_i, a measure of the uncertainty in interval velocity for a given value of two-way time can also be obtained.

A velocity function can thus be prepared for each interval, and used in conjunction with two-way times obtained from seismic data to calculate the interval velocity in, and hence the thickness of a lithological interval at any locality. The interval thicknesses can then be summed, starting at the seabed, whose depth is obtained from the bathymetric map, and hence the depth in metres to each reflector can be calculated.

The main sources of error in the calculation are the abovementioned uncertainty in interval velocity, and the uncertainty in picking of the reflectors on the seismic section. These errors give a total error in depth which is tabulated in the final prognosis (Table 2).

In the Troll field, there exists in addition to sea level, a second datum, in the form of the gas/oil contact, which is seen as a clear 'flatspot' on the seismic data, and has a relatively constant depth, which for the purposes of the presents calculations has been taken as 1550 ± 10 m MSL. Thus it is possible to perform a second depth conversion using this datum and calculating interval thicknesses between it and the major reflectors, both above and below. Thus the final depth errors increase from seabed to top BALDER FM, and then decrease to a minimum around the level of top SOGNEFJORD FM, which at the locality of 31/3-2 is near the 'flatspot' level. For reflectors below the gas/oil contact, the contact is used as datum, and the error begins to increase again with depth.

On the basis of the currently available seismic data, it is uncertain whether the well will penetrate the top NESS coal on the upthrown (Alternative 1) or downthrown (Alternative 2) side of the 'boundary fault'. For this reason, two separate depth prognoses have been prepared, taking into account both of these possibilities.

Seismic interpretation

The interpretation of the seismic data in the vicinity of the well location presents certain problems, owing to the poor data quality in the vicinity of the major fault. Sideswipe from this fault interferes with the real seismic events on the downthrown side of the fault. In addition, the thickness of certain intervals, notably the DRAUPNE FM, approaches the limits of resolution of the ST 8007 and ST 8116 seismic data. The water gun data, however, have improved the interpretation in the saddle area.

Seismic picks, 31/3-2

Reference is made to the zero phase processed seismic line ST 8007-405, s.p. 704 (Encl. 2). Due to a slight change in location this is no longer the location line. Only minor changes in picks are expected, however, the seismic picks used in production of the depth prognosis are as follows (Table 2).

CAENOZOIC picks

The base of the NORDLAND GRP is picked as a black peak at 665 ms TWT. In the vicinity of the well location, this reflector is seen to truncate the more steeply-dipping INTRA-OLIGOCENE sequence boundary. This marks a distinct increase in velocity, and has therefore been picked in the white trough at 725 ms TWT. The top EOCENE reflector is discontinuous on the seismic line, but has been picked at 970 ms TWT on the basis of comparison of seismic character between this locality and well 31/2-6, which is located on the same seismic line, at shot-point 522. In the same way, the top BALDER reflector has been correlated from well 31/2-6, and is picked at 1205 ms TWT. The uncertainty of pick for all the CAENOZOIC reflectors is taken as ± 10 ms.

MESOZOIC picks

Top MAUREEN FM (Top DANIAN) is generally a strong, fairly continuous reflector in the area, but at the revised well location it becomes somewhat discontinuous. Whether this is the result of sideswipe from the nearby fault-plane, or of the presence of minor faulting is difficult to ascertain. The Top MAUREEN FM is picked in the white trough at 1600 ms TWT.

Top DRAUPNE FM is even more difficult to pick with confidence than top MAUREEN FM, the seismic data at this level being very unclear owing to the presence of sideswipe from the fault. The question of whether or not the reflector is affected by small-scale faulting is even more critical for this reflector than for the top CRETACEOUS reflector. Top DRAUPNE FM has been picked as a black peak at 1670 ms TWT, and the uncertainty in the pick is expressed as + 20 , -10 ms TWT.

Top SOGNEFJORD FM (top reservoir) is picked at 1690 ms, and appears to coincide with the 'flatspot' which represents the gas/oil contact. This contact is clearly seen on line ST 8007-405, as a white trough whose two-way time appears fairly constant at 1690 ms TWT (picking uncertainty: ±10 ms TWT). In the revised location the top of the SOGNEFJORD FM is picked at 1715 ms TWT.

The picking of the top NESS coal reflector at the well location is complicated by the presence of the 'boundary fault'. The uncertainty in interpretation of this fault has been illustrated (Fig. 3) in the form of two prognoses (Encl. 5,6), one assuming that the top NESS coal is penetrated on the upthrown side of the fault, and the other assuming that the fault is located so far north that the well enters NESS coal on its downthrown side. The throw of the fault is interpreted as around 50 ms TWT, which gives approximately 70 metres after depth conversion. It should be added that the quality of the top NESS coal reflector is also poor in the vicinity of the well, and hence a pick uncertainty of ± 20 ms TWT has been assumed.

7. FAULTING AND SUBSIDENCE

The first tectonic activity recognizable on the Horda Platform is the PERMIAN-EARLY TRIASSIC (?) rift phase (based on preliminary 31/6-1 datings). A subsequent post-rift subsidence created asymmetric LOWER-MIDDLE TRIASSIC depocenters with normal drag developed along downthrown sides of master faults.

The next rift phase occurred in the MIDDLE-LATE JURASSIC after deposition of UPPER TRIASSIC and LOWER-MIDDLE JURASSIC clastics. The faults created reverse drag on the downthrown sides indicating listric movement. Both faults in the vicinity of well 31/3-2 were active in this period. The western master fault that was previously active during the PERMIAN (?)-MIDDLE TRIASSIC rift and post-rift phases was rejuvenated. In 31/2 differential subsidence in the OXFORDIAN-KIMMERIDGIAN is recognized across new and rejuvenated faults. However, based on the seismic picks and the interval velocities no growth across the 'boundary fault' is anticipated.

Post-rift subsidence during the CRETACEOUS is observed with normal drag (Encl. 3, sp 200 and 800) and expanded sequences on downthrown sides of master faults.

8. TRAPPING MECHANISM

Structure

The Troll-East structure is a unconformity/structural closure formed by MIDDLE-LATE JURASSIC rifting and CRETACEOUS post-rift, differential subsidence. The closure is entirely fault bounded to the west (the master fault) and only partly to the east (antithetic faults). To the south and north (near 31/3-2) the structure has a pure dip closure.

Sealing

The flatspot identified as the GOC proves a high sealing capacity for the DRAUPNE FM. Except for 31/6-NE there are no seismic indications of shallower gas near the faults intersecting the reservoir.

Assuming a minimum overburden of 300-400 m for sufficient compaction of the cap rock, low-permeable seal encaged the reservoir from PALEOCENE/EOCENE.

9. DRILLING HAZARDS

Pockmarks with diameters usually between 30-60 m and depths of 1-3 m are abundant in the area. The sediments are very soft unconsolidated to firm clay down to 415 m (Fig. 4). Between 415 and 545 m (base QUATERNARY) the clay is overconsolidated and hard.

Boulders may be encountered between 415-425 m and 460-475 m. In well 31/2-6 gas originated from an interval corresponding to the boundary between unit III and IV (Fig. 4). A sandy layer between 535-545 m may possibly contain gas. There is no indication of gas, however, on analog sparker and digital water gun lines in the 31/3-2 area.

10. FIGURE LISTING

1. Index map.
2. Isochron map top SOGNEFJORD FM.
3. Alternatives 1 and 2.
4. Interpretation of shallow seismic.
5. Thickness relationships Top SOGNEFJORD FM - Top NESS coal, wells 31/2-6, 31/3-2, 31/3-1.

11. TABLE LISTING

1. Prognosed formation tops and thicknesses, 31/3-2, alternatives 1 & 2.
2. Seismic prognosis, 31/3-2.

12. ENCLOSURE LISTING

1. Isochron map top SOGNEFJORD FM., block 31/3, 1:50.000.
2. ST 8007-405 Location and picks.
3. ST 8116-148 Location and picks.
4. T-D curve for well 31/3-2.
5. Geological prognosis 31/3-2, Alternative 1.
6. Geological prognosis 31/3-2, Alternative 2.
7. Isochron map top SOGNEFJORD FM, 31/3-2 area, 1:6.250.
8. NH 8366-301
9. NH 8366-102

TABLE 1a

EXPECTED TOPS AND THICKNESSES, 31/3-2

ALTERNATIVE 1

STRATIGRAPHY	DEPTH (m MSL)	DEPTH (m RKB) (25m RKB)	THICKNESS (m)
Sea Bottom	340	365	
Base NORDL.GRP (L.PLIO.unc.)	520	545	
Top OLIGOCENE SD	520	545	55
Intra OLIGOCENE seq. b.	575	600	
Top EOCENE seq. b.	805	830	220
Top ROGALAND GRP.	1025	1050	425
Top BALDER FM	1025	1050	145
Top SELE FM	1170	1195	175
Top LISTA FM	1345	1370	90
Top MAUREEN FM	1435	1460	15
Top SHETLAND GRP	1450	1475	55
Top CENOMAN seq.	1485	1510	20
Top CROMER KNOLL GRP	1505	1530	20
Top VIKING GRP	1525	1550	410
Top DRAUPNE FM	1525	1550	25
Top SOGNEFJORD FM	1550 (1575)	1575(1600)*	150
G.O.C.	1550	1575	
Top UPPER HEATHER FM	1700	1725	15
Top FENSFJORD FM	1715	1740	125
FAULT PLANE	1820	1865	
Top KROSSFJORD FM	Absent		
Top LOWER HEATHER FM	1820	1865	35
Top BRENT GRP	1875	1900	75
Top TARBERT/NESS FM	1875	1900	45
Top NESS COAL	1885	1910	
Top ETIVE FM	1920	1945	30
Top DUNLIN GRP	1950	1975	
Top DRAKE FM	1950	1975	

*) Revised map and location

T.D. Alternative 1: 2050 m RKB.

TABLE 1b

ALTERNATIVE 2

STRATIGRAPHY	DEPTH (m MSL)	DEPTH (m RKB) (25m RKB)	THICKNESS (m)
Top UPPER HEATHER FM	1700	1725	15
Top FENSFJORD FM	1715	1740	130
Top FAULT PLANE	Absent		
Top KROSSFJORD FM	1845	1870	15
Top LOWER HEATHER FM	1860	1885	95
Top BRENT GRP	1955	1980	75
Top TARBERT/NESS FM	1955	1980	45
Top NESS COAL	1965	1990	
Top ETIVE FM	2000	2025	30
Top DUNLIN GRP	2030	2055	
Top DRAKE FM	2030	2055	

T.D. Alternative 2: 2130 m RKB.

SEISMIC PROGNOSIS, WELL 31/3-2

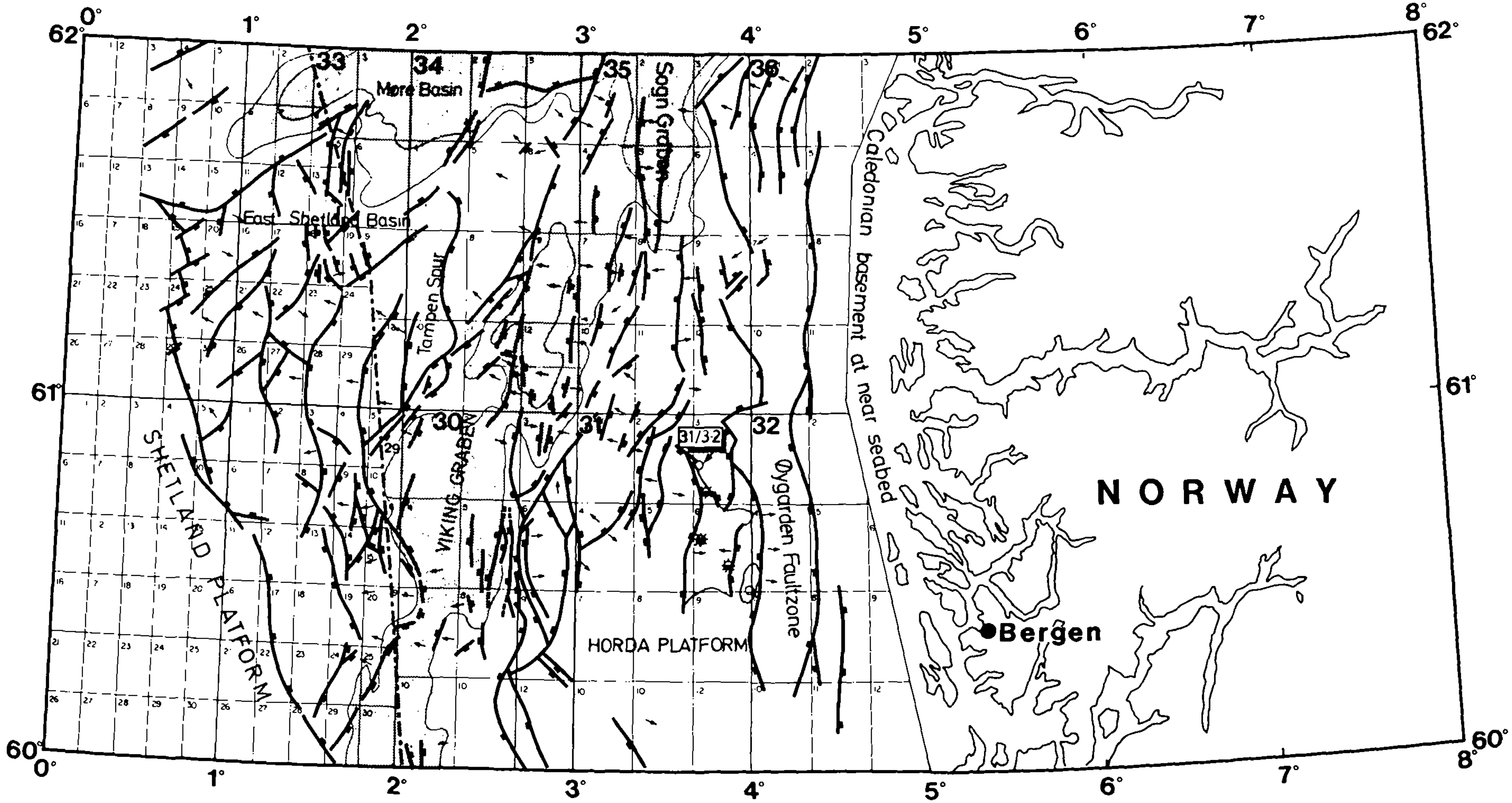
Seismic Pick twt (ms)	Pick Un-certainty (ms)	Interval Velocity (ms^{-1})	Interval Thickness (m)	Expected Depths MSL (m)	Expected Depths RKB (m) [illegible]	Total Seismic Uncertainty	Stratigraphy
460				340	365		Seabed
		1815 ±70	185				
665	±10			520	545	±15	Base NORDLAND GRP
		1855 ±90	55				
725	±10			575	600	±35	Intra OLIGOCENE seq. b.
		1860 ±70	230				
970	±10			805	830	±55	Top EOCENE seq. b.
		1955 ±55	230				
1205	±10			1025	1050	±80	Top BALDER FM
		2095 ±90	415				
1600	±10			1435	1460	±80	Top MAUREEN FM
		2690 ±45	95				
1670	+20 -10			1525	1550	+40 -25	Top DRAUPNE FM
		2390 ±90	25				
1690	±10			1550 (1575)	1575 (1600)$^{3)}$	±15	Top SOGNEFJORD FM
1690	±10			1550	1575	±10	G.O.C.
		3200 ±50	270$^{1)}$abs.$^{2)}$				
1860$^{1)}$abs.$^{2)}$	±20			18201)abs. $^{2)}$	1865$^{1)}$abs. $^{2)}$	±65	Fault plane
		3200 ±50	65$^{1)}$ 415$^{2)}$				
1900$^{1)}$ 1950$^{2)}$	±20			1885$^{1)}$ 1965$^{2)}$	1910$^{1)}$ 1990$^{2)}$	±65	Top NESS coal

Notes 1) Assuming well penetrates Top NESS coal on upthrown side of fault.

2) Assuming well penetrates Top NESS coal on downthrown side of fault.

3) Revised map and location.

G.I.B 27/10/83



Revised	
Date	Sign

Norsk Hydro Oslo Norway

NORTHERN NORTH SEA

Index map with
major structural elements

Contour interval	Interpreted by	Date
	T.Eg/M.B	FEB 83
Scale	Drawn by	Revised
	MR	
		File no

Fig.1

ISOCHRON MAP OF TOP SOGNEFJORD FM BLOCK 31/3

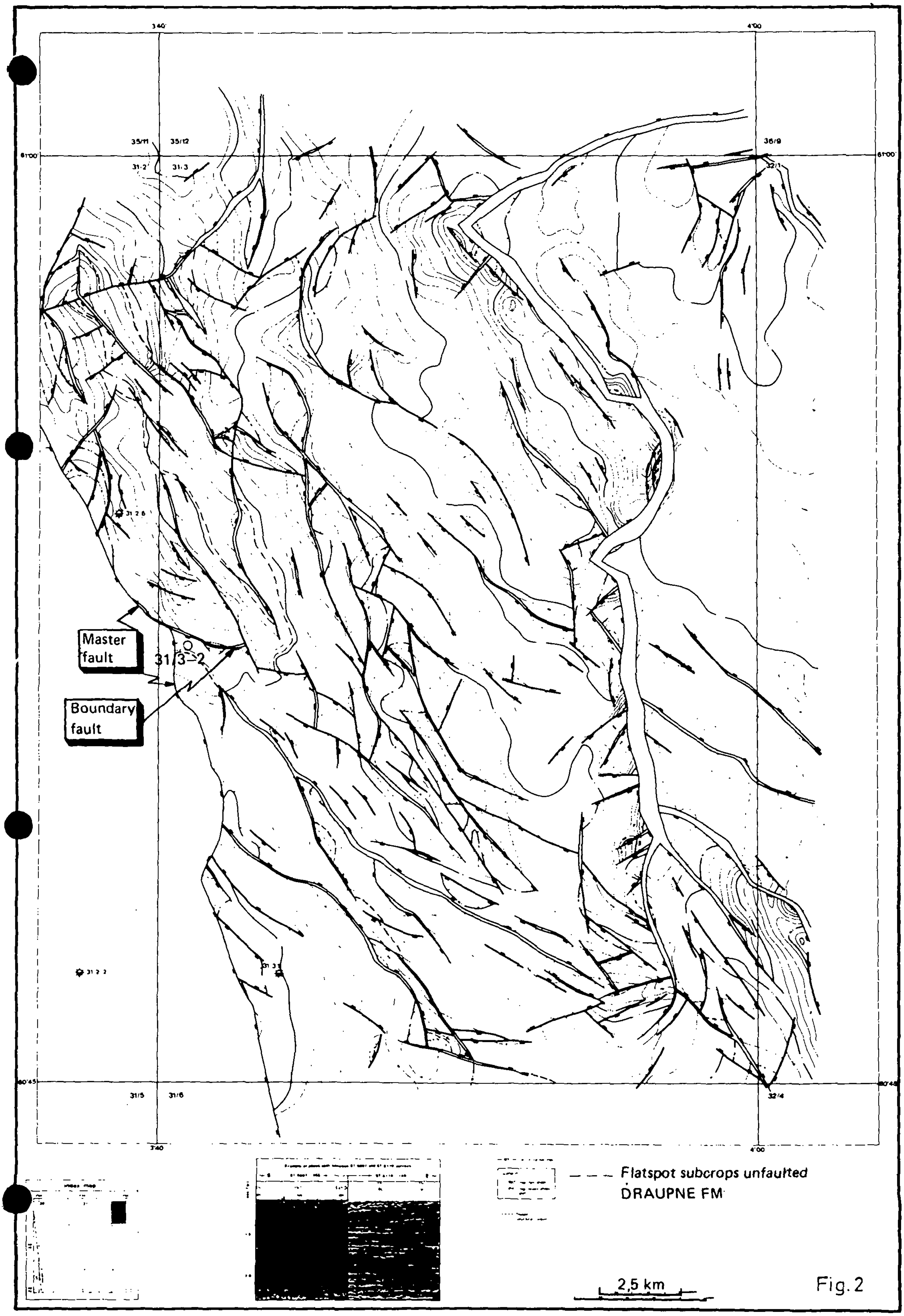


Fig. 2

31/3–2 GEOLOGICAL PROGNOSIS

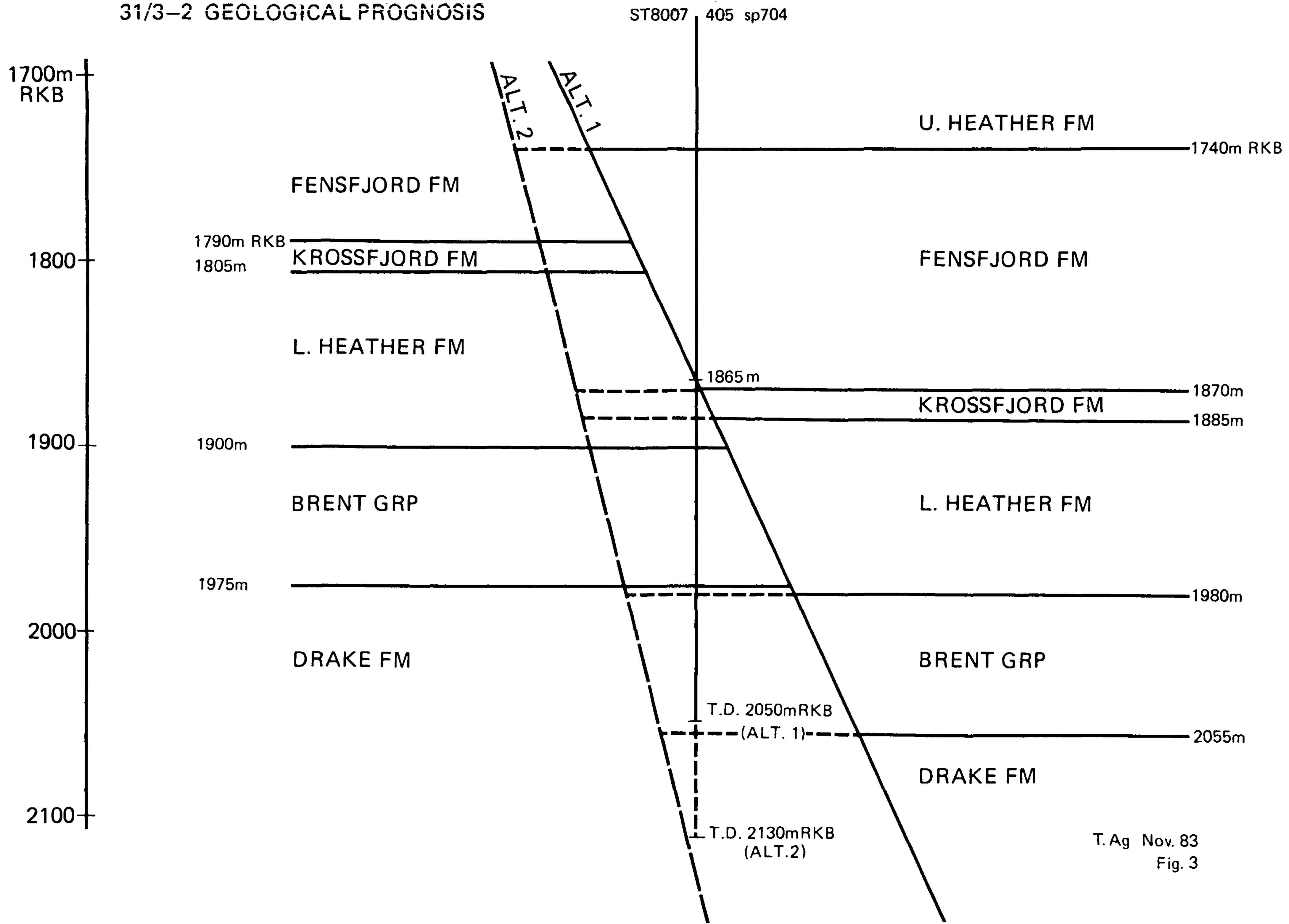


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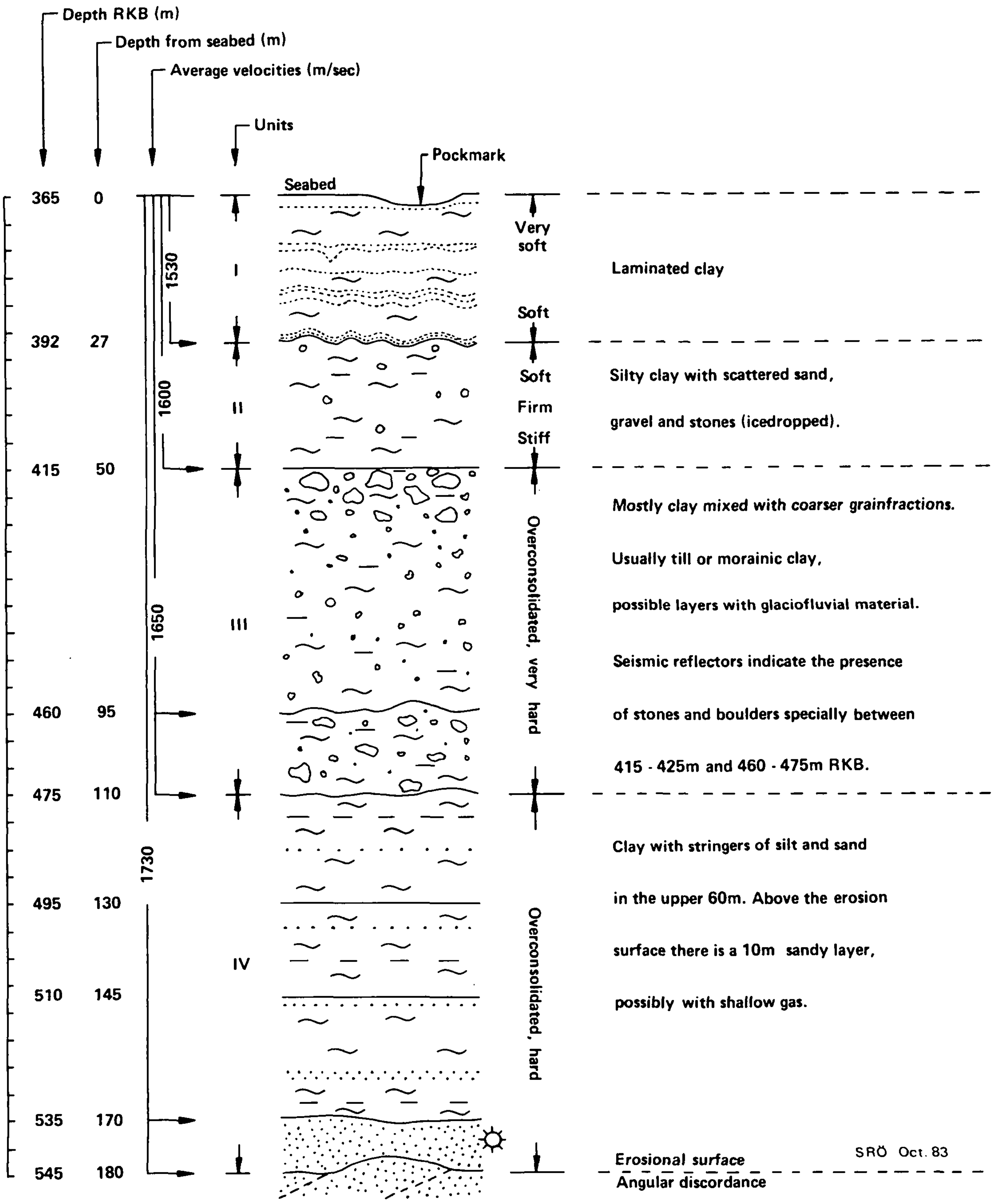
Fig. 3

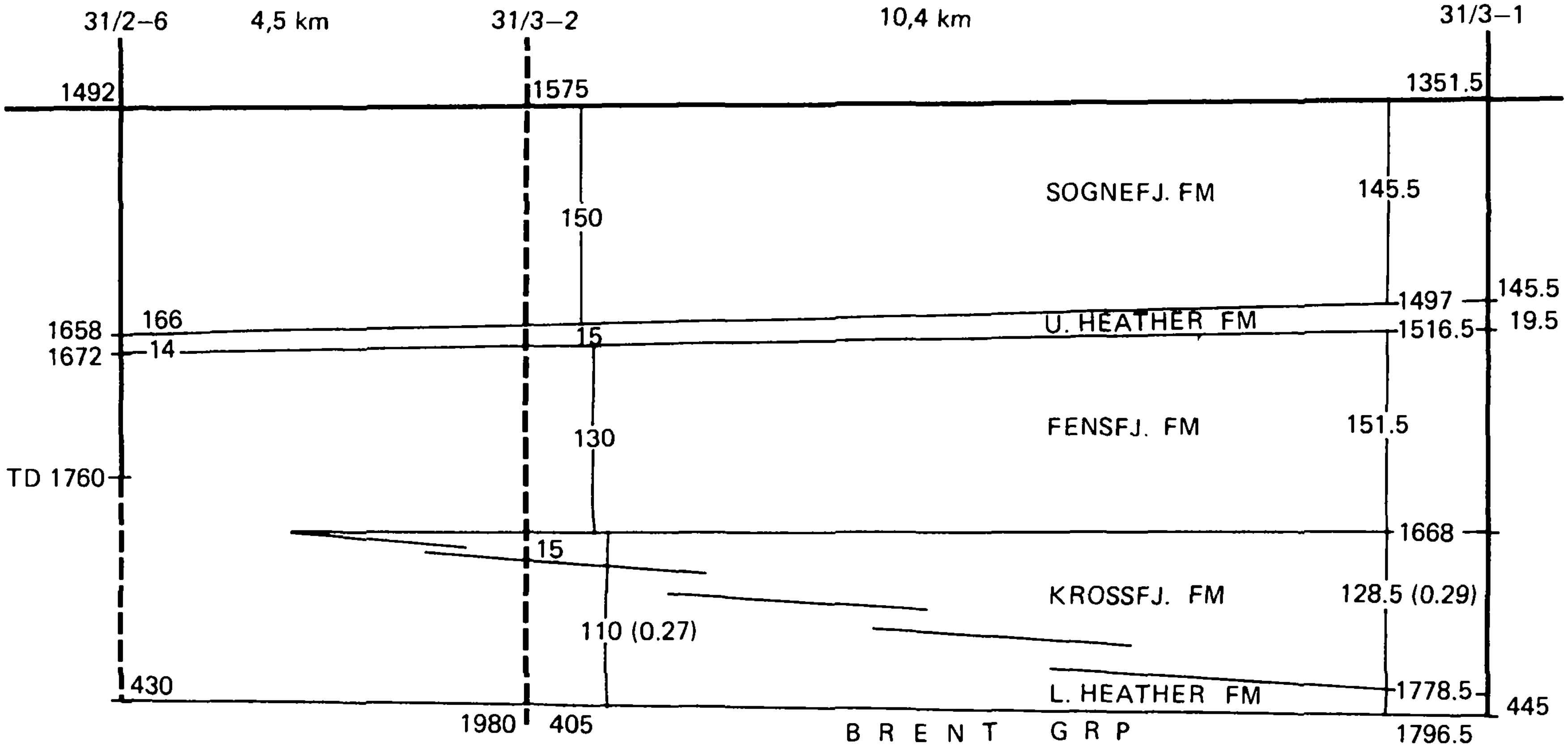
31/3 – 2

Fig.4

INTERPRETATION OF SHALLOW SEISMIC



THICKNESS RELATIONSHIPS, 31/2–6, 31/3–2, 31/3–1



All depths mRKB
Vertical scale: 1: 5000
Horizontal scale: 1: 75000

Fig. 5

COLOUR LEGEND TO SEISMIC INTERPRETATION, 31/3-2

BASE NORDLAND GRP	🟧
TOP OLIGOCENE SD	🟨
INTRA OLIGOCENE SEQ. BOUNDARY	🟨
TOP EOCENE	🟧
TOP BALDER FM	🟨
TOP MAUREEN FM	🟨
TOP CENOMANIAN SEQ.	🟫
BASE CENOMANIAN SEQ.	🟥
TOP DRAUPNE FM	🟦
TOP SOGNEFJORD FM	🟩
FLATSPOT	🟨
TOP NESS COAL	🟥
INTRA DRAKE FM SEQ. BOUNDARY	🟫
TOP JOHANSEN FM	🟧
TOP STATFJORD FM	🟨

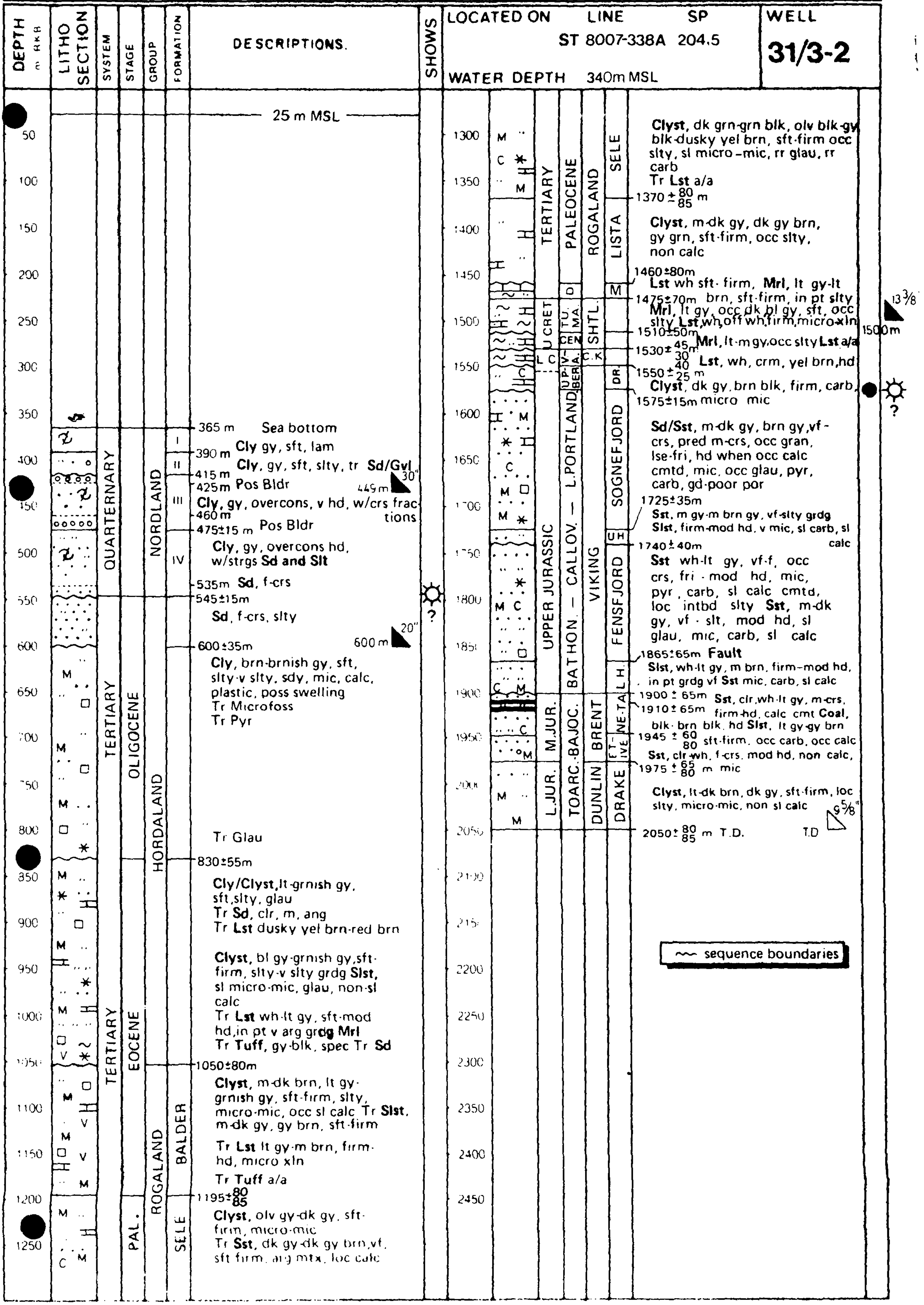
GEOLOGICAL PROGNOSIS

ALT. 1

LOCATED ON LINE ST 8007-338A SP 204.5

WATER DEPTH 340m MSL

WELL **31/3-2**



25 m MSL

365 m Sea bottom

Cly gy, sft, lam

390 m **Cly**, gy, sft, slty, tr **Sd/Gvl**

415 m

425m Pos Bldr

Cly, gy, overcons, v hd, w/crs fractions

460 m

475±15 m Pos Bldr

Cly, gy, overcons hd, w/strgs **Sd and Slt**

535m **Sd**, f-crs

545±15m

Sd, f-crs, slty

600±35m

Cly, brn-brnish gy, sft, slty-v slty, sdy, mic, calc, plastic, poss swelling
Tr Microfoss
Tr Pyr

Tr Glau

830±55m

Cly/Clyst, lt-grnish gy, sft, slty, glau
Tr **Sd**, clr, m, ang
Tr **Lst** dusky yel brn-red brn

Clyst, bl gy-grnish gy, sft-firm, slty-v slty grdg **Slst**, sl micro-mic, glau, non-sl calc
Tr **Lst** wh-lt gy, sft-mod hd, in pt v arg grdg **Mrl**
Tr **Tuff**, gy-blk, spec Tr **Sd**

1050±80m

Clyst, m-dk brn, lt gy-grnish gy, sft-firm, slty, micro-mic, occ sl calc Tr **Slst**, m-dk gy, gy brn, sft-firm

Tr **Lst** lt gy-m brn, firm-hd, micro xln

Tr **Tuff** a/a

1195$\pm^{80}_{85}$

Clyst, olv gy-dk gy, sft-firm, micro-mic
Tr **Sst**, dk gy-dk gy brn, vf, sft firm, arg mtx, loc calc

Clyst, dk grn-grn blk, olv blk-gy blk-dusky yel brn, sft-firm occ slty, sl micro-mic, rr glau, rr carb
Tr **Lst** a/a

1370 $\pm^{80}_{85}$ m

Clyst, m-dk gy, dk gy brn, gy grn, sft-firm, occ slty, non calc

1460±80m

Lst wh sft-firm, **Mrl**, lt gy-lt brn, sft-firm, in pt slty

1475±70m

Mrl, lt gy, occ dk bl gy, sft, occ slty **Lst**, wh, off wh, firm, micro-xln

1510±50m **Mrl**, lt-m gy, occ slty **Lst** a/a

1530$\pm^{45}_{30}$m **Lst**, wh, crm, yel brn, hd

1550$\pm^{40}_{25}$ m

Clyst, dk gy, brn blk, firm, carb, micro mic

1575±15m

Sd/Sst, m-dk gy, brn gy, vf-crs, pred m-crs, occ gran, lse-fri, hd when occ calc cmtd, mic, occ glau, pyr, carb, gd-poor por

1725±35m

Sst, m gy-m brn gy, vf-slty grdg **Slst**, firm-mod hd, v mic, sl carb, sl calc

1740±40m

Sst wh-lt gy, vf-f, occ crs, fri - mod hd, mic, pyr, carb, sl calc cmtd, loc intbd slty **Sst**, m-dk gy, vf - slt, mod hd, sl glau, mic, carb, sl calc

1865±65m **Fault**

Slst, wh-lt gy, m brn, firm-mod hd, in pt grdg vf **Sst** mic, carb, sl calc

1900 ± 65m **Sst**, clr, wh-lt gy, m-crs,

1910 ± 65m firm-hd, calc cmt **Coal**, blk-brn blk, hd **Slst**, lt gy-gy brn

1945 $\pm^{60}_{80}$ sft-firm, occ carb, occ calc

Sst, clr-wh, f-crs, mod hd, non calc,

1975 $\pm^{65}_{80}$ m mic

Clyst, lt-dk brn, dk gy, sft-firm, loc slty, micro-mic, non sl calc

2050$\pm^{80}_{85}$ m T.D.

〰 sequence boundaries

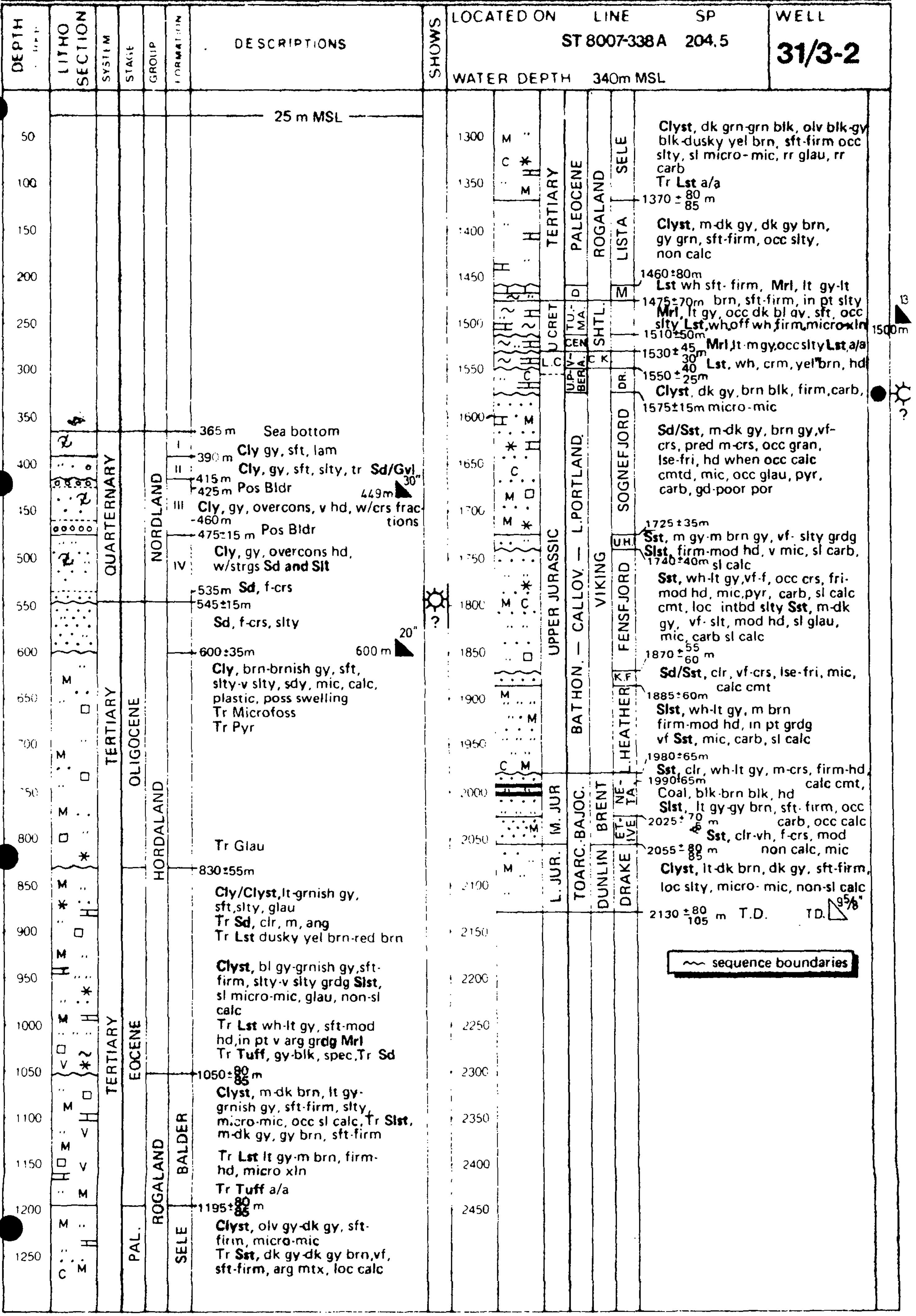
GEOLOGICAL PROGNOSIS

ALT. 2

LOCATED ON LINE ST 8007-338A SP 204.5

WATER DEPTH 340m MSL

WELL **31/3-2**



25 m MSL

365 m Sea bottom

390 m **Cly** gy, sft, lam

Cly, gy, sft, slty, tr **Sd/Gvl**

415 m

425 m Pos Bldr

Cly, gy, overcons, v hd, w/crs fractions

-460 m

475±15 m Pos Bldr

Cly, gy, overcons hd, w/strgs **Sd and Slt**

535m **Sd**, f-crs

545±15m

Sd, f-crs, slty

600±35m

Cly, brn-brnish gy, sft, slty-v slty, sdy, mic, calc, plastic, poss swelling
Tr Microfoss
Tr Pyr

Tr Glau

830±55m

Cly/Clyst, lt-grnish gy, sft, slty, glau
Tr **Sd**, clr, m, ang
Tr **Lst** dusky yel brn-red brn

Clyst, bl gy-grnish gy, sft-firm, slty-v slty grdg **Slst**, sl micro-mic, glau, non-sl calc
Tr **Lst** wh-lt gy, sft-mod hd, in pt v arg grdg **Mrl**
Tr **Tuff**, gy-blk, spec, Tr **Sd**

$1050 \pm {}^{80}_{85}$ m

Clyst, m-dk brn, lt gy-grnish gy, sft-firm, slty, micro-mic, occ sl calc, Tr **Slst**, m-dk gy, gy brn, sft-firm

Tr **Lst** lt gy-m brn, firm-hd, micro xln

Tr **Tuff** a/a

$1195 \pm {}^{80}_{85}$ m

Clyst, olv gy-dk gy, sft-firm, micro-mic
Tr **Sst**, dk gy-dk gy brn, vf, sft-firm, arg mtx, loc calc

Clyst, dk grn-grn blk, olv blk-gy blk-dusky yel brn, sft-firm occ slty, sl micro-mic, rr glau, rr carb
Tr **Lst** a/a

$1370 \pm {}^{80}_{85}$ m

Clyst, m-dk gy, dk gy brn, gy grn, sft-firm, occ slty, non calc

1460±80m

Lst wh sft-firm, **Mrl**, lt gy-lt brn, sft-firm, in pt slty

1475±70m

Mrl, lt gy, occ dk bl gy, sft, occ slty **Lst**, wh, off wh, firm, micro-xln

1510±50m

$1530 \pm {}^{45}_{30}$ m **Mrl**, lt-m gy, occ slty **Lst**, a/a

Lst, wh, crm, yel brn, hd

$1550 \pm {}^{40}_{25}$ m

Clyst, dk gy, brn blk, firm, carb, micro-mic

1575±15m

Sd/Sst, m-dk gy, brn gy, vf-crs, pred m-crs, occ gran, lse-fri, hd when occ calc cmtd, mic, occ glau, pyr, carb, gd-poor por

1725±35m

Sst, m gy-m brn gy, vf-slty grdg **Slst**, firm-mod hd, v mic, sl carb, sl calc

1740±40m

Sst, wh-lt gy, vf-f, occ crs, fri-mod hd, mic, pyr, carb, sl calc cmt, loc intbd slty **Sst**, m-dk gy, vf-slt, mod hd, sl glau, mic, carb sl calc

$1870 \pm {}^{55}_{60}$ m

Sd/Sst, clr, vf-crs, lse-fri, mic, calc cmt

1885±60m

Slst, wh-lt gy, m brn firm-mod hd, in pt grdg vf **Sst**, mic, carb, sl calc

1980±65m

Sst, clr, wh-lt gy, m-crs, firm-hd, calc cmt,

1990±65m

Coal, blk-brn blk, hd

Slst, lt gy-gy brn, sft-firm, occ carb, occ calc

$2025 \pm {}^{70}_{5}$ m

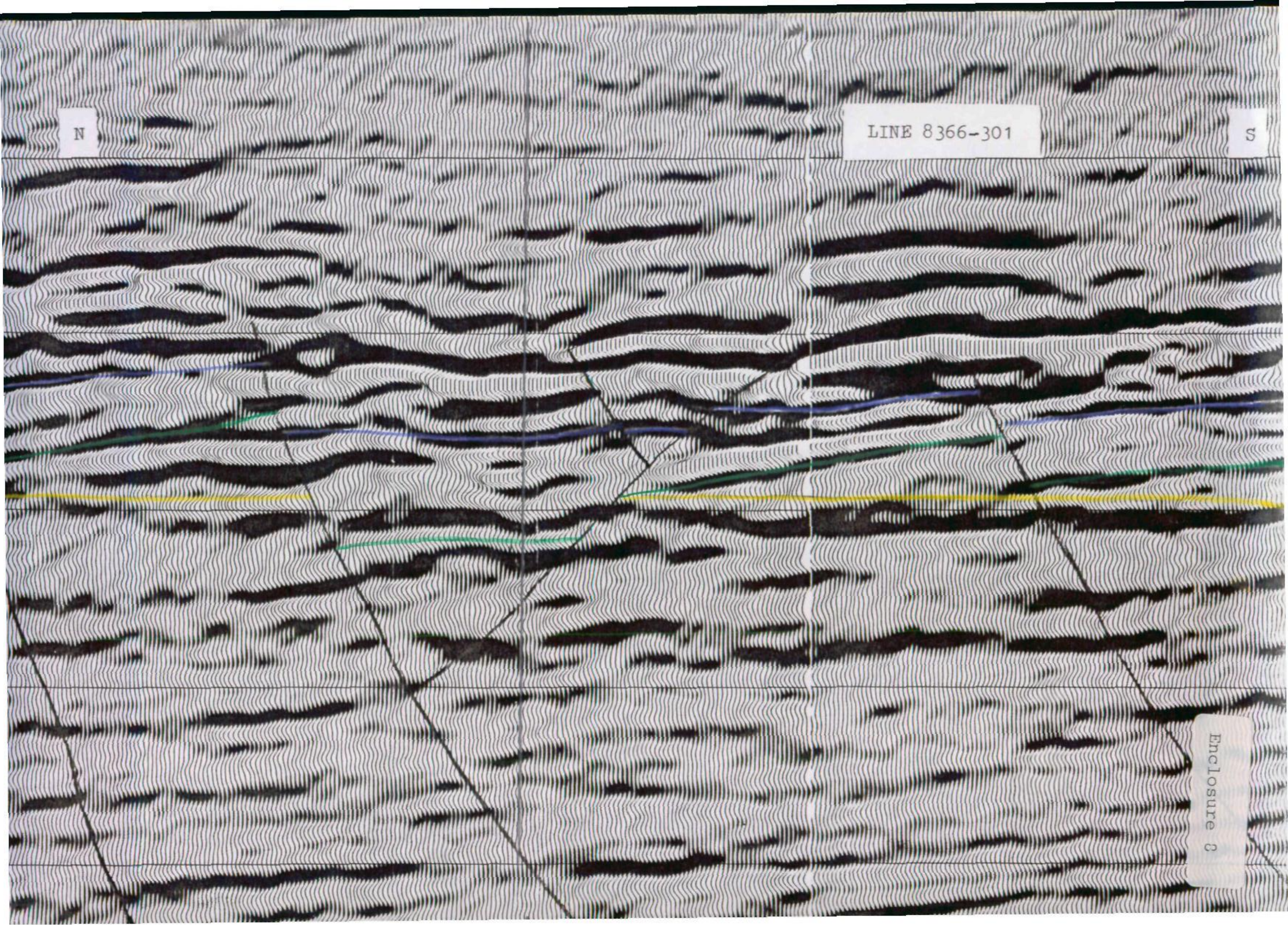
Sst, clr-vh, f-crs, mod non calc, mic

$2055 \pm {}^{80}_{85}$ m

Clyst, lt-dk brn, dk gy, sft-firm, loc slty, micro-mic, non-sl calc

$2130 \pm {}^{80}_{105}$ m T.D.

〰 sequence boundaries



Enclosure 8

Enclosure 9