

Denne rapport  
tilhører



**L&U DOK.SENTER**

L.NR. 20089050033

KODE Well 31/2-5 nr 48

**Returneres etter bruk**

CONFIDENTIAL

NSEP-94

A/S NORSKE SHELL  
PRODUCTION LICENCE 054  
BLOCK 31/2

EXPLORATION WELL PROPOSAL 31/2-F

A/S NORSKE SHELL  
FORUS

SEPTEMBER 1980

31/2-F WELL PROPOSAL

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## 1. INTRODUCTION

It is proposed to drill an exploratory well 31/2-F in block 31/2 at the intersection between seismic lines 79-421 and 79-410. The location is in a water depth of 330 m and proposed TD is 2500 m in Triassic.

The coordinates for the well are:

Latitude            60<sup>0</sup> 46' 16.2" N

Longitude          03<sup>0</sup> 25' 55.1" E

The proposed location is some 6 km west of well 31/2-1, and will be testing a separate fault block west of the main gas accumulation.

The objectives of the well are:

- to test presence and nature of hydrocarbons in a structure west of the main gas reservoir
- to test lateral variation in reservoir characteristics westwards
- to investigate possible causes for the difference in flatspot appearance in this fault block
- to get a good geologic identification of the various seismic reflectors for lateral extrapolation of well data

## 2. CONCESSION SITUATION (Fig. 1)

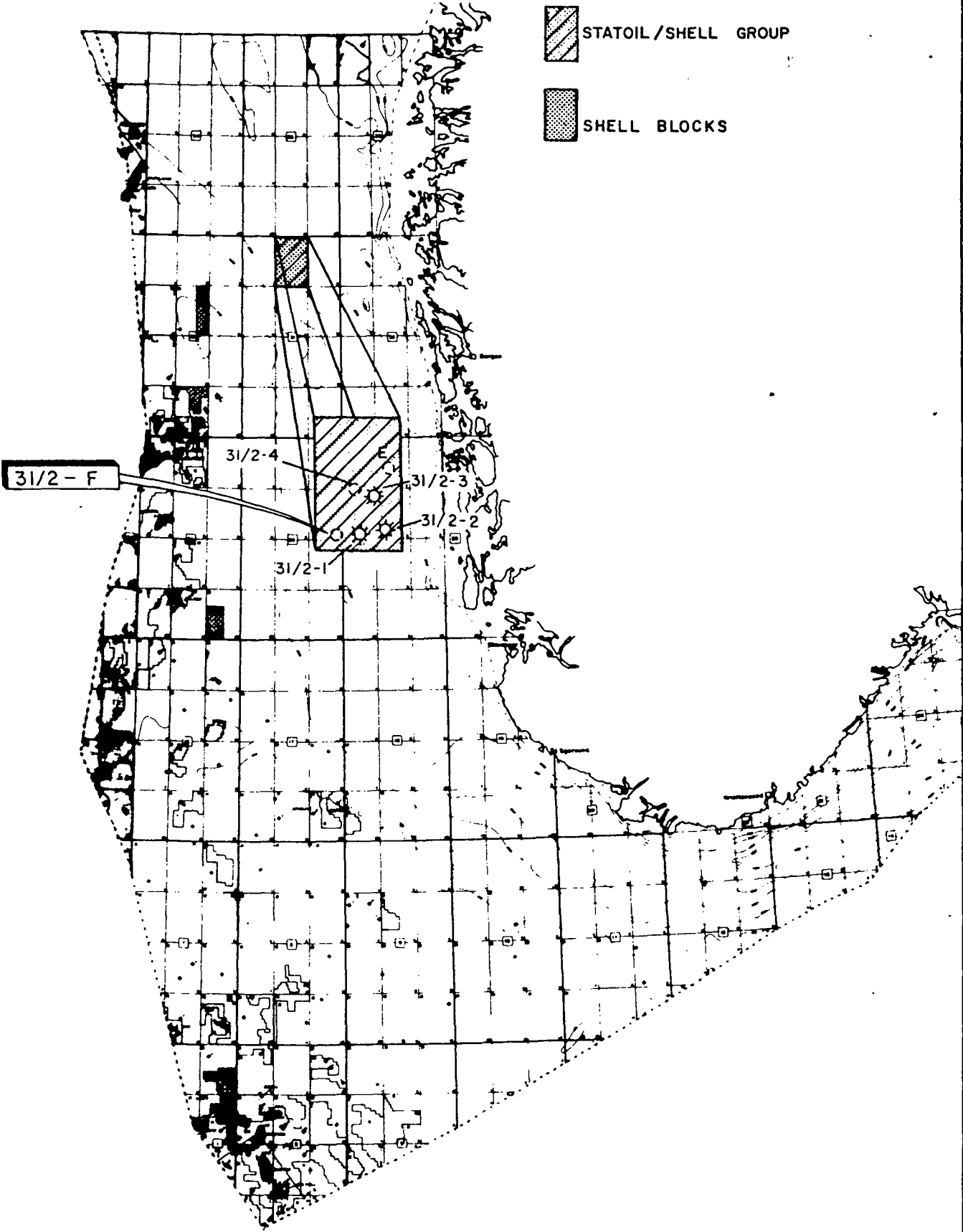
The Licence 054 carries a six well commitment, one of which must reach the Palaeozoic or a maximum of 5000 m. The other five wells must fully penetrate the prospective Jurassic sequence and bottom in Triassic or older sediments. Well 31/2-1, 2 and 3 satisfied the Triassic requirement as will 31/2-F, and 31/2-4 presently being drilled is planned to satisfy the deep test requirement.



## 3. REGIONAL SETTING (Fig. 2)

The Flathead structure is located near the boundary between the Northern Viking Graben and the Horda Platform. It is formed by a large N-S trending tilted fault block, heavily broken by younger faults in the north, but more gentle in the central and southern parts.

## 4. STRATIGRAPHY (Figs. 3, 4, 5, Encl. 1, 2, 3)

The Tertiary series of siltstones and claystones is expected to be very similar to that penetrated by the previous wells in the block. \*A thin sequence of marl and limestones of Palaeocene - Cretaceous age similar to that seen in 31/2-1 and 3 is expected, probably directly overlying the Upper Jurassic reservoir sandstones. The organic Kimmeridge Clay Formation is likely to be extremely thin or absent.




 STATOIL / SHELL GROUP  
 SHELL BLOCKS

31/2 - F

31/2-4  
 31/2-3  
 31/2-2  
 31/2-1

0 50 100 Km

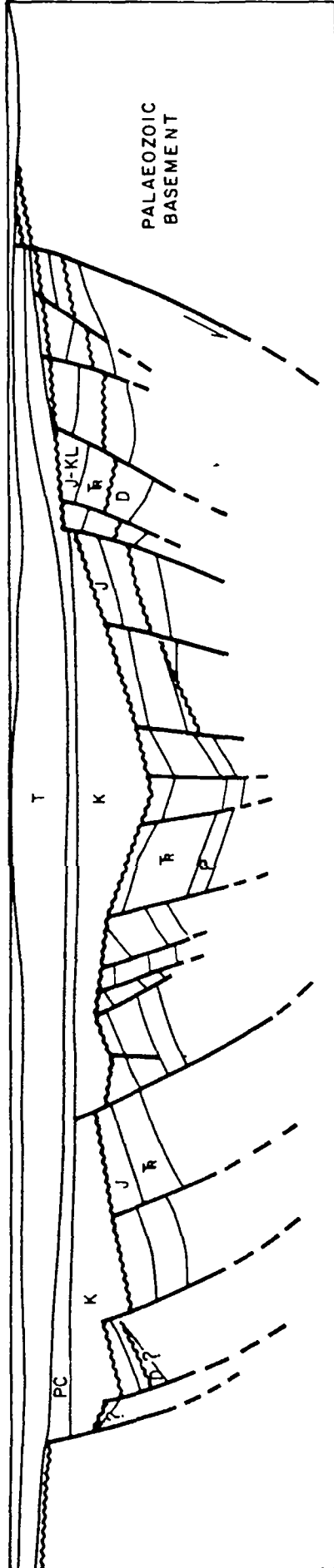
a-s Norske Shell EXPLORATION & PRODUCTION		
<b>CONCESSION SITUATION</b> 31/2-1, 2, 3, 4, E and F		
AUTHOR EPXT/12 RPT No NSEF 94	FIG 1	DATE 1980 DRAW No 715/1

U.K. WATERS ← NORWEGIAN WATERS →


QUAD. 2      QUAD. 3      QUAD. 30      QUAD. 31      QUAD. 32

W

E

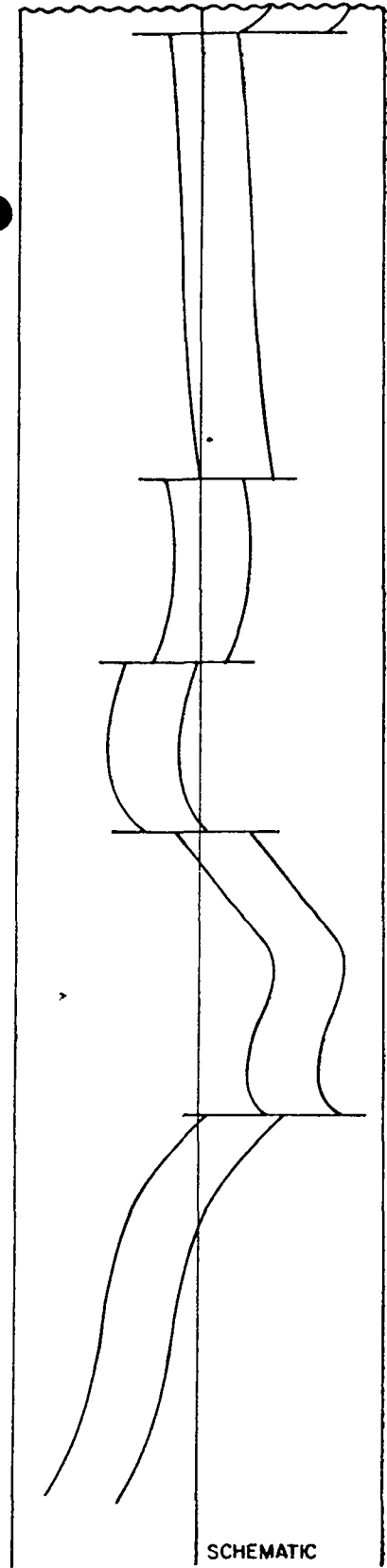
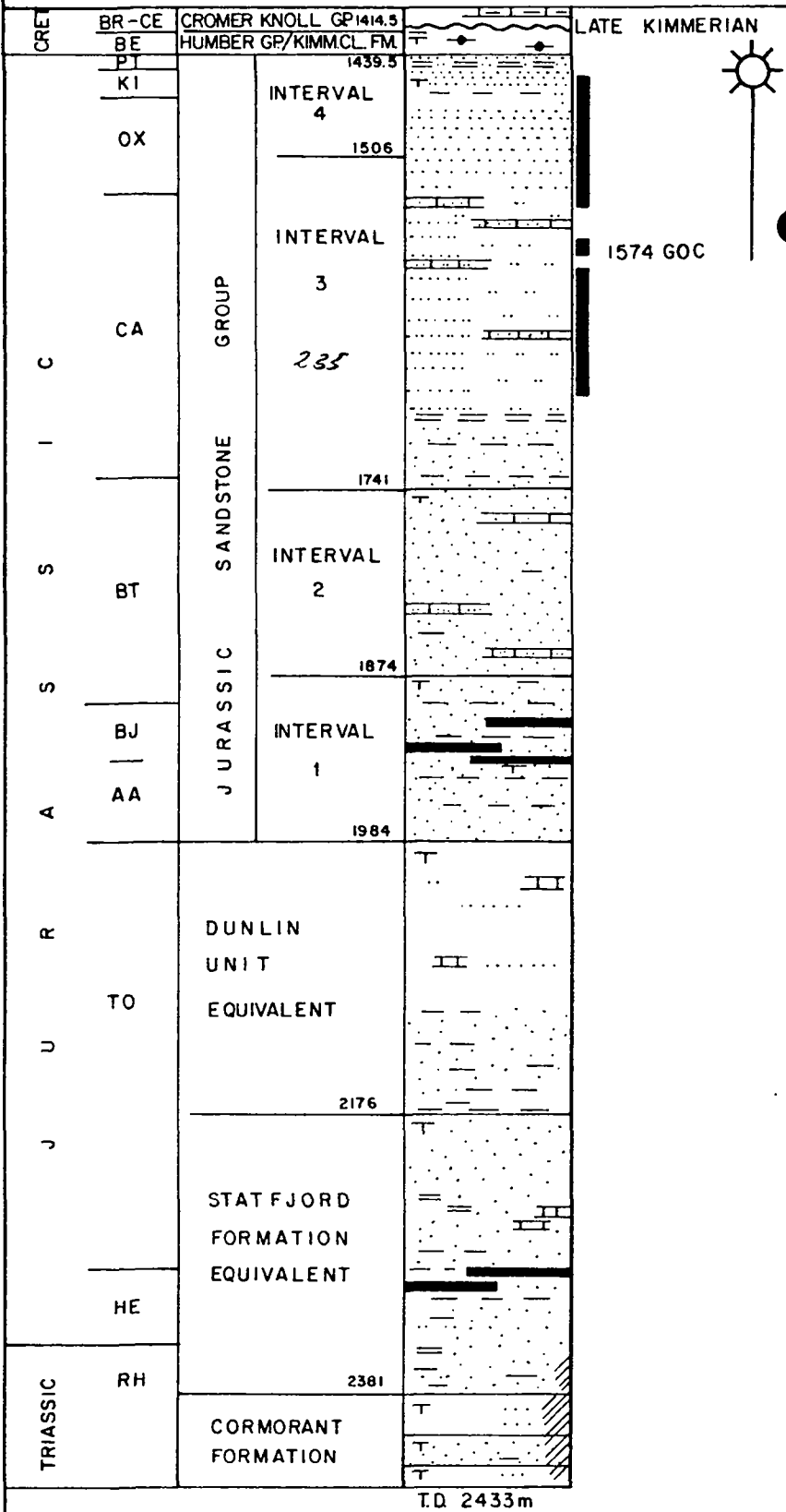


VERTICAL SCALE ca 1: 200 000  
HORIZONTAL SCALE 1: 1000 000

a-s Norske Shell EXPLORATION & PRODUCTION FORUS			
NORTHERN NORTH SEA SCHEMATIC CROSS SECTION			
AUTHOR EPXT/13	FIG. 2	DATE SEPT 1980	DRAW NO 715/2
REPORT NO NSEP 94			

DEPTHS BELOW RKB (25m)

CONT. MARINE  
COASTAL



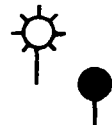
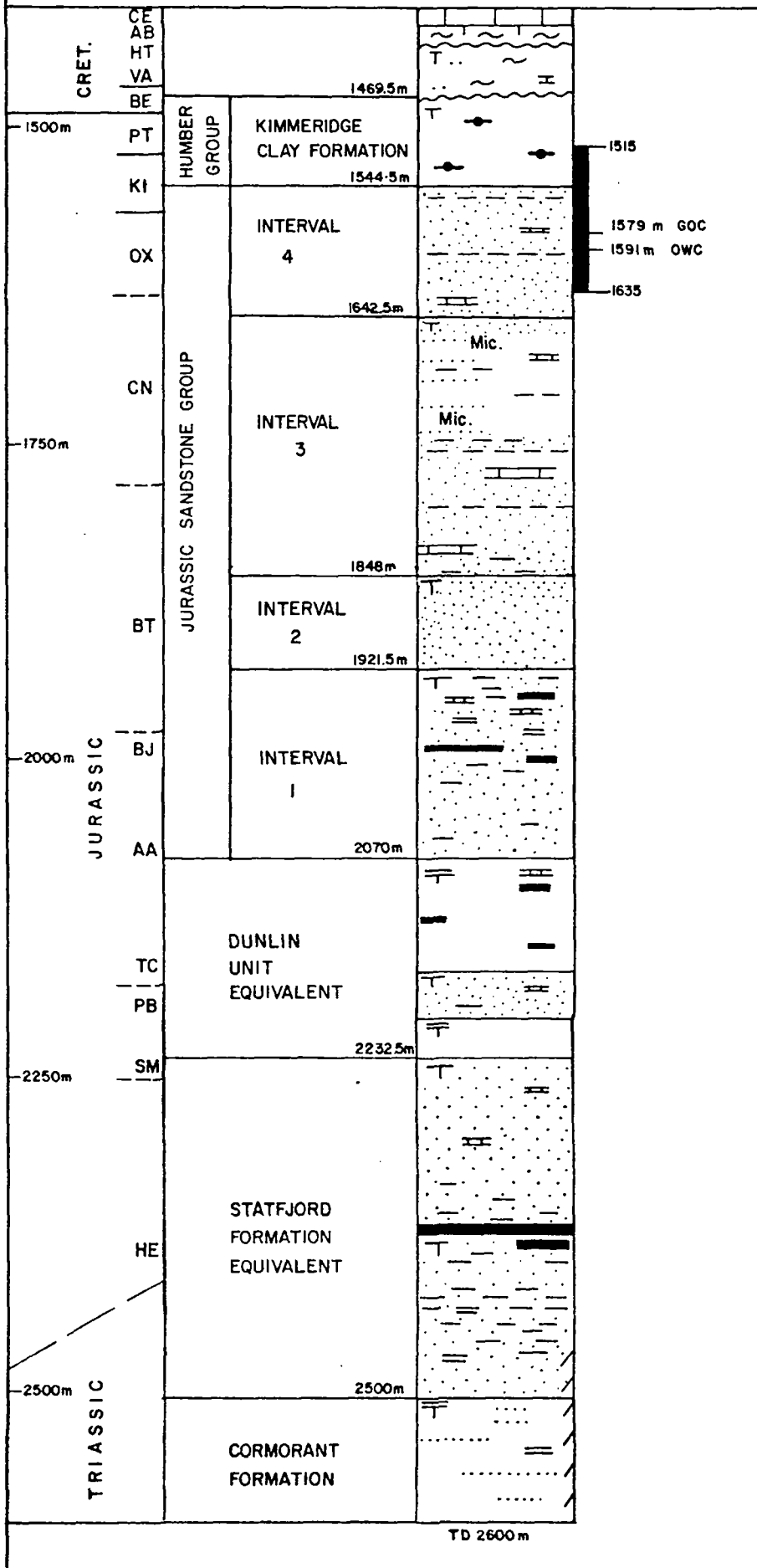
**a-s Norske Shell**  
EXPLORATION & PRODUCTION FORUS

**31/2-1**  
STRATIGRAPHY OF THE  
JURASSIC SECTION

AUTHOR EPXT/13	FIG. 3	DATE SEPT. 1980
REPORT NO NSEP 94	DRAW NO 715/3	



DEPTHS BELOW RKB (32m)

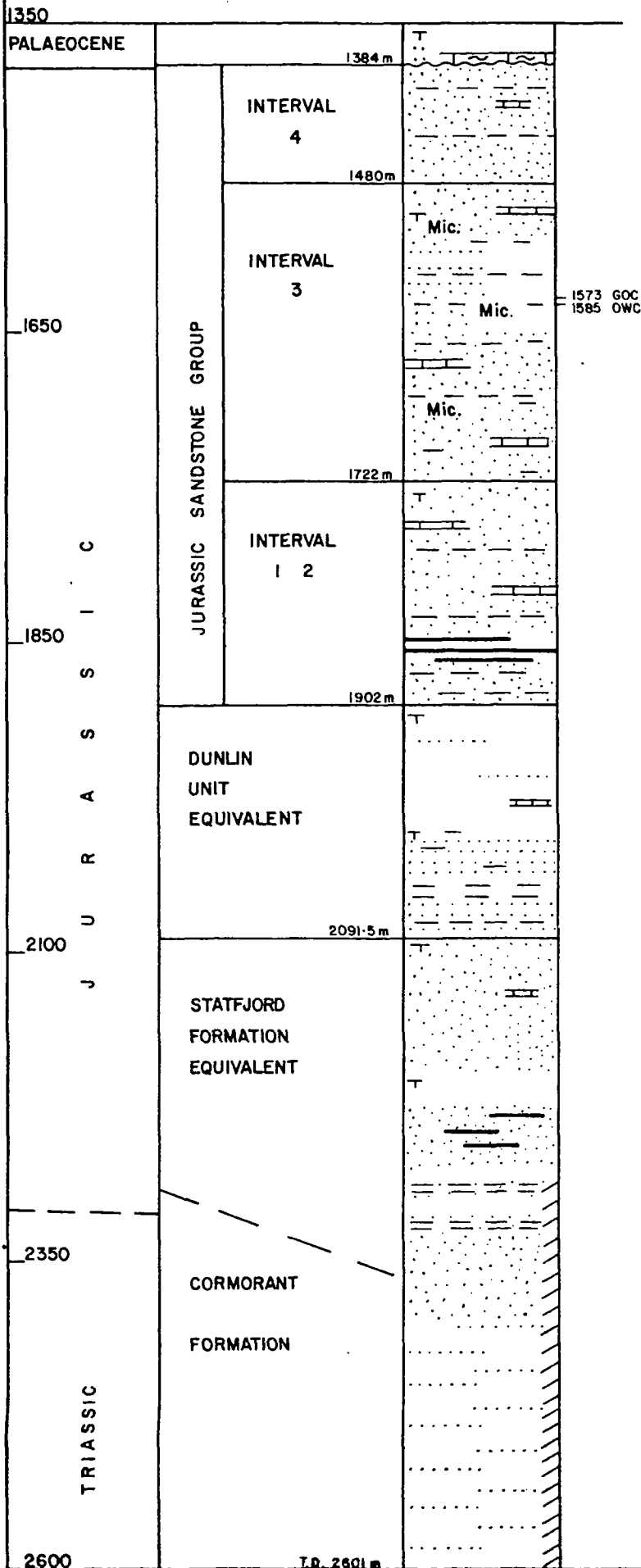


a-s Norske Shell  
EXPLORATION & PRODUCTION FORUS

**31/2 - 2**  
**STRATIGRAPHY**  
**OF THE JURASSIC SECTION**  
SCALE 1:5000

AUTHOR EPXT/13	FIG 1	DATE SEPT 1980
REPORT NO NSEP94	4	DRAW NO 715/4

DEPTHS BELOW RKB (32 m)



a-s Norske Shell			
EXPLORATION & PRODUCTION FORUS			
<b>31/2 - 3</b>			
<b>PRELIMINARY STRATIGRAPHY</b>			
<b>OF THE JURASSIC SECTION</b>			
AUTHOR EPXT/13	FIG. 5	DATE SEPT. 80	
REPORT NO NSEP94		DRAW NO 715/5	

It is anticipated that the upper part of the Jurassic Sandstone Group (Interval 4) will consist of medium-coarse well sorted, poorly consolidated sandstones with interbedded finer micaceous beds. In previous wells this interval has had porosities averaging 36% with correspondingly higher permeabilities. The less good, more micaceous sands are expected to increase downwards to 1570 m (+ 30 m) subsea where the top of Unit IV b+c is interpreted to be from seismic. This unit has been found in all three wells to date, to be very fine, highly micaceous sands with relatively low porosities (av. <24%) and permeabilities (av. <100 md) and has masked the GOC and OWC in 31/2-1 & 3. Assuming the base of the gas to be 1548 m ss, the contacts in this well should be in the better quality sandstones. However it is recognised that lateral variation of the Upper Jurassic Sandstone Group to the west may give a very different sequence to that encountered in earlier wells. A gas bearing column of 53 m is expected.

A similar sequence to that encountered by the first three wells through the rest of the Jurassic is expected at this location, with some local variations, the most notable of these being the possibility of two coal horizons within Interval 1.

TD is prognosed at 2500 m ss to occur within red sands and shales of Triassic age.

## 5. SEISMIC INTERPRETATION

### 5.1 Seismic Data (Fig. 6, Encl. 4, 5)

Block 31/2 is covered by seismic data of several vintages ranging from 1970 through 1979.

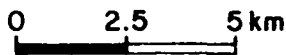
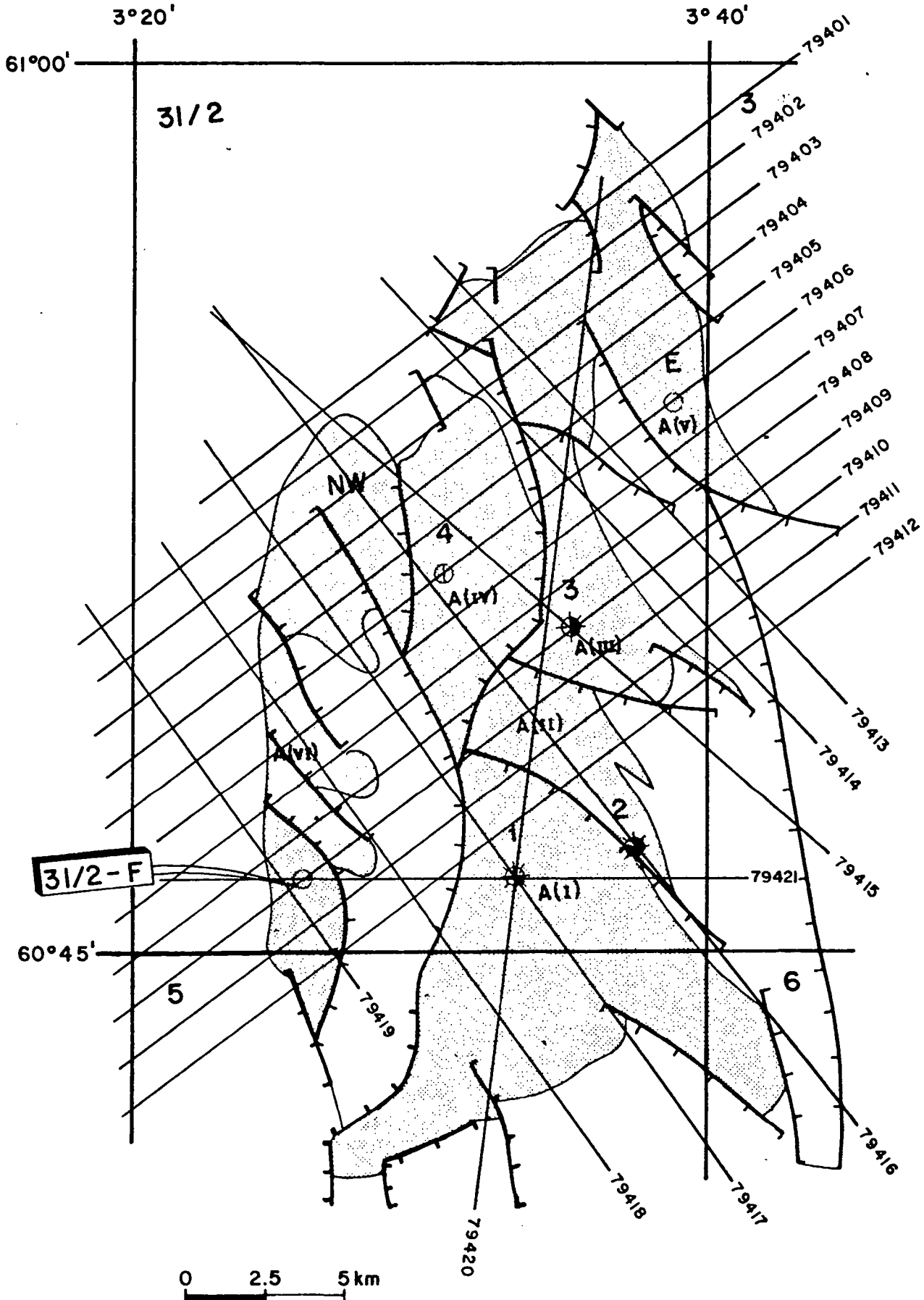
The latest interpreted survey of some 550 km was shot in 1979 by Shell on behalf of lic. 054 partners, and this forms the basis for the present interpretation in the block. This survey was oriented predominantly NE-SW with a linespacing of about 1.3 km.

All these data have been migrated and the very good quality enables a reliable fault correlation over the main structure. In the north and west, however, coverage and orientation of the lines is not optimal for an accurate mapping, and a new seismic survey in a 1x1 km grid over the entire block has been shot in 1980.

Processing of these data will not be completed before November, but a few test lines and early results are available as it looks like a high data quality can be expected. It is believed that interpretation of these data will lead to a better geologic understanding of the uncertain parts of block 31/2.


### 5.2 Stratigraphic Identification of Reflectors (Encl. 4, 5)

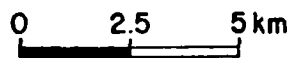
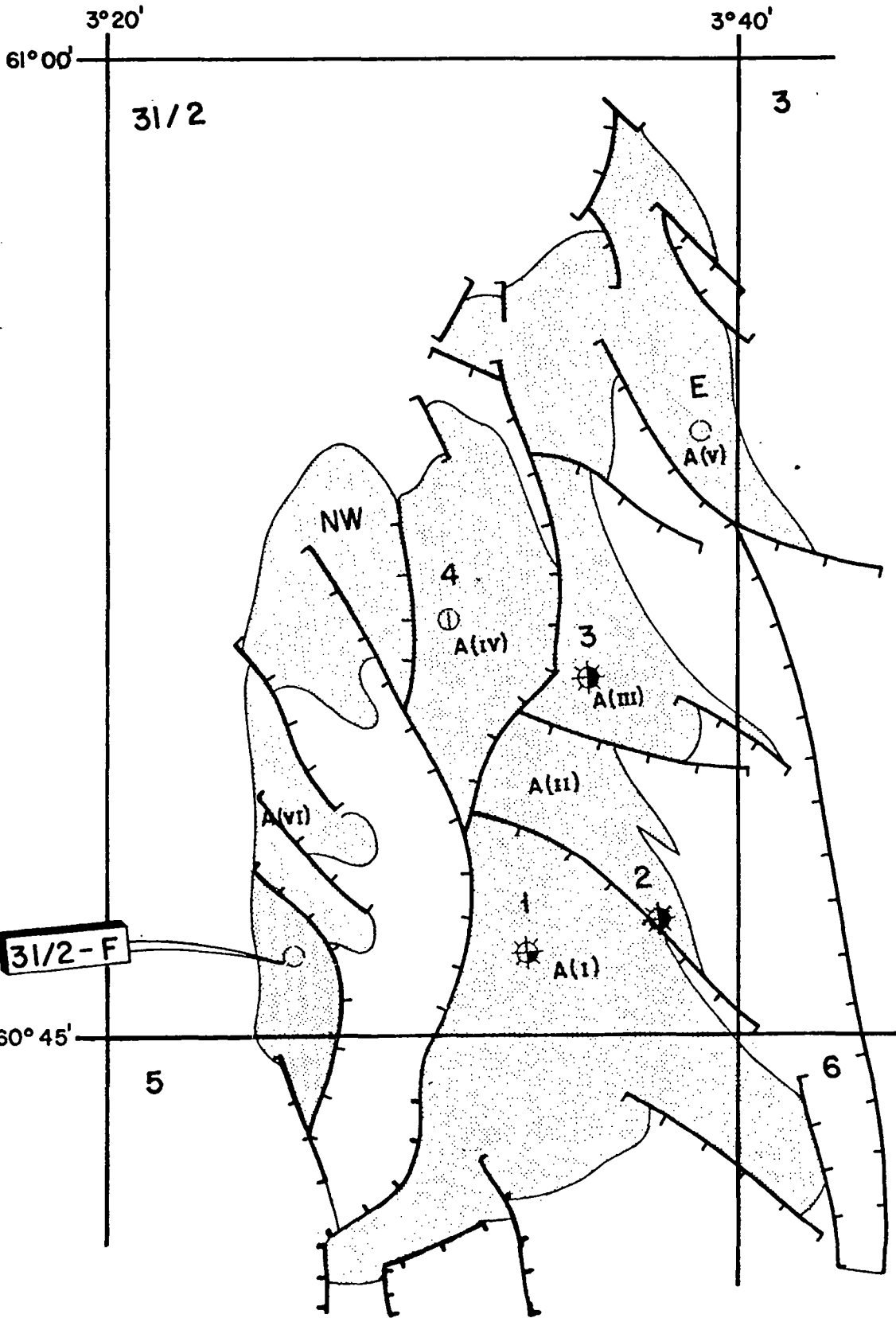
A total of ten seismic lines through all drilled and possible well locations have been processed to band limited acoustic impedance sections. The excellent match between the band limited



 CLOSURE AT RESERVOIR LEVEL


 FAULT

a-s Norske Shell EXPLORATION & PRODUCTION FORUS 		
<b>BLOCK 31/2</b>		
<b>1979</b>		
<b>SEISMIC PROGRAMME</b>		
AUTHOR: EPXT/12	FIG: 6	DATE: SEPT '80
REPORT NO: NSEP94		DRAW NO: 6715/6



 CLOSURE AT RESERVOIR LEVEL

 FAULT

a-s Norske Shell EXPLORATION & PRODUCTION FORUS 		
<b>BLOCK 31/2</b> KEY TO FAULT-BLOCK NOTATION		
AUTHOR EPXT/12	FIG: 7	DATE SEPT. '80
REPORT NO NSEP94		DRAW NO G 715/7

logs from 31/2-1, 2 and 3 and the impedance sections through these wells give a very reliable stratigraphic identification of the various seismic reflections. Important formation tops at 31/2-F location picked from the seismic data are:

- top Balder formation at 1440 ms
- the marls near base Palaeocene at 1600 ms
- top Upper Jurassic reservoir sands at 1620 ms
- top Bathonian sandstone at 1810 ms
- top Middle Jurassic chalky marls at 1900 ms
- top Dunlin shale at approximately 1975 ms
- top Dunlin sandstone at 2025 ms
- top Statfjord formation at 2085 ms
- top Statfjord coals at 2160 ms
- top Cormorant formation around 2230 ms

The seismic flatspot is poorly developed over the western fault block, but it appears to come in at 1660 msec.

### 5.3 Seismic Mapping (Encl. 6)

A revised preliminary seismic contour map (in time) of the top Upper Jurassic sand covering the four blocks 31/2, 3, 5 and 6 is enclosed.

The time picks in block 31/2 is primarily based on interpretation of the 1979 seismic data shot for lic. 054, and in the three adjacent blocks on Norsk Hydro's data from 1978 and Statoil's data from 1979. For a better fault definition all available older data has been incorporated.

## 6. CHOICE OF LOCATION

A location in the downthrown fault block A (vi) west of the main gas accumulation has been chosen for well 31/2-F.

In this fault block a fairly large, low relief structure has been mapped. The areal closure of this structure has some uncertainties because the existing seismic data does not give a clear answer about presence of seismic flatspot and where to pick it. A well in this fault block combined with more seismic data will therefore be of great value to prove additional hydrocarbon reserves as well as for a better geologic understanding of the reservoir development.

It is therefore proposed to drill an exploratory well 31/2-F at the intersection between seismic lines 79-421 and 79-410, to a TD of 2500 m in Triassic.

The proposed location is some 30 m downdip from the crest of the structure. Assuming the flatspot at the same depth as in 31/2-1, a gas column of 53 m is expected.

Prognosis sheet for well 31/2-F is in Enclosure 7 and drilling programme in Appendix I.

APPENDIX I

Drilling Proposal 31/2-F

1. Well Statoil/Norske Shell/Conoco/Superior/  
Norsk Hydro, in Production Licence 054
2. Location Coordinates: Lat. 60<sup>0</sup> 46' 16.2" N  
Long. 03<sup>0</sup> 25' 55.1" E  
  
On seismic line 79421 at S.P. 274 m.  
Water depth 330 m.
3. Objectives 1) Upper/Middle Jurassic sandstones  
proved hydrocarbon bearing in  
31/2-1, 2, 3
4. Total Depth 2500 m ss in Triassic
5. Prognosis (depths in metres subsea)
 

Sea Bed 330 m (+ 5 m)	
330 m (+5) - 1280 m (+20)	<u>Quaternary - Eocene</u> ; claystones, sandstone, thin limestones
1280 m (+20) - ca. 1350 m	<u>Eocene</u> ; tuffaceous claystones, siltstone
ca. 1350 m - 1475 m (+20)	<u>Palaeocene</u> ; silty claystones, marls
1475 m (+20) - 1495 m (+20)	<u>Cretaceous ?</u> limestones, marls
1495 m (+20) - 1570 m (+30)	<u>Upper - Middle Jurassic (Intervals 3-4)</u> medium grained, unconsolidated sands, thin calcareous cemented bands. Finer, more micaceous beds increasing downwards.
<u>1548 m</u>	Base of gas column
<u>1560 m</u>	Base of oil column
1570 m (+30) - 1755 m (+20)	<u>Middle Jurassic (Interval 3)</u> ; very fine, micaceous sandstones, becoming coarser, less micaceous downwards. Thin calcareous cemented beds.



1755 m (+20) - 1900 m (+20)	<u>Middle Jurassic (ca. Interval 2);</u> fine medium clean sandstones, thin calcareous cemented bands, possibly becoming shaly downwards.
1900 m (+20) - 2010 m (+30)	<u>Middle/Lower Jurassic (ca. Interval 1);</u> argillaceous limestones, marls, sandstones, coal horizons, claystones
<u>'B' Reflector</u>	1900 m (+20)
<u>Coal Horizons</u>	1960 m (+20) and possibly ca. 1920 m.
2010 m (+30) - 2085 m (+20)	<u>Lower Jurassic (Dunlin Unit);</u> grey claystones, silty, sandy, with calcareous beds.
2085 m (+20) - 2180 m (+30)	<u>Lower Jurassic (Dunlin Unit);</u> fine, argillaceous sandstones becoming more argillaceous downwards.
2180 m (+30) - 2440 m (+50)	<u>Lower Jurassic/Triassic</u> <u>(Statfjord Formation);</u> medium-coarse clean sandstones, coal horizons, becoming argillaceous and red stained to base.
2305 m (+30)	<u>'C' Reflector:</u> Statfjord coals
2440 m - 2500 m T.D.	<u>Triassic (Cormorant Formation);</u> red sandstone and claystones.

## 6. Cuttings Samples

Ditch cuttings to be collected every 10 m below 30" casing and every 3 m below 1250 m.

## 7. Coring

For a detailed evaluation of the objectives the following coring programme is required:

### 1) Upper/Middle Jurassic Reservoir Section

Interval 1495 - 1900 m ss

Coring to commence immediately above the reservoir and to continue until at least 30 m below the last hydrocarbon cores.

2) Spot cores to be taken on any hydrocarbon shows in sands below the Upper/ Middle Jurassic reservoir section in the well.

8. Casing Programme

To be specified in the final drilling programme.

9. Logging Programme

at 20" casing depth GR/ISF/SONIC/SP NB GR to sea bed  
FDC/CNL/GR/CAL

at 13 3/8" casing depth GR/ISF/SONIC/SP  
FDC/CNL/GR/CAL  
SWS

at 9 5/8" casing depth GR/ISF/SONIC/SP  
FDC/CNL/GR/CAL  
MSFL/DLL/CAL/SP/GR  
SWS  
HDT  
CBL (on 13 3/8" & 9 5/8" casing)

at T.D. GR/ISF/SONIC/SP  
GDC/CNL/GR/CAL  
MSFL/DLL/CAL  
HDT  
SWS  
CBL (on 7" liner if required)  
Velocity Survey

10. Testing Programme

RFT's and/or production tests as required.