

NC5

- 7946 Sandstone, green grey, very fine to medium grained, angular to subrounded, friable, moderately well sorted, very glauconitic and clayey matrix, fair porosity, no show.
- 7906 Shale, dark greenish grey, firm, fissile.
- 7862 not recovered
- 7792 Shale, dark greenish grey, soft, abundant siderite ? globules.

PALEOSERVICES LTD.

PALEONTOLOGICAL AND PETROGRAPHICAL CONSULTANTS

DIRECTOR: DR. V. L. ROVEDA (It.)

PARAMOUNT INDUSTRIAL ESTATE
SANDOWN ROAD
WATFORD, WD2 4XA

TEL: WATFORD 25678
OVERSEAS TELEGRAM: PALEOSERV

January 4, 1972

MURPHY EXPLORATION CO.

Well 2/3-3

Paleontological Final Report

In this report we present the results of the paleontological and stratigraphical study of the samples from well 2/3-3 drilled by Murphy Exploration Co. in the Norwegian offshore.

The samples received were represented by cuttings covering the interval 1040' - 9734' ; they were collected on average every 30' in the upper part of the well and every 20' in the lower part of the well ; no cores and/or side-wall cores were available.

A copy of the Biostratigraphical Log ,scale 1:2000 is attached to this report. Previously, during the drilling, Progress reports have been produced.

%

CONCLUSIONS

- 1 - The well drilled a thick Tertiary/Quaternary section (nearly 8000'), mainly represented by grey sandy clays of Pliocene and Pleistocene age and by brown clays and mudstones of Oligo-Miocene age. The Paleocene and Lower Eocene are represented by varicoloured clays. No potential reservoirs (sands, sandstones and limestones) have been found in the Tertiary.
- 2 - A moderate thickness of Chalk has been penetrated. Approximately the top 140' are of Danian age, the remainder being of Santonian-Maastrichtian age.
- 3 - A thin atypical Lower Cretaceous lies on Kimmeridgian shales. From the base of the Kimmeridgian downwards, the section is poorly fossiliferous and only tentatively dated.
- 4 - The well bottomed in evaporites of Zechstein age, as confirmed by the palynological study of the dolomite.
- 5 - The thicknesses of the various formations drilled can be summarized as follows:

		thickness
<u>Pleistocene</u> (1040-1940')		900'
<u>Tertiary</u> (1940-8140')		6200'
Pliocene	1940-3580'	1640'
Indeterminate	3580-3885'	305'
Miocene	3885-5190'	1305'
Oligocene	5190-6545'	1355'
Indeterminate	6545-6900'	355'

Lower Eocene	6900-7380'	480'	
Paleocene	7380-8140'	760'	
<u>Mesozoic</u>			1460'
Upper Cretaceous	8140-8790'	650'	
Lower Cretaceous	8790-9240'	450'	
Jurassic	9240-9480' ?	240'	
Triassic ?	9480-9600'	120'	
<u>Paleozoic</u>			134'
Zechstein	9600-9734'	134'	

GEOLOGICAL HISTORY

After the deposition of the evaporites during the Zechstein (9734-9600') , continental environmental conditions were introduced into the basin during the Trias (9600-9480'). Possibly, similar conditions existed during part of the Jurassic (interval 9480-9390') ; however, with the advent of the Kimmeridgian (9390-9240') marine sediments were deposited in a sea with restricted circulation and poorly ventilated bottom waters.

The gap existing between the Kimmeridgian and the overlying Lower Cretaceous beds may be related to the Kimmerian orogenic movements.

The Lower Cretaceous sediments deposited over a period of time ranging probably from the Hauterivian to Aptian, were laid down in moderately deep waters. The Albian sands mark the beginning of a regression and probable subsequent non deposition and/or

erosion of Cenomanian, Turonian and Lower Senonian sediments.

The purely carbonatic sedimentation of the chalk took place in a moderately deep sea with good water circulation and no clastic contribution, over a period of time ranging from Middle Senonian to Danian (8790-8000').

With the advent of the Middle Paleocene, the sedimentation become purely argillaceous and, until the end of the Lower Eocene (intervals 8000-7380' and 7380-6900') the clays were deposited in a moderately deep sea, occasionally with connections with the open sea allowing planktonic organisms to enter into the basin.

Due to the lack of diagnostic fossils it is difficult to reconstruct the geological events that took place in this area during the Middle and Upper Eocene and/or Lower Oligocene (6900-6545').

The Middle Oligocene sediments with *Rotaliatina buliminoides* (6545-6220') suggest deep marine conditions with good ventilation; they are followed, during the Upper Oligocene (6220-5190'), by deeper and possibly less ventilated waters.

It was only with the Miocene that the sea become shallower and probably warmer, allowing the development of a rich assemblage of micro-organisms (5190-4185'). Starting from the Upper Miocene (4110') and throughout the Pliocene (3580-1940') there was a gradual reduction in the variety of the benthic forms and in the frequency of planktonic foraminifers. This suggests a progressive shallowing of the sea culminating in Pleistocene times with a very restricted microfauna, in relation with the general cooling of the climatic conditions.

STRATIGRAPHY

In the following pages we are presenting a critical resumé of the paleontological intervals we were able to distinguish in the well 2/3-3, their tentative age and possible environments of deposition. Reference should, of course, be made to the Biostratigraphic Log which is self-explanatory and clearly shows the various paleontological subdivisions.

Pleistocene :

The Pleistocene section from 920' to 1940' is represented by grey sandy clays with whitish sandstone interbeddings from approx. 1460' to 1700'. Shell banks occur in several places, namely from 920' to 1040', around 1370' and from 1600' to 1700'. Microfossils are rare, mainly foraminifers such as Protoelphidium orbiculare, Elphidiella hannai and Elphidium clavatum, suggesting shallow marine environmental conditions.

Pliocene :

The grey clays, more or less sandy, of this age occurring from 1940' to 3580' contain a microfauna composed by Cassidulinas, Ammonia pseudotepida and Sigmoilina schluembergeri in abundance. The upper part of this interval is characterized by the presence of Textularia sculpturata and T. decrescens associated with Loxostomoides lammersi (1940-2330'); the middle and lower part of the interval show an increase in planktonic forms such as Globigerina bulloides and G. eggeri and the first occurrence of Bulimina ovata, Epistomina elegans etc. (2330-3580'). The microfauna suggests shallow marine environmental conditions.

Interval 3580-3885':

The available samples from this interval are represented mainly by cement from the casing, caved Plio-Pleistocene microfossils and a few brown clays (3840-3885') without fossils. Therefore we cannot determine the age of this interval.

Miocene :

The sediments of this age occurring from 3885' to approx. 5190' are represented by brown and grey-brown clays and mudstones, occasionally with a minor sand content (caved? ;3980' ; 4300' and 4520'). Very rare thin brown limestone interbeddings were seen around 4200'.

The rich microfaunal assemblages can be subdivided as follows:

3885-4050' - small fat Elphidium sp.aff.inflatum and Globigerina sp.

4050-4110' - Spongia spiculae

4110-4185' - Elphidium inflatum (no Asterigerina).

4185-4700' - very rich assemblage with Asterigerina staeschei, Uvigerina tenuipustulata, Bulimina elongata, the typical Virgulinitella pertusa from 4410' to 4520' only, Ceratobulimina contraria, etc.; the planktonics are also well represented by Globigerina angulofficinalis, Globigerinoides trilobus, G.cf.sacculifer, Globoquadrina altispira and Globorotalia scitula (& var.). Abundant coral debris were found at 4675'.

4700-5190' - a gradual decrease of the abundance and variety of the microfossils seen above and first occurrence of rare arenaceous foraminifers (Trochammina and Haplophragmoides)

The Miocene sediments were deposited in moderately deep waters, probably well oxygenated from 4185' to 4700'. Shallower conditions apply to the section from 4185' upwards.

As far as the age of these paleontological intervals are concerned, we assume that:

- 3885-4185' Upper Miocene
- 4185-4950' Middle Miocene, although the lower boundary could be drawn at 4700'.
- 4950-5190' Lower Miocene (?).

Oligocene:

The sediments of this age occurring from 5190' to 6545' are represented by brown clays and mudstones; frequent limestone interbeddings occur from 5280' to approx. 5440' ; a small percentage of fine sand was seen around 5900'. Small fragments of lignite were found at 5220' and 5970'.

The Oligocene microfauna is clearly characterized by abundant large Arenaceous such as Trochammina sp., Cyclammina spp., Hyperammina sp., Cornuspira and Ammodiscus spp., the small Silico-sigmoidina (or Spirolocammina sp.) associated with extremely rare benthic forms (Baggatella sp., Asterigerina guerichi etc.); only from 6390' to 6545' the benthic forms are slightly more abundant with several Rotaliatina buliminoides and Gyroidina sp. The above assemblages reflect marine deep to moderately deep environmental conditions.

The assemblages with prevailing Arenaceous are tentatively dated as Upper Oligocene, while the assemblages with benthic forms, particularly with Rotaliatina buliminoides, are dated as Middle Oligocene.

Interval 6545-6900' :

This interval, represented by grey and brown clays and mudstones, do not contain diagnostic microfossils but only Arenaceous of the type seen above and also in the Eocene. Therefore we cannot tell if this interval belongs to the Oligocene or represents part of the Eocene section (Middle ? - Upper ?).

Eocene :

Lower Eocene sediments occur from 6900' to 7380' ; they are represented by grey-green clays mottled in red ; thin beds of dolomite or sideritic limestone occur randomly.

The microfauna is rather scarce; in addition to the large Arenaceous seen above, new forms of small arenaceous foraminifers are present, such as Trochammina cf. gyroides, "Plectina" sp., and Bolivinopsis spectabilis, suggesting moderately deep marine conditions.

The lower boundary is conjectural and could be lowered to 7910'.

Paleocene :

Lithologically the sediments of this age can be subdivided as follows:

7380-7980' varicoloured clays (green, grey, red) with siderite pellets and tuffaceous clays around 7400'.

7980-8010' no samples

8010-8140' white chalk with flint.

Microfossils are rare ; in the interval 7380-7695' presence of Globigerina triloculinoides, Radiolaria and translucent Coscinodiscus sp.1 . Extremely rare microfossils were seen from 7695' to 7890' while a rich faunule occurs from 7890' to 7980' ; it is composed by Anomalina grosserugosa, Allomorphina trigona, Discorynopsis parva, Bulimina midwayensis, Globigerina triloculinoides, Globorotalia compressa, etc. The chalk is clearly characterized by abundant Globigerina pseudobulloides and Radiolaria.

The environmental conditions of the Paleocene started with open sea conditions (chalk) and were followed by moderately deep conditions (7980-7890') becoming gradually restricted (7890-7695); finally, good ventilation was re-established by currents bringing into the basin some planktonic foraminifers.

On the basis of the fossils content, the argillaceous section is dated as Middle-Upper Paleocene, while the chalk is equated with the Danian (Lower Paleocene).

Upper Cretaceous:

The sediments of this age occurring from 8140' to 8790' are represented by white and cream-coloured chalk with rare flint. However, the samples from the chalk are mixed with abundant clay and mudstone caved from the Tertiary, making any detailed paleontological subdivision impossible.

Apart from few rare benthic forms, generally undiagnostic, the chalk contains Rugoglobigerina rugosa group from 8140' to approx. 8600' and a few Globotruncana lapparenti lapparenti from 8640' to 8760', both suggesting marine open sea environmental conditions.

The chalk with Rugoglobigerina is tentatively dated as Maastrichtian, while the chalk with Globotruncana as Santonian/Campanian.

Lower Cretaceous:

The sediments of this age occurring from 8790' to 9240' are mainly represented by grey mudstones and shales, apart from 8790' to 8820' where rare red marls and sands have been observed. Pyrite crystals and aggregates are often very abundant. Paleontologically we can distinguish the following intervals:

8790-8820' - red coloured Hedbergella delrioensis gr., Valvulineria gracillima and Glomospira. Probably ALBIAN.
8820-9060' - Lenticulina muensteri, L. multireticulosa, Gavelinella intermedia, Uvigerinammina sp., etc. ; rare small Arenaceous with Verneuillinoidea neocomiensis, Gaudryinella scherlocki etc. Probably BARREMIAN to APTIAN.

9060-9240' - Lenticulina muesnteri gr., L.nodosa, Conorboides sp., small Trohammina sp., Schucleridea sp. Probably HAUTERIVIAN to BARREMIAN.

The palynological study of a samples from 9000' revealed the presence of a poor assemblage with forms common to the section from Valangianian to Aptian e.g. Lycopodiumsporites clavatoides, L.eminulus, Klukisporites pseudoreticulatus and Trilites tuberculiformis. However, two items, Cyathidites concavus (an Aptian indicator) and cf. Cicatricosisporites potomacensis (Barremian-Apt.) together favour an Aptian age.

The environmental conditions of this Lower Cretaceous section were probably marine moderately deep, with connections with the open sea during Albian times.

Jurassic :

Upper Jurassic, Kimmeridgian sediments, were recognized from 9240' to 9390' ; the dark grey to brown mudstones with large Haplophragmoides cf.volgensis and small pyritized Radiolaria (Dictyomitra sp.) seem to indicated restricted, poorly oxygenated waters.

Also the barren sands from 9390' to 9480' ,possibly of deltaic origin, are tentatively dated as Jurassic because of their stratigraphical position between the Kimmeridgian and a possible Trias.

Trias :

The red sands, siltstones and shales occurring from 9480' to 9600' have been tentatively dated as Trias on the basis of lithological analogies with Triassic beds of other North Sea wells, very likely of continental origin.

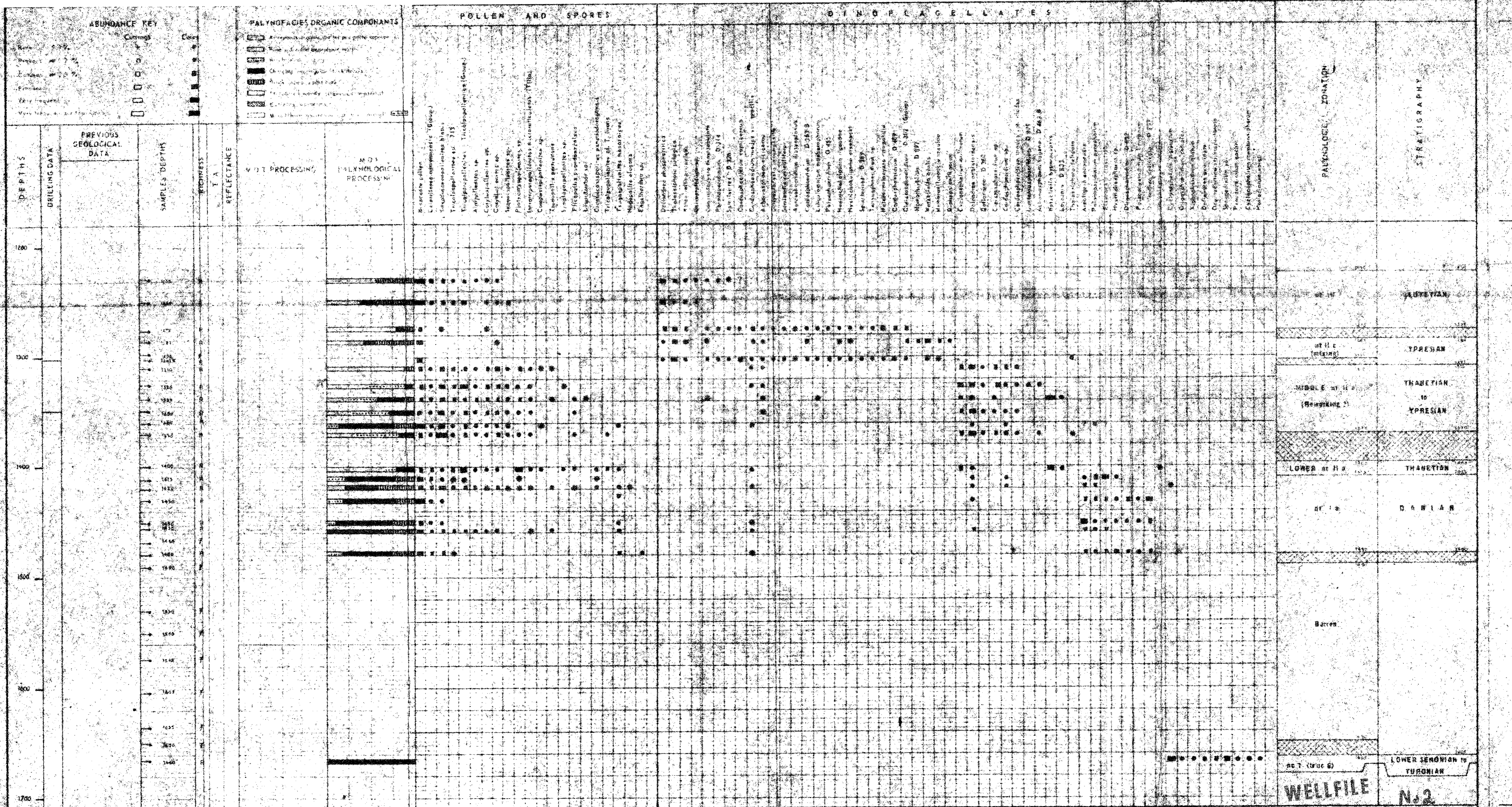
Permian :

The dating as Upper Permian of the dolomites and anhydrites occurring from 9600' to 9734' has been confirmed by the palynological study of the sample from 9600-9620', of which the assemblage is dominated by Lueckisporites virkkiae together Tacniaesporites sp., Protohaploxypinus sp., Alisporites nuthal-
lensis, Nuskoisporites spp., ect. Stratigraphically, most of these forms do not appear before the Upper Permian (Zechstein) and do not persist into the Trias.

The above sediments were deposited under evaporitic environmental conditions.



Vittorio L. Roveda



WELLFILE No. 2

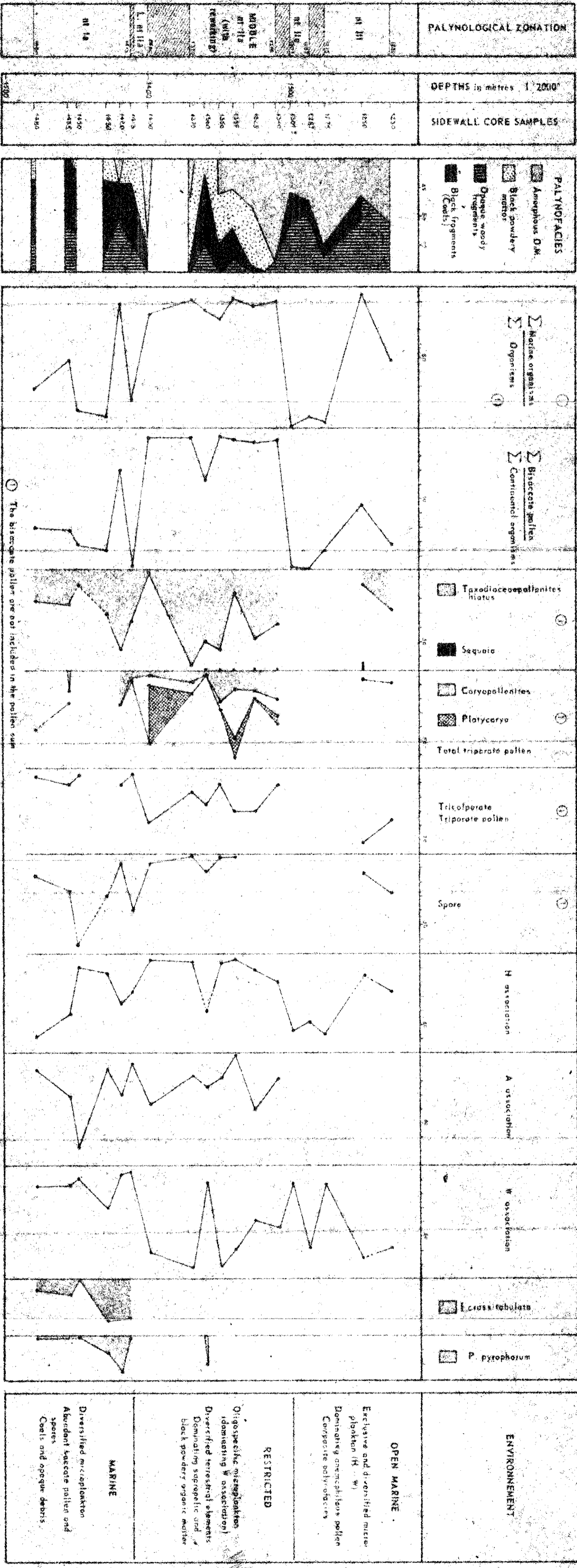
NORVEGIAN ELP ROYSE PETRONOR

WELL NO. 2-1

PALYNOLOGICAL RANGE CHART

LOWER TERTIARY

PL. 1



NORVEGE
ELF NORGE

PETRONORD

WELL 16 3-2
PALYNOLOGICAL DIAGRAM
QUANTITATIVE DATA

PL 2

NOV 76
SUCCEANX
C137

WELL 16 3-2

Nov 76

NORSKE MURPHY OIL COMPANY

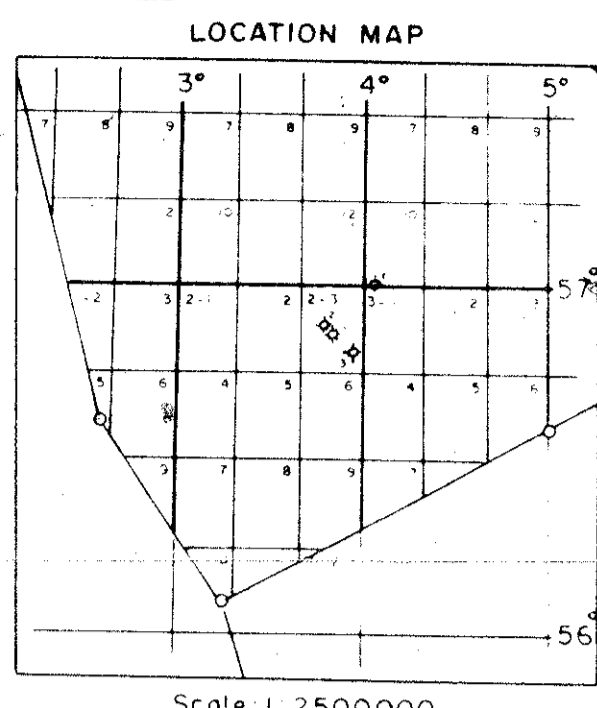
COMPLETION LOG

COMPANY NORSKE MURPHY WELL NUMBER 2/3-3 COUNTRY NORWAY OFFSHORE.
 LOCATION LAT. 56°48'18.9"N LICENCE BLOCK 2/3 PRODUCTION LICENCE 022
 LONG. 03°58'11.8"E
 DATE SPUDED 8 OCT. 1971. DATE COMPLETED 20. NOV. 1971. STATUS P & A
 ELEVATION: KB 103 feet. DF — WATER DEPTH 183 feet.
 TOTAL DEPTH 9753' (SCHLUMB) PBDT 350'
 CASING RECORD 9741' (DRILLER)

TESTING AND COMPLETION SUMMARY.

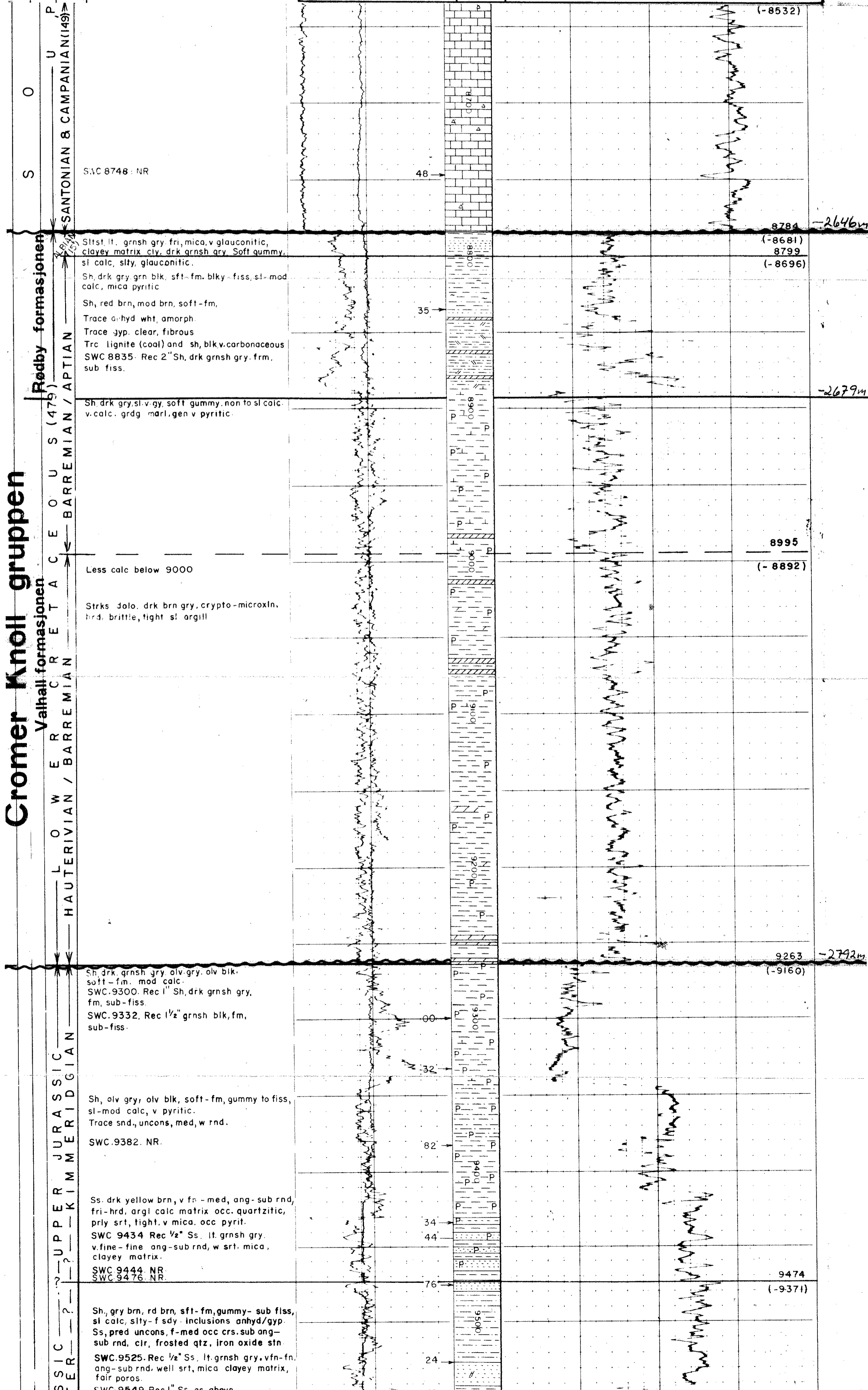
REMARKS:
Geologists: W. HARTUNG.

UNDOK SENTER
2009039031



Conglomerate	Marl	Gypsum	Calcareous Shale
Sandstone	Limestone	Anhydrite	Dolomitic Shale
Siltstone	Dolomite	Salt (Na Cl)	Coal
Granite Wash (Arkose)	Dolomite Limestone	Salt Casts	Chert
Breccia	Argillaceous Limestone	Potassium Salt	Pyrite
Sandy Shale	Sandy Limestone	Sylvite	Fossils
Silty Shale	Silty Limestone	Carnallite	Oolites
Shale - Clay Red - Green - Gray	Coquina Ls (50% fossil)	Polyhalite	Glauconite
Shale Dark gray-black		Kainite	Siderite
			Limonite Nodules
			Phosphate Nodules
			Carbonate Nodules
			No Samples
			Bentonite
			Cement
			Show(Gas-Green) Show(Oil-Red)
			Gas Positive DST
			Asphalt

AGE	LITHOLOGY	GAMMA RAY		INTERVAL TRANSIT TIME	
		API UNITS		MICROSECONDS PER FOOT	
		0	300' - 3557'	80	1/500
		0	3557' - f.d.	120	140
		120		240	90
					190
					40
					140
		CALIPER			
		HOLE DIAM IN INCHES			
		8"	Bit size 12 3/4"	18"	



Cromer Knoll gruppen

Valhall formasjonen
Redby formasjonen
SANTONIAN & CAMPANIAN (149)
BARREMIAN / APTIAN
BARREMIAN / BARREMIAN
HAUTERIVIAN / BARREMIAN
UPPER JURASSIC
KIMMERIDGIAN

S.W.C 8748: NR
Siltst. lt. grnsh gry. fri. mica. v. glauconitic, clayey matrix clay. drk grnsh gry. Soft gummy. sl calc. silty, glauconitic.
Sh. drk gry grn blk. sft-fm. blk. fiss. sl-mod calc. mica pyritic
Sh. red brn. mod brn. soft-fm.
Trace a-hyd wht. amorph
Trace gyp. clear, fibrous
Trc lignite (coal) and sh. blk. v. carbonaceous
S.W.C 8835: Rec 2" Sh. drk grnsh gry. frm. sub fiss.
Sh. drk gry. sl. v. gy. soft gummy. non to sl calc. v. calc. grdg. marl. gen v. pyritic.
Less calc below 9000
Strks. Jolo. drk brn gry. crypto-microxln. hrd. brittle, tight sl argill
Sh. drk grnsh gry. olv. gry. olv. blk. soft-fm. mod calc.
S.W.C. 9300. Rec 1" Sh. drk grnsh gry. fm. sub-fiss.
S.W.C. 9332. Rec 1 1/2" grnsh blk. fm. sub-fiss.
Sh. olv. gry. olv. blk. soft-fm. gummy to fiss. sl-mod calc. v. pyritic.
Trace snd., uncons. med, w. rnd.
S.W.C. 9382. NR.
Ss. drk yellow brn. v. fn - med. ang. sub rnd. fri-hrd. argl calc matrix occ. quartzitic. pry srt. tight. v. mica. occ pyrit.
S.W.C 9434 Rec 1/2" Ss. lt. grnsh gry. v. fine - fine ang-sub rnd. w. srt. mica. clayey matrix.
S.W.C 9444 NR
S.W.C 9476 NR.
Sh. gry brn. rd brn. sft-fm. gummy - sub fiss. sl calc. silty - f. sdy. inclusions anhyd/gyp.
Ss. pred uncons. f-med occ crs. sub ang-sub rnd. clr. frosted qtz. iron oxide stn.
S.W.C. 9525. Rec 1/2" Ss. lt. grnsh gry. vfn-fn. ang-sub rnd. well srt. mica clayey matrix. fair poros.
S.W.C. 9549. Rec 1" Ss. as above.

(-8532)
8784 -2646m
(-8681)
8799
(-8696)
35
-2679m
8995
(-8892)
9263 -2792m
(-9160)
900
32
82
34
44
76
9474
(-9371)
24
49