

RECONNAISSANCE GEOLOGICAL REPORT
ON AND PERIPHERAL TO F.P.C. PERMITS
LOWER MACKENZIE VALLEY, N.W.T.

M. de Matharel

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INTRODUCTION

The F.P.C. permits in the Lower Mackenzie Valley were visited during the 1968 summer season to examine certain acreage recently acquired by the Company and to more fully evaluate the Upper Devonian stratigraphy and reservoir potential.

(1) F.P.C. ACREAGE

The area under consideration is situated between 62° and 65° latitude, 121° and 126° longitude where French Petroleum interest is distributed as follows:

Carlson Lake Permit

118.950 acres - 100% F.P.C., 3% G.O.R., issued November 11, 1966.

Root River Permit

29.325 acres - 50% F.P.C., Tenneco 50%, issued December 14, 1962.

Keele River Permit

250.236 acres - 100% F.P.C., 3% G.O.R., issued November 15, 1966.

(2) Previous Work

Some reference is made to the general Root River area by E.M. Kindle¹ in 1919 and Camsell and Malcolm² in 1921. The first important report on this area was published by Hume³ in 1921. Later, during the war, Bath⁴ did a reconnaissance report on the Canol Project which contains little detail.

A complete study including lithology, facies, thickness distribution and mapping has been conducted by R.J.W. Douglas and D.K. Morris^{5,6,7} in 1960-61 and 1962.

Also in 1960, a detailed study of the Root River anticline was made by D.E. Duff⁸ in order to evaluate the reservoir potential on the acreage jointly held by French Petroleum Company of Canada Ltd. and Tennessee Gas Transmission Company.

References

- 1 Kindle, E.M. The Discovery of a Portage Fauna in the Mackenzie River Valley; Geol. Surv. Can. Mus. Bull. 29, 1919.
- 2 Camsell, C. & Malcolm, W. The Mackenzie River Basin; Geol. Surv. Can. Memoir 108, 1921.
- 3 Hume, G.S. North Nahanni and Root River area and Caribou Island, Mackenzie River District; Geol. Survey Can. Summ. Report PE. B, 1921.
- 4 Bath, Lt. G.D. Mackenzie River Area from Camsell Bend to Fort Norman; Canol Rept. A, No. 34, 1944.
- 5 Douglas, R.J.W. & Norris, D.K. Virginia and Sibbeston Lake Map Areas, N.W.T. G5F and G5G, Paper 60-19.
- 6 " Camsell Bend and Root River Map areas. District of Mackenzie, N.W.T. Paper 61-13
- 7 " Dahadinni and Wrigley Map Areas. District of Mackenzie, N.W.T. Paper 62-33.
- 8 Duff, D.E. Geological Report on Lower Root River Area, N.W.T. Dept. Northern Affairs, Nat. Resources. Report to Minister by French Petroleum Company, Calgary, 1960. Open file.

(3) Present Work

During the period August 21 to August 26, the writer checked some Upper Devonian outcrops previously described as reefoidal and tried to study their distribution and reservoir potential in the vicinity of the F.P.C. acreage.

The field party was conducted by the writer assisted by Garry Ferguson and was under the supervision of D.E. Duff during the three first days.

The party was serviced by Associated Helicopters Ltd. Model Super G-2 with Aksel M. Porsild, pilot, and Ed Saeliga, engineer.

The crew was based at Wrigley Airport and particular acknowledgment is due to Dez and Deanna Snider for the many courtesies extended.

(4) General Character of the Area

The Franklin Mountains in the north, Cansell and McConnel Ranges in the middle and the Nahanni Range in the south lie on the central part of this area. Between the McConnel and the Cansell Ranges is situated a rather large north-south trending ridge called the Root River anticline. In that area the exposures are quite good because of the escarpments formed by the more resistant beds of Middle Devonian and older rocks. The elevations generally do not exceed 3000' but can reach in some places 5000' like the Cap Mountain in the Franklin Mountains.

East of the mountain front the west part of the interior plains is heavily wooded and mantled by glacial debris. The ridges are due to the resistant sandstone west of the Upper Devonian which caps the highlands in plateaus and overlies the Fort Simpson shales in the central part of this area. The Cretaceous is mainly present in the north and forms south of the Mackenzie River some typical butte-like reliefs (Martin Hills, Ebbutt Hills).

West of the mountain, in the Mackenzie Valley, the Fort Simpson shales lying in the topographic lows are also capped by the sandstone unit at the base of which a limestone reef unit is developed in

several separate bodies forming a narrow belt trending roughly south to north.

The main stream is the Mackenzie River which flows in a westerly direction up to the Canwell bend. An abrupt 90° change in the course of the Mackenzie River occurs at that point. This remarkable feature, likely fault-controlled, is due to the fact that the Mackenzie River comes through the Franklin Mountains which is the main obstacle in its course.

In the plains the exposures are very poor and occur mainly along the tributaries of the Mackenzie River. Some outcrops exist on the plateaus but generally cannot be reached by helicopter because of the scarcity of landing spots.

UPPER DEVONIAN STRATIGRAPHY

The thickness of the Upper Devonian is not very well-known for different reasons.

- (1) One cannot measure a continuous section from the Middle Devonian carbonates to the Mississippian.
- (2) There are no continuous markers in the shale units.
- (3) Folding within the shales is very common.
- (4) Facies change occur very rapidly, so if the lower part of the Upper Devonian is relatively well-known in the outcrops and in the wells, the upper part has been described in few places.

Two nearly complete sections have been measured by the G.S.C., one south of Carlson Lake on the flanks of the Yohin syncline, the other one along the Redstone River in three partial sections with a total thickness of 7700 feet.

(1) Fort Simpson Formation - Unit 1

The Nahanni carbonates of Middle Devonian age are overlain by 3000 feet of shale known as the Fort Simpson formation. The shale is soft, fissile, brown to black interbedded with siltstone. At the base the contact with the Nahanni carbonate is sharp. The top of the formation is easily found when the following unit 2 is present. It is the only case where it has been observed by the writer in the field.

The F.P.C. Root River No. 1 starts near the top of the Fort Simpson formation. The Middle Devonian carbonates have been encountered at 2717'.

North of Root River No. 1 the Shell Wrigley No. 1 starts also in the "Fort Simpson" shale which is 2793' thick. In this particular well, at the base of the formation, the gamma log shows two radioactive zones instead of one in the F.P.C. Root River well. Just above the carbonates, the first radioactive zone (2893-2780') is equivalent to the Gayna River shale outcropping in the Norman Wells area. Then between 2780' and 2630' is the Hare Indian formation of Middle Devonian age which pinches out between Wrigley and Root River due to the erosion of the Upper Devonian Canol.

It has been possible for the G.S.C. to map a "unit 22" (Dahadinni-Wrigley map area) called "Horn River formation" in the same area. That "unit 22" would be equivalent to the Hare Indian shales (?).

(2) Reef Unit - "Unit 2"

West of the Camsell Range a limestone unit occurs at the top of the Fort Simpson formation. It exists also east of the Camsell Range in the vicinity of the Root River anticline.

This unit consists mainly of dark-grey to dark-brown argillaceous, sometimes sandy and very fossiliferous limestone. Coral beds are abundant and Stromatoporoids occur at several places. A particularly large Brachiopod has been found at several levels and seems to be a good marker in the visited area.

South of Carlson Lake this unit is missing and has changed to a sand facies.

Northeast of the Wrigley anticline (Stop 9 - attached map) the unit fairly exposed consists largely of Stromatoporoids, forming a

massive, poorly-bedded limestone. Vuggy porosity has been observed in several places. The same facies, poorly-exposed, exists on the Ochre River two miles east of the Mackenzie River.

So far, the extension to the north of this unit is not well-known. It disappears below the younger beds in the Mackenzie Valley and has never been found along the tributaries of the Mackenzie River north of the Ochre River.

The thickness of the unit varies from 0' to 275' with an average thickness of 150'. Near Carlson Lake the writer measured 240' (Stop 10). Near Wrigley (Stop 9) 100' have been measured but the base of the unit has not been observed.

In the B.A. H.B. Root River No. 1, 80' of limestone encountered between 1990' and 2070' can be correlated with the unit described on the field. It is the only well where the unit has been preserved by recent or Cretaceous erosion.

Several sections studied in outcrop are presented on the attached map.

(3) Upper Part of the Upper Devonian

Above the "reef unit" or above the Fort Simpson shale when the "reef unit" is absent, the G.S.C. mapped a "unit 22" (Camsell Bend-Root River area) which consists of calcareous sandstone interbedded with silts and shale. This unit forms the ridges and caps many of the hills in this area. The contact with the Fort Simpson shale and the overlying unit are generally covered. According to the G.S.C. this unit is 600' to 700' thick.

Upper Devonian strata lying above this unit consist mainly of shale and siltstone with a few limestone beds. One of these is thick

enough to be mappable in the Root River area. This limestone bed occurs 1000' to 1200' above the reef unit. It is relatively resistant and marked by the abundance of Brachiopods (*Leiorhynchus*). Roughly 200' thick, it is one of the best markers which can be followed by the seismic south of the Mackenzie in the interior plains. North of the Mackenzie River it outcrops in several places such as stops 1, 2, 6. Also, it has been found in the B.A.H.B. Root River No. 1 between 600' and 830'.

UPPER DEVONIAN RESERVOIR POTENTIAL

None of the sandstone beds seem to be prospective in the Upper Devonian of the lower Mackenzie area. So if the source rocks are well-developed the reservoirs are quite poor. Potential productive reservoirs would appear to be limited to the "Reef Unit".

This unit outcropping in the Root River anticline area and west of the Camsell Range has never been found on the west flank of the Mackenzie syncline. It likely disappears quickly west of the outcrops by facies change as it has been observed by the G.S.C. on a tributary from the west of Carlson Creek.

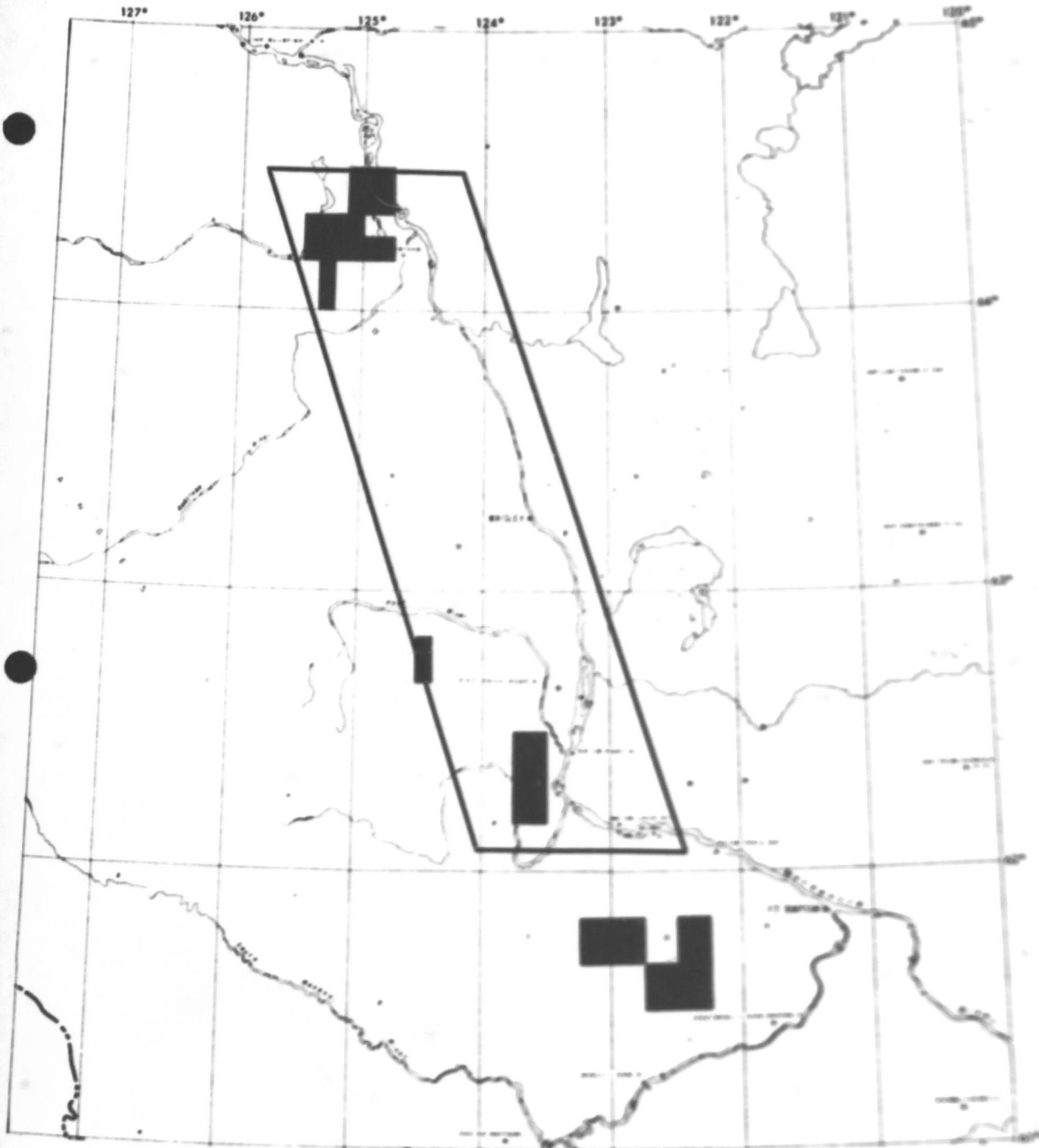
This unit could be present north of the Ochre River in the Mackenzie Valley overlain by younger sediments. But it can also shale out as it is suggested by the "barrier facies" found in the Wrigley area.

The only place where the Reef Unit is reasonably prospective is the interior plains south of the Mackenzie River where it has been protected from recent or Cretaceous erosion.

The outcrops in the southern part show a well-bedded limestone where the abundant coral beds are characteristic of a reefal environment. So a reefal and porous facies could be developed in the vicinity.

In the north where the reefal facies has been observed a vuggy porosity exists at scattered levels but the limestone is mainly tight.

This unit, 80' thick, has been encountered in the B.A. H.B. Root River No. 1 but in this well the limestone is not reefal and has no porosity. Because of the lack of subsurface control to date, we are unable to figure any distribution of the thickness and facies of the unit in the interior plains.



INDEX MAP

AREA COVERED BY REPORT

 F.P.C. ACREAGE

SCALE: 1" = 32 Miles

FIG. 1

TABLE OF FORMATIONS - Upper Devonian, N.E. B.C. & N.W.T.

NORMAN WELLS	ROOT RIVER	GREAT SLAVE LAKE	N.E. B.C.	FAUNA	
		CRETACEOUS	MISSISSIPPAN		
	SHALE UNIT <i>Leiorhynchus</i> L.M.		KOTCHO	<i>Leiorhynchus</i> cf. <i>L. seversoni</i> (McLAREN)	
			TETCHO	<i>Basilicorhynchus</i> <i>basilicum</i> CRICKMAY <i>Leiorhynchus</i> WALCOTTI	FAMMENNIAN
IMPERIAL		TROUT RIVER	TROUT RIVER	<i>Leiorhynchus</i> <i>albertensis</i>	
	SANDSTONE UNIT	KAKISA	KAKISA		
		REDKNIFE	REDKNIFE GROUP MEMBER JEAN MARIE MEMBER	<i>Phacellophyllum</i> <i>tructense</i> - (McLAREN)	
		TATHLINA		<i>Atypaciliipes</i> CRICKMAY	
		TWIN FALLS			FRASNIAN
		ALEXANDRA HAY RIVER	FORT		
			SIMPSON		
CANOL				<i>Cyrtospirifer</i> <i>kenricotti</i> <i>Eleutherokomma</i> <i>reidfordi</i>	
UNNAMED BEDS					

WRIGLEY SECTION

STOP No. 9

63° 20' - 123° 58'

Samples 25-40
(every 5')



39-40: Stachyodes - Rare Amphiporae

34-38: Stroms - cemented per places by
shaly micrite -
Non-porous

33: Biomicrite with Brachs, Spicules, Gastos

31-32: Stroms cemented by biomicrite

29-30: micrite and biomicrite with Brachs,
Gastos, Crins, 1 Beresella?

28: Stroms

27: fine α limestone with Crins, Brachs

26: Stroms

25: micrite with some Brachs -
Stachyodes?

CARLSON LAKE SECTION

STOP No. 10
 62° 27' - 123° 40'
 Samples 9-24'
 (every 15')

9	○ 9
10	2 9
11	○ 9
12	○ 9
13	○ 9
14	○ 9
15	9 0
16	III
17	○ 9
18	— 9
19	9 9
20	9 9
21	9 9
22	9 9
23	9 9
24	9 9

GIRVANELLA

9-12: silty Coral limestone with Brachs, Crin interbedded with calcareous siltstone and sandstone
Foraminifera
Chlorite oolites

13-15: Intra-micrite ("calcia gravelles") with Foraminifera, Calcisphere, Brachs and Corals

16: 1 Strom

17: Coral and Crinoidal Ist.

18: fine cx. Ist with Foraminifera Brachs (fine shells)

19: micropelletoid Ist ("microgravelles")

20-24: micrite and biomicrite with Brachiopods (firmshells)
 Gastropods, Ostrocods?? Foraminifera (Textularia?
 Nodosaria?)

A few small traces of quartz