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THE PRE-MESOZOIC STRATIGRAPHY AND STRUCTURE OF TUKTOYAKTUK PENINSULA, PHASE II

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ABSTRACT

The Tutoyaktuk Peninsula, to the northeast of the Mackenzie Delta in the Northwest Territories, is underlain by a Mesozoic and younger sequence, which in turn is underlain by a complex succession of pre-Mesozioc formations. This study deals with the pre-Mesozoic succession only. The formations below the sub-Mesozoic unconformity form a complex system of horsts and grabens. The formations are penetrated in variable amounts by about 50 wells, and a substantial amount of core and drill cuttings is available. Study of the available sample material revealed a lithological subcrop pattern, in which a horst runs, along a northeasterly trend, obliquely across the peninsula and off into the Beaufort Sea: the Quartzite Ridge. Conodont and fossil ages provided the key to the correlation of the lithological units with formations in the Northern Interior Plains. The Ridge is flanked to the southeast side by a regular succession, with as youngest rocks the Devonian Imperial Formation; a similar succession can be found underlying the Northern Interior Plains and can be correlated through the well Killannak A-77 to the formations present on Banks Island. Of note are the conglomerates present in the Imperial Formation here. They are rare outside the study area. To the northwest, the Ridge is flanked by carbonates. They are limestones and dolomites, and form going from southwest to northeast an alternating pattern of Gossage dolomites and limestones with Ronning age dolomite areas. Part of these Ronning carbonates have a Middle Ordovician age, which is not known in the Northern Interior Plains, but only in the Mackenzie, Richardson and Ogilvie Mountains. In the Parsons area, the Ronning carbonates change facies to basinal shales. The

Quartzite Ridge itself contains quartzites, dolomites, volcanics and clastic sequences. The quartzites are of Lower Cambrian, and the dolomites at the northern end of the Ridge of Middle Ordovician age. The latter are probably overlying the quartzites unconformably or by fault contact. The volcanics could not be dated, but are assumed to be of Precambrian to Cambrian age; the clastics have some similarities with the Imperial Formation, but a number of their characteristics, and the presence of dolomite above and below them preclude correlation to this formation. They are considered to be Cambrian or Precambrian in age. To the southwest, the carbonate area is overlain, probably unconformably, by tentative Permian age rocks.

Structurally, the alternating pattern in the carbonate area indicates the presence of pre-Mesozoic and post Devonian or "Ellesmerian" deformation, which again is absent from the Northern Interior Plains and present in the Richardson and Ogilvie Mountains, and links the study area closer to this region than the Plains area. The timing of deformation is further restricted to pre-Permian and Post Devonian by the unconformably overlying Permian rocks. It is unclear if the carbonate formations butt against the Ridge, or if the swing aroud to parallel the Ridge, as appears to be indicated by dip measurements.

The Campbell Uplift is related to the Quartzite Ridge, but appears a separate unit, with formations as young as Hume. The large amounts of sand in the Ronning carbonates in the nearby well Inuvik D-54 may indicate an emergence of this area during Early Paleozoic times. The Lower Cambrian rocks on the Ridge indicate that the area was underlain by a Cambrian basin, separated from the one underlying the Northern Interior Plains; the threshold between the two basins could have provided the clastics in Ronning carbonates in Inuvik D-54.

INTRODUCTION

The Tuktoyaktuk Peninsula lies to the northeast of the Mackenzie Delta in the Northwest Territories, between 68° 20′ and 70° 20′ northern latitude and 129° and 135° western longitude (Fig. 1). Cenozoic and Mesozoic clastic sequences are underlain by Paleozoic and Proterozoic clastic and carbonate strata. Differential uplift and subsidence by faulting and possibly by folding has produced a complex formational subcrop pattern beneath the pre-Mesozoic unconformity. Initial interpretation of a GSC seismic deep-reflection line, crossing the southwest part of the peninsula, indicates potential major pre-Mesozoic deformational foreshortening (Cook et al., 1987). In addition, relief on pre-Mesozoic structures, with or without modification by Mesozoic tectonism have produced regionally significant potential hydrocarbon traps, which under the right conditions could host a major oil or gas field. A thorough understanding of the pre-Mesozoic geology of the Tuktoyaktuk area is fundamental in verifying and understanding pre-Mesozoic deformation and the hydrocarbon potential of the area.

Objective and methods of Study.

A two-phase geological study of pre-Mesozoic borehole data was initiated in late 1986. Phase 1, a pilot project designed to acquire a reconnaissance description of the pre-Mesozoic stratigraphy and map patterns in the vicinity of the reflection line, has been completed (Wielens, 1987). Phase 2 involved a detailed sample and core study of the entire Tuktoyaktuk Peninsula in order to be able to affirm or disprove the model that emerged from the first phase of the study. Virtually all borehole data and samples were studied, and many cores and cutting intervals sampled, to obtain microfossil ages to confirm or revise correlation of pre-Mesozoic rocks established with the Phase I study.

Previous work

Most of the previous studies of the pre-Mesozoic sequences were limited in scope. A general regional overview and some seismic lines of this and adjacent areas have been presented by Lerand (1973); he considered mainly the Beaufort Basin in a general geological and tectonic relationship to the basins and arches in the Northern Yukon, the southwestern Arctic Islands, and Northern Interior Plains. Paleontological age determinations for several wells have been published by Brideaux et al.(1975, 1976).

Glaister and Hopkins (1974) interpreted cores of Nuvorak O-09 on the northern part of the Peninsula as turbidity current flows of Devonian Imperial age.

Dyke (1975) described the structure in Campbell Uplift as an elongated dome-like feature, cut by numerous, mainly vertical, longitudinal faults with a general northeastern trend. The Precambrian rocks display locally severe deformation, while the Paleozoic succession overlies them unconformably and on all sides dips gently away from the centre part of the dome at a small angle. M.P. Cecile and L.S. Lane (pers. comm., 1987) in preliminary mapping of the Uplift, found no evidence of severe deformation of Proterozoic strata. The total structural relief produced by the faults is in the order of 1000 to 1500 m. Although the Campbell Uplift is of Laramide age, it is possibly a rejuvenation of "Ellesmerian" structures. Norris and Calverley (1978) described exposed rocks of Precambrian, Paleozoic and Mesozoic age in the Campbell Uplift. The youngest, Middle Devonian carbonates overly the Paleozoic Vunta dolomites of unknown age. These in turn unconformably overly Precambrian grey quartzites; red, green and grey argilites; and silty, greyish-red, fine grained dolomites, in which beds with stromatolites are present.

A recently acquired GSC deep reflection line was interpreted by Cook et al. (1987). They found evidence for major pre-Mesozoic, probably compressional, structural deformation. Mesozoic and younger formations are bounded by listric, normal faults, paralleling features of Precambrian age. Thrust faults are visible in the Proterozoic formations underlying the Campbell Uplift and are of Proterozoic or Late Paleozoic age. This implies that "Ellesmerian" or older compressional structures, may underly the Arctic Coastal Plain.

Wielens (1987) presented an preliminary study of the pre-Mesozoic geology of the area. The main findings of the study were the presence of formations which appear correlatable to formations in the surrounding areas, and the presence of complex pre-Mesozoic ("Ellesmerian") structures involving Paleozoic and Precambrian formations. A pattern emerged, in which a northeast trending Precambrian (?) Quartzite Ridge is flanked on the southwest by Late Paleozoic clastics, and on the other side by Paleozoic carbonates and shales in a complex subcrop pattern. To avoid frequent referrals and to obtain a coherent text, part of the Phase I report is repeated in this report.

Mesozoic and Cenozoic successions on the Tuktoyaktuk Peninsula were described by Dixon (1982, 1986).

STRATIGRAPHY

Regional Stratigraphy

The stratigraphy in the Northern Interior Plains (north of 66^{o} Latitude) involves Proterozoic, Paleozoic, and younger formations. The pre-Mesozoic formations consist of a complex succession of lithologies, which are generally not easy to distinguish from each other. In addition, both Paleozoic and Proterozoic lithologies can be quite similar to each other. The Paleozoic succession is fairly well understood, but the Precambrian rocks in the subsurface are generally penetrated to a depth of only a few metres and therefore difficult to correlate to outcrops, where similar lithological sequences belong to formations widely different in age. To establish a reference framework of the stratigraphy in the study area, a brief description of the pre-Mesozoic formations is necessary. The strata are described in some detail by Tassonyi (1969), Pugh (1983) and Aitken et al. (1973).

Precambrian Strata - Northern Interior Plains

A tremendous thickness of Precambrian supracrustal rocks underlies the Northern Interior Plains. Seismic reports, submitted to the Canadian Oil and Gas Lands Administration (COGLA), show 8-12 km of layered sequences beneath an angular sub-Cambrian unconformity. Beneath this supracrustal succession is a seismically transparent zone, assumed to be the crystalline basement. These strata have not been penetrated outside the study area in wells in the direct neigbourhood (100 km south or east of the study area).

South of 68^{o} and across the entire Northern Interior Plains, the Precambrian succession has been penetrated in only a few wells. Once penetrated, it was usually drilled for only a few tens of metres, and thus it is difficult to correlate the subsurface strata to the better understood outcrop areas. From seismic sections, large scale folding (wave lengths of a few kilometres) and faulting (offsets of a few hundred metres) are evident below the sub-Cambrian unconformity in the Northern Interior Plains.

Supracrustal, Precambrian successions outcrop in the Mackenzie Mountains (Aitken et al., 1982), in the Brock Inlier on the Coppermine Arch (Balkwill and Yorath, 1970) and nearby Banks and Victoria Islands (Thorsteinsson and Tozer, 1962; Miall, 1976).

Where penetrated, the Precambrian of Peel map-area and in the Northern Interior Plains, comprises a wide variety of lithologies. A general, lithologic subdivision was proposed by Pugh (1983). He distinguished from older to younger a. **Shaly**; b. **Dolomitic**; c. **Argillitic**; and d. **Orthoquartzitic** units. Lithologically, these units resemble those of the Shaler Group (Thorsteinsson and Tozer, 1962) and the Mackenzie Mountains Supergroup (Aitken, 1981).

The **Shaly** unit comprises a section of over 200 m of interbedded dark grey and some brown siliceous shale, siltstone and orthoquartzite. The **Dolomitic** unit is over 250 m thick and refers to varicoloured cherty dolomite. The colours range from pink to yellow, green or white, locally with characteristic red streaks. Black shale or siltstone may be present. The dolomite has features in common only with the unnamed unit H1 in the Mackenzie Mountains (as suggested by Aitken, (1979) in: Pugh, 1983, p.6), and not with the dolomite of the Little Dal Formation. The **Argillitic** unit consists of over 800 m of black, siliceous argillite. Some varicoloured chert and orthoquartzite may be present in the section. It overlies the Dolomitic unit with a sharp contact. The rocks in the **Orthoquartzite** unit are composed of quartzose, coarse siltstones and fine sandstones, and are over 160 m thick. The upper part of the unit may grade into a siliceous dolomite.

Paleozoic Suite

Lithologically, the Paleozoic suite underlying the northwestern part of the Northern Interior Plains can be broadly subdivided into a lower clastic, middle carbonate and upper clastic unit, each comprising several formations.

Lower clastic unit

The lower clastic unit consists entirely of Cambrian clastic sequences. At the base are Lower Cambrian, white, clear quartzose sandstones of the **Old Fort Island Formation**, which reach a maximum thickness of 70 m in the Colville area, but thin rapidly to a zero edge to the west. They unconformably overly the Proterozoic formations. The sandstones are generally friable, but locally they can be well indurated by extensive silicification. The formation is conformably overlain by the Early to Middle Cambrian **Mount Cap** shales, which consist of a glauconitic succession of varicoloured shales, interbedded with siltstones and dolomites and may reach a thickness of up to 180 m in the Colville area. The Mount Cap thins westward and reaches a zero edge on the Mackenzie Arch (Aitken et al., 1982), at a position farther west than the underlying Mount Clark Formation (an equivalent to the Old Fort·Island Formation). The Mount Cap is succeded by the Upper Cambrian, evaporitic **Saline River Formation**. It consists of a lower and upper unit of varicoloured shales with interbedded anhydite, which may envelop a middle salt unit. The thickness of the salt varies tremendously from well to well; the complete formation reaches 470 m in thickness in the Colville Area, but rapidly decreases to zero, probably close to the zero edge area of the Old Fort Island Formation. The top of the Saline

River Formation is picked at the highest level where red shales are present under thick Paleozoic carbonates.

Carbonate unit

A thick succession of platform carbonates with minor shales overlies the lower clastic unit. Dolomite is the dominant rock type, and limestones are present only in the upper part of the unit, which comprises several formations.

Overlying the Saline River conformably is the Upper Cambrian to Early Ordovician **Franklin Mountain Formation**. It has been subdivided into three members (Macqueen, 1969, 1970): the lower Cyclic member with fine crystalline, cream dolomite, near the base of the member grey and interbedded with grey shale; the middle Rhythmic member composed of fine to medium crystalline, cream coloured dolomite; and the fine to medium crystalline upper Cherty member of cream white to pale brown, fine to medium crystalline dolomite with, in its upper part, abundant white coloured chert, silicified oolites and stromatolites, and euhedral quartz crystals. The Cherty member can be up to 400 m thick. The formation is not very fossiliferous and reaches a thickness of up to 920 m in the Northern Interior Plains (Pugh, 1983). Only the Cherty member is of importance for this study for correlation purposes, because the underlying members are difficult to distinguish in the subsurface and the characteristics that allow division disappear to the west.

The Franklin Mountain Formation is overlain by the Late Ordovician to Silurian **Mount Kindle Formation**, which contains very fine to coarse crystalline, light to dark brown dolomite with only small amounts of white chert and quartz crystals; the formation commonly contains silicified fossils. A thickness of 500 m have been reported in the Northern Interior Plains area (Pugh, 1983). Middle Ordovician rocks are absent from the Northern Interior Plains, and this period of time is represented by an unconformity, which diminishes in importance westward, until it is replaced by equivalent shales in the Richardson Trough. Although a major unconformity, the contact with the underlying Franklin Mountain Formation is difficult to pick in the subsurface. In many areas in the Northern Interior Plains, where it has been identified, it is characterized by a gamma-ray wireline log kick, and/or the presence of green shales and/or floating, rounded quartz grains (Wielens and Williams, 1988, in press). In the south part of and locally in the north part of the Northern Interior Plains, there even may be a sandstone present, equivalent to the Little Doctor sandstone of the basal Mount Kindle Formation in the southern part of the Interior Plains (Meijer-Drees, 1975). Brachiopods in this sandstone suggest a Middle to Late Ordovician age for these rocks (Norford, in: Meijer-Drees, 1975, p. 55).

The Upper Silurian to possibly Early Devonian **Peel Formation**, (Pugh,1983) which is composed of pale grey to buff microcrystalline dolomite, locally silty or argillaceous, conformably overlies the Mount Kindle Formation; it can reach a thickness of 390 m in the Northern Interior Plains.

The Franklin Mountain, Mount Kindle and Peel Formations form the **Ronning Group**. Separation of the carbonate formations within the Ronning Group, on the basis of wireline logs in the area north of the 68th parallel, is very difficult, because they consist of a succession of very similar and monotonous lithologies. The dolomites of the group change facies to the black shales of the Road River Formation in the Richardson Trough to the west, at the location of the present day Richardson Mountains.

The **Tatsieta Formation** (Pugh, 1983) of probably Early Devonian age is a pale buff limestone with interbedded green shales and usually one or more interformational, conglomeratic beds. It overlies the Peel Formation with sharp contact and can be up to 165 m thick in the northern Interior Plains. The Tatsieta is equivalent to Tassonyi's Lower Limestone Member of the Gossage Group. No age determinations are available for this formation. In total, the Tatsieta represents an unconformity bounded unit with many internal gaps; the conglomerate may represent an important phase in the sub-Devonian transgression (G.K. Williams, and D. Morrow, pers. comm., 1987);

The Early to Middle Devonian **Arnica Formation**, consisting of light to dark brown, medium to respectively fine crystalline dolomite, overlies the Tatsieta conformably; its thickness is a function of dolomitization processes, and the contact with the overlying Landry Formation is diachronous. The fossil-poor Arnica increases in thickness at the expense of the overlying formation, and the contact can be sharp or gradual.

The Middle Devonian **Landry Formation**, is a brown, aphanitic limestone with pellets, fossil debris and usually crinoid ossicles with twin canals, which indicate an Emsian age.

The Landry and Arnica Formations form the **Gossage Group**, which has a maximum thickness of about 570 m in the Northern Interior Plains. The group increases in thickness toward the west.

The Middle Devonian **Hume Formation** consists of dark-grey to black, argillaceous, bioclastic and fossiliferous limestones and interbedded shales, which have a remarkably constant thickness of about 100 m throughout the Northern Interior Plains. The contact with the underlying Landry Formation is sharp, easy to pick on wireline logs and may be disconformable. In general, the lower part of the formation is quite argillaceous, the upper part is a limestone. The top of the Hume marks the end of carbonate deposition in this area, where the younger, laterally discontinuous Ramparts Formation is absent.

Carbonates of the Gossage Group and the Hume Formation change facies towards to the Richardson Trough, where they grade into the shales of the Road River Formation (Pugh, 1983).

Upper clastic unit

The Hume Formation is overlain with a sharp contact by the upper clastic unit. The base of the unit is a succession of Upper Devonian, radioactive, black, bituminous, basinal shales of the **Hare Indian Bluefish Member** (Pugh, 1983). The shales are about 20 m thick throughout the area; they are locally overlain by **Hare Indian** grey shales and siltstones. These clastics are interbedded and form a monotonous succession of up to 250 m thick (including the Bluefish member). The upper part of the formation, the grey shales thins towards the west, to a zero edge; the lower part of the formation, the Bluefish member, does not thin. The Hare Indian black or grey shales are overlain by the black, basinal shales of the Canol formation, the Ramparts Formation being absent in the Northern Interior Plains.
The **Canol Formation** consists of radioactive, siliceous shales, whose high organic content makes them an excellent potential source rock (Snowdon et al.,

1987). The Canol's maximum thickness is about 100 m. It appears that in the areas where the Ramparts Formation and the Hare Indian grey shales are absent, a period of non-deposition in a starved basin preceded the deposition of the Upper Devonian Canol Formation.

The youngest, Upper Devonian formation in most of the area is the **Imperial Formation** (Braman, 1981; Williams, 1986), which consists of marine, interbedded shales and siltstones with minor sandstone of up to 1900 m thick, conformably overlying the Canol Formation with a gradual contact. The Imperial formation is in most of the Northern Interior Plains overlain by Cretaceous formations, which are distinguishable from the Imperial only by micropaleontological determination. The large, erosional hiatus is extemely difficult to pinpoint in the subsurface and outcrop.

Carboniferous and Permian clastics are only present at the northeastern edge of the Richardson Mountains and in the Eagle Plain, west of the Richardson Mountains.

Unconformities

Three major unconformities are widespread and readily recognized in and above the subsurface Paleozoic suite: the sub-Cambrian, the sub-Devonian (Tatsieta) and the major sub-Mesozoic unconformity, which marks the end of the suite. In the literature, other unconformities are described or inferred from the surface or subsurface. One of these is the important unconformity found between the Mount Kindle and Franklin Mountain Formation (Norford and Macqueen, 1975), but, as previously noted, it is difficult to recognize within the subsurface Ronning Group of the area.

PRE-MESOZOIC STRATIGRAPHY OF THE TUKTOYAKTUK AREA

About 52 wells penetrated pre-Mesozoic rocks on the Tuktoyaktuk Peninsula. The majority of the wells is located on the southwestern part of the Peninsula, and another cluster on the northwest coast near Atkinson Point. The total drilling depth ranges from 905 m to 4447 m, and the penetrated interval of pre-Mesozoic rocks from 1 m to 1767 m (Tables I and II). The pre-Mesozoic lithology penetrated varies considerably, even within smaller areas. A number of these wells are designated as oil and gas wells.

The pre-Mesozoic lithology, where penetrated in the wells on Tuktoyaktuk Peninsula was examined to obtain a subcrop pattern. The results are displayed as generalized lithologic columns for each well on a 1:500 000 scale base map (Encl. 1; numerical information regarding depth, thickness, etc. is available in Tables I through IV). An extensive description of the lithologies from core and drill cutting study for each well can be found in the Appendix. It is subdivided into a Clastics and a Carbonate section, with the wells sorted alphabetically for each areal lithology group.

The stata underlying the sub-Mesozoic unconformity can be grouped into four large areas, each being characterized by similar general rock types: the Quartzite Ridge area; the clastics area to the southeast of the Ridge; the carbonates area to the northwest of the Ridge; the Aklavik area to the south of the Ridge (Figs. 1 and 3). The first two of these areas can be subdivided into a number of smaller units with similar lithology. A more or less separate unit, Campbell Uplift, will be discussed under the Quartzite Ridge area. To display the lithology, depth of penetration and pertinent information, more detailed lithologic columns for each well are presented (Fig. 9), grouped according to the different lithologic areas and alphabetically ordered. Imperial measures are indicated at the left side of the columns, metric values at the right side. In an attempt to obtain ages for the lithologic groups observed, both paleontological and absolute age dating have been attempted. The lithology, age and correlation of each areal group will be discussed in this chapter.

1. THE QUARTZITE RIDGE AREA

Trending obliquely northeast across the Tuktoyaktuk peninsula is an area of white quartzites, one of dolomites, and to the south one of volcanics, each of which has been penetrated in a number of wells. Seismic evidence indicates these lithologies are a pre-Mesozoic horst structure, which will be referred to herein as the "Quartzite Ridge" (Fig. 3).

The Ridge quartzites

Lithology

Well indurated, white to light grey, nearly pure quartzites were penetrated in the wells Atkinson M-33, H-25, Magak A-32, and Natagnak H-50, K-53 and O-59. They consist of coarse to fine, angular to rounded, clear quartz grains, tightly cemented together by milky silica. The rocks are thin bedded, display faint sorting within the beds, and crossbedding and prograding ripples, suggestin a fluvial orogin.

Ages

In the well Magak A-32 on the Quartzite Ridge, the upper parts of cores through the top of the quartzite formation contain ochre coloured, thin shale layers. The shales are apparently parallel to the bedding dip of the quartzites and therefore in succession with them. In two of these, shales poorly preserved, silicified fossils were found, which have been tentatively identified as Saltarella (Fritz and Wielens, in prep). They indicate a Lower Cambrian age. Although the interrelationship between the quartzites and shales is not unequivocally established, a Cambrian age will be assigned here to the quartzites.

In addition, quartzite samples were crushed and subjected to heavy mineral separation to obtain apatite and zircon for fission track dating; although the yield was low, they have been submitted for analysis.

Correlation

The lithology of the Quartzite Ridge quartzites is atypical of Paleozoic strata in Northern Interior Plains. White quartzites are absent from the Paleozoic upper clastic suite. Nothing is known about the beds underlying the quartzites, and the maximum penetration is only about 30 m. The degree of induration of the quartzites (drilling times of up to 6 hrs/m while coring these rocks are mentioned in the well history reports) suggests high levels of diagenesis or low grade metamorphism, and up until now they were considered to be of Precambrian age. The fossils found in the well Magak A-32, however, indicate a Lower Cambrian age for the quartzites. In some of the wells around the Tedji Lake area in Anderson Plain, the white, quartzose, mature and typically friable sandstones of the Lower Cambrian Old Fort Island Formation are well cemented, and are potential lithological correlatives. These sands, however, pinch out not far to the west of the Tedji Lake area. Thus, if the Quartzite Ridge quartzites are correlative with the Tedji Lake Cambrian strata they would belong to a separate basin, distinct from the one in the Northern Interior Plains.

The Ridge volcanics

A significant succession of over 100 m of volcanic rocks overlying brecciated dolomite is present in Eskimo J-07. A few metres of detrital volcanics, contemporaneously with the host strata redeposited from older units, have been found in Inuvik D-54; detrital volcanic material has been observed in the East Reindeer wells C-38 and P-60. These minor occurrences are not included in this group.

Lithology

In the Eskimo J-07 well, there is a 70 m thick succession of basalts. These basalts are hydrothermally altered, dark grey rocks with locally green or red patches. They are best described as an amygdaloidal, aphanitic to porphyritic rock, and locally are even an olivine basalt. Zeolite minerals indicate a later hydrothermal phase.

The thick basalts and nodules in Eskimo J-07 and in the East Reindeer wells C-38 and P-60 have been subjected to X-ray analysis. The results are presented in

Table V (elemental analysis) and Table VI (mineral composition). The Eskimo J-07 and East Reindeer C-38 basalts are alkalic, those in East Reindeer P-60 tholeitic. All samples have in general fairly normal concentrations of the elements, with the exception of those in P-60, which have a high silica content. Iron and titanium values are low, while potassium and silica are somewhat above normal values. Calcium values are quite variable, probably an effect of the hydrothermal phase evident in the core. The barium content is normal and not comparable to the elevated barium content reported by Cecile (1982) for Lower Paleozoic basalts in the Misty Creek Embayment in the Selwyn Basin. They are similar to the alkalic basalts of Lower Paleozoic age described by Moore (1987) in the central and eastern Brooks range. These fairly standard values do not provide any clue to their age.

The dolomite underlying the basalt is a dense, partly mottled, partly laminated, fine crystalline, grey to orange/pink rock with some solid hydrocarbon (black, soft) in vugs. The major fraction of the dolomite is stromatolitic (Plate I), suggesting a biostrome or bioherm. Many of the stromatolites appear to be in growth position, and are usually associated with pink coloured laminae. Their lack of active branching and walls prevents determination and thus dating. Part of the dolomite breccia has rounded, laminated clasts floating in a pinkish sandy matrix.

Ages

The volcanic basalts in Eskimo J-07 were sampled for absolute age dating. Thin section study revealed that the rock underwent severe hydrothermal alteration, rendering the K-Ar method useless for whole-rock or mineral dating, because the K-bearing minerals did not remain closed systems, and large amounts of calcite and epidote are present. Results of Rb-Sr dating on minerals notoriously are poor for this type of basalts, and has not been attempted. As an alternative, samples were crushed and concentrations of the minerals apatite and zircon were submitted for fission track dating. However, these attempts to obtain absolute age dates for the hydrothermally altered volcanics in Eskimo J-07 have been so far unsuccessful. The dolomites were barren of conodonts.

Correlation

Basic igneous rocks are present in the Mackenzie Mountains as sills and dikes intruded at levels as high as the Grainstone member of the Proterozoic Little Dal Formation (Aitken, 1981); as flows in the Proterozoic Copper Cycle (Aitken, 1981); in the Lower Cambrian of the British Mountains in the Northern Yukon (Norris, 1981); and in the Paleozoic Marmot Formation, Mackenzie and Selwyn Mountains (Cecile, 1982). In the Coppermine area, and especially on Victoria Island, similar volcanic rocks are found in the upper part of the Proterozoic, as the Natkusiak Formation (Young, 1981; Jefferson et al., 1985). The Natkusiak has been dated at about 700 Ma (Rb-Sr, Baragar and Loveridge, 1982). Thus, the clastics derived from any volcanics, as can be found in the East Reindeer and Inuvik wells, are likely younger than the Little Dal formation or 700 Ma Natkusiak Formation, and could be up to Middle Paleozoic in age. Based on these observations, the volcanics in Eskimo J-07 are tentatively considered to be of Precambrian to Cambrian age.

The dolomites, which they overly, are largely massive, but undatable stromatolites (Plate I). According to J. Aitken (pers. comm., 1987) they do not have a Phanerozoic appearance, nor do they resemble those which can be observed in the Precambrian Little Dal Formation. The similarity with those in the Precambrian H1 Formation, where bitumen is also present, is very strong. The spotty orange colour of the dolomite is also a characteristic for the H1 Formation, as are crystals of quartz and pseudomorphs of gypsum. The quartz crystals have been observed in this well, but pseudomorphic gypsum crystals not.

Based on the character of the stromatolites, a Precambrian age for these dolomites is likely, and could be expected with regard to the age of the overlying basalts.

The Ridge dolomites

Near the northern end of the Tuktoyaktuk peninsula, three wells (Kannerk G-42, Louth K-45 and Natagnak K-23) in a small area, close to the southeastern edge of the Quartzite Ridge, contain dolomites.

Lithology

The Ridge dolomites are fine to medium crystalline and mainly white, light buff to flesh coloured, with varying amounts of varicoloured (green, red, purple), phyllitic, interbedded shales. In one well, Kannerk G-42, the shales, interbedded with the dolomite, are red and green. In the other two wells the dolomite is described as orange to yellow and pink. The dolomite may be laminated and contain fenestrae.

Ages

The stratigraphic position of the Ridge dolomites is given by the conodont ages: In one of the three wells (Natagnak K-23), they are of middle Ordovician age; in Louth K-45 undiagnostic Ordovician to Triassic conodont elements were found. Kannerk G-42 could not be sampled, because of the heavy shale caving.

Correlation

The colours, described above for these rocks, are atypical of the Ronning Group. As far as is known, the middle Ordovician is not penetrated in the well Kiligvak I-29. In Killanak A-77 the interval about 500 m above TD has a Silurian to Middle Devonian conodont age (Table VII; Uyeno, pers, comm. 1988), and an interval deeper in the well was barren. However, the carbonates in these two wells do not match the description of the Ridge dolomites. Thus it is unknown if the Middle Ordovician is present in the subsurface to the southeast of and in the neighbourhood of the Quartzite Ridge; it appears to be absent from the wells Kugaluk N-02 and Wolverine H-34. The dolomites are much younger than the Quartzites, and the juxtaposition of wells with these lithologies makes a regular stratigraphic succession unlikely; a normal fault contact could be interpreted here, with the dolomites forming a separated, faulted sliver lying on the Quartzite Ridge, or an unconformable relationship could explain the observed pattern.

OTHER WELLS ON THE QUARTZITE RIDGE

Farther to the southwest on the Ridge, is the Akku F-14 well, and in the Reindeer area the wells East Reindeer A-01, C-38 and P-60, plus Ogeoqeoq J-06. The lithologies of these wells are different from those with the quartzites and dolomites described above. The well Inuvik D-45 belongs to the Ridge, but because it has a Lower Paleozoic carbonate succession overlying the older clastics, it will be discussed in the Campbell Uplift section.

<u>Akku F-14</u>

Lithology

The pre-Mesozoic succession in Akku F-14 consists of buff to pink, fine crystalline dolomite with some laminations, and interbedded with green and red phyllitic shales. Small amounts of buff cloured chert are present. Near the bottom of the succession, the dolomite grades into quartzite.

Age and correlation

In Akku F-14 only one smooth conodont cone was recovered. Although indeterminate, it indicates an age of at least Upper Cambrian or younger Paleozoic; it should also be kept in mind that the sample was taken from drill cuttings, introducing an additional uncertainty to the age.
The lithology at first glance suggests a Proterozoic age for the rocks in this well. The single conodont appears to refute that. Similar coloured dolomites are found in the area of the Ridge dolomites, in which conodonts indicated a Middle Ordovician age. In those wells, no quartzites were penetrated.
Considering the lithology of Akku F-14 and the conodont age, a Middle Ordovician age is assumed. If so, we may actually be seeing, in this well, the rocks underlying the Middle Ordovician dolomites to tyhe northeast. The succession in this well is similar to probably Proterozoic rocks exposed in the

Campbell Uplift (M. Cecile and L. Lane, pers. comm. 1987).

Reindeer area

Lithology

The succession in P-60 consists of nearly 1000 metres of green-grey shales, with interbedded siltstones and conglomerates, which overlie 15 m of cherty dolomites near the bottom of the well. The well-indurated sandstones are quartzitic and have a salt and pepper colour. The clastic sequence is to some degree similar to the Imperial Formation, and the dolomites have been correlated to the Silurian-Ordovician on Can-Strat lithologs. There are, however, a number of characteristics of these clastics that are atypical of the Imperial Formation: Plant remains, carbonaceous flakes and mica are absent. The total amount of sand is unusually large for the Imperial Formation, although this may be explained by proximity to a source, as is indicated also by the conglomerates present here. In core, the shales are far more indurated than is typical in the Imperial Formation and contain extensive (vertical) fractures cemented by quartz.

In addition, distal source turbiditic sequences with DE sequences are evident in the shales, and soft sediment deformation is extensive. In the conglomerates, a fair number of the pebbles are composed of weathered, amygdaloidal, ophitic volcanic rocks.

Similar, but more strongly deformed clastics have been penetrated in East Reindeer A-01 and C-38, and in Ogeoqeoq J-06. In A-01, the well indurated sandstones are very white and composed of clear quartz, but less indurated than the quartzites on the Quartzite Ridge and interbedded with a few, up to 3 m thick, dark grey shale beds. In C-38, as in Akku F-14, dolomite overlies the clastics. The succession in Ogeoqeoq contains interbedded dolomite, and the shales are grey or red. None of the cores from these wells shows any sign of bioturbation.

Age and correlation

A limestone bed, intercalated in the clastics in East Reindeer C-38, was barren of conodonts. Shale samples were collected throughout the cores of P-60 for palynology. No palynomorphs were found (GSC Rep. 3-JU-87), only a few black fragments. To determine the nature of these black fragments, additional larger samples were processed. The resulting few black fragments showed no reaction to oxidation, which indicates that the fragments are not coal, and probably inorganic. The total absence of palynomorphs and paucity in carbonaceous material is highly unlikely for the Imperial Formation. The sequence is therefore tentatively assumed to be Cambrian or possibly Precambrian. The Middle Cambrian Slats Creek Formation of the Richardson Trough (Fritz, 1974) is similar in lithology and bedding style. Pugh's (1983) Precambrian Argillite unit is another potential correlative. The succession in the Reindeer area, however, contains volcanic debris beds, and volcanics are only present in formations younger than Pugh's Precambrian units. If equated to the Slats Creek Formation, they may have been deposited as a clastic wedge in a northern extension of the Richardson Trough, somewhat like a wedge of Cambrian clastics found in the northwestern Misty Creek Embayment (Cecile, 1982). This depositional area then extended northward, to include the quartzites of the Quartzite Ridge. If the rocks in this area are Precambrian, it indicates that the formations subcropping on the Ridge become successively older from northeast to southwest (Fig. 6).

The Campbell Uplift

The Campbell Uplift, at the southern end of the Quartzite Ridge, southwest of Inuvik, exposes carbonates with minor clastics unconformably overlying Precambrian argillites and sandstones. North of Inuvik, the well Inuvik D-54 has penetrated a similar section with carbonates overlying argillites and sandstones. Although an uplift, the relation to the Quartzite Ridge is unclear.

Lithology

In the Campbell Uplift, the pre-Mesozoic succession consists of carbonates overlying clastics. The uppermost carbonates are limestones, overlying dolomites with a fault contact. The contact of these dolomites with the underlying clastic strata is covered, and from dip measurements appears to be unconformable. The clastics are a succession of interbedded, varicoloured argillite, quartzite and dolomite.

The succession in the nearby well Inuvik D-54 consists of sandy dolomites overlying a thick clastics sequence. The clastics are shales with some interbedded sandstone overlying a thin volcanic bed. The interval below 4100′ (1250m) contains from top to bottom a section of black, slightly dolomitic shales; a package of white quartzites; a section of red and green shales; and a thick sequence of white quartzites. A core through the lowermost quartzites at 5120′ (1561m) depth indicates that they are composed of clear, white, well cemented, immature sandstone.

Age and correlation

One of the youngest limestone units exposed in the Uplift contains crinoid ossicles with twin canals, indicating an Emsian to lowermost Eifelian age (Norris, 1985) and corresponding in age to the Landry Formation. In addition, conodonts from the uppermost unit have an age equivalent to the Hume Formation (Uyeno and Mason, 1975). The contact below the Emsian limestone is a fault. The underlying dolomites were assigned by Norris and Calverley (1978) to the Vunta, of Ordovician to Early Devonian age, but no fossil ages were reported. Samples for conodonts are being processed (G. Nowlan and S. Maccrachen, pers. comm., 1988).

The contact with the underlying Proterozoic clastics appears unconformable.

A paleomagnetic study of the varicoloured Precambrian clastics found the geomagnetic dipole here corresponding to an age of approximately 1000 Ma on the mean polar wandering curve for North American Precambrian rocks (Norris and Black, 1964). This would correlate them with the Shaler Group (ibid).

The Inuvik D-54 sequence is peculiar and may indicate a Cambrian or Proterozoic history for the Campbell Uplift area. According to Norris and Calverly (1978), the covered interval between the Vunta dolomites and Proterozoic rocks, is represented in Inuvik D-54 by red or green shales and sandstones. Although they do not indicate the exact interval in the well, it probably lies between 4600' and 4700' (1400m-1430m) depth. The weathered volcanics above these depths, at 4100' (1250m) depth, are similar to those in the well Eskimo Lakes J-07 on the Quartzite Ridge, to the north. If these

volcanics are of Late Proterozoic or Early Cambrian age (discussed above), it could place the top of the Proterozoic at the level of the volcanics. The white, clear quartzose sandstone directly above it, may be age equivalent to the Lower Cambrian Old Fort Island Formation and the quartzites on the Quartzite Ridge; the shales overlying the sandstones in turn could be the lithologic equivalents of those of the Mount Cap or Saline River Formations, except that these rocks were deposited in a distinct northern basin. In the internal well-history report, ostracods from the interval below the volcanics are mentioned by C. Yorath on the GSC litholog at 4260′ (1298m) and 4300- 4320′ (1311m-1317m). Carefull study of the drill cuttings from these intervals did not reveal any ostracods, but ostracod-like impressions were observed from round, olive-green, translucent, crystalline material.
The clastic Proterozoic sequence, consisting of black dolomitic shales, red and green shales and white quartzites and underlying the volcanics, does not compare well with any of Pugh's (1983) four Precambrian units, but it is similar to either the Shaler Group (Kilian or Reynolds Point Formations (Young, 1981)) on Victoria Island to the northeast or the Upper Tsezotene Formation (Aitken, 1981) of the Mackenzie Mountains, south across the Anderson Plain.

Rocks tentatively assigned to the Mount Kindle Formation, based on their lithology, subcrop immediately below the Mesozoic unconformity. Its contact with the underlying Franklin Mountain Formation is picked on the basis of the wireline gamma ray log pattern; sand grains are present here, but are not diagnostic due to the presence of sandstone throughout the Ronning dolomites in this well. Samples taken for conodonts in the Ronning interval between 2334′-2360′ (711 m-719 m) depth proved barren. It should be noted that the lithology of the Ronning Group is atypical here in that there is an abundance of sandstone, whereas chert in the assumed Mount Kindle and Franklin Mountain Formations is relatively sparse. The shaly and sandy dolomites near the bottom of the Ronning carbonate section between 3500' and 3780' (1067 m-1152 m) depth, are typical of the widely recognized shaly basal Franklin Mountain Formation (Norford and Macqueen, 1975). The abundance of sandstone in this well and not in others, suggests that it is a locally derived accumulation, perhaps associated with a Lower Paleozoic positive area, that would include the area of the Campbell Lake Uplift. It may even have included parts of the Quartzite Ridge area, in this case the Middle Ordovician Ridge carbonates, which unconformably overly the Ridge quartzites.

2. THE CLASTICS AREA

Southeast of the Quartzite Ridge are shales, with interbedded siltstones, sandstones and conglomerates. Wells with deeper penetrations, like Kiligvak I-29 and (offshore between the Tuktoyaktuk peninsula and Banks Island) Killannak A-77, encountered a sequence comparable to the regular Paleozoic section as found in wells in the Northern Interior Plains (Kugaluk N-02, Wolverine H-34, located about 80 km from the Ridge itself). Other wells in this area are Amaguk H-16, Amarok N-44, Kanguk F-24 and I-24, Kapik J-39, Nuvorak O-09 and Russell H-23.

Lithology

The clastics in this flyshoid group consist of salt and pepper coloured siltstones, sandstones and conglomerates, interbedded with dark grey to grey shales. The pebbles consist of mainly carbonate, the sand and silt of quartz with mica flakes and irregularly distributed carbonaceous flakes. Generally the lower part of the succession is mainly shale.

Kugaluk N-02 in the Anderson Plain was cored from 818' (249m) to total depth of 8045' (2452m). The following observations are common to the Imperial Formation:

- plant remains and carbonaceous flakes are present;
- the sand and siltstone have a salt and pepper appearance, mainly caused by the presence of detrital mica;
- the shales are indurated, but not enough to keep them from splitting in the core box;
- the sands contain cross bedding, but soft sediment deformation is rare;
- laminations are usually present in the argillaceous beds;
- no evidence for burrowing was found in the sands;
- scouring features are present, as well as Bouma sequences in the shalier parts;
- the sand beds are usually thicker than in the cores of the East Reindeer wells.

Ages

Core samples for palynological dating were taken from the wells Nuvorak O-09, Kanguk I-24, Amarok N-44 and Russell H-23 on the northernmost part of the Peninsula in the Imperial Formation group. They were not particularly rich in pollen, but contained enough material to establish a Devonian age (J. Utting and C. McGregor, pers. comm., 1988).

Correlation

The siliciclastics belong to the Imperial Formation, as indicated by lithology and by palynological evidence. Carbonate-clast and chert-clast conglomerates were encountered within this siliciclastic section in several wells. The presence of the conglomerates, together with an unusually large proportion of sandstone, indicates that they are proximally sourced. Because the conglomerates are carbonate and chert rich, the Paleozoic "carbonate unit", now found north of the Quartzite Ridge, is the most likely source. Probale source of the carbonates are either erosional truncation of uplifted structures to the north of the Quartzite Ridge, and/or erosion of carbonates which formerly overlay the ridge. The wells with deeper penetration in the Anderson Plain record an undisturbed section of rocks into formations as old as the Mount Kindle Formation, and in Kugaluk N-02 and Wolverine H-34 the Franklin Mountain Formation (Encl. 5). A similar sequence was encountered in the well Killanak A-77, offshore to the north of the peninsula.

This part of the study area is geologically similar to the northwestern Anderson Plain, where Mesozoic strata rest directly upon a westward thickening wedge of the Imperial Formation; the thinning of the Formation close to the Quartzite Ridge visible on seismic lines is probably caused by pre-Cretaceous erosion.

3. THE CARBONATES AREA

To the northwest of the Quartzite Ridge is an area of mainly carbonates. The majority of the rocks consists of dolomites and shales rich in chert, but some wells were completed in limestones. Each lithological subgroup will be discussed separately.

The carbonates were sampled where possible to obtain conodonts from cores and drill cuttings of the wells (Figs. 2 and 4; Table VII). One suite was taken from the wells with limestone, the other from wells with dolomite. The conodonts were identified by T. Uyeno and G. Nowlan (pers. comm., 1988).

The carbonates, Limestone

Limestone was penetrated in five wells: Atkinson A-55, Mayogiak J-17 and M-16, Pikiolik E-54, and Tuktu O-19. Both Mayogiak wells contain a minor amount of dolomite. In addition, the offshore well Kilannak A-77 penetrated a succession of limestones underlying the clastics of the Imperial and Canol Formations. Because of similarities and correlation, this well will also be described in this chapter, although with its Imperial Formation subcropping below the sub-Mesozoic unconformity, it could have been described in the chapter about the clastics area. The wells containing limestone define two narrow, north trending bands on the subcrop map (Figs. 3, 5 and 6).

Lithology

The limestone in this subgroup is generally dark grey to black, pellitic, micritic, nodular and fossiliferous. The nodules can be rounded or angular. Mottling of the limestone is caused by dolomitization. The limestone is generally fractured horizontally and vertically, with the fractures filled by calcite spar.

Ages

The limestone in the wells Killanak A-77, Mayogiak J-17, Pikiolik E-54, and Tuktu O-19 contains crinoid ossicles with twin or even four central canals, and corals, all indicating an Emsian age. Conodonts confirm this age in Mayogiak J-17, Tuktu O-19 and Killanak A-77. In Pikiolik E-54, the conodonts indicate an age somewhere in the range of middle Ordovician to Middle Devonian. The limestone/dolomite successions in the wells Pikiolik M-26, Mayogiak M-16 and Atkinson A-55 did not contain the twin-canal crinoid ossicles, but could correlate to Middle Devonian rocks of the Gossage Group on the basis of their lithology. No conodonts were recovered from Pikiolik M-26 and Atkinson A-55, but tiny fragmented brachiopod shells were recovered in the latter. A.W. Norris (pers. comm., 1988) tentatively suggested a possible Early Paleozoic age for these fragments. One sample from Mayogiak M-16 was barren, the other contained conodonts of probably Middle Devonian age.

Correlation

The limestone strata are lithologically similar to those of the Landry Formation in the Northern Interior Plains. The crinoid ossicles with twin canals date the rocks as Emsian to lowermost Eifelian (A.W. Norris, 1985), the age of the Landry, but not Hume Formation. This Emsian age is confirmed by the conodonts.

The fossil content of the rocks in Atkinson A-55 is not very diagnostic. Conodonts were not recovered from the samples. Pelletal material is present; the poorly preserved imprints of fossils, which suggest Amphipora, Thamnopora, etc (see Appendix), preclude determination. The total assemblage is similar to that found in rocks of the Landry Formation in the Northern Interior Plains. Thus, this well would define the northernmost, small, north trending band of Devonian Carbonates, and the other limestone containing wells the middle band (Figs. 3, 5 and 6).

<u>The carbonates, Dolomites</u>

The remainder of the carbonates area is taken up by wells containing dolomite. Included in this group are wells in the Parsons area which contain black shales and chert.

The wells in this area are: Atkinson L-17, Imnak J-29, Kimik D-29, Mayogiak L-39, Nuna A-10, Pikiolik G-21 and M-26, Tuk M-09, and Wagnark C-23. In the Parsons area, a large cluster of wells is formed by East Reindeer G-04, Kamik D-48, Parsons A-44, D-20, F-09, L-37, L-43, N-10, O-27, P-41 and P-53 and Siku A-12, C-11 and E-21.

Lithology

To avoid repetition, the lithology for subgroups of the dolomites will be presented below, where they will be needed under "Correlation"

Ages

Out of the 27 samples procesed for conodonts from dolomite successions in the carbonate area, 18 were barren. Conodonts recovered from the other dolomites indicate a Middle Ordovician age in the well Atkinson L-17, and Lower Ordovician (early to middle Canadian) ages in the wells Parsons F-09 and

N-10. A probable Middle to Upper Ordovician age is indicated for Kimik D-29 and Parsons P-53.

Correlation

Middle Ordovician time is represented by a hiatus on the mainland; dolomites with this age assignment are reported only in the Porcupine, Ogilvie and Mackenzie Mountains, and in the Quartzite Ridge dolomites described above; they are inferred to be present under the westernmost Peel area. Rocks of this age are absent from most of the subsurface of the Northern Interior Plains. This indicates a closer relation of the carbonates of this age range in the study area to those in the Mackenzie and Richardson Mountains, than to those on the Northern Interior Plains.

The cherty dolomites of the Parsons area have a Lower Ordovician and one probably Upper Ordovician age. Other wells in this same area are extensively stratified with chert and black shale, indicating a position in or proximal to the carbonate-shale transition, a position analogous to the dolomites in the westernmost Peel area. They thus represent a northward extension of the Richardson Trough or Franklinian Geosyncline. They lie in the southwesternmost Ronning area on Figure 5.

No ages are available for the remainder of the dolomites. Lithological correlation indicates a Arnica Formation equivalent age for these for Imnak J-29 and Wagnark C-23. The dark grey to white, fine sucrosic dolomites in these wells are unfossiliferous, do not contain chert other than in rare, small, well rounded pebbles, and may contain a few shale beds. Especially the absence of the large amounts of chert and the darker colours point to the Landry Formation of the Northern Interior Plains as an equivalent. These wells define the southernmost band with Devonian carbonates as is indicated on Figure 5.

The dolomite in Nuna A-10 in comparison is lighter coloured and contains dolomitized fossils. Its lithology closely matches that of the Mount Kindle Formation in the Northern Interior Plains, and would exclude it from the area with tentative Devonian rocks occupied by the Imnak and Wagnark wells. The debris flow and black shales in Tuk M-09 are similar to lithologies in the Road River Formation in the Richardson and Mackenzie Mountains, and the rocks encountered in the Parsons area, although chert is not abundant in this well. The position of the coarse crystalline, white dolomites in Mayogiak L-39 is unclear. The shallow, 20 m penetration and extremely heavy caving render the samples unrepresentative. The rocks could belong to the Arnica Formation, but are coarse crystalline and white, or they could be equivalent to the Mount Kindle Formation, but are white coloured, or to the Franklin Mountain Formation but lack chert and are coarse crystalline. The area containing these three wells is probably underlain by Ronning age formations and forms the southern Ronning area enclosed by the bands of Devonian bands on Figure 5.

The northern enclosed Ronning area has two wells with Middle Ordovician ages, and two wells barren for conodonts, Pikioloik M-26 and G-21. The G-21 well contains dark to light grey, fine crystalline dolomite with light buff to dark brown chert and red quartz grains. This lithology is also found in the Cherty Member of the Franklin Mountain Formation in the Northern Interior Plains. The M-26 well contains a micritic to fine crystalline, laminated, dark to light grey dolomite with oolites (silicified?) and coloured chert pellets.

Although the white chert is absent, the rocks could belong to the upper part of the Franklin Mountain Formation.

4. THE AKLAVIK AREA

The Aklavik area is located in the southwesternmost part of the Mackenzie Delta and at the southwestern extension of the carbonates area. The pre-Mesozoic was penetrated in the wells Aklavik A-37 and F-38, Beaverhouse H-13, Kugpik L-21 and O-13, Napartok M-01, Napoiak F-31, Ulu A-35 and Unak B-11 The area is underlain by a succession clastics with a few interbedded carbonates.

Lithology

The carbonates are mainly limestones rich in chert, whereas the clastics may contain varicoloured shales, siltstones, sandstones, conglomerates and chert beds.

Age and correlation

The clastics in the Aklavik area match the complex lithologies as described for the Carboniferous and Permian rocks in outcrop (Bamber and Waterhouse, 1971). A few Permian palynological ages mentioned in well-history reports corroborate this lithologic correlation. The wells in this area have not been studied in detail. The boundary with the carbonate area as drawn on Figure 5, is arbitrary in direction and could swing to other directions.

CROSS SECTIONS

To illustrate the characteristics of the different lithological areas, four stratigraphic cross-sections have been constructed. Three of them are essentially parallel in a southeasterly to northwesterly direction; one covers the wells penetrating the regular successions with Imperial and older formations, and is connected through the offshore well Kilannak A-77 to Orksut I-44 on Banks Island. The other two sections parallel the Quartzite Ridge Area and the Carbonates Area. Along the southwest end, a more or less east-west section crosses and connects the areas covered by the other sections, and it also connects to the GSC deep-reflection seismic line which extends northwesterly, parallel to the southwest edge of the Tuktoyaktuk Peninsula (Fig. 1).

The structural section for each of the stratigraphic sections are also displayed. Both types of section have the pre-Mesozoic erosional surface as a datum. On the structural sections, the sea-level line represents the post-Mesozoic structural component.

1. Section A-A', through the clastics area to the southeast of the Quartzite Ridge, from Anderson Plain to Banks Island

The stratigraphy of Tuktoyaktuk Peninsula to the southeast of the Quartzite Ridge is similar to that of the Northern Interior Plains. A cross-section (Encl. 2) through wells in this area demonstrates this. Regrettably, only one well on the Peninsula, Kiligvak I-29, penetrates the carbonates underlying the clastics of the Imperial Formation. The only other well in this general area with a more complete regular succession is the offshore Killannak A-77; it provides a great opportunity for correlation with the stratigraphy of the nearby Banks Island well Orksut I-44, and allows a tie between the stratigraphy of the Northern Interior Plains to that of the Arctic Islands, through Tuktoyaktuk Peninsula.

On section A-A' (Encl. 2), going from southwest to northeast, the first well is **Kugaluk N-02**, on the Anderson Plain. It is also present on section D-D' (Encl. 5), to be discussed below. This well has a typical Northern Interior Plains succession. An unusually thin Imperial Formation subcrops under the sub-Mesozoic unconformity; truncation of pre-Mesozoic formations is visible on seismic lines (J. Dietrich, pers. comm., 1988). This demonstrates significant post-Imperial and pre-Mesozoic erosion in this area. The upper part of the Imperial contains mainly the usual silt- and rare sandtones, while the lower part is a nearly pure shale. The underlying Canol Formation overlies the Bluefish Member of the Hare Indian Formation; the grey shales of Hare Indian Formation and the Ramparts carbonates are absent. The Hume Formation is rather thin, and displays the usual subdivision in an upper limestone and lower shale section. The underlying Landry Formation is fairly thick in this area and changes gradually into the Arnica dolomites. The Tatsieta Formation below the Gossage Group consists of the usual limestone. The stratigraphy of the Ronning dolomites deeper in the Kugaluk N-02 is tied down by several conodont ages: conodonts recovered between 5590'-5614' (1704m-1711m) depth and at 5819' (1774m) were recovered and indicate a Silurian age. Between 6111'-6126 (1863m-1867m) and at 6491' (1978m) depth conodonts indicate a late Middle Ordovician to Late Silurian age, equivalent to the Mount Kindle Formation (Norford et al., 1973). The contact between Franklin Mountain and Mount Kindle Formation is marked by floating sand grains. The well bottoms in the Franklin Mountain

Formation.

The next well on the section, **Kiligvak I-29**, at a distance of 109 km from Kugaluk, also penetrated some of the carbonates underlying the Paleozoic upper clastic unit. The Imperial Formation, in contrast to the previous well, contains conglomerates with pebbles of carbonate and chert, and a large proportion of sandstone. No internal correlation of the Imperial Formation in this well with Kugaluk is apparent. The Canol Formation again directly overlies the Bluefish Member and both are, together with the underlying Hume Formation, quite similar in lithology and thickness to the sequence in Kugaluk. The Landry Formation is somewhat thicker, and changes gradually to the dolomites of the Arnica with depth; lack of samples at this interval forces a correlation based on only the wireline logs for the bottompart of the succession penetrated.

The next three wells on the section are, in order, **Amaguk H-16**, **Amarok N-44** and **Russell H-23**. The first two of these wells contain conglomerates and a large proportion of sandstones. None of the three penetrates the complete formation, and this may be the reason why only in Russell the nearly pure shale section, which can be observed elsewhere in the Imperial Formation, is present. With Russell, the section moves off the peninsula.

The next well is **Killannak A-77**, whose succession near the bottom of the Imperial is not as shaly as usual: cherty sandstones underly a shaly and silty sequence. Here, the formations begin to display similarities to the stratigraphy of both the Northern Interior Plains and the Arctic Islands. Therefore, the Arctic Islands Nomenclature (henceforth indicated as AIN) will be given where possible. The AIN equivalent of the Imperial is the Cape de Bray Formation, and the siliceous sandstones are in the AIN the Blackly Formation. The Imperial Formation overlies a thin, silicious, black shale: the Canol Formation and possibly Bluefish Member (AIN: Kitson Formation). The underlying

Hume limestones are still quite similar to those in the Northern Interior Plains, and contain the usual lower shale member. They are equivalent to the upper limestones of the AIN Blue Fjord Formation, the top of which may be lowermost Eifelian in age, the bottom is not older than Emsian. Conodonts and crinoidea in the sequence directly underlying the Hume Formation in this well indicate Emsian ages, which tie this succession to the Landry Formation. The formation gradually becomes more dolomitic with depth, and changes into the Arnica dolomites. The Tatsieta is here not recognizable by a limestone lithology, and it is tentatively assigned to the dolomitic sequence with noisier gamma-ray and sonic wireline logs. The AIN equivalent is the Unnamed Shaly Dolomites. The lowermost sequence of light brown dolomites may be equivalent to the Peel Formation, but contains floating quartz crystals; its AIN equivalent is the Unnamed Dolomite.

The final well on the section is Orksut I-44, on Banks Island. The pre-Mesozoic succession starts with the Cape de Bray clastics, equivalent to the Imperial Formation. It is underlain by the radioactive, black, siliceous shales of the Kitson Formation, and has a thickness similar to the equivalent Canol Formation in the Northern Interior Plains. It is underlain by undifferentiated limestones and dolomites of the Blue Fjord Formation. The limestones are fairly thin, compared with those of the combined Hume and Landry Formations, but the equivalent of the Lower Hume shales is still evident in the upper 40 m of the Blue Fjord Formation. The dolomites of the Blue Fjord Formation are tied down by an Emsian conodont age (Uyeno, 1974; in: Miall, 1976). The somewhat shalier, underlying Unnamed Shaly Dolomites have a Middle Ordovician to Middle Devonian conodont age. The well bottoms in the underlying, cleaner Unnamed Dolomites.

2. Section B-B', parallelling the Quartzite Ridge.

The southwest-northeast section B-B' (Encl. 3) illustrates the relationships of the pre-Mesozoic rocks on the Quartzite Ridge. Going from southwest to northeast, the section starts with **East Reindeer P-60** and **C-38**. Both contain a clastic sequence of Cambrian, or possibly Precambrian age, as has been discussed above. P-60 overlies cherty dolomite, while the sequence in C-38 starts with dolomites, overlying the clastics. A few tentative correlations are indicated for the clastics in both wells. It is unlikely that the dolomites in P-60 and C-38 are equivalent. There is no evidence that the dolomite in C-38 could belong to the Ronning carbonates, although it has the wireline-log characteristics of the Franklin Mountain Formation.

The next well, **Eskimo J-07** contains volcanics. They have been assigned a Cambrian to Precambrian age and overly stromatolitic dolomites, which were assigned a Precambrian age. These dolomites are dissimilar to those in the previous two wells; they could be older.

In the next well, **Akku F-14**, dolomite overlies clastics again, as in East Reindeer C-38. The shaly dolomites do not have the very quiet wireline-log pattern as in C-38, but did contain a conodont fragment in the drill cuttings, indicating a Paleozoic, probably post Cambrian age. The clastics do not appear correlatable to those in the East Reindeer wells.

The next wells on the section are, in order, **Magak A-32**, **Atkinson M-33**, and **Natagnak H-50**. All three contain the white, well indurated quartzites of the Quartzite Ridge, that are interpreted as Lower Cambrian in age, based on the fossils found in Magak A-32.

The final well, **Louth K-45**, penetrated the shaly Ridge dolomites, and conodonts indicate an Ordovician to Triassic age. The conodonts in the neighbouring Natagnak K-23 indicated a Middle Ordovician (Whiterockian) age, which wil probably also apply to K-45. The carbonates overly the Ridge quartzites probably with an unconformable or a fault contact.

If the succession in the East Reindeer wells is Precambrian in age, it would indicate a general northward dipping plunge of the Ridge at the time when the formations were subjected to erosion, whereby the southwest end of the Quartzite Ridge was truncated to a lower stratigraphic level than the northeast end.

3. Section C-C', paralleling the dolomites area

Section C-C' (Encl. 4) displays the pre-Mesozoic relationships of the carbonate area located at the northwest side of the Quartzite Ridge. Going from southwest to northeast, two wells (**Parsons P-53** and **F-09**) represent the Parsons area, the southwesternmost area with cherty dolomites of Lower Ordovician age, equivalent to the Ronning Group. The black shales indicate proximity to a facies change into the Road River Formation and indicates that the Richrdson Trough extended northward to include this area.

The dolomite in the next well, **Imnak J-29**, has been assigned a probable Arnica age. This sequence would then lay in the southernmost of the Devonian Carbonate bands (Figs. 5 and 6).

The next two wells are **Pikiolik E-54** and **Mayogiak J-17**; both contain dolomites and limestones of the Gossage Group and are tied down by Emsian crinoidea and conodonts. The wells are located on the middle band of Devonian carbonates, the section having jumped over the interlying Ronning carbonate area.

The section continues with **Kimik D-29**, where it contains Middle to Upper Ordovician conodonts. In these Ronning dolomites, the interval with the gamma ray kick on the wireline logs, grey shales and floating quartz grains is most

probably the contact between the Franklin Mountain and Mount Kindle Formations. From this Ronning carbonate area, the section continues into the northernmost Devonian limestone area with Atkinson A-55. The sequence of interbedded limestone and dolomite is quite similar to the transition zone between Landry and Arnica Formations and is not characteristic of the underlying Ronning carbonates in the Northern Interior Plains. The reported Early Paleozoic fossil age is based on tiny, broken brachiopod fragments, and very tentative.
On the structural section, the correlations in Imnak J-29, Pikiolik E-54 and Mayogiak J-17 are shown in normal stratigraphic contact with their neighbouring wells. Another explanation for the contact is faults. Many faults in the pre-Mesozoic sequence are visible
on seismic lines in this area, but their nature in relation to this contact is difficult to ascertain.

4. Connecting section D-D' through wells in the vicinity of the reflection line.

A number of wells lie in proximity to the GSC seismic deep reflection line (Fig. 1). Section D-D' (Encl. 5) illustrates the relationships of wells in the neighbourhood of this line and ties them to the adjacent Anderson Plain area and the lithological areas on Tuktoyaktuk Peninsula.

Going from east to west, the first wells on the section are Wolverine H-34 and Kugaluk N-02; the latter has already been described under section A-A'. Both wells contains a typical Northern Interior Plains succession. An unusually thin Imperial Formation subcrops under the sub-Mesozoic unconformity in both wells, demonstrating significant post-Imperial and pre-Mesozoic erosion in this area. The thickness of the Imperial Formation normally increases westward as a result of the westward dip of the Paleozoic formations in a homocline. This suggests, together with some truncation below the sub-Mesozoic unconformity as is visible on seismic lines (J. Dietrich, pers. comm., 1988), pre-Mesozoic tilting and erosion of Imperial and older strata.

The sequence in **Inuvik D-54**, to the west of the previous two wells, is peculiar and may indicate a Cambrian or Proterozoic history for the Campbell Uplift area. Rocks assigned tentatively to the Mount Kindle (as discussed above), subcrop immediately below the sub-Mesozoic unconformity and are underlain by Franklin Mountain Formation dolomites.

The lithology of the Ronning Group is atypical here in that there is an abundance of sandstone in both the Mount Kindle and Franklin Mountain Formations, whereas chert is relatively sparse. The shaly and sandy dolomites near the bottom of the Ronning carbonate section between 3500′ and 3780′ (1067 m-1152 m) depth, are typical of the widely recognized shaly basal Franklin Mountain Formation (Norford and Macqueen, 1975). The abundance of sandstone in this well, as discussed above, suggests that it is locally derived, and perhaps associated with a Lower Paleozoic positive area, that included the Campbell Lake Uplift.

The interval with shales and some interbedded sandstones between 3780′ and 4080′ (1152 m-1244 m) is considered to be Cambrian in age, based upon the volcanics found near 4100′ (1250 m) depth, that are thought to be Proterozoic to Cambrian in age (see previous discussion). The Cambrian succession in the Anderson Plain area thins westward and essentially pinches out to the east of the Tuktoyaktuk Peninsula. Therefore, this represents a reappearance of Cambrian strata in a distinct, northern basin area.

The sequence underlying the volcanics contains, from top to bottom, black, slightly dolomitic shales; white quartzites, red and green shales; and another thick succession of white quartzites, all of which are considered to be Proterozoic.

From Inuvik D-54, northwest of the Campbell Uplift, the section changes direction to the north. Direct correlation to the strata in the next well, East Reindeer P-60, is impossible. A thick sequence of clastics lies on top of dolomites found near the bottom of the well. As discussed above, a Cambrian or possibly Precambrian age is assigned to the clastics in P-60, as well as those in the next well on the section, Ogeoqeoq J-06, where a succession of interbedded white and grey sandstone, red and grey shales and grey dolomite has been penetrated. The information available for both wells does not allow any correlation within the clastics package.

The northwesternmost well in the section, Parsons P-53, cannot be connected to Ogeoqeoq, and contains rocks of probably Middle to Upper Ordovician age (equivalent to the Road River Formation or transitional to basin facies): dolomite with interbedded black shales and large amounts of chert. Wells in the Parsons area, such as Parsons F-09 and N-10, have Lower Ordovician dolomites, while others may contain cherty dolomite only, suggesting that the area is close to the shale-out edge of the Paleozoic carbonates. The subcrop of the Paleozoic in these wells indicates that they are located on the downfaulted blocks of the area to the northwest of the Quartzite Ridge. Anhydrite is present in this well and is anomalous, because it is normally not present in the Lower Paleozoic Formations in this area. It is probably allochtonous, and was transported in the form of concretions during the formation of the carbonates.

THERMAL MATURITY

Wherever possible, samples were taken from shales in cores for geochemical analysis. Most samples were analyzed on the Rock Eval intrument; a few samples were processed for measurement of reflectance data of coaly or bituminous material. Additional information was gained from Thermal Alteration Indices (TAI) and Conodont Alteration Indices (CAI). Not enough data were available to present a coherent picture of the maturity pattern in the study area. The data are presented in Table VIII. Most maturities are fairly high for the sample depths, and indicate either anomalously high heatflows or erosion of a thick succession from this area.

STRUCTURAL IMPLICATIONS - EVIDENCE FOR ELLESMERIAN OROGENESIS

The pre-Mesozoic subcrop-geological map (Figs. 5 and 6), which uses the sub-Mesozoic unconformity as a datum, shows a complex pattern of rock units of Precambrian to Late Devonian age. Regardless of the exact nature of the deformation that produced this pattern, it requires a major structural event(s) of post-Devonian and pre-Cretaceous age.

In the area underlain by Palaeozoic carbonates, northwest of the Quartzite ridge, there is an alternating pattern of subcropping Ronning Group (Cambrian - Silurian) dolomites and Emsian limestones (Gossage Group). Contacts between these alternating carbonate subcrop areas are fairly limited in their directional trend by well control, and trend north or possibly northwest (Fig. 5). This pattern could be produced in three ways: by folding, thrust faulting, or normal faulting (Fig. 10). It is interesting to note that "Ellesmerian" structures in the Barn Mountains (Dyke, 1974; Norris and Yorath, 1981), which are potentially of the same age as the Tuktoyuktuk sub-Mesozoic structures, also trend northerly. The "Ellesmerian" structures in the mountains are compressional and therefore thrusting and possible folding are favoured as options for the structures in the carbonates to the north of the Quartzite Ridge.

The contact of these structures with the Quartzite Ridge is problematic. They are either abruptly truncated against a northeast trending fault or change trend abruptly to swing in parallel to the ridge. This will be further discussed under the Chapter "Dipmeter data" below.

Rocks to the southeast of the Quartzite Ridge are Imperial Formation, and this abrupt, consistent change in stratigraphic position appears best explained by faulting (Fig. 11). This southeastern fault could be a strike-slip fault, a normal fault or a thrust fault. The presence of conglomerates with chert and carbonate clasts in the nearby Imperial Formation suggests that, whatever the nature of the fault, movement on it was in part contemporaneous with deposition of the Imperial Formation. On seismic sections a thinning of the Formation close to the Ridge is evident (J. Dietrich, pers. comm., 1988). This requires a certain amount of uplift of the Imperial in the neighbourhood of the Quartzite Ridge, followed by pre-Mesozoic erosion, which bevelled the area.

The peculiar nature of units in the Inuvik D-54 well suggests the possibilty of a Paleozoic high in the area of the Campbell Uplift. The anomalous abundance of sandstones in the carbonates in this well, but not in other wells of the area, suggests that they were locally derived. The reappearance of (tentatively) Cambrian sandstones is also a significant anomaly. In the Anderson Plains area to the south, Lower and Middle Cambrian rocks thin westward towards a northern extension of the Lower Paleozoic Mackenzie Arch, and are absent on it; west of the Arch a thick succession of Cambrian sandstones reappears in the Richardson Trough. This situation is analogous to the Quartzite Ridge quartzites and in the Inuvik area it would also explain the reappearance of the Cambrian sandstones, while the abundant sandstone in the Ronning carbonates could later be derived from erosion on the crest of this inferred high. In addition, the presence of Middle Ordovician carbonate, which may unconformably overly the Quartzite Ridge at its northeast end, indicates Paleozoic relief in the area of the Ridge

Thus, although the present day exposure of the Campbell Uplift is the product of Mesozoic tectonism and the Quartzite Ridge of post-Devonian to pre-Cretaceous tectonism, it is entirely possible that earlier Paleozoic structures played a major role in controlling the location and character of these younger uplifts.

Dipmeter data and structure

Dipmeter data were collected, where·available from the dipmeter wireline logs. The mean values of dip and strike above and below the pre-Mesozoic unconformity were recorded. With the help of a Schmit nomogram, the Mesozoic dip values were subtracted from the pre-Mesozoic data, thus yielding the original dip of the formations subcropping below the pre-Mesozoic unconformity at the onset of Mesozoic sedimentation. The measured and recalculated data are presented in the Appendix at the heading paragraph of each well, and in Fig. 7.

After discarding the data with a wide variation or other uncertainties in the measurements, the remaining datapoints were plotted on a map (Fig. 8). A general pattern emerges, in which the Imperial Formation dips westward (in accordance with the general trend in the Anderson Plain;the northeast dip in Amaguk H-16 is therefore considered anomalous), and the carbonates at the other side of the Ridge more or less eastward; the Ridge itself is represented in the north by a northwest dip, and in the south by a shallow southwest dip. This pattern appears to confirm the rotation of the carbonate fault blocks as depicted in Figure 11. Especially in the carbonates, the rather wide variation in dip directions can be explained by the extensive faulting the successions have been subjected to, and which is evident on seismic information in COGLA Reports.

On Figure 8, the dip direction of the northernmost well with Devonian carbonates (Atkinson A-55) suggests a connection with the Devonian carbonates in the well Mayogiak J-17 farther to the south is possible. The narrow middle band of Devonian carbonates would swing around and be connected to the northernmost subcrop area. But this configuration cannot accomodate the older Ronning age carbonates bordering these Devonian carbonate bands. In cross section, a pattern as in Figure 12 is visualized, with an Imperial succession on the southeast side with westward dips similar to the mainland in Anderson Plain, but with some uplift close to the Quartzite Ridge. This uplift is deduced from the thinning of the formation on seismic lines (J. Dietrich, pers. comm., 1988). The quartzites and carbonates of the Quartzite Ridge have been thrust up, and appear to dip westward. The carbonates on the other side dip eastward, due to the rotation of the faulted blocks. Wells very close to the Ridge have fairly consistently a strike parallel to the fault bounding the Ridge, and may indicate that the structures change trend to swing in parallel to the Ridge. The Quartzite Ridge extends a fair distance farther north into the Beaufort Sea, and is visible on seismic section (J. Dietrich, pers. comm., 1987)

Timing of the deformation

The **Aklavik area** is underlain by probably Permian strata (Fig. 5). The Permian rocks overly the carbonates in the southwestern part of the peninsula. If these clastics overly the older rocks unconformably, like in the northern Richardson Mountains (Bamber and Waterhouse, 1971), the "Ellesmerian" deformation would then predate the onset of Permian clastic deposition. If the subcropping pre-Mesozoic succession in Aklavik F-17 is indeed Cambrian in age, the formation of Quartzite Ridge either predates the Permian, or it was a positive feature during the Permian.

CONCLUSIONS

This study demonstrates that careful study of rock samples can yield solutions to many geological puzzles in an area, without having to rely on expensive techniques like seismic lines, aeromagnetics, etc. Persistent micropaleontological sampling yielded ages crucial to the understanding of the area.

A pattern of regional lithology groups could be defined, that are correlatable to formations in the Northern Interior Plains and even be connected in a cross-section to the stratigraphy of the Arctic Islands.

Paleozoic rocks are present on both sides of the Quartzite Quartzite Ridge and on a large part of the Ridge itself, which is a horst structure underlying the Tuktoyaktuk Peninsula.

The white quartzites and varicoloured dolomites on the Ridge were thought to be of Precambrian age. Fossils indicate that the quartzites are of Lower Cambrian, and the dolomites of even younger, Middle Ordovician age. Both ages have profound consequences for the area. First of all, they indicate that the Tuktoyaktuk Peninsula was underlain by a Cambrian basin separated from the one in the Northern Interior Plains by a high located to the southeast of the Peninsula. Secondly, rocks of Middle Ordovician age are found only in the Richardson, Ogilvie, and Mackenzie Mountains, and are absent from the Northern Interior Plains, with the possible exception of the westernmost Peel area. This links the Ronning Group formations on the Tuktoyaktuk Peninsula rather with these Mountain areas in the Yukon than with the Plains area. The clastics in the East Reindeer area, at the south end of the Ridge, are of Cambrian or Precambrian age, based on the lithology. Should they be of Precambrian age, a northward dip had to be present before the onset of Mesozoic erosion, which so could cut down into successively older formations to the south.
The Campbell Uplift is probably part of the Ridge, but appears to be a separate unit of it. It contains limestones as young as Hume, plus Paleozoic dolomites, overlying Proterozoic clastics and dolomites. These Paleozoic rocks contrast with the Cambrian or Precambrian rocks subcropping in the Reindeer area. Although the Campbell Uplift is a Laramide age feature, the nearby well has indications for a emergent area in this neigbourhood during the deposition of the Ronning carbonates. Although presently a higher structure than the Quartzite Ridge, the youngest formations in the Uplift indicate that

tectonically it lies below the Ridge at the pre-Mesozoic subcrop level.

The Paleozoic formations to the southwest of the Ridge are part of a regular stratigraphic succession, common to the Northern Interior Plains, and can be followed all the way through to the Arctic Islands, where minor changes can be observed in the succession.

The Paleozoic carbonates to the northwest of the Ridge appear a normal Lower to Middle Paleozoic sequence with some structural complexities. Their subcrop pattern forms an alternating succession of areas underlain by older Ronning dolomites and younger Devonian limestones and dolomites, all of which have been deformed after the Devonian and before the onset of Mesozoic or even Permian sedimentation: evidence for "Ellesmerian" deformation. Part of the Ronning carbonates on the southern part of the Peninsula are in a transitional facies into the shales of the Road River Formation, indicating that the Richardson Trough extended into this area. It links the Peninsula to the northern Yukon area, rather than the Northern Interior Plains. Dolomites farther to the north again have a Middle Ordovician age.

Permian rocks appear to be present near the southwest side of the Peninsula, under and to the southwest of the Mackenzie Delta, at the southwestward extension of the carbonate area. If the Permian rocks in the subsurface overly the carbonates area unconformably, in analogy to the outcrops in the Northern Richardson Mountains, they restrict the time interval for the "Ellesmerian" deformation to post-Devonian and pre-Permian.

The juxtaposition to the northwest of the Quartzite Ridge of alternating areas, in which wells penetrated Ronning and Gossage age rocks has structural implications, no matter how the pattern is explained. From the lithological subcrop pattern, the presence of complex "Ellesmerian" structures involving Paleozoic and Precambrian rocks is evident. The pattern can be explained by folding or by faulting, or a combination of both. Evidence for this "Ellesmerian" deformation phase has nowhere been observed in the Northern Interior Plains. It is evident in the Barn Mountains and northern Richardson Mountains, and again links the Tuktoyaktuk area more to the Mountain area in the Northern Yukon than to the Northern Interior Plains.

RECOMMENDATIONS

Further study is required to unravel the geology of the Aklavik area, which is underlain by Permian rocks. Their correlation to the formations described by Bamber and Waterhouse (1971) is necessary, and will require extensive sampling for fossil material (especially palynology). In addition, structural information may be derived from dipmeter logs, to confirm some of the ideas on structure and timing presented above.

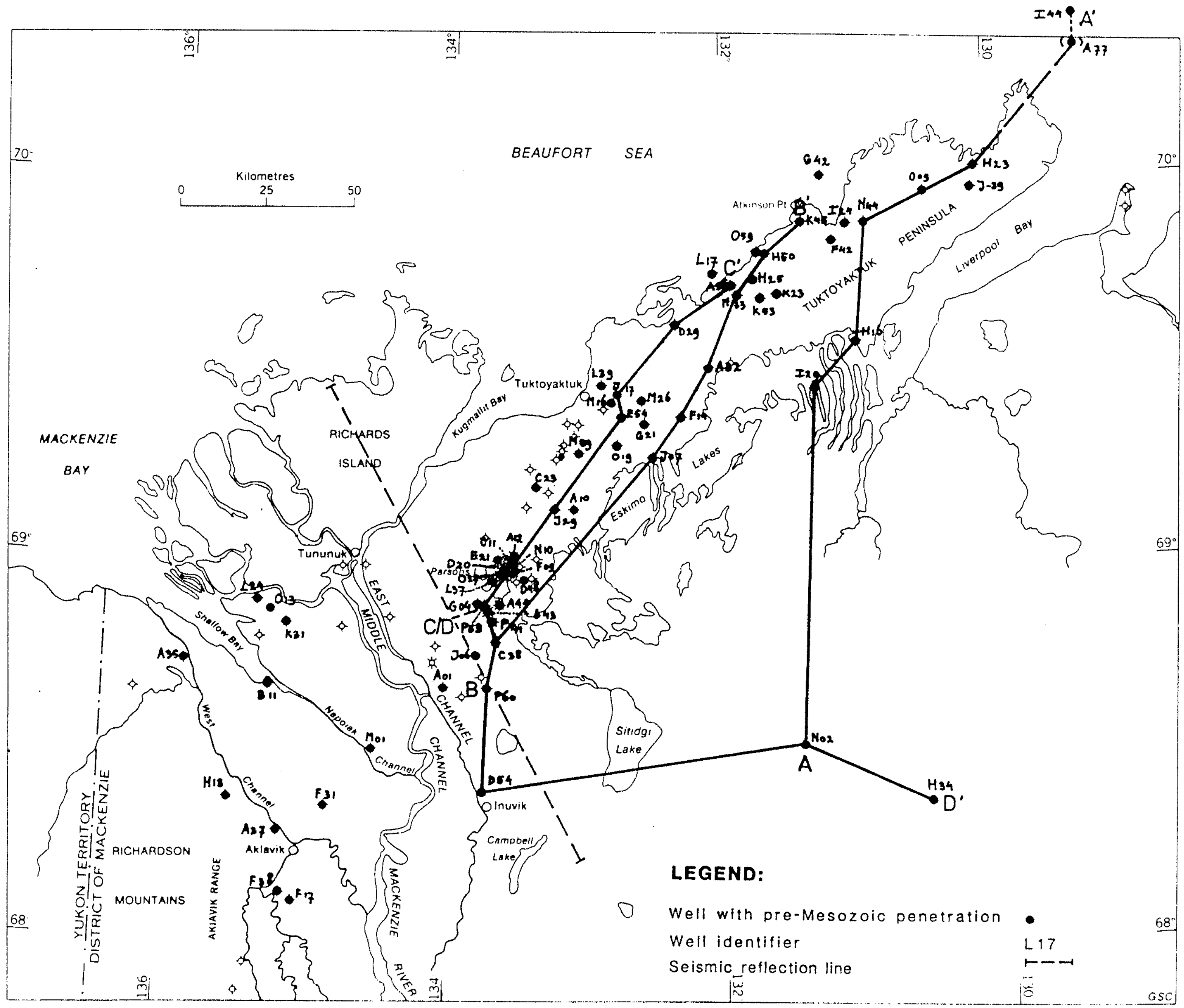


Figure 1: Wells with pre-Mesozoic penetration and location of cross-sections aA-A', B-B', C-C' and D-D'.

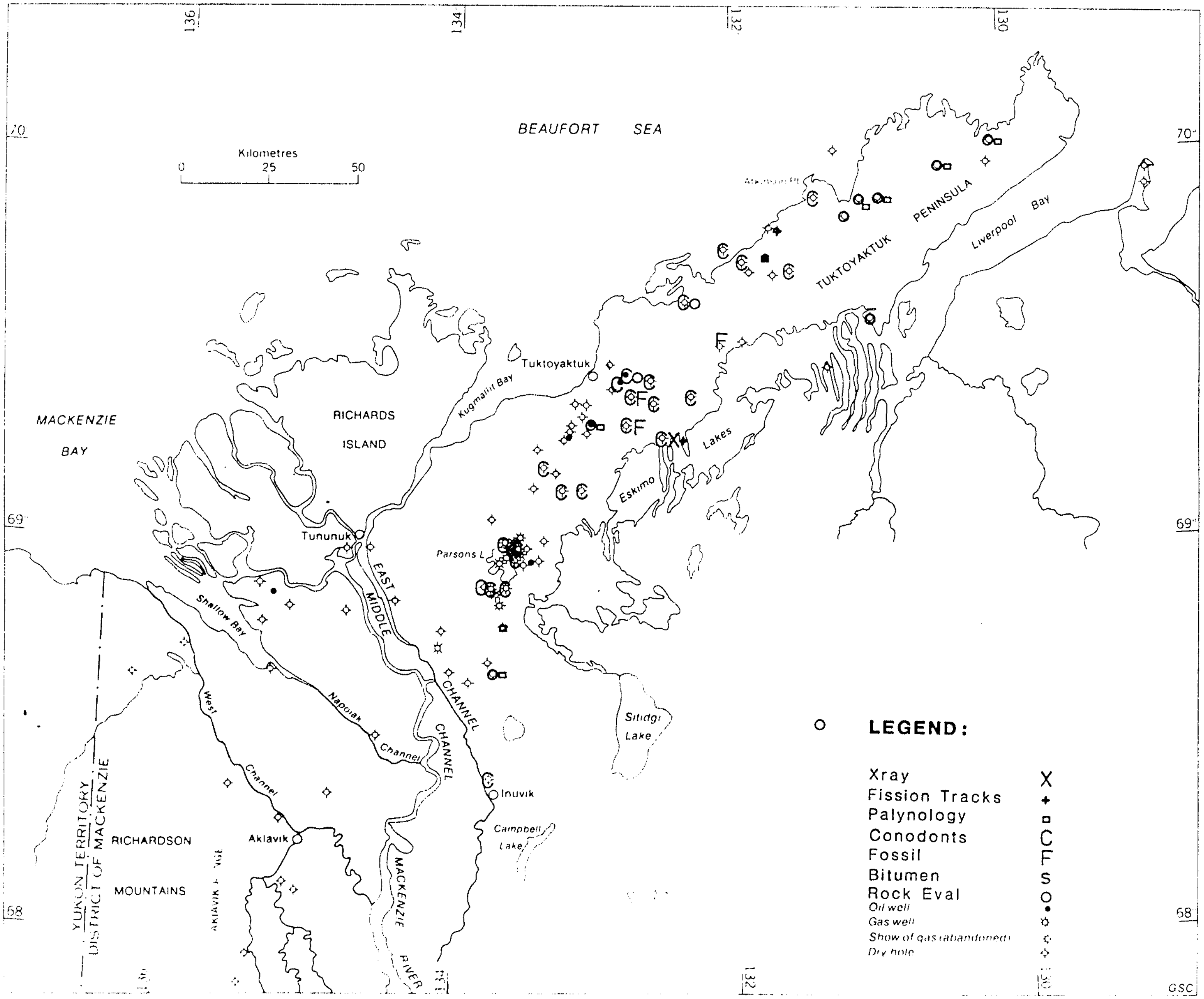


Figure 2: Locations and purpose of samples collected

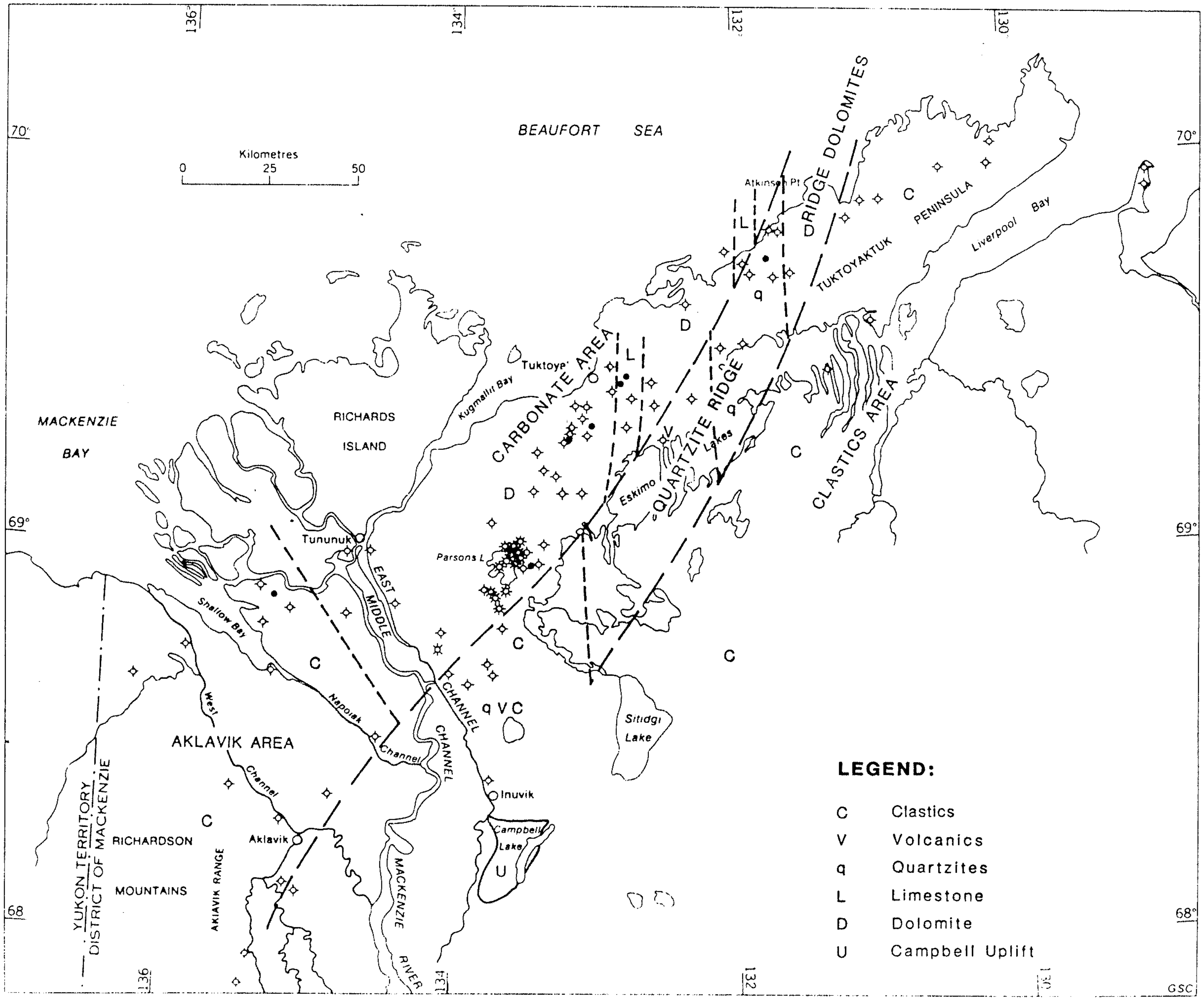


Figure 3: Lithology subcrop pattern.

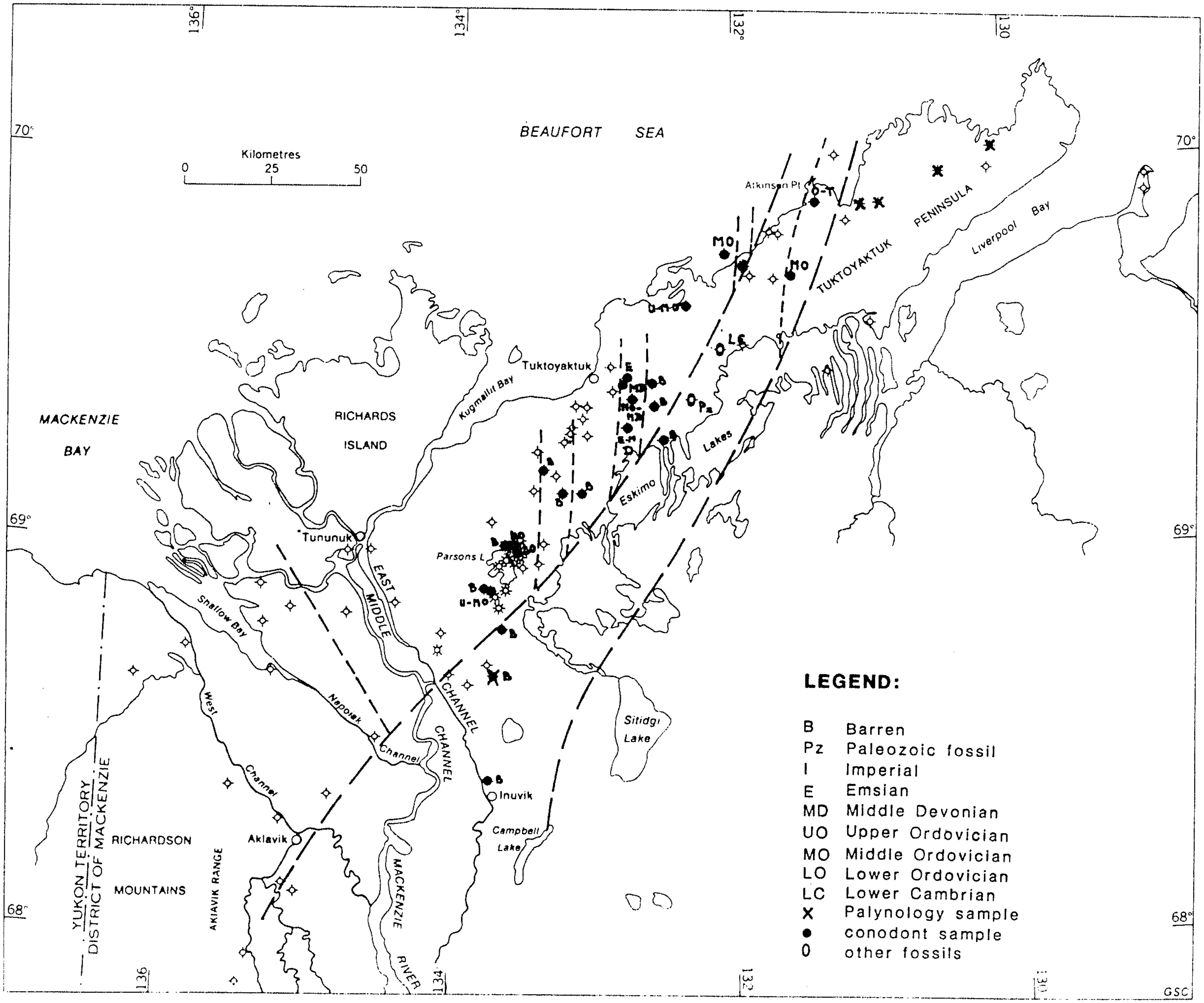


Figure 4: Fossil locations and ages

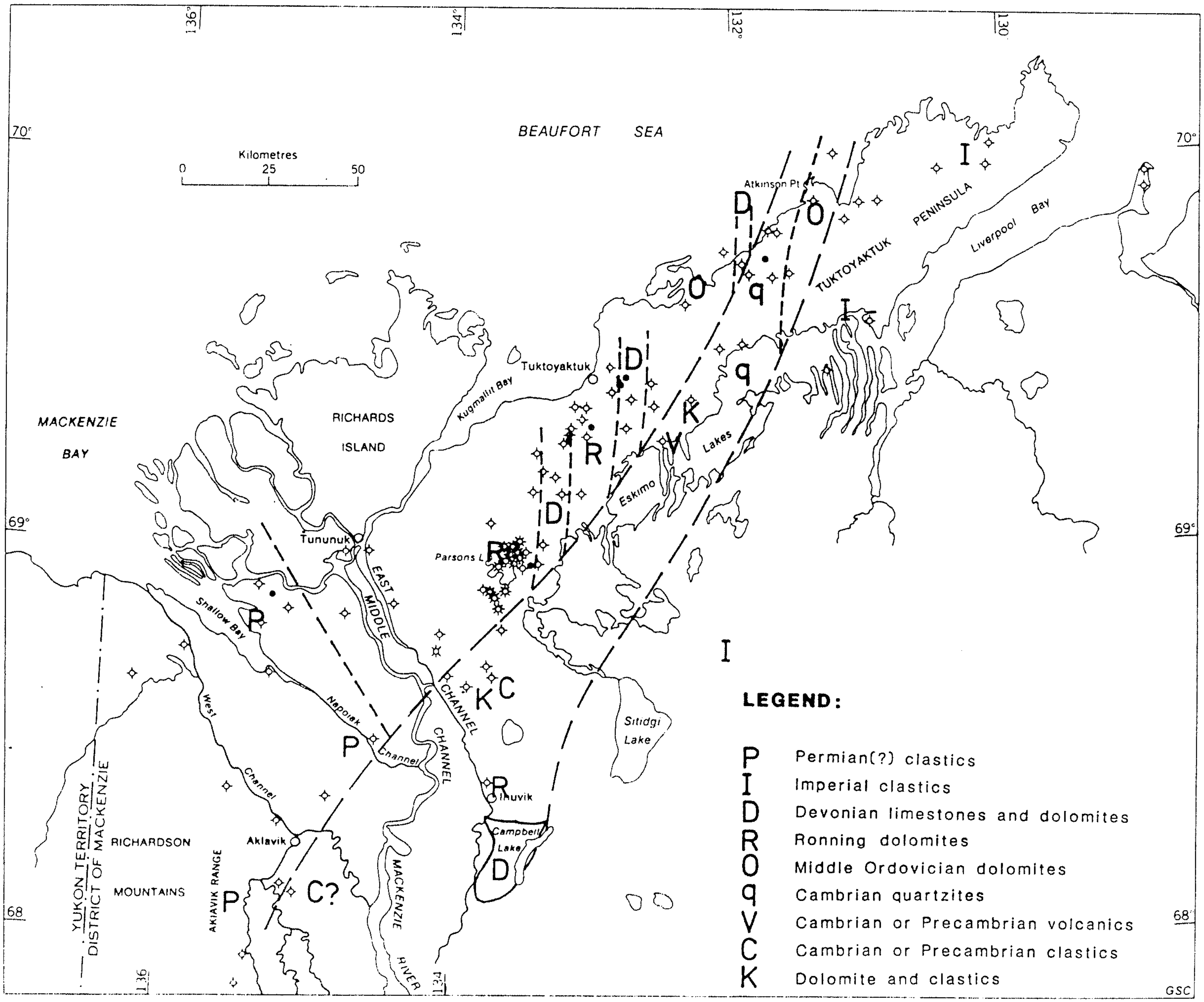


Figure 5: Lithology subcrop pattern in relation to formation ages

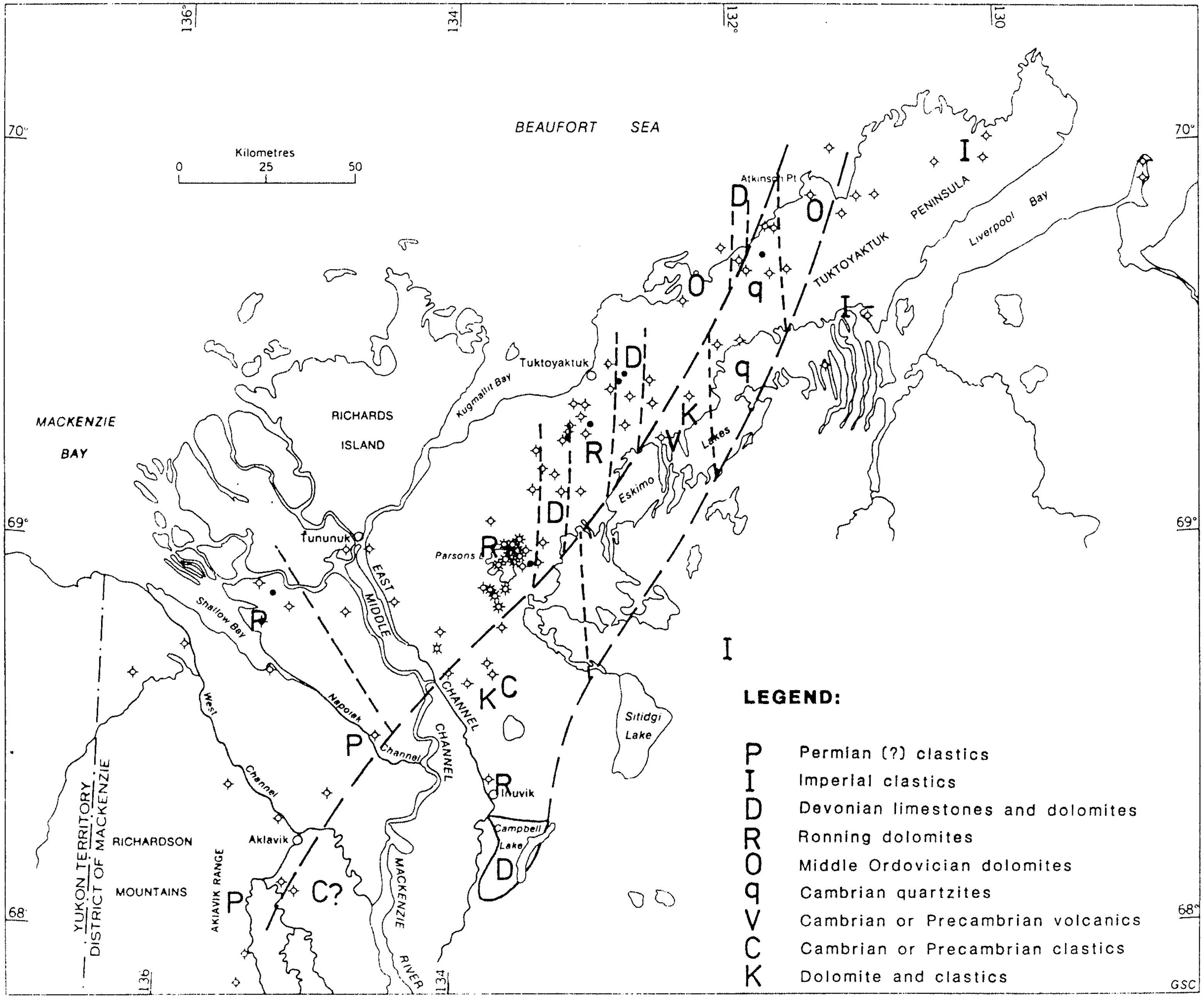


Figure 6: Alternative subcrop pattern of lithology in relation to formation ages.

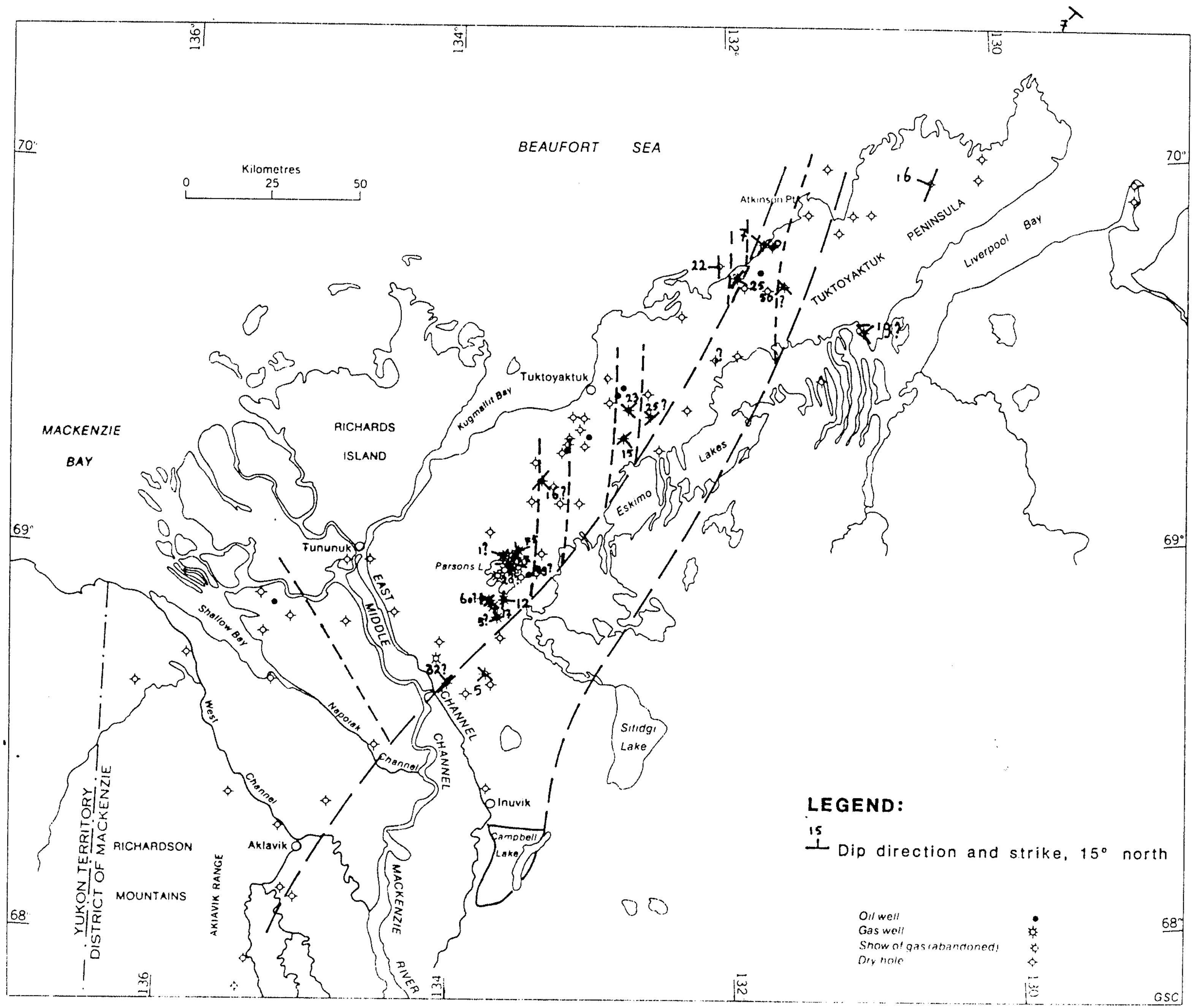


Figure 7: Dip measurements, all data.

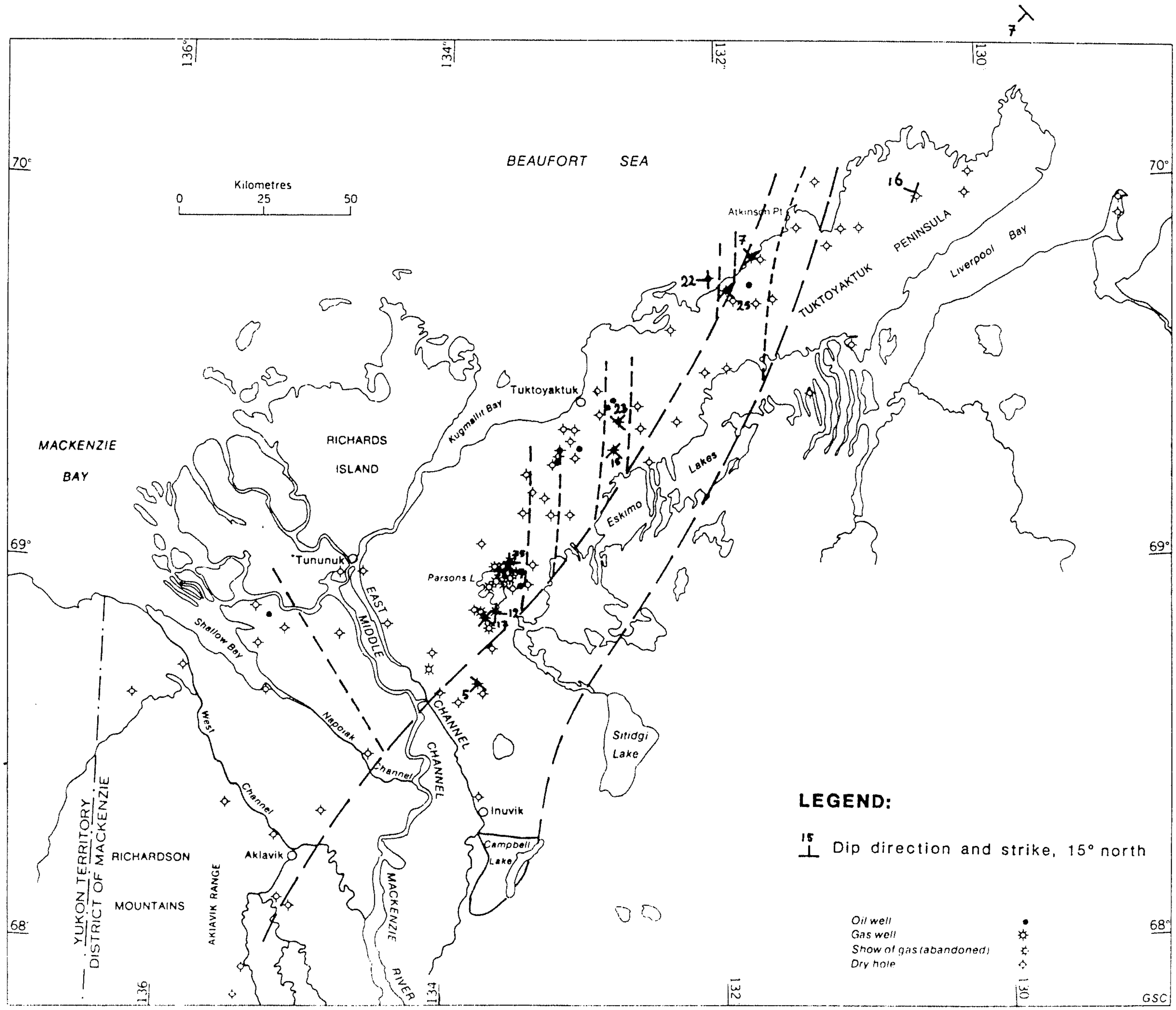


Figure 8: Dip measurements: uncertain data subtracted.

CLASTICS

WELLS PENETRATING DEVONIAN IMPERIAL FORMATION

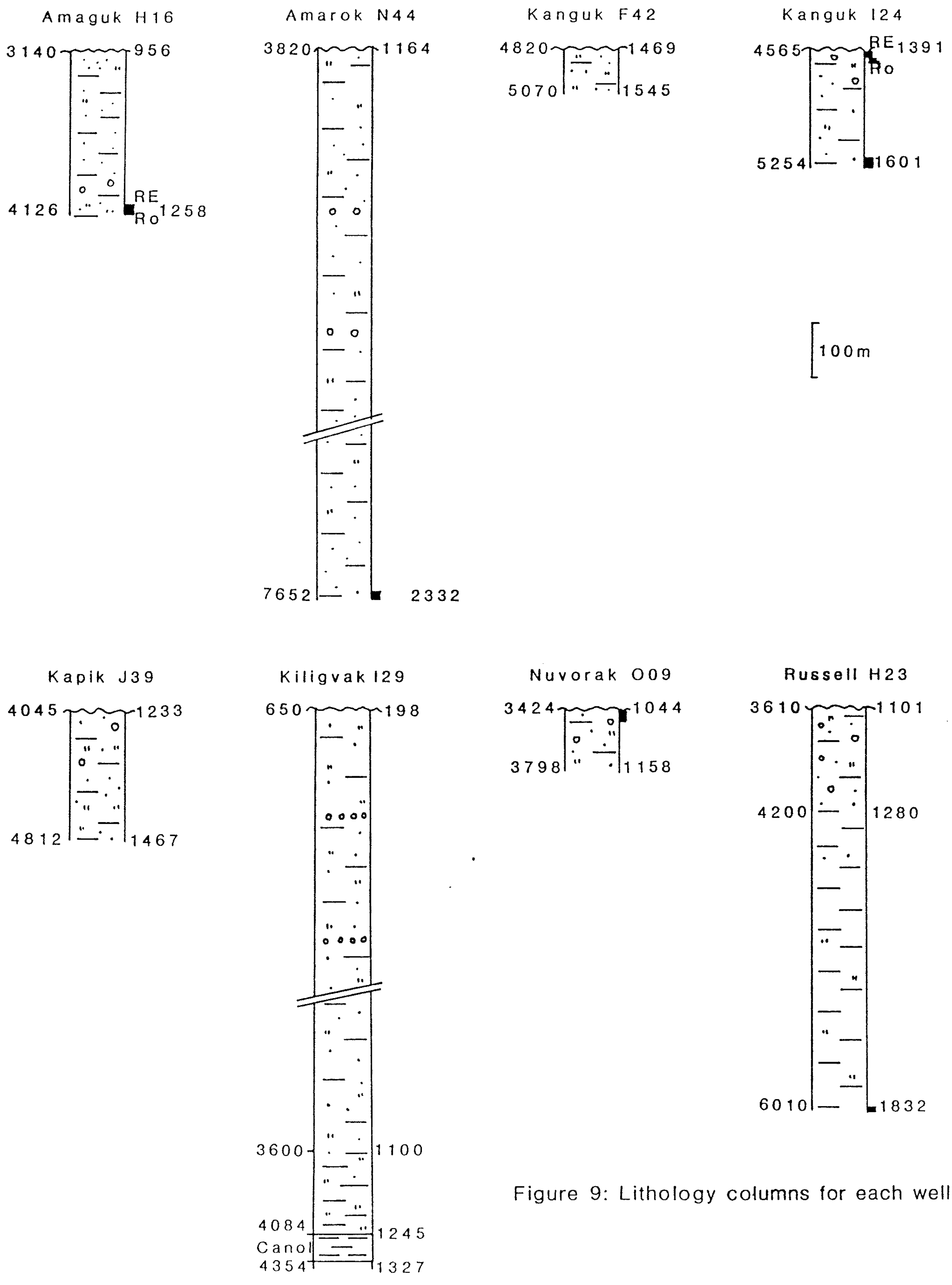


Figure 9: Lithology columns for each well

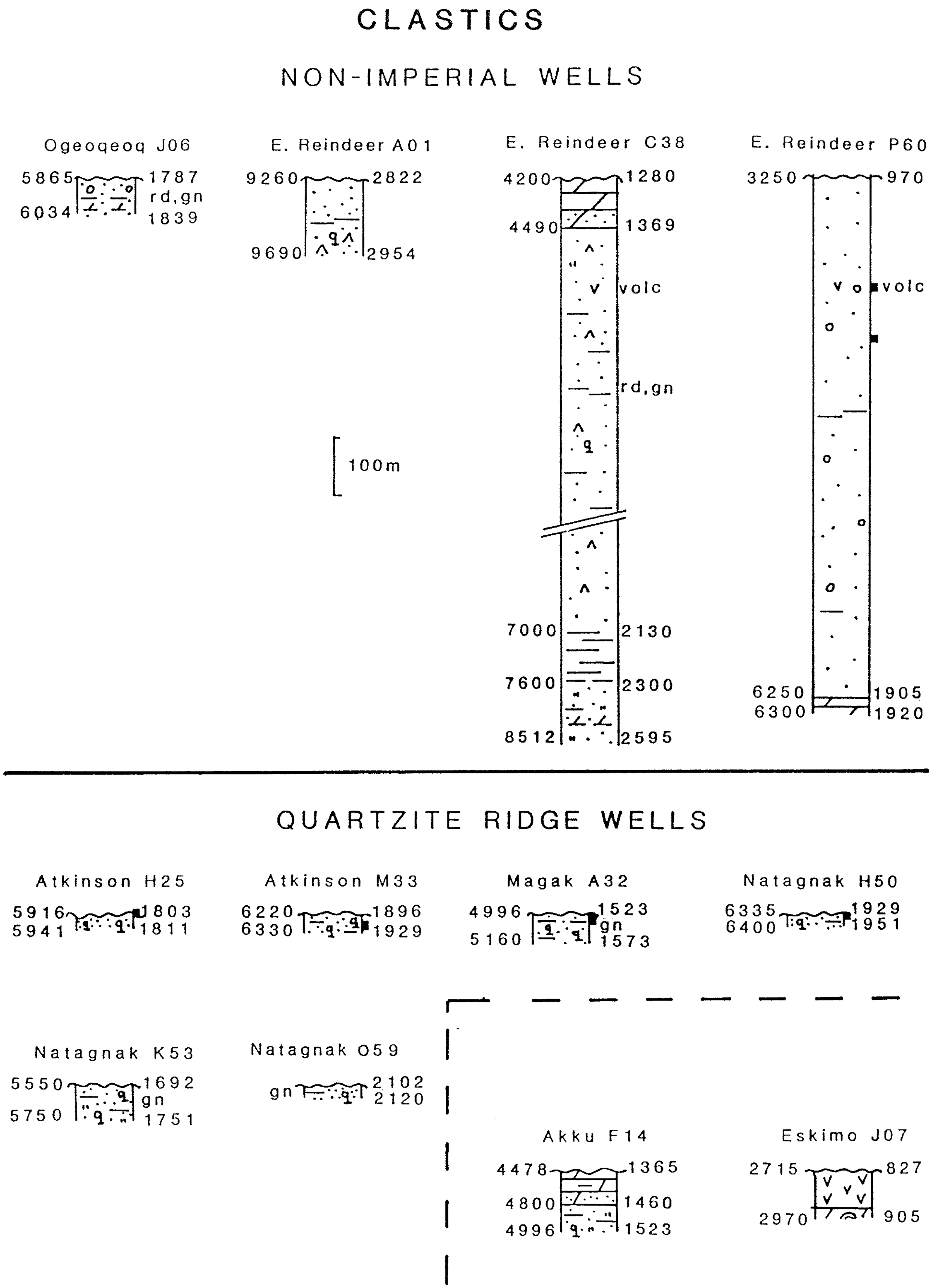


Figure 9 continued

CARBONATES

DOLOMITE SEQUENCES (cont.)

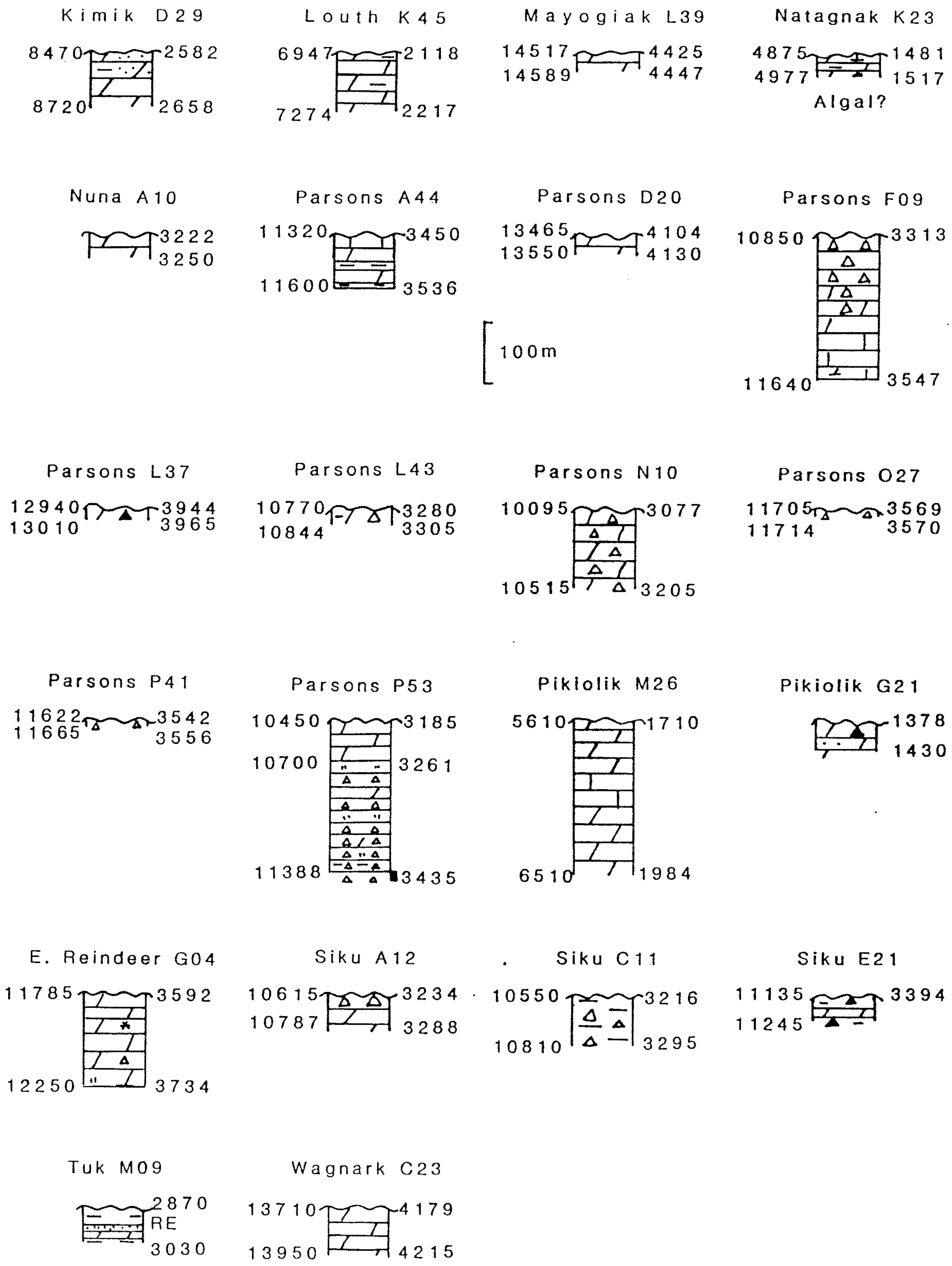


Figure 9 continued

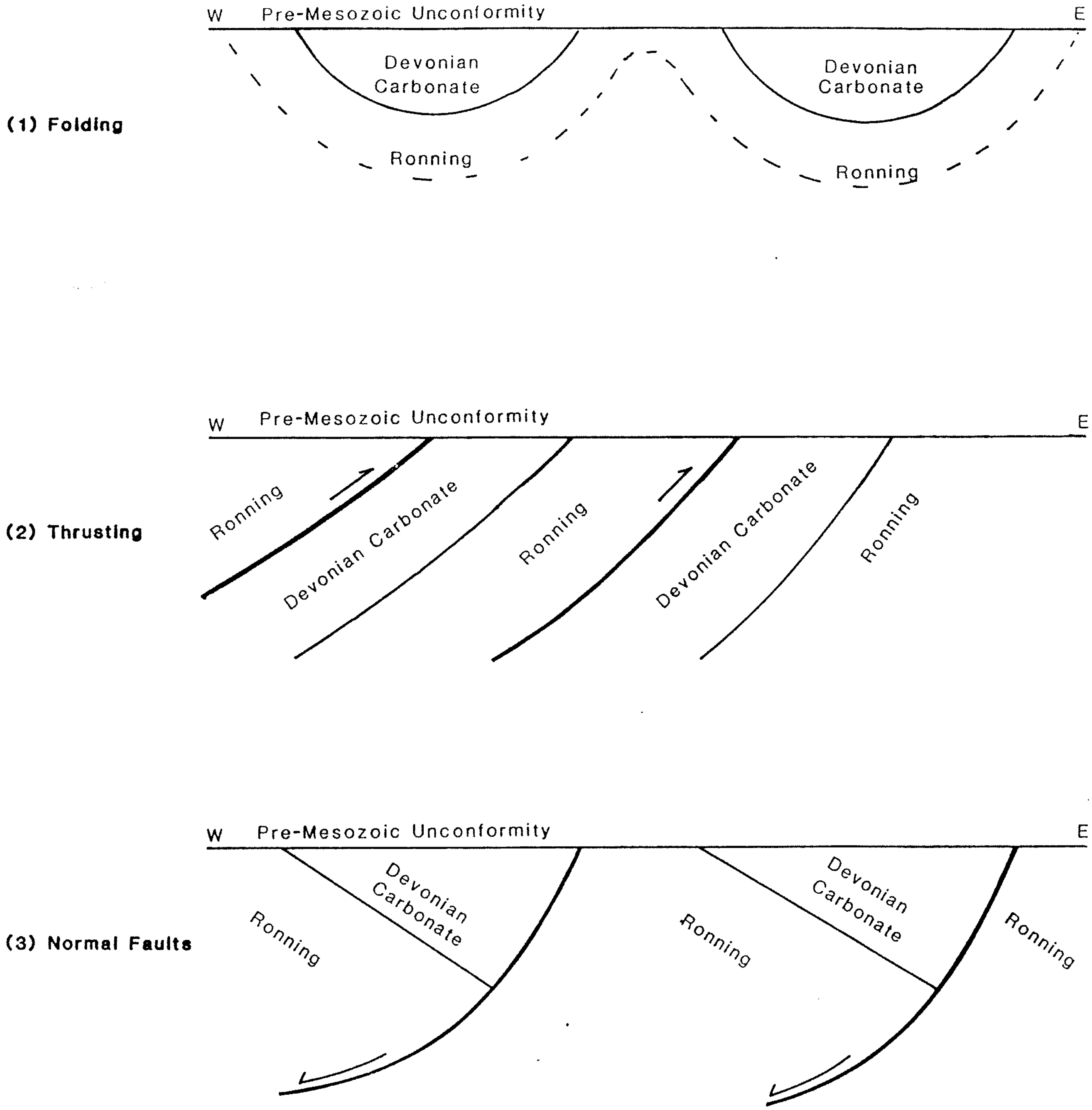
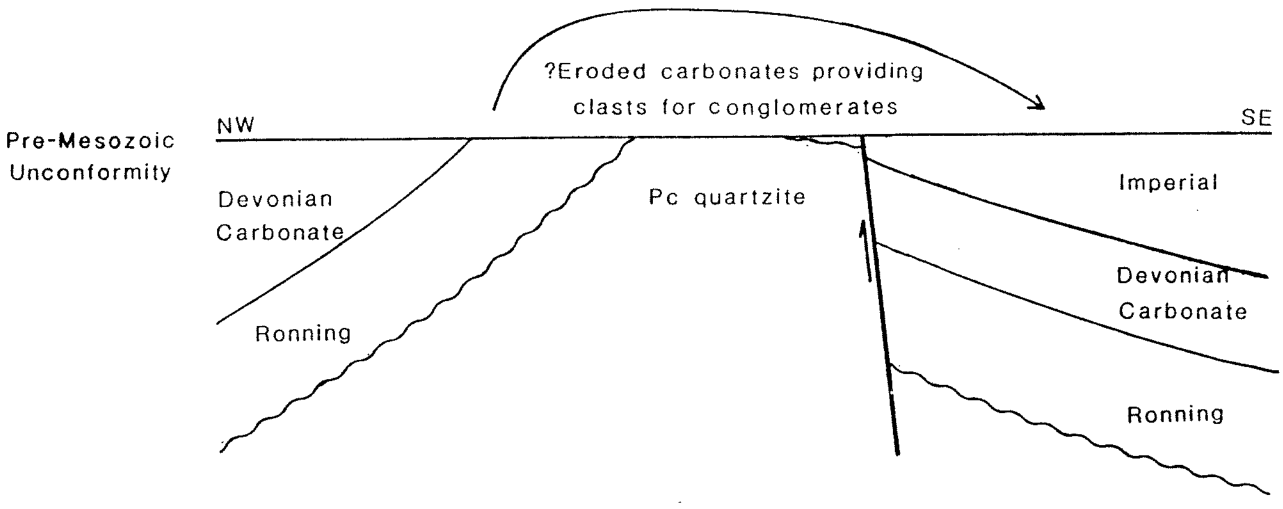
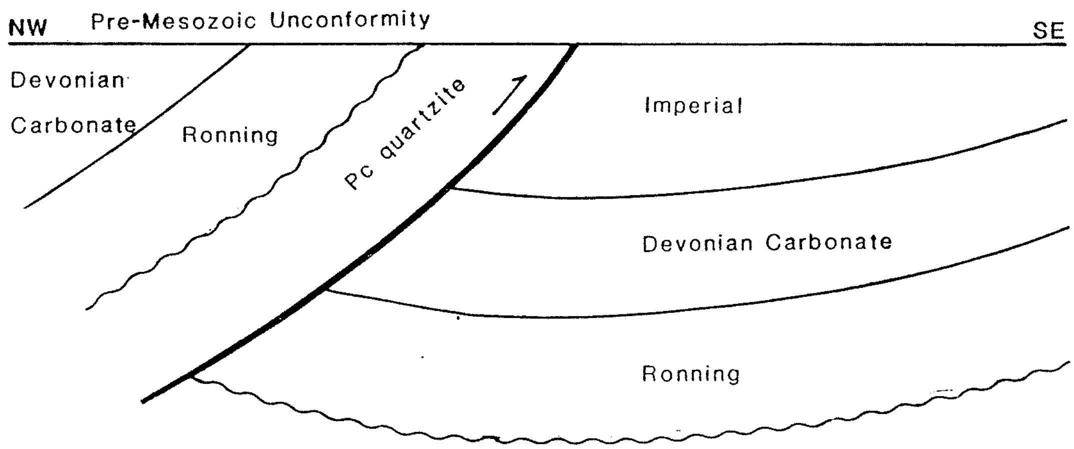


FIGURE 10: POSSIBLE CROSS-SECTIONS FOR GEOLOGICAL PATTERNS NORTH OF THE QUARTZITE RIDGE



(1) Normal or Transcurrent Faulting, possibly contemporaneous with Devonian Sedimentation



(2) Thrusting

FIGURE 11: SOME POSSIBLE CROSS-SECTIONS FOR GEOLOGICAL PATTERNS AROUND THE QUARTZITE RIDGE

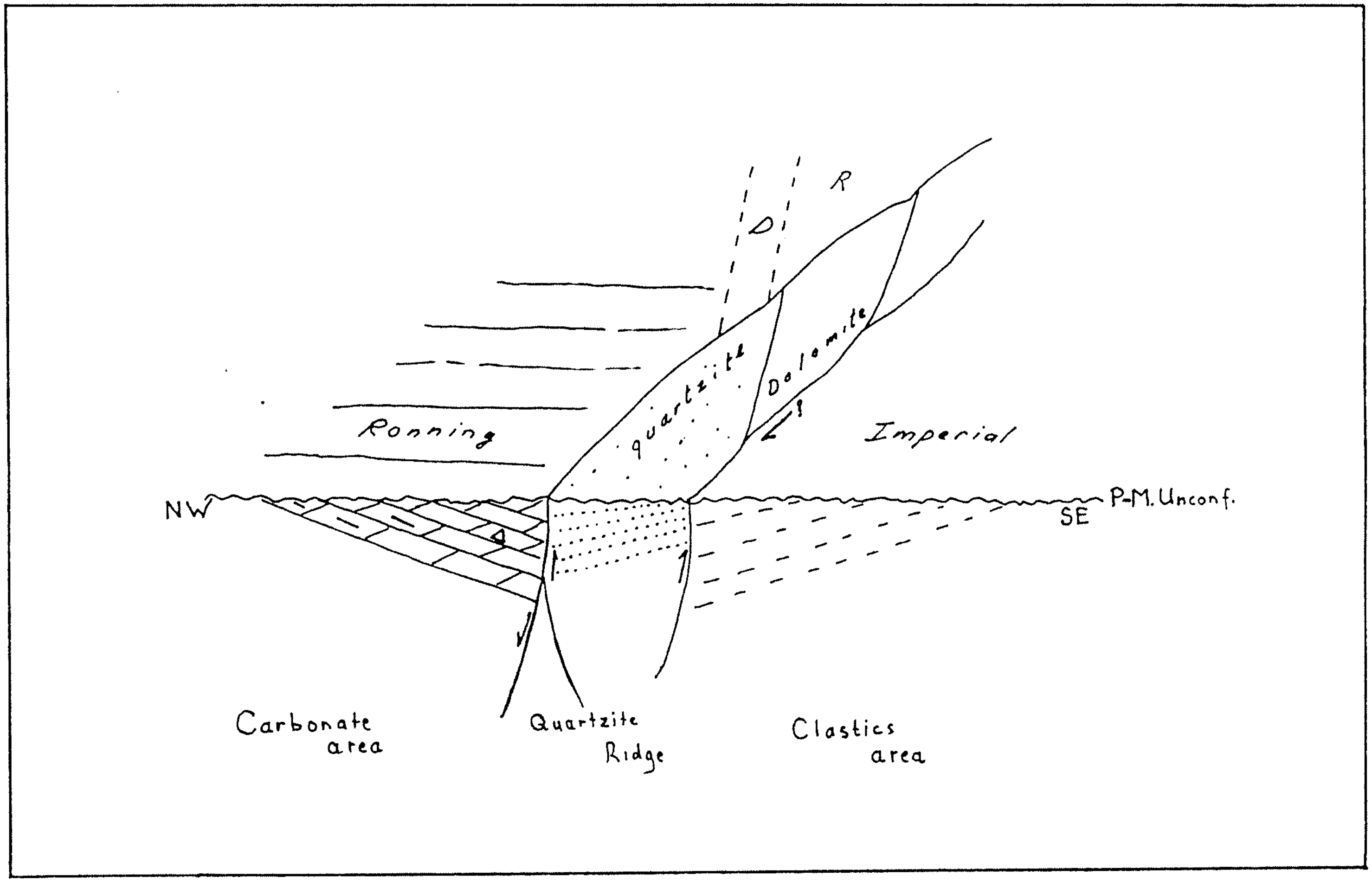


Figure 12 Schematic diagram based on dip measurements

Plate I: Stromatolites in carbonates underlying volcanics in Eskimo J-07.

Plate II: a. Saltarella(?) in shale in Magak A-32,
b. bioturbation in shales in Magak A-32.

Legend for tables I, II, III and IV

R.R.	:	Rig release date
KB	:	Kellybushing depth
TD	:	Total depth
DEV	:	Deviated hole
FM	:	Probable formation underlying sub-Mesozoic unconformity
UNCONF	:	Depth of sub-Mesozoic unconformity
DELTA	:	Thickness of pre-Mesozoic section penetrated
UNC.SS	:	Depth of sub-Mesozoic unconformity below sea level
REC	:	Amount of core recovered
*	:	Deviated hole
**	:	Well with all data in metric

TABLE I: Pre-Mesozoic of Tuk Peninsula

METRIC Wells with Pre-Mesozoic penetrations I CORES IN PRE-MESOZOIC

NAME		R.R.	KB	TD	DEV	FM	UNCONF.	DELTA	UNC.SS	FROM	TO	REC.	FROM	TO	REC
RUSSELL	H23	1974	10.7	1831.8		DIM	1100.9	730.9	-1090.3	1821.2	1831.8	2.4			
KANNERK	G42	1977	12.2	2480.5		M.OR	2387.2	93.3	-2375.0	--					
NUVORAK	O09	1970	11.0	1157.6		DIM	1043.6	114.0	-1032.7	1046.7	1065.0				
KAPIK	J39	1975	13.4	1466.7		DIM	1232.9	233.8	-1219.5	--					
LOUTH	K45	1975	8.5	2217.1		C	2118.4	98.8	-2109.8	--					
KANGUK	F42	1973	7.9	1545.3		DIM	1469.1	76.2	-1461.2	--					
KANGUK	I24	1971	11.3	1601.4		DIM	1394.5	207.0	-1383.2	1390.2	1404.2	14.0	1596.8	1601.4	4.6
AMAROK	N44	1974	19.2	2332.3		DIM	1163.7	1168.6	-1144.5	2326.8	2332.3	5.5			
NATAGNAK	H50	1970	6.4	1951.3		C	1929.4	21.9	-1923.0	1930.6	1931.5	0.6	1939.7	1951.3	11.6
NATAGNAK	K23	1970	26.8	1517.0		M.OR	1481.3	35.7	-1454.5	1510.0	1517.0	6.7			
NATAGNAK	K53	1973	20.1	1751.7		C	1691.6	60.0	-1671.5	--					
NATAGNAK	O59	1983	9.2	2120.0	**	C	2100.0	20.0	-2090.8	2101.3	2101.9	0.6			
ATKINSON	A55	1974	9.1	2232.7		DGSG	2061.7	171.0	-2052.5	2226.6	2232.7	6.1			
ATKINSON	H25	1970	8.5	1810.8		C	1803.2	7.6	-1794.7	1798.3	1807.5	0.0			
ATKINSON	M33	1970	12.8	1928.5		C	1895.9	32.6	-1883.1	1912.3	1915.7	3.4	1924.2	1928.5	4.3
ATKINSON	L17	1982	13.9	2480.0	**	M.OR	2331.0	149.0	-2317.1	2337.0	2350.2	13.1	2411.5	2430.2	18.7
KIMIK	D29	1972	18.6	2657.9		M.OR	2581.7	76.2	-2563.1	2579.5	2585.3	4.3	2601.8	2608.5	
AMAGUK	H16	1973	20.1	1257.6		DIM	955.9	301.8	-935.7	1253.3	1257.6	3.4			
MAGAK	A32	1971	35.1	1572.8		C	1522.8	50.0	-1487.7	1525.2	1531.3	5.5	1567.3	1572.8	4.9
KILIGVAK	I29	1973	17.4	1965.0		DIM	198.1	1766.9	-180.7	1801.7	1806.2	2.7			
MAYOGIAK	L39	1974	14.3	4446.7		RO	4424.8	21.9	-4410.5	--					
MAYOGIAK	M16	1980	18.9	3093.0	**	DGSG	2867.0	226.0	-2848.1	2887.3	2894.3	6.2			
MAYOGIAK	J17	1971	22.6	3686.3		DGSG	2856.6	829.7	-2834.0	2854.8	3685.9	Many cores,see TABLE 3			
PIKIOLIK	E54	1972	24.4	3118.1		DGSG	2738.6	379.5	-2714.2	2757.8	2776.1	18.3			
PIKIOLIK	G21	1983	74.8	1429.6	**	RO	1378.0	51.6	-1303.2	--					
PIKIOLIK	M26	1972	24.1	1984.2		RO	1709.3	274.9	-1685.2	1716.9	1720.6	3.5			
AKKU	F14	1973	40.2	1522.8		C?	1364.6	158.2	-1324.4	--					
TUK	M09	1984	31.2	3030.0	**	RO	2966.5	63.5	-2935.3	3008.0	3009.0	0.9			
TUKTU	O19	1971	30.5	2315.6		DGSG	2199.4	116.1	-2169.0	2240.3	2252.5	12.2	2311.0	2315.6	4.6
ESKIMO	J07	1969	27.1	905.6		PC	827.2	78.3	-800.1	841.2	844.3	2.1	868.4	881.5	13.1
WAGNARK	C23	1976	30.5	4251.0		RO	4179.4	71.6	-4148.9	--					
NUNA	A10	1984	54.2	3250.5	**	RO?	3222.0	28.5	-3167.8	3243.0	3250.5	7.5			
IMNAK	J29	1975	18.3	3404.6		RO	3304.0	100.6	-3285.7	--					
SIKU	A12	1976	64.6	3287.9		ORD	3234.5	53.3	-3169.9	--					
SIKU	C11	1976	63.1	3294.9		ORD	3215.6	79.2	-3152.5	no cuttings					
SIKU	E21	1977	64.6	3427.5		ORD	3393.9	33.5	-3329.3	--					
PARSONS	A44	1975	63.1	3535.7		RR	3450.3	85.3	-3387.2	--					
PARSONS	D20	1976	70.4	4130.0		RO	4104.1	25.9	-4033.7	--					
PARSONS	F09	1972	63.1	3547.3		ORD	3313.2	234.1	-3250.1	--					
PARSONS	L37	1977	46.6	3965.4	*	RO-RR	3944.1	21.3	-3897.5	--					
PARSONS	L43	1976	57.9	3305.3		RO-RR	3279.6	25.6	-3221.7	--					
PARSONS	N10	1973	67.7	3205.0		ORD	3077.0	128.0	-3009.3	3432.0	3435.1	0.9			
PARSONS	O27	1974	42.1	3570.4	*	RO-RR	3569.2	1.2	-3527.1	--					
PARSONS	P41	1977	71.3	3555.5	*	RO-RR	3542.4	13.1	-3471.1	--					
PARSONS	P53	1974	51.2	3435.1		ORD	3185.2	249.9	-3134.0	3432.0	3435.1	2.7			
KAMIK	D48	1976	33.2	3235.1	*	RO	3212.6	22.6	-3179.4	--					
E. REINDEER	A01	1971	190.5	2954.4		C-PC	2822.4	132.0	-2631.9	2905.4	2908.7	3.0			
E. REINDEER	C38	1970	71.6	2594.5		C-PC	1280.2	1314.3	-1208.5	1439.9	1446.6	6.7	1769.4	1776.4	6.7
E. REINDEER	G04	1971	52.1	3733.8		RO	3591.8	142.0	-3539.6	--					
E. REINDEER	P60	1970	115.8	1920.2		C-PC	1039.4	880.9	-923.5	1389.9	1399.9	10.1	1579.5	1585.3	5.0
OGEOQEOQ	J06	1975	81.1	1839.2		C-PC	1787.7	51.5	-1706.6	--					
INUVIK	D54	1969	42.1	1562.4		RO	320.0	1242.4	-278.0	711.4	719.3	7.0	1559.1	1562.4	1.5
KUGALUK	N02	1969	215.8	2452.1		DIM	51.8	2400.3	164.0	246.0	2452.1				

TABLE II: Pre-Mesozoic of Tuk Peninsula

Wells with Pre-Mesozoic penetrations I

IMPERIAL NAME		R.R.	KB	TD	DEV	FM	UNCONF.	DELTA	UNC.SS	FROM	TO	REC.	CORES IN PRE-MESOZOIC FROM	TO	REC
RUSSELL	H23	1974	35	6010		DIM	3612	2398	-3577	5975	6010	8			
KANNERK	G42	1977	40	8138		M.OR	7832	306	-7792	--					
NUVORAK	O09	1970	36	3798		DIM	3424	374	-3388	3434	3494	58			
KAPIK	J39	1975	44	4812		DIM	4045	767	-4001	--					
LOUTH	K45	1975	28	7274		C	6950	324	-6922	--					
KANGUK	F42	1973	26	5070		DIM	4820	250	-4794	--					
KANGUK	I24	1971	37	5254		DIM	4575	679	-4538	4561	4607	46	5239	5254	15
AMAROK	N44	1974	63	7652		DIM	3818	3834	-3755	7634	7652	18			
NATAGNAK	H50	1970	21	6402		C	6330	72	-6309	6334	6337	2	6364	6402	38
NATAGNAK	K23	1970	88	4977		M.OR	4860	117	-4772	4954	4977	22			
NATAGNAK	K53	1973	66	5747		C	5550	197	-5484	--					
NATAGNAK	O59	1983	9.2	2120.0	**	C	2100.0	20	-2090.81	2101.3	2101.9	0.6			
ATKINSON	A55	1974	30	7325		DGSG	6764	561	-6734	7305	7325	20			
ATKINSON	H25	1970	28	5941		C	5916	25	-5888	5900	5930				
ATKINSON	M33	1970	42	6327		C	6220	107	-6178	6274	6285	11	6313	6327	14
ATKINSON	L17	1982	13.9	2480.0	**	M.OR	2331.0	149	-2317.11	2337.01	2350.2	13.1	2411.5	2430.2	18.7
KIMIK	D29	1972	61	8720		M.OR	8470	250	-8409	8463	8482	14	8536	8558	
AMAGUK	H16	1973	66	4126		DIM	3136	990	-3070	4112	4126	11			
MAGAK	A32	1971	115	5160		C	4996	164	-4881	5004	5024	18	5142	5160	16
KILIGVAK	I29	1973	57	6447		DIM	650	5797	-593	5911	5926	9			
MAYOGIAK	L39	1974	47	14589		RO	14517	72	-14470	--					
MAYOGIAK	M16	1980	18.9	3093.0	**	DGSG	2867.0	226	-2848.11	2887.3	2894.3	6.2			
MAYOGIAK	J17	1971	74	12094		DGSG	9372	2722	-9298	9366	12093	TABLE 3, MANY CORES			
PIKIOLIK	E54	1972	80	10230		DGSG	8985	1245	-8905	9048	9108	60			
PIKIOLIK	G21	1983	74.8	1429.6	**	RO	1378.0	51.59	-1303.21	--					
PIKIOLIK	M26	1972	79	6510		RO	5608	902	-5529	5633	5645	11.5			
AKKU	F14	1973	132	4996		C?	4477	519	-4345	--					
TUK	M09	1984	31.2	3030.0	**	RO	2966.5	63.51	-2935.3	3008.0	3009.0	0.9			
TUKTU	O19	1971	100	7597		DGSG	7216	381	-7116	7350	7390	40	7582	7597	15
ESKIMO	J07	1969	89	2971		PC	2714	257	-2625	2760	2770	7	2849	2892	43
WAGNARK	C23	1976	100	13947		RO	13712	235	-13612	--					
NUNA	A10	1984	54.2	3250.5	**	RO?	3222.0	28.5	-3167.8	3243.0	3250.5	7.5			
IMNAK	J29	1975	60	11170		RO	10840	330	-10780	--					
SIKU	A12	1976	212	10787		ORD	10612	175	-10400	--					
SIKU	C11	1976	207	10810		ORD	10550	260	-10343	no cuttings					
SIKU	E21	1977	212	11245		ORD	11135	110	-10923	--					
PARSONS	A44	1975	207	11600		RR	11320	280	-11113	--					
PARSONS	D20	1976	231	13550		RO	13465	85	-13234	--					
PARSONS	F09	1972	207	11638		ORD	10870	768	-10663	--					
PARSONS	L37	1977	153	13010	*	RO-RR	12940	70	-12787	--					
PARSONS	L43	1976	190	10844		RO-RR	10760	84	-10570	--					
PARSONS	N10	1973	222	10515		ORD	10095	420	-9873	11260	11270	3			
PARSONS	O27	1974	138	11714	*	RO-RR	11710	4	-11572	--					
PARSONS	P41	1977	234	11665	*	RO-RR	11622	43	-11388	--					
PARSONS	P53	1974	168	11270		ORD	10450	820	-10282	11260	11270	9			
KAMIK	D48	1976	109	10614	*	RO	10540	74	-10431	--					
E. REINDEER	A01	1971	625	9693		C-PC	9260	433	-8635	9532	9543	10			
E. REINDEER	C38	1970	235	8512		C-PC	4200	4312	-3965	4724	4746	22	5805	5828	22
E. REINDEER	G04	1971	171	12250		RO	11784	466	-11613	--					
E. REINDEER	P60	1970	380	6300		C-PC	3410	2890	-3030	4560	4593	33	5182	5201	16.5
OGEOQEOQ	J06	1975	266	6034		C-PC	5865	169	-5599	--					
INUVIK	D54	1969	138	5126		RO	1050	4076	-912	2334	2360	23	5115	5126	5
KUGALUK	N02	1969	708	8045		DIM	170	7875	538	807	8045	CONTINUOUS CORE			
KILANNAK	A77	1981	12.8	2966	**	DIM	1267.0	1699.0	-1254.2	--					

TABLE III: CORES IN MAYOGIAK J-17

Imperial			Metric		
FROM	TO	REC.	FROM	TO	REC.
9366	9383	17	2854.8	2859.9	5.2
9394	9397	3	2863.3	2864.2	0.9
9407	9410	0.8	2867.3	2868.2	0.2
9426	9429	3	2873.0	2874.0	0.9
9450	9453	3	2880.4	2881.3	0.9
9462	9465	3	2884.0	2884.9	0.9
9481	9632	149	2889.8	2935.8	45.4
9634	9656	13	2936.4	2943.1	4.0
9659	9692	24	2944.1	2954.1	7.3
9692	9705	11	2954.1	2958.1	3.4
9787	9817	30	2983.1	2992.2	9.1
10321	10347	23	3145.8	3153.8	7.0
10596	10602	5.5	3229.7	3231.5	1.7
10940	10947	6	3334.5	3336.6	1.8
11238	11251	12	3425.3	3429.3	3.7
11499	11521	22	3504.9	3511.6	6.7
12070	12093	23	3678.9	3685.9	7.0

TABLE IV: Wells with probably Permian penetration on and to the south of Tuktoyaktuk Peninsula.

METRIC

NAME		R.R.	KB	TD	DEV	FM	UNCONF.	DELTA	UNC.SS	I FROM	TO	REC.	CORES IN PRE-MESOZOIC FROM	TO	REC
TULLUGAK	K31	1977	9.8	2926.1		P???	1802.9	1123.2	-1793.1						
BEAVERHOUSE	H13	1971	74.7	3747.5		P	1176.5	2571.0	-1101.9	2085.1	2085.7	0.2	2515.2	2524.0	8.8
AKLAVIK	A37	1970	10.1	2584.4		P	1758.7	825.7	-1748.6	2579.2	2584.4	5.2			
AKLAVIK	F17	1973	8.2	891.5		C?	771.1	120.4	-762.9	890.6	891.2	0.6			
AKLAVIK	F38	1973	12.2	2056.5		P	1626.7	429.8	-1614.5	--					
KILANNAK	A77	1981	12.7	2996.0	*	DIM	1260.0	1736.0	-1247.3	--					
KUGPIK	L24	1975	12.2	2817.0		P	2731.0	86.0	-2718.8	2257.0	2267.7	10.1	2494.8	2505.8	10.1
KUGPIK	O13	1973	10.4	3689.0		P?	3240.0	449.0	-3229.7	3095.2	3102.3	6.7	3651.5	3654.6	2.4
NAPOIAK	F31	1974	13.1	1528.6		P	1264.3	264.3	-1251.2	1514.9	1525.5	10.7			
NAPARTOK	M01	1969	15.8	1960.0	*	P?	1683.0	277.0	-1667.2						
ULU	A35	1976	11.3	3919.7		P?	2772.5	1147.3	-2761.2	2939.2	2947.4	8.8			
UNAK	B11	1974	9.2	2120.0	**	P???	2100.0	20.0	-2090.8	2101.3	2101.9	0.6			

IMPERIAL

NAME		R.R.	KB	TD	DEV	FM	UNCONF.	DELTA	UNC.SS	FROM	TO	REC.	FROM	TO	REC
TULLUGAK	K31	1977	32	9600		P???	5915	3685	-5883	--					
BEAVERHOUSE	H13	1971	245	12295		P	3860	8435	-3615	6841	6843	0.5	8252	8281	29
AKLAVIK	A37	1970	33	8479		P	5770	2709	-5737	8462	8479	17			
AKLAVIK	F17	1973	27	2925		C?	2530	395	-2503	2922	2924	2			
AKLAVIK	F38	1973	40	6747		P	5337	1410	-5297	--					
KILANNAK	A77	1981	12.7	2996	*	DIM	1267	1729	-1254.3	--					
KUGPIK	L24	1975	40	9242		P	8960	282	-8920	7405	7440	33	8185	8221	33.3
KUGPIK	O13	1973	34	12103		P?	10630	1473	-10596	10155	10178	22	11980	11990	8
NAPOIAK	F31	1974	43	5015		P	4148	867	-4105	4970	5005	35			
NAPARTOK	M01	1969	15.8	1960	*	P?	1683	277	-1667.2	--					
ULU	A35	1976	37	12860		P?	9096	3764	-9059	9643	9670	29			
UNAK	B11	1974	33	10975		P???	8180	2795	-8147	9495	9525	30			

TABLE V: SAMPLING FOR TUKTOYAKTUK PENINSULA PROJECT

WELL NAME	#	CORE DEPTH	CORE ANAL	CUTTINGS DEPTH	CUTTINGS ANAL.	COMMENTS
AKKU	F-14			4500-4600	con	
AKKU	F-14			4600-4700	con	
AKKU	F-14			4700-4800	con	
AMAGUK	H-16	4113	gech			
AMAGUK	H-16	4123	gech			
AMAROK	N-44	7650	gech			
AMAROK	N-44	7641	gech			
AMAROK	N-44	7651- 7652	pln			
ATKINSON	L-17	2340.6-2344.4	con			
ATKINSON	L-17	2337.0-2340.6	con			
ATKINSON	L-17	2344.4-2350.2	con			
ATKINSON	A-55	7305- 7325	con	6770- 7300	con	
E. REINDEER	P-60	5187	XRF	3260	gech	PICKED SHC
E. REINDEER	G-04			12100-12250	con	
E. REINDEER	P-60			3280	gech	
E. REINDEER	P-60			3270	gech	
E. REINDEER	G-04			11800-12100	con	
ESKIMO	J-07	2891	XRF			
ESKIMO	J-07	2929	XRF			
ESKIMO	J-07	2955-2968	gech			
ESKIMO	J-07	2963-2971	con			
ESKIMO	J-07	2945	XRF			
ESKIMO	J-07	2865	XRF			
ESKIMO	J-07	2919	K-Ar			
ESKIMO	J-07	2919	XRF			
ESKIMO	J-07	2954-2963	con			
ESKIMO	J-07	2765	XRF			
ESKIMO	J-07	2945-2954	con			
IMNAK	J-29			10860-11170	con	
INUVIK	D-54			1900- 2150	con	
INUVIK	D-54			3100- 3350	con	
KANGUK	I-24	4595- 4599	gech			
KANGUK	I-24	4607	pln			
KANGUK	I-24	4560	pln			
KANGUK	I-24	5246- 5248	gech			
KILLANAK	A-77			2100.0-2160.	con	
KILLANAK	A-77			2165.0-2230.	con	
KILLANAK	A-77			2235.0-23050	con	
KILLANAK	A-77			2310.0-2360.	con	
KILLANAK	A-77			2365.0-2460.	con	
KILLANAK	A-77			2750.0-2850.	con	
KIMIK	D-29	8613- 8624	con			
KIMIK	D-29	8476	gech			
KIMIK	D-29	8602- 8613	con			
KIMIK	D-29	8466	gech	8480- 8720	con	
LOUTH	K-45			6970- 7270	con	

TABLE V, continued

WELL NAME	#	CORE DEPTH	CORE ANAL	CUTTINGS DEPTH	CUTTINGS ANAL	COMMENTS
MAGAK	A-32	5004- 5007	pal			Saltarella
MAGAK	A-32	5007	pal			Saltarella
MAGAK	A-32	5020- 5022	pal			Saltarella
MAGAK	A-32	5008- 5011	pal			Saltarella
MAGAK	A-32	5007.7	pal			Saltarella
MAYOGIAK	J-17	9813	gech			
MAYOGIAK	J-17	9371	gech			
MAYOGIAK	J-17	9375	gech			
MAYOGIAK	J-17	9638	gech			
MAYOGIAK	M-16	2850	gech			
MAYOGIAK	J-17	9686	gech			
MAYOGIAK	M-16	2866- 3005	con			
MAYOGIAK	J-17	10596-10602	con			
MAYOGIAK	M-16	2920	gech			
MAYOGIAK	J-17	9681	gech			
MAYOGIAK	M-16	3005- 3093	con			
MAYOGIAK	J-17	9533- 9610	con			
MAYOGIAK	M-16	2990	gech			
NATAGNAK	H-50	6388- 6394	FT			
NATAGNAK	K-23	4965- 4977	con			
NATAGNAK	K-23	4954- 4965	con	4900- 4970	con	
NATAGNAK	H-50	6119- 6127	FT			
NUNA	A-10	3243.0-3245.0	con			
NUNA	A-10	3245.0-3248.0	con			
NUNA	A-10	3248.0-3250.5	con			
NUVORAK	O-09	3482	gech			
NUVORAK	O-09	3460	gech			
PARSONS	A-44			11330-11440	con	
PARSONS	P-53			10450-10820	con	
PARSONS	N-10			10120-10515	con	
PARSONS	F-09			11240-11450	con	
PARSONS	F-09			11000-11240	con	
PARSONS	F-09			11450-11650	con	
PIKIOLIK	M-26	5620- 6470	con			
PIKIOLOIK	G-21			1380-1428.0	con	
PIKIOLOIK	E-54	9048- 9078	con			
PIKIOLOIK	E-54	9101	pal			CORALS
PIKIOLOIK	E-54	9102.3	pal			CORALS
PIKIOLOIK	E-54	9102	pal			CORALS
RUSSELL	H-23	6008	gech			
RUSSELL	H-23	5978	gech			
SIKU	E-21			11160-11245	con	
TUK	M-09	3008.5	gech	2860.0	gech	
TUK	M-09	3008.0-3009.0	pln	2865.0	gech	
WAGNARK	C-23			13720-13950	con	

LEGEND:

FT	Fission Tracks		
K-Ar	K-Ar dating	gech	Geochemistry
SHC	Bitumen	pal	Paleontology
XRF	X-ray Fluorescence	pln	Palynology
con	Conodonts		

TABLE VI: XRF Analyses of volcanics in Eskimo J-07, East Reindeer P-60 and C-38.

	J-07	J-07	J-07	J-07	J-07	J-07	C-38	P-60	P-60
depth:	2765	2865	2891	2919	2929	2945	5187	6127	6399
	%, normalized								
Fe2O3	6.24	12.53	7.84	9.39	10.56	5.53	9.58	3.59	1.59
MnO	0.15	0.09	0.30	0.14	0.14	0.01	0.03	0.06	0.11
TiO2	0.90	0.66	0.53	0.60	0.58	0.86	0.72	0.55	0.17
BaO	0.04	0.04	0.01	0.03	0.03	0.03	0.03	0.03	0.04
CaO	0.14	0.85	12.98	7.33	6.27	0.09	3.10	9.33	0.04
K2O	6.62	7.14	1.19	3.36	4.19	8.22	2.72	2.42	2.39
P2O5	0.10	0.06	0.06	0.08	0.07	0.08	0.10	0.06	0.02
Al2O3	17.27	16.28	14.51	14.06	14.28	20.72	18.71	7.91	3.89
SiO2	55.11	50.59	48.43	49.44	48.95	51.79	47.50	63.58	90.49
MgO	7.06	5.16	9.30	9.47	10.27	2.93	6.09	0.57	0.26
Na2O	2.16	1.61	2.12	1.51	0.75	0.28	3.53	0.16	0.05
SO3	0.01	0.09	0.00	0.00	0.00	3.85	2.00	2.71	0.36
LOI	4.20	4.90	2.90	4.60	3.90	5.61	5.90	9.01	0.60
BASALT	Alkal.	Alkal.	Alkal.	Alkal.	Alkal.	Alkal.	Alkal.	Thole.	Thole.

	ppm:								
F	-	-	-	-	-	-	-	-	-
Zn	99	30	44	60	63	1	67	26	0
Cu	67	8	48	54	38	27	114	4	21
Pb	0	0	5	0	0	0	0	7	8
Ni	84	107	119	128	157	67	77	38	28
Ag	-	-	-	-	-	-	-	-	-
Mo	-	-	-	-	-	-	-	-	-
As	-	-	-	-	-	-	-	-	-
Hg	-	-	-	-	-	-	-	-	-
Sb	-	-	-	-	-	-	-	-	-
Rb	67	117	20	62	78	144	72	56	46
Cs	-	-	-	-	-	-	-	-	-
Sr	40	46	311	102	122	35	54	95	36
Ba	380	415	126	393	439	253	380	311	304
U	-	-	-	-	-	-	-	-	-
Ce	-	-	-	-	-	-	-	-	-
Cr	76	349	384	424	478	643	394	185	294
V	231	101	203	202	212	226	172	75	20
Y	13	18	10	15	15	17	13	11	5
La	-	-	-	-	-	-	-	-	-
Zr	69	61	110	65	66	64	75	220	118
Th	-	-	-	-	-	-	-	-	-
Mn	1018	628	1034	1009	1017	24	163	476	803
S									

- = below detection limit of 5-10ppm

TABLE VII: MATURITY DATA; ROCK EVAL, TAI AND CAI, AND BITUMEN REFLECTANCES

R O C K   E V A L

WELL NAME	#	CORE	CUTTINGS	Tmax	S1	S2	S3	I	S2/S3	TOC	HI	OI
AMAGUK	H-16	4113		522	0.07	0.11	0.13	0.39	0.85	0.82	16	13
AMAGUK	H-16	4123		497	0.12	2.27	0.15	0.05	15.13	4.78	3	47
AMAROK	N-44	7650		0	0.00	0.00	0.03	0.00	0.00	0.67	4	0
AMAROK	N-44	7641		300	0.00	0.01	0.05	0.00	0.20	0.73	7	1
E. REINDEER	P-60		3260									
E. REINDEER	P-60		3270									
E. REINDEER	P-60		3280									
E. REINDEER	P-60	4574		USELESS								
E. REINDEER	P-60	4587		340	0.14	0.06	0.2			0.17		
E. REINDEER	P-60	4587		371	0.16	0.12	0.29			0.16		
ESKIMO	J-07	2955-2968										
KANGUK	I-24	4560		349	0.21	0.08	0.14	0.72	0.57	0.76	18	11
KANGUK	I-24	4607		587	0.08	4.03	0.76	0.02	5.30	4.23	18	95
KIMIK	D-29	8466		431	0.61	11.37	0.53	0.05	21.45	2.78	19	409
KIMIK	D-29	8476		425	0.75	14.38	0.81	0.05	17.75	3.48	23	413
MAYOGIAK	J-17	9686		471	0.65	2.52	0.54	0.21	4.67	4	14	63
MAYOGIAK	J-17	9371		444	0.44	7.43	0.25	0.06	29.72	2.79	9	266
MAYOGIAK	J-17	9681		468	0.92	2.62	0.78	0.26	3.36	5.39	14	49
MAYOGIAK	J-17	9375		445	0.32	4.37	0.27	0.07	16.19	1.73	16	253
MAYOGIAK	J-17	9638		407	0.27	0.53	0.95	0.34	0.56	8.86	11	6
MAYOGIAK	J-17	9813										
MAYOGIAK	M-16	2850		439	0.46	1.53	0.45	0.23	3.40	1.48	30	103
MAYOGIAK	M-16	2920		437	0.95	2.24	0.93	0.30	2.41	2.85	33	79
MAYOGIAK	M-16	2990		439	0.44	1.02	0.59	0.30	1.73	1.89	31	54
NUVORAK	O-09	3460		494	0.11	0.18	0.21	0.38	0.86	0.70	30	26
NUVORAK	O-09	3482		483	0.17	0.74	0.28	0.19	2.64	1.59	18	47
RUSSELL	H-23	5978		495	0.01	0.12	0.23	0.08	0.52	0.45	51	27
RUSSELL	H-23	6008		486	0.02	0.09	0.12	0.18	0.75	0.38	32	24
TUK	M-09		2860.0	436	0.33	1.06	0.94	0.24	1.13	1.67	56	63
TUK	M-09		2865.0	436	0.23	0.97	1.54	0.19	0.63	1.66	93	58
TUK	M-09	3008.5		366	0.47	0.60	0.38	0.44	1.58	1.29	29	47
KUGALUK	N-02			384	0.42	0.23	0.10	0.65	2.30	0.82	12	28
KUGALUK	N-02			420	0.01	0.25	0.95	0.04	0.26	0.68	140	37
PIKIOLIK	E-54		8980	444	0.40	3.90	0.31	0.09	12.58	2.95	11	132
PIKIOLIK	E-54		9300	444	0.79	5.14	0.59	0.13	8.71	2.37	25	217

P A L Y N O L O G Y

WELL NAME	#	CORE	CUTTINGS	TAI	COMMENTS
E. REINDEER	P-60	4566-4577			barren
E. REINDEER	P-60	4578-4593			barren
E. REINDEER	P-60	5197-5201			barren
NUVORAK	O-09	3437-3460		2+	
NUVORAK	O-09	3481-3494		2+	
KANGUK	I-24	4569		3+to 4-	
KANGUK	I-24	4594-4607		3+to 4-	
KANGUK	I-24	5244-5254		4-	
RUSSELL	H-23	5975-6010		2+	
AMAROK	N-44	7634-7644		HIGH	no pollen

TABLE VII, continued

C O N O D O N T S

WELL NAME	#	DEPTH	CAI	COMMENTS
AKKU	F-14	4500-4600	3.5	
AKKU	F-14	4600-4700		barren
AKKU	F-14	4700-4800		barren
ATKINSON	A-55	7305- 7325		barren
ATKINSON	L-17	2337.0-2340.6	5	
ATKINSON	L-17	2340.6-2344.4	5	
ATKINSON	L-17	2344.4-2350.2	5	
E. REINDEER	G-04	11800-12100		barren
E. REINDEER	G-04	12100-12250		barren
ESKIMO	J-07	2945-2954		barren
ESKIMO	J-07	2954-2963		barren
ESKIMO	J-07	2963-2971		barren
IMNAK	J-29	10860-11170		barren
INUVIK	D-54	1900- 2150		barren
INUVIK	D-54	3100- 3350		barren
KILLANAK	A-77	2100.0-2160.0	3	
KILLANAK	A-77	2165.0-2230.0	3	
KILLANAK	A-77	2235.0-2305.0	3.5	
KILLANAK	A-77	2310.0-2360.0	2.5	
KILLANAK	A-77	2365.0-2460.0	3	
KILLANAK	A-77	2750.0-2850.0		barren
KIMIK	D-29	8480- 8720		barren
KIMIK	D-29	8602- 8613	5	
KIMIK	D-29	8613- 8624	5	
LOUTH	K-45	6970- 7270	5	
MAYOGIAK	J-17	9533- 9610	5	
MAYOGIAK	J-17	10596-10602	5	
MAYOGIAK	M-16	2866- 3005		barren
MAYOGIAK	M-16	3005- 3093	5	
NATAGNAK	K-23	4954- 4965	5	
NATAGNAK	K-23	4965- 4977	5	
NATAGNAK	K-23	4900- 4970		barren
NUNA	A-10	3243.0-3245.0		barren
NUNA	A-10	3245.0-3248.0		barren
NUNA	A-10	3248.0-3250.5		barren
PARSONS	A-44	11330-11440		barren
PARSONS	F-09	11000-11240	4	
PARSONS	F-09	11240-11450		barren
PARSONS	F-09	11450-11650		barren
PARSONS	N-10	10120-10515	5	
PARSONS	P-53	10450-10820	4.5	
PIKIOLIK	M-26	5620- 6470		barren
PIKIOLOIK	E-54	9048- 9078	5	
PIKIOLOIK	G-21	1380.-1428.0		barren
SIKU	E-21	11160-11245		barren
TUKTU	O-19	7352- 7371	5	
WAGNARK	C-23	13720-13950		barren

B I T U M E N S

WELL NAME	#	CORE	CUTTINGS	Rmax	Ro equiv.	WELL NAME	#	CORE	CUTTINGS	Rmax	Ro equiv.
AMAGUK	H-16	6940		1.9	1.617	KUGALUK	N-02	2599		2.7	2.130
KANGUK	I-24	4607		3.2	2.451	KUGALUK	N-02	2655		2.7	2.130
KUGALUK	N-02	830		2.2	1.810	KUGALUK	N-02	2673		2.5	2.002
KUGALUK	N-02	2406		2.4	1.938	KUGALUK	N-02	2674		2.5	2.002
KUGALUK	N-02	2552		2.7	2.130	KUGALUK	N-02	2681		2.7	2.130

NOTE: Decimal depths are in metric, the others in Imperial

TABLE VIII: CONODONT SAMPLING AND RESULTS FOR TUKTOYAKTUK PENINSULA PROJECT

WELL NAME	#	CORE DEPTH	CUTTINGS DEPTH	RESULTS
AKKU	F-14		4500-4600	post Cambrian through Devonian
AKKU	F-14		4600-4700	barren
AKKU	F-14		4700-4800	barren
ATKINSON	A-55	7305- 7325	6770- 7300	barren, brachiopod fragments: E. Paleozoic
ATKINSON	L-17	2337.0-2340.6		early M. Ordovician (Whiterockian)
ATKINSON	L-17	2340.6-2344.4		early M. Ordovician (Whiterockian)
ATKINSON	L-17	2344.4-2350.2		early M. Ordovician (Whiterockian)
E. REINDEER	G-04		11800-12100	barren
E. REINDEER	G-04		12100-12250	barren
ESKIMO	J-07	2945-2954		barren
ESKIMO	J-07	2954-2963		barren
ESKIMO	J-07	2963-2971		barren
IMNAK	J-29		10860-11170	barren
INUVIK	D-54		1900- 2150	barren
INUVIK	D-54		3100- 3350	barren
KILLANAK	A-77		2100.0-2160.	indeterminate
KILLANAK	A-77		2165.0-2230.	M. Ord - M. Dev, probably Early to early M. Devonian
KILLANAK	A-77		2235.0-2305.	Late Emsian
KILLANAK	A-77		2310.0-2360.	Late Silurian to Middle Devonian
KILLANAK	A-77		2365.0-2460.	Late Silurian to Middle Devonian
KILLANAK	A-77		2750.0-2850.	barren
KIMIK	D-29		8480- 8720	barren
KIMIK	D-29	8602- 8613		probably Middle to Upper Ordovician
KIMIK	D-29	8613- 8624		probably Middle to Upper Ordovician
LOUTH	K-45		6970- 7270	Ordovician through Devonian
MAYOGIAK	J-17	9533- 9610		late Emsian
MAYOGIAK	J-17	10596-10602		late Emsian
MAYOGIAK	M-16	2866- 3005		barren
MAYOGIAK	M-16	3005- 3093		probably Middle Devonian
NATAGNAK	K-23	4954- 4965		indeterminate
NATAGNAK	K-23	4965- 4977		early M. Ordovician (Whiterockian)
NATAGNAK	K-23		4900- 4970	barren
NUNA	A-10	3243.0-3245.0		barren
NUNA	A-10	3245.0-3248.0		barren
NUNA	A-10	3248.0-3250.5		barren
PARSONS	A-44		11330-11440	barren
PARSONS	F-09		11000-11240	Lower Ordovician (lower to mid Canadian)
PARSONS	F-09		11240-11450	barren
PARSONS	F-09		11450-11650	barren
PARSONS	N-10		10120-10515	Lower Ordovician (lower to mid Canadian)
PARSONS	P-53		10450-10820	probably Middle to Upper Ordovician
PIKIOLIK	M-26	5620- 6470		barren
PIKIOLOIK	E-54	9048- 9078		Middle Ordovician to Middle Devonian
PIKIOLOIK	G-21		1380.-1428.0	barren
SIKU	E-21		11160-11245	barren
TUKTU	O-19	7352- 7371		probably Early to early Middle Ordovician
WAGNARK	C-23		13720-13950	barren

NOTE: Decimal depths are in metric, the others in Imperial

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APPENDIX

1. CLASTIC ROCKS

The wells penetrating the clastics of the Quartzite Ridge and the Imperial Formation at the southwest of it are described here by group and in alphabetical order. Figure 9 contains schematic lithologic columns for each well.

Wells with Imperial:

Amaguk H-16	Kiligvak I-29
Amarok N-44	Nuvorak O-09
Kanguk I-24	Russell H-23
Kanguk F-42	
Kapik J-39	

General remarks.

The depth values are presented in this text in the original system in which they were measured, thus facilitating the relation to existing wireline and lithologs. The wells with Imperial Formation will be described starting from the northeast.

Observations made by workers with experience in the clastic formations in the surrounding area, having a bearing on the clastic rocks in the study area, will be presented here.

K. Williams: In the plains area there is no easy distinction possible between Cretaceous and Imperial Formation, except where a Lower Cretaceous sandstone overlies the Devonian formation. Both formations are cherty, contain plant remains, carbonaceous flakes, etc..

J.Dixon: The Martin Ck and Husky Formation sands are chemically mature; they are quartz sandstones with very little, but if any, typically white chert. The colour of the sandstone is grey to light grey. Individual grains and porosity are visible. The Cretaceous sandstones are lightly cemented. The Imperial Formation is much better indurated than the Cretaceous. In the Imperial, fractures run through the grains, indicating a fair amount of silification. The Cretaceous wirelinelogs are correlatable, whereas those of the Imperial Formation are not.

H.Wielens: There appear to be two main divisions in the Imperial Formation: a sandy/ silty succession (1), underlain by a shaly succession (2). Quartz veins are common. The Imperial Formation contains mainly chert in the sandstone: white, grey, bluish, milky, some green and red. Cuttings from this type of sandstone can be found in every drill cutting sample. Clear quartz is present in two varieties: 1. rounded, frosted grains and 2. clear, broken, faced crystals, which have originally been euhedral. Another variety of siliceous rocks is jasper, which is usually present in the form of small pebbles. The Imperial is largely silicified, and virtually no visible porosity is left. Plant remains and carbonaceous flakes are common in the shales and siltstones. The siltstone and shales are micromicaeous. The shale, especially in the more shaly successions, usually contains thin siltstone stringers.

In core samples, distal Bouma DE sequences (Glaister & Hopkins, 1974) are evident in the sandier parts, together with bottom marks, tool marks, soft sediment deformation by load casting etc., all of these on a centimetre scale. This turbiditic character is probably also prevalent in the other, non-cored, sandy Imperial intervals.

Amaguk H-16

Comments: The dips are 20-NW for the Cretaceous and 25-30N for the Imperial Formation, both values are quite variable; the reconstructed Paleozoic dip is 19-NE. Top of the pre-Mesozoic succession is picked at 3140', TD at 4126'. A little coal seam is present near the bottom of the core, at depth 4123', and was sampled for Rock-Eval and vitrinite analysis. Another sample was taken at 4113' for Rock-Eval.

Cuttings

The rocks are very similar to those found in the Imperial Formation and contain indurated, cherty, salt and pepper sand- and siltstones plus interbedded shales. The section is shale dominated, with some coarse sandstones containing plant remains and carbonaceous flakes. The sandstone is rather dark coloured; chert is mainly grey.

Core 4112'-4126'

The core consists mainly of sandstone with quartz-cemented vertical cracks. The sandstone beds are up to 1 m thick. Grain size reaches up to 3 mm, and the grains are suspended in a finer matrix of sand to silt size material. The sandstone is internally divided into coarse and finer intervals. A small number of shale clasts are suspended in the sandstones.

In the shales, soft sediment deformation from slumping and a few ripple marks are the main sedimentary structures; no evidence has been found of bioturbation.

Amarok N44

Comments: No dipmeter log has been run, but the bedding attitude in core appears vertical. Top of the pre-Mesozoic succession is picked at 3820', TD 7652'. Samples for Rock-Eval were taken at depths 7641 and 7650 feet, from the internal parts of the core, and at 7651-7652 feet for palynology.

Cuttings

The salt and pepper coloured sandstone is composed of indurated chert and quartz grains and similar to that in previous wells, although some yellow iron staining is present, as well as jasper. Lower in the well, the iron staining is absent and the sandstone is indistinguishable from that in the other wells. The occasional brown chert pebble is found. At depth 4950', the sandstone contains green chert, is whiter and somewhat more porous than typical Imperial sandstones. Below the 5000 feet level, the usual Imperial sandstones are present again. The main colour of the chert grains is aquamarine. Some of the sandstones contain chert pebbles and are fairly coarse.

Core: 7634'-7652'

The core comprises black to dark grey shale with a small amount of pyrite. The main characteristics are generally vertical partings and many straight or wobbly slickensides. The shale is hard, and indurated; no evidence for bioturbation has been found. The shale streak is grey, indicating a low source rock potential. Some silt size material is present. In a large part of this core, bedding attitudes are vertical, and there is evidence of much soft sediment deformation on a decimetre scale.

Kanguk F-42

Comments: No dipmeter log was run; top of the pre-Mesozoic succession is picked at depth 4820′ under Cretaceous sandstone, TD at 5070′. The shale between depths 7050′ and 7200′ has been sampled for Rock Eval, but does not look very promising, because when scratched, it produces a white powder.

Cuttings

Noteworthy are conglomerates, which are found at the depths 4900, 6770 and 7050 feet. The pebbles are composed of chert, which is typically white, grey, bluish or green. The conglomerates are very indurated, and like the sandstones, they fracture through the grains. The sandstone is similar to the salt and pepper Imperial sandstones found in other wells, and shows yellow iron stains in this well. It contains mainly clear quartz and a little green or blue coloured chert. Quartz veins cementing fractures are composed of milky quartz. The sandstone layers locally are brown from siderite cementation. Dark grey shale occurs between the 7050 and 7200 feet level. Pebbles are unusually abundant in this well.

Kanguk I-24

Comments: No dipmeter was run; top of the pre-Mesozoic succession is picked at 4565′, TD at 5254′. A coal seam at depth 4607′ was sampled for determination of vitrinite reflectance values. Other samples were taken at depths 4560' for Rock-Eval, and at 4595'-4599' and 5246'-5248' for palynology.

Strata in this well resemble typical Imperial Formation, with the presence of interbedded grey shales and indurated, cherty, salt and pepper silt- and sandstones. Minor exceptions are the absence of jasper and a smaller amount of rounded quartz grains. There is not much green or blue coloured chert present. Euhedral quartz grains occur and could have been derived from quartz veins. A fraction of the chert sandstones is even coarser than those in Nuvorak O-09.

Core: 4561'-4607'

The Cretaceous-Devonian contact is preserved in the core at 4565'. The Cretaceous sandstone is softer and more friable, while the Imperial Formation sandstone is very well indurated. The uppermost Imperial sandstone is about 1m thick and consists of coarse, angular chert grains of up to 3mm in size, suspended in a matrix composed of finer sandstone, up to 0.5mm in grain size. There are a large number of vertical fractures, with clasts of sandstone wedged inside them, and cemented by quartz and calcite. In the sandstone the grain size varies throughout the medium thick (10 cm) beds. In the deeper sandstones, fining upward sequences are visible. There, the fractures are offset up to 5mm by a younger fracture set. The shales actually contain many healed fractures. Much of the fracturing obviously took place after some induration, especially in the siltier parts. Evidence neither of bioturbation, nor of fossils, has been found anywhere in the core. In the shales much slumping is evident, on thin to medium thick intervals; some of it occurred after initial induration. Small faults are common, ripple marks are rare. Of note is a thin bitumen layer of 1mm thick at depth 4607', which was sampled and has a equivalent reflectance to vitrinite reflectance of 3.1, indicating that strata at this level are overmature with respect to oil generation.

5239'-5254'

The bottom part of the core displays flame structures and probable tool marks in the shale, but these 'marks' could also be the result of small scale slumping on a slope. The bedding size ranges from thick bedded in sandstone to thin and medium beds in shales. Other than that, the sandstones, siltstones and shales are similar to those in the interval of the upper core in this well.

The absence of fossils, ripples or bioturbation, and presence of coal may indicate a brackish depositional environment, close to the sediment source. It could be located at the inside of a delta system.

Kapik J-39

Comments: No dipmeter was run, no core is available; top of the pre-Mesozoic succession is picked at 4045', TD 4812'.

Cuttings

The rocks are similar to those in H-23, with salt and pepper coloured sandstone, composed largely of cherty material (chalcedony), siltstone, shales, and a few pyrite crystals. Glauconite and some pyritized wormtubes are present. The sandstones are poorly sorted and the chert is angular; rounded quartz grains and chert pebbles are the only rounded material. Several beds have a browner colour.

Typical successions consist of salt and pepper, locally brown, quartzose sandstones, siltstones and silty shales. Sandstone and siltstone are composed of unsorted clear quartz , chert (white, black, brown, green, blue) and unidentified black minerals, possibly hornblende. The salt and pepper colour is caused by the mixing of black and white minerals, and is usually on the dark side. The siltstone and shale are micromicaeous. Carbonaceous flakes and plant remains are, as usual, present. In the shales, the sand- and siltstone can form thin stringers or thin beds. In the coarser sandstones, chert pebbles may be present. Rounded, frosted grains of clear quartz and jasper are present in many of the samples. The only fossils observed in these rocks, are scaphopods. The depositional environment must therefore be marine, in a location with occasionally influxes of coarser clastics, probably as tubidity currents.

Kiligvak I-29

Comments: No dipmeter was run at the unconformity interval. Top of the pre-Mesozoic succession is picked at 650'; TD is at 6447' in carbonates. This well penetrated an in general normal Paleozoic sequence such as can be observed on the mainland in the Anderson Plains area. The carbonates underlying the clastics will be described under the CARBONATE chapter of the Appendix.

Cuttings

The conglomerate layers in this well.are noteworthy, as well as the large number of pebbles present throughout the succession. These are not found in wells on the Northern Interior Plains, and are exceptional in this well because of its proximity to the mainland and distance from the Quartzite Ridge. The salt and pepper coloured sandstones can be very coarse; like the siltstones, they are composed of indurated chert and quartz grains, and contain some carbonaceous flakes. Also noteworthy is the presence of some white chert pebbles. These sandstones are similar to those described in the wells above. Fractures were cemented by milky quartz. In this well, the succession can be divided into an upper sandy and a lower shaly section. The shales are grey and micromicaeous. The succession is shale dominated from 3600' down into the black, radioactive, siliceous, organic-rich shales of the Canol Formation. The sub-3600' Imperial shales contain a fair amount of silt, but virtually no sandstone.

Nuvorak O-09

Comments: Top of the pre-Mesozoic succession is picked at 3424', TD 3798'. Dipmeter data: Cretaceous 3-S, Imperial Formation 15-WNW; if the Cretaceous dipplane is rotated back to flat-lying, the resulting dip 16-NW of the pre-Mesozoic plane should be the dip at the onset of Mesozoic sedimentation. Two samples were taken for Rock-Eval, at 3460' and 3482'. The latter contains plant material, and a sample was submitted for vitrinite reflection measurement.

Cuttings:

The rocks are similar to those described from H-23 and J-39, and consist of intercalated, indurated sand-, siltstone and shale beds. This well penetrated the sandy division only. Part of the salt and pepper, indurated and tight sandstone, which contains largely chert, appears coarser than in H-23 or J-39. The siltstone is composed of similar materials. Paleontology samples were described in GSC Paper 74-11 by Chamney and will not be considered, due to doubt about their validity.

Core:

This core is composed of interbedded grey to dark grey shales and sandstones of Imperial Formation. Typical bedding thicknesses vary from a few millimetres in shales to 30 cm in sandstones. The sandstones are chert-rich, and contain fining upward sequences, with grain sizes ranging from 0.1 to 1-2 mm. Plant remains and carbonaceous flakes are visible. In the sandy part of the shales, soft sediment deformation is evident on a centimetre scale, caused by slumping and loading. Outside the areas of soft sediment deformation, the rocks display undisturbed lamination, indicating that the deformation is sedimentary and not enterolithic. Scouring and tool marks are visible at the bottom of sandstone layers. Also, there are Bouma DE sequences, typical of distal turbidites. Vertical cracks were healed by quartz and some calcite cement. The sand grains are angular or sub-rounded, white, milky black, blue or green chert. Some of the black grains are not chert, but possibly weathered hornblende. The observed dark brown nodules are composed of siderite. Most of the shale has disintegrated in the core box.

Russell H-23

Comments: No diplog was run. The contact Paleozoic-Mesozoic is at 3610', TD at 6010'. Two samples were taken for Rock-Eval analysis from 6008 and 5978 feet depth.

Cuttings

Below the contact, the rocks become sandy and silty grey, replacing the overlying, black, Cretaceous shales. All the dark shales in the samples may well be cavings, but could represent interbedded layers. The sandstone is composed of well cemented quartz and chert, and contains pebbles of chert. The brick-red material present was probably recently oxidized in the sample vial, because it still retains a black core (oxidation by a combination of marcasite and organic material?). Pyrite crystals, as well as rounded quartz grains are present in each sample, while plant material can be found in a large number of them. The siltstone and shale contain small mica flakes.

Thus the main rock component is sandstone, with siltstone and shale. The sandstone has a salt and pepper grey colour, caused by white chert with intermixed black chert and other, softer, black matrix material. Some of the sand- and siltstone has a dark brown colour. Below 4200′ depth, the rocks are dominantly shale. The sandstone, where present, still contains quartz, chert and jasper. At the 4470′ level, bituminous material or coal is present inside the sandstone. Glauconite and pyritized wormtubes are common accessories. Below 4750′ depth, only black shale is present. Its source rock potential between 4750′ and 5020′ should be checked, because of its sonic log character. The 4930′-4940′ interval is a quartz-pebble conglomerate. The interval between 5230 and 5270 feet contains very fine, fissile shale with iron shavings only and probably results from a drilling problem. The underlying material is again black shale. Chert pebbles of all colours, plus clear quartz can be found at the depths 5300′ and 5820′.

<u>Core</u> 5975-6010′

The core consists of a black, very fissile shale. Soft sediment deformation on a centimetre scale was caused by slumping. Fractures, with offsets of more than 5 cm vertically, were recemented shortly after that deformation, as is indicated by the presence of shale cement similar to the main rock type. Slickensides are ubiquitous and are coated by probably gypsum (soft, black to clear mineral with perfect cleavage). 95% or more of the core is shale.

In the Russell H-23 clastic succession, a division is possible into an upper part with turbidity flows, and a virtually completely shaly succession in the lower part. Few of the other wells do contain a similar lower shale section, regardless of the thickness of clastics penetrated.

WELLS WITH IMPERIAL, OUTSIDE THE STUDY AREA

The wells in this section are of importance for the study area:

Killannak A-77

Kugaluk N-02

Killannak A-77

Comments: The pick of the Imperial top is dubious, and may be at 1267m; TD is at 2966 m. Dipmeter data indicate for the Imperial Formation a questionable dip of 2-W, while the value for the Cretaceous is very variable around 8-NE; the reconstructed original pre-Mesozoic dip is 7-SW.

Cuttings

The succession contains interbedded sandstones, siltstones and shales. The light grey, well indurated sandstone and siltstone are composed of dirty quartz grains, cemented by quartz, but fracture around the grains. The salt and pepper sandstone contains some black grains, but generally the grains are brown to grey or white, dull, rounded to angular chert or quartz. Calcite and muscovite are present as cement and in fractures. Below the depth of 1830 m, the dark grey sandstone becomes similar to the Imperial sandstones: it is composed of rounded or angular, blue, white, grey and black chert grains with a few quartz grains, muscovite, is cemented by quartz and fractures through the grains. Accessories, are rounded clear quartz grains, broken euhedral quartz grains, and jasper. Chert pebbles are present at 2030 m depth (brown and blue coloured). The shales at this depth have very glossy slickensides, in contrast to the dull ones higher up in the succession. Carbonaceous flakes also are present at this level.

In general, the sandstones have a somewhat darker colour than farther to the south. The equivalent of the Canol Formation starts at 2070 m and has a sharp contact with the Imperial Formation. The Canol is very cherty, black shale and scratches brown; in this well the Canol Formation is thinner than usual.

Kugaluk N-02

Comments: The pick of an Imperial top is dubious, but using a kick on the sonic log, it could be placed at 170'. TD is at 8045'. No dipmeter logs are available.

Drill cuttings were available from depths 160' to 800', and had to be washed before examination. The remainder of the well was cored continuously. The core has been studied in a cursory fashion only, because the main interest lays in the composition of the sandstones.

Cuttings

Both plant remains and large muscovite flakes are present. The sandstones are porous, not very well indurated, contain some chert and fracture around the grains. They are similar to Cretaceous sandstones, and differ in their induration, composition and porosity from the Imperial rocks in the wells to the north and also from the Reindeer area sandstones (described below).

Although the age of the rocks is uncertain, an Imperial Formation age is assumed here, because of the lack of any other good wireline log picks and the postulated Imperial age on the surface-geological maps.

OTHER NON-QUARTZITE CLASTICS

The wells in this section are:

East Reindeer A-01

East Reindeer C-38

East Reindeer P-60

Ogeoqeoq J-06

East Reindeer A-01

Comments: Top of the pre-Mesozoic succession is picked at 9260', but cannot be picked from cuttings; TD at 9693'. Dipmeter data are: Pre-Mesozoic 42-NW, and about 10-NW for Cretaceous, with much scatter; the reconstructed pre-Mesozoic dip is 32-NW.

Cuttings

The sandstone is very white, consists of rounded to subrounded, clear and somewhat milky quartz grains, cemented by milky quartz, and is very well indurated. The rocks fracture through the grain. Some of the sandstone is less indurated, and porous, but this may be caved material. The sandstone contains a few black grains. The shales are grey to grey-green, micromicaeous and waxy. Pyrite is abundant.

The core has been described before in Wielens, 1987.

The sandstones in this well, because of their white colour and high content of clear quartz, differ from those in P-60 and in the Imperial Formation, although they are closer related to P-60 in their appearance with the abundance of rounded and quartz cemented clear quartz grains. The grey shales do not provide much information.

<u>Core</u> 9532'-9543'

The core is a succession section of shale with centimetre scale interbeds of fine grained sandstones and siltstones. All beds dip about 40^{o}-45^{o}. Laminations are very fine and wavy or broken and recemented. Beds are thinner than 2 cm, and always disturbed. Soft sediment deformation, on a scale from millimetres to decimetres, is extensive throughout and appears in places to be enterolithic. The shale is black, phyllitic, glossy and slickensided. Vertical fractures throughout were recemented by quartz. The sand stringers are indurated to hard quartzites. Noteworthy is the large amount of detrital biotite at 9540' (2908m). No evidence of bioturbation was observed. Characteristics of the Imperial Formation are absent. The amount of pyrite and extent of soft sediment deformation, caused by load and slumping, is much larger here than in the other East Reindeer wells. The lithology is very similar to the that observed in East Reindeer P-60. A tentative Cambrian to Precambrian age is suggested for the rocks in A-01.

<u>East Reindeer C-38</u>

Comments: A dipmeterlog is not available. Top of the pre-Mesozoic succession is picked at the top of a carbonate unit at 4200', TD 8512'. The sample quality is poor, due to extreme caving.

Cuttings

The succession consists of a dolomite near the top, underlain by a thick succession of clastics. The dolomite near the top of the succession is masked heavily by cavings. The underlying sandstone consists of round, clear quartz, well indurated by a milky quartz cement. The sandstone fractures through the grains. It is unclear which of the shales in the samples belong to this succession. They are probably the silty, micromicaeous and dark grey shales. The siltstones have a similar colour. They, like the sandstones, are composed of clear quartz, and contain no chert. The mica present is a muscovite. There are a few quartz veins, filling the fractures. The sandstone below the 5600' level is quartzitic, contains an increased amount of milky quartz, but only a few chert grains. Glauconite and biotite are accessories.

A few dolomite beds have been observed within the clastic succession. A large part of the dark grey shale, deeper in this well, is phyllitic. Distinct micromicaeous, brick-red shale, and a minor amount of green-grey shale can be found below 6000 feet depth. The siltstone there has the same red colour.

Part of the dolomite in this succession is white, crypto crystalline, while the coarser fragments are black. Both the sandstone and dolomite underlying the 6500' level can have a red colour. The greenish shale at this depth may contain rounded, clear quartz grains. It is well cemented and extremely indurated. Of the other greenish coloured rocks, the sandstone is composed of rounded, clear quartz grains with a greenish matrix. Underlying this coloured succession is a thick succession of black shales, between 7000 to 7600 feet depth. The shales do not contain as much mica as those higher in the well. They are silty and contain pyrite.

Around the 7000' level, a few cuttings were observed which appear to be tuff. They contain phenocrysts and vesicules. Some of the sandstone contains a malachite green coloured mineral (too dark for glauconite). Below 7900' depth, the sequence comprises dark grey siltstone and some white, silty dolomites. Underlying those, at depth 8000', are sandstones with a few chert pebbles (which are similar to those found near the top of the pre-Mesozoic succession) dark grey, silty shales and white dolomites.

The presence of interbedded dolomites and clastics, and the coloured shales point to a Cambrian or Precambrian age. Cambrian and Precambrian rocks in both the subsurface of the Anderson Plains and the outcrops in the Mackenzie Mountains feature reddish shales and carbonates. In addition, this succession resembles Precambrian clastics in the western part of the Campbell Uplift (M.P. Cecile and L.S. Lane, pers. comm., 1987). Additionally, the extreme induration and large amounts of sandstone make the Precambrian age more probable, while the mica content would be anomalous for a Cambrian formation. The presence of glauconite indicates a marine depositional environment for the clastics.

<u>Core</u> (4724'-4746'; 1440m-1447m).

This core is characterized by well indurated, dark shale with some thin siltstone stringers in fining upward sequences and contains a fair amount of pyrite. The highly contorted stringers show evidence of small and large scale soft sediment deformation. After induration, extensive fracturing took place. While some cracks were wide enough to be filled with silica cement, others are nearly invisible. There is no evidence of bioturbation.

5805'-5828' (1769m-1776m).

This core is similar to the one described above. Around 5824' (1775m) the sediment has been broken up after induration; part of it was rotated and recemented. Soft sediment deformation on a centimetre to decimetre scale is common elsewhere in this core.

Both of these above cores are lithologically very similar to the East Reindeer P-60 core, but there is evidence of more deformation. Characteristics for the Imperial Formation are absent.

6342'-6365' (1933m-1940m).

The upper part of the core consists of a 3 m thick light-grey to buff limestone bed with extensive calcite-filled fractures. The fine laminations are the result of variations in argillaceous content; pyrite grains parallel the laminations. The limestone is well indurated, and has no burrows, mottling or fossils. Fine laminations and fine grain size indicate low energy deposition, during turbiditic sedimentation. No conodonts could be recovered from samples collected between 6349'-6352' (1935m-1936m) (GSC Rep. 18 TTU -86).

Underlying the limestone are green-grey shales with interbedded conglomerates, sand- and siltstones. They contain fining upward sequences, with thicknesses ranging from centimetres to decimetres. Some of the sandstones have ripple marks. Scouring features are present near the bottom of the conglomerate beds. Thin section study shows that in the conglomeratic beds the pebbles consist of chert and weathered, vesicular, doleritic rock.

8052'-8065' (2454m-2458m).

The main part of this core is a debris flow with clasts larger than 5 cm. In thin-section, the clasts are rounded chert pebbles and weathered vesicular volcanic rocks, which are suspended in a coarse, unsorted matrix composed of the same material. Proximity to the same source, which provided the volcanics in the other East Reindeer wells is probable.

General comment: Strata in this well were extensively disturbed after induration in two or more phases, as is indicated by silica filled cracks, broken and offset by younger fractures also cemented by silica.

The lithology of the described sequence is similar to the one of A-01, or P-60, which will be described next. A CAmbrian or Proterozoic age is suggested.

<u>East Reindeer P-60</u>

Comments: Top of the clastics interval is near 3250', TD at 6300'. The dipmeter log is unavailable. The core has been described before in Wielens (1987).

<u>Core</u> 4560'-4593'

The upper 3 metres of this core consist of coarse conglomerates. They overlie a 45m thick succession of green-grey, well indurated shales with interbedded sand- and siltstones.

The conglomerate contains both angular and rounded clasts of up to 15 cm. Part of the rock is clast-supported. Some of the angular clasts were still fairly soft during deposition, as is shown by their indentation. Thin section study shows that the clasts are composed of carbonate, rounded chert pebbles or greenish, weathered, vesicular, ophitic volcanics. One large very irregular clast has the appearance of travertine, with encrustation and enduration.

The matrix is a very fine shale, except in the areas protected by the corners of the angular clasts, where it is coarse sandstone. In the fine matrix, soft- sediment deformation by loading is evident, on a centimetre to decimetre scale.

The underlying succession is composed of laminated, very fine clastics, with fining upward sequences on a centimetre scale, and the occasional sand-pebble layer. Bouma DE sequences indicate a distal source for the fine material. Slumping and load deformation of the soft sediment has left its marks throughout. No evidence was observed of bioturbation.

5183'-5201'

A debris flow containing angular and rounded clasts of up to 7 cm forms the main part of this core. The clasts are suspended in a matrix of coarse unsorted sandstone. Thin section study indicates that both the clasts and matrix are composed of chert, carbonate and weathered vesicular, ophitic volcanics.

The paraconglomerate overlies fractured shales with some centimetre-thick interbedded sand-/siltstones containing, Bouma DE sequences and soft sediment deformation reflecting loading and slumping. No evidence was found for bioturbation.

Cuttings

This well contains a succession of sand-, siltstones and shales. The majority of the sandstones consists of clear quartz grains, with a milky quartz cement. There are some black grains of chert or other minerals. Near the top of the pre-Cretaceous section a large amount of (now) solid hydrocarbon is present. Samples were taken from unwashed cuttings and the bitumen picked for biomarker analysis, to determine if it compares to the Cambrian bitumens in the

Colville area. This bitumen appears to have been in a fluid state during the drilling.

The sandstone is well indurated, and fractures through the grains. Contrary to the Imperial sandstones, chert has not been observed as grain size component of the sandstones, although it is present in pebble size. The chert pebbles are of a milky white, brown or grey colour and always have a coarse, frosted surface. They also have a grainy appearance under the microscope. By comparison, typical Imperial Formation chert clasts are semi-glossy on their surfaces and appear smooth. The coarser sandstones are quite white in comparison to the Imperial sandstones. Round, frosted quartz grains are present throughout the succession. The siltstones and sandstones are micromicaeous, grey, and grade into each other. They also have a dull, matte appearance. Parts of the siltstone are brown, as if oilstained. It is unclear if these siltstones are cavings from overlying Mesozoic formations or not. They are frequent near the top of the pre-Mesozoic section, and the 'stain' may be related to the bitumens mentioned above.

Deeper down in the well, the siltstones are grey. There, some of the finer sandstones are porous, and break along the grains. Locally the sandstones contain what appears to be red garnet, almandine or pyrope. Some glauconite is present, but none of the plant remains mentioned on the Canstrat lithologs could be found. It is possible that the few scattered biotite flakes were mistaken for plant remains. Many of the siltstones and shales have a stained appearance. The main shale interval is grey, silty and micromicaeous. Much of the deeper sandstone is quartzitic, with some milky white to grey chert pebbles. Some of the shale, below 6000' depth, is greenish.

The dolomite interval at the bottom of the well is very similar in colour to the overlying clastic material: it is dark grey, but is has a glossy appearance, resulting from the crystal faces.

In general, the sandstones in this well are quite distinct from those typical of the Imperial formation, and are of unknown age.

Ogeoqeoq J-06

Comments: Dipmeter measurements around the unconformity are for the Cretaceous 20-SW, and for the pre-Mesozoic 15-SW. They are very variable on both sides of the unconformity; the calculated original pre-Mesozoic dip is 32-NW. Top of the pre-Mesozoic clastic succession is at 5865', TD 6034'.

Cuttings

The top of the sequence consists of a tight sandstone composed of white, rounded, clear quartz, well cemented by milky quartz, and fracturing through the grains. It differs significantly from the overlying, porous, Cretaceous sandstone. The underlying shales have a green or red colour and are silty. Deeper down in the well, the sandstone turns pink, and here and there grey, due to the increased black mineral content (biotite?).

The rock colours, composition and similarity to P-60, A-01 and C-38 suggest a Cambrian or Precambrian age.

QUARTZITE RIDGE AREA

The wells in this section are:

Akku F-14 Magak A-32

Atkinson H-25	Natagnak H-50
Atkinson M-33	Natagnak K-53
Eskimo J-07	Natagnak O-59

Akku F-14

Comments: No dipmeter logs nor core are available. Top of the pre-Mesozoic succession is picked at 4478', TD at 4996'.

Cuttings

The main rock type is dolomite, overlying shale-sandstone strata. The dolomite varies in colour from buff to light grey and is fine crystalline, tight. Some beds have a pinkish or light green colour. No fossils were found.

The clastic succession consists of black shales, black siltstone and coarse to fine sandstone. The siltstone is composed of dark, clear quartz and some black minerals, and is well cemented and tight. The sandstone is composed of rounded to sub-angular, clear quartz, cemented tightly by milky quartz and is in fact a quartzite of white to grey colour. Both the silt- and sandstone are glossy, and contain amphibole or biotite-like minerals. Part of the sandstone is stained red to yellow by iron inclusions in the cement. Lower in the core are interbedded shales; they are brick-red to yellow, with some green and black. The black shales may be younger strata, caved into this part of the well. Near the lower end of the core, the sandstone is very fine.

The colours in the shales and to some extent in the dolomite indicate a Cambrian or even a Precambrian age.

Atkinson H-25

Comments: Top of the pre-Mesozoic section is at 5916', TD at 5941'. Only core is available from this well, no cuttings, nor dipmeter logs. Samples taken below the depth of 5760 feet proved barren of dinoflagellates and spores.

Core

The Cretaceous is represented by a conglomerate with a few interbeds of sandstone of up to 1 m thickness. Both rock types are porous, and have a light-brown to grey colour. The pebbles vary in size from 2 mm to 3 cm, are well rounded, and composed of light to dark grey quartzite. The dip angle is a maximum 10 degrees.

The sub-unconformity quartzite is grey, with extensive horizontal and vertical fractures. These fractures are mainly filled by quartz, leaving some porosity. The vertical ones appear to have offsets of about 5mm, but the core is too broken up to be certain. Lower in the well, the fractures are less well cemented, and there the core disintegrates. The infill has a white-yellowish colour. The intact quartzite beds are up to 10 cm thick. Bedding dip angle varies from 10 to 40 degrees. The quartzite is composed of coarse to fine, clear, rounded to sub- angular quartz, tightly cemented by milky quartz. Pyrite crystals are present as an accessory. The propagating ripples, suspended pebbles, coarser beds, rapid grainsize variation in the quartzite beds, all indicate a high-energy depositional environment, and is likely of fluvial origin.

The appearance of the quartzite suggests a Cambrian or Precambrian age and a fluvial depositional environment.

Atkinson M-33

Comments: Top of the pre-Mesozoic section is at 6220', TD at 6327' depth. Dip direction of the Cretaceous conglomerate is 5-SW; of the quartzite 25-NW; the restored pre-Mesozoic dip is 25-NW.

Cuttings

The overlying Cretaceous conglomerate is composed of white, quartzose, rounded pebbles.

The pre-Mesozoic quartzite is tight, white and composed of angular to rounded, coarse, clear quartz, cemented by mainly-milky quartz. Pyrite crystals and a few dark minerals are the accessories, which are concentrated in biotite-like bands. Part of the siltstone is also composed of clear, white quartz, but is porous. Lower in the well, the quartzite contains a dark substance in the matrix and also as coating on the grains; this could be bitumen, coating the clear grains and giving the rock a grey colour. There is some porosity here, which could be explained by protection of the quartz grains by the "bitumen".

Core 6274'-6285'

The green shales and sandstones near the top of the core are laminated on a sub-millimetre scale and contain centimetre thick bands of sandstone. The shales are extremely bioturbated. The vertical and horizontal burrows are filled with a sandstone, which is composed of clear, rounded quartz grains. There has also been deformation after initial induration, as is indicated by small recemented fractures. Pyrite is abundant.

Lower in the core, the quartzitic sandstone layers can be up to 3 cm thick, and display crossbedding; the green colour has changed to grey, and the shales are less extensively laminated and bioturbated.

6313'-6327'

The quartzite succession in this core is typical of this area, consisting of coarse to fine, rounded to subangular sandgrains, with small, up to 5mm large pebbles, and thin bands of coarser grains containing a small amount of blue chert. Bedding angles varying between 45 to 20 degrees, and prograding ripples and high angle crossbedding indicate a fluvial origin for these strata. The many fractures form the only porosity. Pyrite is present in large quantities. No evidence has been found of solid hydrocarbon in this core, which originates from a level some distance below the unconformity; possible bitumen coating has been described above in the cuttings from this same interval.

Eskimo J-07

The pre-Mesozoic sequence in this well has been cored nearly continuously. It consists of basalts overlying carbonates, which will be described under the Chapter "Carbonates" in the Appendix.

The sub-Mesozoic unconformity sequence at 2715' (827m) depth is unique, and consists of 5 m thick, brown sandstone overlying a 70 m thick volcanic succession. The volcanics are an amygdaloïdal, aphanitic to porphyritic rock, or even an olivine basalt. The rocks are dark grey, with locally patches of green and red, caused by alteration. Zeolite minerals indicate a later hydrothermal phase. These volcanics overlie 8 m of brecciated and probably metamorphosed, pink to light grey dolomite.
The dolomite contains many stromatolites, and appears a bioherm. A tentative Precambrian age is suggested for this section.

Magak A-32

Comments: Top of the pre-Mesozoic section is at 4996', TD at 5160'. Dip values are so variable that they are useless. The Cretaceous in this well contains a 60 m thick, coarse, porous sandstone, composed of white quartzite grains. These grains are similar to those in the underlying quartzites.

Cuttings

The pre-Mesozoic consists of a light olive-green shale, overlying a white, porous, glauconitic sand- to siltstone. The quartzite is tight and composed of coarse to fine, clear, rounded to subangular grains cemented tightly by milky quartz. Pyrite crystals are present in both shale and quartzite.

Core 5004'-5024'

The top part is a bioturbated, olive-green, waxy shale with minor, thin, interbedded sandstone. This shale resembles the one described in Atkinson M-33, which appeared to be laminated. At the depths 5007' and 5007.7', fossil cones have been found in the shale, and have been determined by Fritz and Norford (1987, GSC internal report C-3-WHF-1987; C-3-BSN-1987; Wielens et al., in prep) as Saltarella, an Early Cambrian fossil. The sandstone interbeds are similar in appearance to the quartzites; they are white and composed of clear quartz, with milky quartz cement.

The underlying quartzite contains some intercalated, green shale bands similar to the one described for the top of this core. The quartzite itself is composed of coarse to fine, interbedded, clear quartz, with bed sizes in the order of centimetres. The grains range in size from sub-millimetre to a few millimetres. Bedding dips are very steep and vary from 80 to 60 degrees. There are some fractures. Locally, the coarser grained quartzites are porous, possibly due to leaching. In this well there are hardly any suspended pebbles, but the rocks still resemble a fluvial deposit in a high enegy environment, as is indicated by prograding ripples, rapid variation of grain size and high angle cross bedding. Some parts of the core have interbeds of green shale of up to a few centimetres in size, others contain thin laminations only. The green shale appears to be depositionally related to the quartzite.

The presence of Cambrian fossils has a profound bearing on the age of the quartzites. As has been described above, the shales appear to be closely related to the quartzites, and have locally laminations parallel to the bedding in the quartzites. This would point to an Early Cambrian age for both these shales and the quartzites. This is the first evidence that Cambrian sedimentation occurred in this area, and indicates the possibility of a Cambrian depositional basin here, separate from the one to the south on the mainland.

Natagnak H-50

Comments: Top of the pre-Mesozoic section is at 6335', TD 6402'. Dipmeter values are very variable. Mean dip value's for the Cretaceous conglomerate are 18-S, while the undelying quartzites also dip 18-S, indicating a reconstructed flat surface as original dip. Samples were collected from the conglomerate, between depths 6119-6127 feet, and from the quartzite, between 6388-6394 feet, for fission track dating.

Cuttings

The Cretaceous conglomerate is largely composed of material from the underlying pre-Mesozoic quartzites. There is also some sandstone, shale and green chert. Many of the grains in the Cretaceous sandstone are rounded. The sandstones contain many rounded pebbles.

The pre-Mesozoic, white quartzite is similar in composition to that in the Reindeer wells. It is a coarse quartzite, and contains unsorted, rounded and angular, clear quartz with smaller amounts of milky quartz, cemented by clear and some milky quartz. The quartzite is devoid of any porosity and contains pyrite crystals as accessory mineral.

Core. 6334'-6337'

This core straddles the pre-Mesozoic unconformity. The Cretaceous consists of a conglomerate interbedded with sandstone. The conglomerate is composed of rounded to sub-rounded quartzite and chert pebbles, which are of white, clear, green and light grey colour. Clasts range in size from a few millimetres to a few centimetres, and are cemented by a matrix of sandy and argillaceous material, with different degrees of induration. As a result, the state of the cores grades from disintegration to extreme induration.

Interbedded with the conglomerates are coarse sandstone beds of a few decimetres in thickness, composed of quartz and chert grains. A large fraction of matrix, sandstone and pebbles in the conglomerate was derived from the underlying sub-unconformity quartzite.

The sub-unconformity quartzite is described below.

6364'-6402'

The quartzite is well indurated, white to light grey, with a few interbedded thin, greenish, argillaceous bands of a few millimetres in thickness. Pyrite, found mainly in the green argillaceous bands, and other, small, unidentified pink and black rounded minerals are accessories.

The grains in the quartzite vary in size from sub-millimetre to commonly a few millimetres, and are composed of clear to somewhat milky quartz. Vertical, recemented fractures, which show evidence of leaching, cut across the bedding. Locally, rounded quartz pebbles of up to 5 millimetres in size, are suspended in the poorly sorted coarse matrix. Sedimentary structures are high angle crossbedding and prograding ripples (depth 6369', angle about 30 degrees). Bedding size ranges from a centimetre to a decimetre scale, and the grain size grades more or less from fine to coarse inside the beds, changing abruptly only where an argillaceous layer is present. Leaching formed some porosity in a few of the coarser-grained beds.

The environment of deposition appears fluvial, as is indicated by the crossbedding, prograding ripples, and absence of sorting as in a high-energy environment.

Note: no green chert has been observed in the quartzite.

<u>Natagnak K-53</u>

Comments: No dipmeter was run. Top of the pre-Mesozoic section is at 5550' depth, TD at 5747'. The sequence was assigned an Imperial age by Can-Strat, but has an abnormally high gamma ray log response. No evidence has been found for a thin, 1 m thick dolomite indicated on the litholog.

<u>Cuttings</u>

The succession consists of interbedded shale, silt- and sandstone, with siltstone as main component. The siltstone is composed of clear quartz grains, cemented by quartz and has a low porosity. The sandstone is well indurated and consists of slightly milky, clear, coarse quartz grains and some dark grey minerals, tightly cemented by quartz. Some of these quartzites are clear, white-grey, others are dark. Their grains are rounded to angular. Fractures cross through the grains, and the resulting fracture plane has a glossy appearance. These fractures are dark coloured, due to the presence of black minerals (hornblende or pyroxene?). The same is true for the siltstones. The shale is green grey. Except for the shale, these rocks are very dissimilar to typical Imperial strata.

NATAGNAK O-59

Comments: Top of the pre-Mesozoic section is at 2101.5 m, TD at 2120 m. The dip direction is 5-E in the Cretaceous conglomerate; and 5-N in the quartzite; the restored pre-Mesozoic dip is 7-NW.

Cuttings:

The cuttings are identical to those in Natagnak H-50, both above and below the unconformity, except that the content of milky quartz grains and cement is higher.

Core: 2101.3-2101.9m

As in Natagnak H-50, the Cretaceous conglomerate is in various states of disintegration. Green or yellow pebbles comprise the bulk of the rock. Some black clasts are shale, and others chert. The pebbles measure are up to 15mm. Glauconite grains and pyrite crystals are accessories in the matrix material.

The sub-unconformity quartzite is composed of well indurated, white to light grey quartz grains, ranging in size from sub-millimetre to generally a few millimetres. It is similar to the quartzite in Natagnak H-50, but contains somewhat more milky quartz. The pyrite crystals are again concentrated in the greenish argillaceous bands present, some of which appear stylolitic. Prograding ripples represent the sedimentary structures, as well as some fining upward sequences, and cross bedding. Abrupt changes in grain size to coarser material can be observed in high angle cross bedding laminae, which are cut by bands with larger grains. This suggests that the environment of deposition was fluvial.

The rocks are very similar to the strata in the Natagnak H-50 well.

2. CARBONATE WELLS

Wells penetrating carbonates in the study area are described below. Most of the wells are from the area northwest of the Quartzite Ridge. Some wells are dominated by limestone and others by dolomite; therefore they are grouped according to their composition and in alphabetical order according to the well name.

LIMESTONE GROUP

The wells in this group are:

Atkinson A-55	Pikiolik E-54
Mayogiak J-17	Tuktu O-19
Mayogiak M-16	

Atkinson A-55

Comments: No dipmeter was run; top is picked at 6766', TD is at 7325'. The core was sampled to obtain conodonts between the depths 7305' and 7325'; unwashed cuttings between 6770' and 7300'.

Core 7305'-7325'

The rocks are dark grey to black, mottled, nodular, heavily fractured limestone with locally developed dolomitization. The nodules are grey, the matrix is black, similar in appearance to those in Tuktu O-19. Some of the nodules are rounded, others angular with a brecciated appearance. Surfaces, which have an apparent dip of about 45 degrees, are coated heavily with solid hydrocarbon. It is not obvious if these surfaces represent the bedding planes or fractures, but as calcite spar fills a set of fractures (which were formed in two generations) a beddingplane is the most likely explanation.

As fossil material, there are small, calcite-filled fossil imprints of brachiopod shells, and abundant pellets; other fossils are poorly preserved, precluding determination. Usually they have a circular outline, giving the impression of Amphipora, Thamnopora, Crinoidea ossicles with one central canal, or Scaphopods. Stylolites are present.

Cuttings

The succession consists of mainly dolomitic limestone with minor limy dolomite. Near the top of the succession is a pelletal limestone, with dark grey pellets and a light grey matrix. Present over a large interval are rounded, clear quartz grains, embedded in a dolomite matrix; locally they are quite numerous. Rounded, clear quartz is also found separately, as well as a few brown and black rounded chert pebbles. There is one thin layer composed of clear quartzite with glossy fracture, and a sandstone with mainly dolomite as the cementing matrix. Locally, light green, indurated shale can be found.

The dolomite is micritic to fine crystalline and varies in colour from white to black. It also contains a fair amount of rounded quartz grains at several levels. The quartz ranges in size from fine to coarse; free grains are frosted.

The limestone is micritic and dark grey. There are hardly any recognizable fossils in it. (All samples were checked both dry and wet for fossils). At 7030' depth, the indistinct remains of bivalves, ostracods or sponge spicules have been found. The only pyrite observed was a fossil tube.

The carbonates appear to contain some fossil remains, which would indicate a

Paleozoic rather than Proterozoic age. The sandstone and quartz content is anomalous and reminds of the Sandy Marker as described by G.K. Williams (pers. comm., 1987) for the base of the Mount Kindle or Delorme Formations. Should the sand in this well correspond to that marker, the limestone could correspond to the Tatsieta limestone. On the other hand, the sand could be a local phenomenon, and the limestone be related to a facies transition.

Mayogiak J-17

Comments: No dipmeterlog is available; the top of the pre-Mesozoic is at 9372', TD 12094'. Samples were taken at the depths 9371', 9375', both of Cretaceous age, for Rock-Eval; at 9533-9610 and 10596-10602 feet for conodonts; at 9638, 9681, 9686, 9813 feet for Rock-Eval.
The carbonate in this well is considered to be Landry Formation, but some aspects are atypical of the Landry.

Core

General remarks about the cores. The cores are mainly limestone, but contain some dolomite. The limestone is black to very dark grey, locally dolomitized, but the few fossils are still recognizable. The depositional environment was low-energy and anoxic, and in a location, where coral rubble etc, collected. A black, powdery, coaly material is present in several intervals and may be bitumen. Compared with Landry and Hume Formations on the mainland, this core resembles more the Hume than the Landry Formation, except that the thickness is far too large for the Hume. The presence of crinoidea ossicles with two to five central canals, dates this succession as Emsian (Landry Formation). The limestone itself is a micrite. Dips range from 45^{o} near the top to about 15 degrees deeper in the well. Mottling in the core is caused by dolomitization, and although this process is considered a result from bioturbation, very little other evidence has been found of bioturbation.

Fracturing occurred in two distinct phases; the first set was filled by calcite and was later offset by the second set of fractures, and/or contorted to an enterolithic shape.

In comparison to the adjacent mainland, the presence of a dolomite near the contact with the Hume Formation is anomalous; however, this phenomenon has been observed in the Mackenzie Mountains.

9366'-9383'

The uppermost core is a limy, grey to brown-grey and micritic dolomite. Calcite fills the fractures, of which the steeper ones are offset by a younger, second set, oriented nearly horizontally. Some centimetre-scale banding and fossil ghosts are present in the more limy parts. In the banded succession, the bedding dip is about 45 degrees. The fossil remains have the appearance of, and originate probably from digitate stromatoporoids. Parts of the dolomite are brecciated.

9490'-9520'.

This limestone core is mottled by dolomitization. Bedding dip is about 45^{o}; brecciation is evident. The limestone is black and micritic, and may be laminated locally; the dolomite is grey and fine crystalline to micritic. Fractures are filled by calcite spar.

Identifiable fossils are Amphipora, Thamnopora, Alveolites, Stachioides and brachiopods. There are only few stylolites. At 9503' depth, the limestone is brecciated, with the clasts suspended in a sandy to silty matrix. Laminations in the clasts are partially destroyed by bioturbation. Evidence of a submarine hardground is visible at the 9507′ level.

9522′-9552′.

This core consists of limestone with mottling, and the bedding/banding dip angle is 45^{o}. Parts of the core are brecciated; the fractures were filled by calcite spar and later offset by a second phase of fracturing. Some intervals in the limestone are fossil-rich, and have the appearance of bioherms, although the depositional environment was probably to deep for formation of bioherms. Debris flows from more elevated carbonate banks are considered a more probable origin for the observed accumulation of bioclastic material. Among the fossils in this black limestone are bulbous Stromatopora, Thamnopora, with small sized Amphipora as the most abundant.

9552′-9582′.

This core is a black, micitic limestone, with a few brecciated dolomite beds, and a bedding dip of 45 degrees. Calcite filled the vertical fractures, which were offset by a second set of fractures. The same fossils are present as described in the core directly above, although less abundant; additionally, crinoid ossicles with double central canals have been observed. A portion of the limestone has been altered to a micritic dolomite, which was later brecciated; it contains a few stylolites and laminae.

The top part of this core appears to represent a deeper depositional environment, as reflected by the presence of crinoidea, plus some tabular stromatoporoids. The crinoidea indicate an Emsian age for this interval.

9582′-9632′.

This core is again a black micritic limestone, with a bedding dip of about 40^{o}, and fractures filled by calcite and/or pyrite; locally the rock is brecciated and pyrite and sand/silt fill part of the fractures. The pyrite bands in this breccia is closely associated with black limestone clasts, appears to have been broken together with them, and was later overgrown by a younger generation of pyrite. Part of the matrix in the breccia is laminated. It was deformed by slumping, while still in a plastic stage. The few fossils present, gastropods and crinoidea ossicles with twin central canals, are suspended in the mud matrix. Slickensides are present and coated with highly reflective material, possibly graphite.

9634'-9656'.

The core is a black, fractured, micritic limestone, containing the same type of fossils as to those described in the cores above: Amphipora, Thamnopora, Alveolites, Stachioides, brachiopods and crinoidea ossicles with twin central canals. Fractures in this otherwise featureless rock are partially filled by bitumen.

9659'-9675'.

This core is similar in general description to the core described above, with gastropods, Amphipora, Thamnopora, Alveolites, Stachioides, brachiopods and crinoidea ossicles with twin central canals, suspended in the micritic limestone, and extensive fractures, which were cemented by white calcite.

9675'-9705'.

This core comprises a black, micritic limestone succession as described in the core above, with gastropods, Amphipora, Thamnopora, brachiopods, and in addition encrustation of Alveolites on Stachioides. Large size coral fossils are present. The bedding dip is about 20 degrees.

9787'-9817'.

The core consists of black, micritic limestone, which is similar to the one in the core above, with the exception of a white, laminated limestone breccia of probably allochtonous origin at one depth interval. The slight mottling locally is caused by alteration to dolomite. Fossils are gastropods, Amphipora, Thamnopora, Alveolites, Stachioides and brachiopods.

10321'-10347'.

The core is a dark grey, crinoidal, grain-supported limestone sand, with nearly horizontal bedding. Apart from the crinoidea, a few large corals are present. Crinoidea ossicles may have one, but usually do have two central canals. There are a few large brachiopods. The rock colour is less dark than in the previous cores. Part of the fractures has been filled by calcite spar.

10596'-10602'.

The core consits of black, micritic, crinoidal lime-mudstone, with a nearly horizontal bedding dip. No other fossils have been observed. The rock is fractured, and the resulting space has been filled by calcite spar.

10940'-10947'.

This interval contains again a black, micritic limestone with a few brachiopods and crinoidea suspended in the mud. The bedding dip is nearly horizontal. The few fractures have been filled partialy by calcite spar.

11238'-11251'.

The core is a slightly dolomitic, micritic, black limestone, riddled with vertical fractures, some of which are filled by calcite, some are open; part of the fractures were offset by a younger generation. The only fossils are a few gastropods.

11499'-11521'.

The top of the core is a dolomitic, micritic, black limestone, the bottom part a grey dolomite. Stylolites have increased dramatically in number as compared to the cores above; there are also vertical fractures, offset by a second set of fractures, and all of them were cemented by calcite spar. Amphipora is present in the limestone, and remains also discernable in the fine crystalline dolomite, where it is less extensively dolomitized than the surrounding matrix. Lower in this core, the fossils have been leached out and were replaced by calcite. The bedding dips about 15 degrees.

12070'-12093'.

The rocks consist of light grey dolomite. Amphipora remains are still recognizable. Vertical fractures, cemented by calcite, are present. The bedding dips 15 degrees. Lower in the core, the dolomite has laminations, cryptalgal structure and also fenestrae, although not of the bird's-eye type. There are also vertical cracks visible in the fenestrae, that are associated only with them; they have been described by Shin (1983) as Stromatactis. In one interval of the core, remains of Amphipora can be observed. The matrix rock is a micritic, mottled dolomite. A submarine hardground is visible at depth 12086'.

Cuttings

The cuttings do not nearly render as much detail as the cores. The only additional information is the presence of Tentaculites, especially in the black micritic limestone, where no other fossils are present. One of these Tentaculites was found between 11270-11280 feet depth and has been identified as Nowakia richteri Boucek & Prandl, of Upper Emsian age, - Serotinus zone in conodonts (W. Norris, 1987; pers. comm).

Mayogiak M-16

Comments: A dipmeterlog was not run. Top is picked at 2866 m, TD is at 3093 m. Samples for geochemical analysis were taken at the depths of 2850, 2920 and 2990 m; for conodonts between 2866 and 3005 m in the dolomite and between 3005 and 3093 m in the limestone.

Core 2887.3-2894.3m.

The core consists of brecciated, micritic, light grey to buff, limy, and locally laminated dolomite with a bedding dip of about 30^{o}. Many stylolites, both vertical and horizontal, and fractures are present. Ghosts of fossils, Crinoidea or Amphipora, with a central canal, a brachiopod and a fenestral texture are visible. Some fracturing occurred right after the first induration, resulting in angular, platy fragments suspended in the mud matrix, especially in the laminated, fenestral parts.

Cuttings

The cuttings are from a micritic to fine crystalline, locally sandy/silty, dark grey to buff coloured dolomite. There are a few small, rounded grains of clear quartz, some cemented in a pyrite matrix. Rounded, black chert pebbles are very rare. In the dolomites, a few shaly beds are intercalated (they cannot be caved, because the casing shoe was set in the overlying dolomite), consisting of dark brown to black, greasy shale, which may have source rock potential. These rocks are slickensided.

Below 3005 m the dominant rock type is a grey, argillaceous, pyritic and dolomitic limestone. At 3020 m a Tentaculitoid and possibly a brachiopod fragment were found in this limestone plus some Crinoidea ossicles with a single canal and probably Amphipora, in addition to stromatoporoidea fragments. A sponge fragment, Cheatetes (A. Pedder, 1987; pers. comm.), indicates an age range for the rocks from U. Ordovician to Permian.

Although no detailed fossil ages are available, an age close to Emsian appears likely, on the basis of lithological and faunal comparison with Emsian rocks in nearby wells.

<u>Pikiolik E-54</u>

Comments: Top is picked at 8987', TD is at 10230'. Dipmeter readings for the Cretaceous are 6-10^{o} NW, for the Pre-Mesozoic 14-36^{o} NE. If the post-unconformity surface is rotated back to horizontal, the resulting pre-unconformity or original pre-Mesozoic dip is about 23^{o} NE. Cores, on the other hand, appear to have a horizontal dip. Core samples were collected for conodont dating of the crinoidal interval (9048-9078 feet), and from the corals at 9101, 9102 and 9102.3 feet. For maturity analysis, brown shale cuttings were sampled from the Devonian interval at 9280'-9300', and the Cretaceous between 8970' to 8980' for Rock-Eval. The Devonian shale could be caved material.

<u>Core</u> 9048'-9108'.

The core consists of dark grey, micritic limestone, somewhat mottled by dolomitization. The upper part is a crinoidal wackestone, the bottom part contains a large number of corals and stromatoporoids. Fractures have been cemented by calcite spar; the oldest set was later offset by another generation. The bedding appears to be horizontal. The few slickensides are covered by graphite-like material. In the crinoidal intervals, the crinoid ossicles generally have two to four central canals, which indicates an Emsian age. This age is corroborated by coral fossils lower in the core. Other, less abundant fossils are Tentaculites, brachiopods and stromatoporoid fragments. Part of the fossil-rich limestone is a grainstone, but generally the fossils are suspended in the mud matrix.

Stylolites are present, at a frequency of about one per every 5 cm depth. Some of the vertical, calcite spar-filled fractures grade into horsetails. Black bitumen covers part of the fracture surfaces. Locally, sandbeds and breccias with rounded to subrounded clasts can be found in the sequence. At depth 9085', there is an abundance in fossils; this may represent a bioherm, although a debris flow is a more probable explanation for its origin. Some of these fossils are in direct contact, forming a grainstone, but most are suspended in the mud, forming a wackestone. At this level, a breccia composed of dolomitic material contains some cryptalgal lamination and a fenestral texture, although bird's-eyes are absent. Amphipora and Alveolites are the major fossils here, especially in the sandier parts. Part of the stromatoporoids are encrustions on the Alveolites, while others are large, bulbous stromatoporoids. Other fossils are Rugosae (Favosites) and Spongonaria, which is approximately time-equivalent to the crinoidea with twin-canal ossicles and indicates an Emsian age (A. Pedder, 1987; pers. comm).

The environment appears to have been deeper during deposition of the top part of the core; nevertheless, the black micritic muds in the complete interval indicate too deep an environment for in situ deposition of the corals and stromatoporoidea.

Cuttings

Notable are the small quantities of chert in the dolomite present below 9300' depth. This dolomite is light or dark grey, and micritic.

The lowermost carbonate is a black, micritic limestone containing Crinoidea, Tentaculites and Amphipora. The Crinoidea ossicles have one, two, or four central canals, indicating an Emsian age.

In overview, the section contains from top to bottom a crinoidal limestone, a dolomite and another crinoidal limestone, with a total penetration of over 300m. The complete interval has an Emsian age. Pedder (1974b) describes in detail the corals mentioned above.

Tuktu O-19

Comments: Top is picked at 7215', TD is at 7597'. Dip of the Cretaceous surface is 6-NNW; of the pre-Mesozoic 18-ESE, the reconstructed pre-Mesozoic dip is 15-SE. Pedder (1974a) described a Spongonaria, of Lower Emsian age, in the core from this well. The core has been sampled for conodont dating, between 7352 and 7371 feet depth.

Core 7350' - 7390'.

The core consists of black micritic limestone with some mottling from dolomitization. Several types of fossils are present: corals, such as

Favosites; Alveolites, bulbous stromatoporoids encrusted on Favosites, Amphipora, Tentaculites, Crinoid ossicles with one, two or four central canals, and pelletal material. Locally the Amphipora is grainsupported, but usually the fossils are suspended in the limemud matrix. There are two generations of fractures; a portion of them are filled with a limestone breccia in a dolomitized sandy matrix. There area a few limestone bands with a lighter colour, indicating a bedding dip of about 15^{o}. These bands may display a vague fenestral texture. The limestone can be rubbly, comprising a black matrix and slightly lighter nodules, which contain fossils. This appearance may be the result of bioturbation. Dissolution generated stylolites and a few vugs, which show evidence of leaching at their tops and locally geopetal sediment at their bottoms

Vertical burrows, smaller than 1cm, are present. All of them are cemented by calcite spar; in the burrows the spar is a clear or milky calcite with a pelletal appearance. This core is very similar to the one described for Pikiolik E-54, except for the more pelletal character and the burrows, all of which indicate a somewhat shallower environment of deposition.

7582'-7597'

This core consists of dolomite with a minor amount of limestone, both rock types very brecciated. The bedding appears to be horizontal or vertical; the vertical dips may represent the bedding in larger, tilted debris blocks. The 'vertical' clasts are up to 1 m in size and give the impression of internal, algal lamination. The clasts are angular and composed of grey dolomite, or green, red, brown or grey limestone. The matrix of the breccia contains a large amount of pyrite and argillaceous material, and is dolomitized. The middle section of the core, is a less disturbed interval. This undisturbed part is laminated and has soft-sediment deformation structures, caused by loading.

The algal lamination indicates a shallow marine origin for these dolomites. Part of the calcite spar has an anhydritic appearance, and may represent a replacement process.

Cuttings

The cuttings did not yield any additional information.

In overview, the penetrated succession consists of a limestone-dolomite-limestone succession, with several indications for a shallow depositional origin.

DOLOMITE GROUP

The wells in this group are:

Akku	F-14	Kimik	D-29	Pikiolik	G-21
Atkinson	L-17	Louth	K-45	Pikiolik	M-26
Eskimo	J-07	Mayogiak	L-39	Tuk	M-09
Imnak	J-29	Natagnak	K-23	Wagnark	C-23
Kannerk	G-42	Nuna	A-10		

Akku F-14

Comments: Top is picked at 4478, TD is at 4996 feet. A dipmeter log was not run. Samples for conodonts were collected between the depths of 4500-4600, 4600-4700 and 4700-4800 feet in dolomite.

Cuttings

The rocks consist of a buff to pink, fine crystalline dolomite with a few laminations, some of which are curved and contain pyrite and fenestrae. Interbedded are greenish, indurated shales with a phyllitic appearance and indurated, brick-red shales, which grade into pink dolomite. Locally, below the 4640′ level, the dolomite colour changes to dark grey. Coarse, white dolomite spar occurs as fracture filling, and a little buff-coloured chert is present, but in substantial smaller quantities than the pyrite. At 4750′ depth, a quartzitic layer, containing pyrite and biotite, can be observed. Below that level dolomite is present and appears to grade more and more into quartzite to lower depths. Near the bottom of the dolomite succession, the clear quartz grains are suspended in the carbonate, in a transition zone. This dolomite and shale succession is similar to Proterozoic rocks exposed in the Campbell Uplift (M.P. Cecile & L.S. Lane, pers. comm. 1987).

The colour of the red and green shales and the pink dolomite point to a Cambrian or Precambrian age. The quartzitic clastics would be anomalous for younger Paleozoic formations.

Atkinson L-17

Comments: Dipmeter data indicate for the Cretaceous a dip of 2-SE, and for the Paleozoic 20-W; the reconstructed pre-Mesozoic dip is 22-W. Top is picked at 2331.5, TD 2480 m. Sampled from the core for conodont dating were the following intervals: 2337.0-2340.6 m, 2340.6- 2344.4 m, and 2344.4- 2350.2 m; unwashed cuttings were not available.

Core 2337-2350.2 m

The rocks are a mottled, light grey dolomite, which is fractured and locally oil stained. Ghosts of indistinct fossils can be observed.

At 2338.5 m depth, pellets are recognizable, which indicate a bedding dip of about 30 degrees. Below 2339.0 m, the dolomite is a yellowish grey, micritic mudstone, where soft sediment deformation by fracturing occurred right after the initial induration. Ten centimetres deeper, spar filled fossil imprints resembling Amphipora are present. At 2339.25 m depth, remnants of fenestrae are visible, and pellets at 2340.0 m. Vugs are small and may be filled by dolomite spar. At the 2341.15 m level, possible crinoidea can be observed. At 2341.75 a breccia/debris flow, overlies a layer of dolomite with what is possibly a bulbous stromatoporoid. The matrix consists of dolomite sandstone, and broken pyrite bands, which were later overgrown by new pyrite. At 2342 m depth, Amphipora-like fossil remains are present, underlain by laminated dolomite with apparent fenestrae at 2342.25 m. At the 2344.4 m level a gastropod has been found.

The extensive fracturing throughout the core shows some offsets, indicating a two stage generation, with recementation by white spar dolomite. There are only a few stylolites.

2411.5-2413.2 m

This core is composed almost entirely of light buff, well indurated claystone, heavily fractured and slickensided, locally even brecciated. The bedding appears to dip about 30 degrees, but is very indistinct. Parts of the rock are laminated. Intercalated in the shale is one 10 cm thick, dark grey, brecciated dolomite containing a crinoid with a single central canal. Attempted breakdown of the claystone for microfossil separation was unsuccessful.

Cuttings

The cuttings are mainly caved shale and mask the dolomites. The dark grey dolomite is fine crystalline; the light brown dolomite is micritic. Pyrite is present in thin bands. There are a few clear quartz crystals in addition to rounded, clear, and yellow to red, frosted quartz grains. The dolomite spar occupies a large percentage of the total rock, is clear to milky, varies from fine to coarse crystalline, and fills vugs and fractures. One vague imprint of a shell was found. Chert is absent in this well. Near the bottom of the penetrated succession, the dolomite crystals become coarser.

In general, the section consists of dolomite with a few intercalated layers of claystone. There is a small amount of pyrite present, but no chert. Much of the rock is fractured. The depositional environment appears shallow at some levels, but was possibly deeper in general. The fossil ghosts indicate a Paleozoic age, whch may be possibly further restricted to Devonian.

Eskimo J-07

Comments: Top is picked at 2714', TD 2971'. No dipmeter was run. There are core samples only. The bedding dip is about 20 degrees. The rocks were sampled for conodonts between depths 2945-2954, 2954-2963, 2963-2971 feet; for geochemistry between 2955-2968 feet; the basalts for X-ray analysis.

Core 2760'-2770', 2849'-2892', 2905'-2971'.

A 70m thick sequence of basaltic rocks which were hydrothermally altered in varying degrees, overlies dolomite.

The dolomite is a dense, partly mottled, partly laminated, fine crystalline, grey to orange/pink rock with some solid hydrocarbon (black, soft) in vugs. The rock contains numerous stylolites and brecciated parts, and is recemented in many places. A large fraction of the dolomite is stromatolitic. These fossils have not been described before in this core, although they are visible even on the outside of the core (Plate I). Many of the stromatolites appear to be in growth position, and are usually associated with pink coloured laminae. Plate I shows one which is branching passively; the lack of active branching and walls prevents determination and thus dating. The specimens range in height from 5 to 15 cm. Near their bottom, laminations with fenestral textures can be observed. In the few vugs, after a first pink/red dolomite spar coating, white dolomite spar fills the space and is in some of the vugs followed by nearly clear quartz crystals. Inside the stromatolites, the vugs have an elongated shape, while in the matrix between them the shape is more or less rounded. Spar filled fractures are offset by a younger, uncemented generation of fractures. The dolomite in the matrix surrounding the stromatolites has a sandy to silty texture. There is also evidence of leaching, in spots where the dolomite has a sandy and vuggy appearance. These leached dolomites are cut by the last generation of fractures, and not by the first. Brown, clast-like pebbles are included in the sandy parts. The possibility that the leaching is caused by weathering in organ pipes should be considered.

Contact metamorphism on a small scale can be observed near the contact with the overlying volcanics. The dolomite there is generally orange to red, has a marbly, brecciated appearance and contains large amounts of pyrite. Deeper in the succession, many of the fractures are coated or filled with a graphite-like, black material, which may be bitumen. Especially the laminated dolomite contains black spots, possibly the same material. Part of the dolomite breccia has rounded, laminated clasts floating in a pinkish, sandy matrix.

The dolomite is largely composed of stromatolites, suggesting a biostrome or bioherm. The spotty orange colour observed in the dolomite, varies from a pebbly appearance to an indistinct shape fading into the surrounding grey dolomite.

Based on the character of the stromatolites (see text), a Precambrian age for these dolomites is likely, and could be expected with regard to the age of the overlying basalts. These volcanics were altered too much to be able to give a reliable absolute age date with the K-Ar method. Fission tracks may contain the only clue to their age. At present, the age constraints range from Precambrian through Middle Paleozoic, if ages of volcanics in the neighbourhood are considered indicative.

Imnak J-29

Comments: Top is picked at 10840', TD is at 11170'; no dipmeterlog was run; no core is available. Samples were taken for conodonts between 10860-11170 feet in dolomite.

Cuttings

The dominating lithology is a sucrosic, fine crystalline, mottled dolomite, composed of a mixture of white and black dolomite crystals, with a resulting dark grey total colour. There are hints of fossil ghosts. Accessories are pyrite and rounded, frosted, clear quartz grains, some of which are embedded in dark brown shale, as can be found in post-Paleozoic formations. Broken quartz crystals are present also. Although some of the shale in the samples is fairly indurated, it is unclear whether its origin is from cavings, or if it actually belongs in the dolomite sequence. The small amount of white to clear dolomite spar is probably fracture filling. Rounded chert pebbles or grains, and grey chert are rare. Below 11130' depth, the dolomite colour changes gradually to lighter buff, and shows a slight increase in crystallinity.

The complete succession is a dark grey, sucrosic dolomite with possibly a few black shale beds, and may be of Paleozoic age.

Kannerk G-42

Comments: No dipmeter log was run. Top is picked at 7832'; TD is at 8138'. No samples were taken for conodonts, due to the abundance of shale.

Cuttings

The rocks form a succession of indurated shales and dolomites. Both vary considerably in colour. The main colour is light green, but it may range from brick-red through pink to light green and even white, while locally dark grey cuttings are present. The shales, in addition, can be purple.

The dolomite is fine crystalline; the shales have a phyllitic appearance. Locally, rounded, clear quartz grains can be found in the red shales; thin bands and nodules of pink dolomite may be intercalated. At some levels, the dolomites grade into finegrained marls. A few well rounded, black chert pebbles have been observed. Near the TD, the amount of well rounded, clear quartz grains increases. Pyrite can be found throughout the section in small quantities.

The rock colours point to a Cambrian (Saline River) or Precambrian age, the latter being more probable, because of the fairly intense and wide range of colours.

Kimik D-29

Comments: No dipmeter was run; top is at 8470', TD is at 8720'. Samples were collected for Rock-Eval at 8466' and 8476'. The carbonates were sampled from the core for conodonts between the depths 8602-8613 and 8613-8624 feet, and from the unwashed cuttings between 8480-8720 feet.

Cores 8463'-8482'.

Of this core, straddling the pre-Mesozoic unconformity according to the wireline logs, the lower dolomite interval was not recovered. It consists of dark brown shale and a chert pebble conglomerate near the contact. The shales were dated by Brideaux (1975) as Late Jurassic.

8536'-8558'.

The top of this core interval consists of interbedded, laminated and fractured, light grey sand-, siltstone and shale. Laminations are in the order of millimetre to centimetre size, and represent a succession of shale and sandstone layers, all of which are fining upwards but have fairly sharp boundaries at top and bottom. The shales have flame structures. Other deformation is by fractures, which did offset the laminations after initial induration. There is no evidence for bioturbation. Below 8545' feet depth, the sandstone beds increase in thickness to over 10 cm. These sandstones overlay a brecciated debris flow of sandstone and shale clasts.

A 1 m thick dolomite bed is present below the 8550' level. It is light grey, mottled and fine crystalline. Fractures are abundant and cemented by a small amount of calcite and mainly dolomite spar. Underlying the dolomite is another very soft, unconsolidated sand/shale bed.

This sequence of poorly consolidated clastics in the carbonate succession is anomalous, and is not found in the formations on the Northern Interior Plains.

8602'-8624'

This core consists of a fine crystalline, heavily fractured dolomite with a few stylolites. Some of the fractures are offset by a younger generation. The bedding dip is about 30°. There are indications of fossils, possibly brachiopods and crinoid ossicles with only one canal. Porosity is visible in the form of pinpoint vugs. The dolomite is partly laminated, and grades into featureless carbonate due to bioturbation. The rocks give the impression of an original deposit of sandy and muddy limestone. At the 8615' level, both pelletal structures and fenestral pores are present. Below this depth, the dolomite is laminated with locally indications of crossbedding, giving again an overall impression of a carbonate sand/mud depositional environment. Some sponge spicules have been observed.

Cuttings

The penetrated succession comprises a dolomite with an interval of about 10 m of sand/siltstone and shale beds. Fossil remains are present at the 8500' level and include Scaphopods, an indication for a marine environment. The fine crystalline dolomite ranges in colour from pitch black through grey to light buff, with as main colour grey. There are some rounded, frosted, clear and red quartz grains present. Black chert pebbles are well rounded. They are usually associated with caved, brown shale, and therefore were probably derived from Mesozoic formations. Some pyrite is present. Dolomite spar fills vugs and fractures.

The sandstone consists of a quartz matrix and some larger, up to 1 mm size, rounded, frosted quartz grains; the siltstone is also composed of quartz grains.

In general, this section of mainly dolomite contains some marine clastics. Fossil ghosts point to a Paleozoic age. There are several indications for a shallow depositional environment. The clastic interval is anomalous, and not found as such In the Northern Interior Plains nearby. It may relate to the Sandy Marker (Williams, pers. comm., 1987), and/or could be of similar age as the clastics desribed in Atkinson A-55.

Louth K-45

Comments: No dipmeter log was run. Top is picked at 6947', TD is at 7274'. The rocks were sampled between 6970-7270 feet for conodonts.

Cuttings

The overlying Cretaceous conglomerate contains pebbles derived from the Quartzite Ridge!

The pre-Mesozoic succession consists of dark grey to buff, fine to medium crystalline dolomites with spar infill in vugs and fractures, and minor pyrite and other sulfides as accessories. A large fraction of the spar is reddish to orange coloured and coarse crystalline. A few marly, thin beds of pinkish colour are present. Deeper down, below 7000' depth, some of the dolomite itself is pinkish along hairfractures. Brown, well rounded chert pebbles are rare. Below the 7100' level, the pink or rather flesh coloured (as Prisma colour pencil #936) dolomite increases considerably in quantity, and alternates with yellowish beds, in which the dolomite is finer crystalline. A few cuttings show evidence of slight leaching. Fossil shading, as is mentioned in CSS lithologs, has not been observed.

The pink colour of the dolomite may point to a Cambrian or Precambrian age. No other age indications are available.

Mayogiak L-39

Comments: Top is picked at 14517', TD is at 14589'. No dipmeter log, only the electric wirelinelog is available for this interval. Canstrat indicates on the litholog a dolomite below 14516' feet, while D. Myhr mentions in an internal GSC well-history report "no evidence at all for Paleozoic." Due to the abundance of caved younger shales this well was not sampled for conodonts.

Cuttings

The actual rocks of the pre-Mesozoic interval are masked by extremely heavy caving, but there are a few coarse crystalline, light grey to white dolomite cuttings, some of which appear to be leached or rounded off. They are of questionable value for a rock description, but contradict D. Myhr's statement quoted above. Part of the dolomite consists of white and black grains mixed together, giving the rock a grey appearance. No chert has been observed in these samples.

Based on this information, any age estimate other than pre-Mesozoic, is impossible.

Natagnak K-23

Comments: Top is picked at 4875', TD is at 4977'. The dip for the Cretaceous is 6-E; Paleozoic 45-NW(?); the reconstructed pre-Mesozoic dip is 50-SW. The core was sampled for conodonts between the depths 4954-4965 and 4965-4977 feet, and cuttings between 4900-4970 feet.

Core 4954'-4977'

The rocks are a micritic, laminated, light grey, foetid, limey dolomite. The laminae in the dolomite are usually white to buff in colour, but may be dark grey, and have an algal appearance. The darkly coloured and less disturbed laminae are quite limy. Between the laminae, sandy grains can be observed. Stromatactis, vertical desiccation cracks in the laminae, were cemented by calcite, probably soon after deposition. There are many bird's-eye fenestrae. The bedding is indicated by the lamination and dips about 40 degrees. At 4965' depth, the laminae are deformed into enterolithic folds. Otherwise, the lamination can be very straight, or wavy with radii of 3-5 cm. Pellets are present in the mudstone part of the dolomite. The dolomite infill spar may have the appearance of anhydrite pseudomorphs.

At 4961' depth, ghosts of possible brachiopods of very small size are present. A pelletal dolomite is present at 4971', and an unidentified fossil at 4972' depth. While part of the dolomite is strictly laminated, parts are brecciated, with laminated angular clasts occur in a spar matrix. These clasts range in size from a few centimetres to blocks of 20 cm.

The dolomite contains fractures and vugs, some of which are healed by a first generation of dolomite spar and a subsequent generation of very coarse calcite spar. The fracture system shows the usual two subsequent generations of formation; one set is vertical, oblique to bedding dip. In some of the horizontal fractures, geopetal cement was deposited prior to the spar infilling.

Cuttings

The rocks consist of light grey to white, fine crystalline dolomite and coarse crystalline dolomite spar. Pyrite is ubiquitous. Near the top of the pre-Mesozoic section there is some white marl present. A few clear, euhedral and also well rounded, frosted quartz grains have been observed.

In general, the laminated dolomite with the one fossil ghost may be of Paleozoic age. The vertical fractures are again oblique to bedding dip, which may indicate that at least the vertical set was formed after the area obtained its tilt.

Nuna A-10

Comments: Top is picked at 3222 m, TD is at 3250.5 m. The dipmeter was run only above this interval. Cuttings are not available. The core was sampled for conodonts between 3243-3245, 3245-3248, and 3248- 3250.5 m.

Core

The main lithology is a mottled, light grey-brown, vuggy dolomite, fine to medium crystalline with a brecciated appearance and possibly a bedding dip of about 40°. There are only few stylolites and open fractures. A number of vugs are (especially at deeper levels) completely filled by white, milky dolomite spar. Others have a quartz crystal lining, covering the spar. Part of the dolomite is a mudstone, elsewhere it appears to have been brecciated before dolomitization and contains many ghosts of fossils. These fossils range in shape from circular shapes with a central canal, to remnants of digitates, possibly corals or Amphipora.

The impression the assembly of ghosts of fossils gives, is one of a bioclastic debris. Some of the clasts in the breccia are angular, others rounded. Soft- sediment deformation by fracturing with later recementation occurred in a fraction of the clasts.

At lower levels in this core, the rocks resemble tabular stromatoporoids and have a fenestral texture. The milky dolomite spar there appears to be a replacement of anhydrite. In addition, there are a few light brown, thin shale beds in which there are small white specks, which may be fossil remains. Near the bottom, the core becomes locally sandy, possibly representing infilling of cavities by sand. A number of the fractures were cemented by pyrite.

In general, the core is a light grey-brown, vuggy dolomite, with indications of brecciation and recementation prior to dolomitization. Ghosts of fossils point to a Paleozoic age, and the abundance of possible Amphipora may restrict this age to Devonian or Silurian.

<u>Pikiolik G-21</u>

Comments: Dipmeter data indicate for the Cretaceous a dip of 6-N, for the Paleozoic 30?-NW; the reconstructed pre-Mesozoic dip is 25-NW. The top of the pre-Mesozoic is picked at 1377.5, TD is at 1429.6 m. There is no core. The unwashed cuttings were sampled for conodonts between 1380 and 1428 m, because of the micritic character of the rocks.

<u>Cuttings</u>

The dolomite near the top of the pre-Mesozoic succession is riddled with pinpoint vugs, and contains large amounts of chert, which range in colour from dark brown grey to light buff. In addition, rounded, frosted, clear, brown and red quartz grains are abundant. The presence of a white sandstone is indicated by rounded, clear quartz grains, cemented together by milky quartz, and grading into a well indurated quartzite. This quartzite is similar to that found on the Quartzite ridge. The dolomite ranges in colour from dark to mostly light grey, and is fine crystalline to micritic. Nothing reminds of fossil remains. There is some pyrite present.

When compared to the other wells described above, the colour of the dolomite is markedly lighter, and the chert and quartz contents are distinctly higher. Some of the quartz is even present in thin quartzitic layers and there is one white sandstone/quartzite bed, which resembles the thick quartzite on the Quartzite Ridge. No information has been found regarding the age of the rocks.

<u>Pikiolik M-26</u>

Comments: No dipmeter has been run; top is at 5610', TD is at 6510'. The cuttings were sampled between 5620 and 6470 feet depth for conodont dating. There is an indication of some limestones on the Canstrat litholog; this well is located just to the east of wells which contain large amounts of limestone.

<u>Core</u> 5633'-5645'.

The core consists of a limy, light to dark grey, micritic dolomite with a bedding dip of about 45^{o} and horizontal stylolites, which terminate vertical, calcite filled fractures. There are a few calcite spar filled vugs. The rocks display lamination (algal?) and ghosts of pellets or possibly Amphipora; locally fenestrae can be discerned in the laminated parts. The sediment was heavily bioturbated in some places, and not at all in others. Most of the core is brecciated. A fair amount of pyrite is present on one vertical fracture plane.

The algal(?) laminations in the core indicate a shallow environment of deposition, and the ghosts of pellets and fossils indicate a Paleozoic rather than Proterozoic age. The stylolites postdate the fracturing. The fractures are mainly vertical, as is usual in most other carbonate cores, and independant of the bedding. This may indicate that the vertical fracturing occurred after the rocks were tilted. The few fractures parallel to the bedding may represent an earlier fracturing phase; a two-stage relationship with offset fractures is not obvious in this core.

<u>Cuttings</u>

The cuttings provide some additional information. A small amount of red, brown, black, well rounded chert pebbles is present. One or two clear quartz grains have been found. The dolomite is micritic to fine crystalline, at one depth even sucrosic. The dolomite is brecciated at greater depths. The colour of the dolomite ranges from light grey to buff, but may grade even to black in a few thin beds. Limestone is rare.

The succession in this well is different from that in the nearby wells Tuktu O-19 and Pikiolik E-54 in several aspects. The limestone content is minimal. The rocks here appear to have been deposited in a shallower environment and contain no recognizable fossils, probably also due to the dolomitization. A somewhat older age, Ronning-equivalent, instead of Emsian is considered more likely for these rocks because of the domination of dolomite in the succession.

<u>Tuk M-09</u>

Comments: Dipmeter logs were not run. The top of the pre-Mesozoic is at 2870 m, TD is at 3030 m. Samples were collected for palynology between the depths of 3008 and 3009 m (and proved barren!), and at 3008.5, 2865 and 2860 m for Rock-Eval. The last two samples were collected from unwashed cuttings; they were washed and handpicked. Although this well penetrated mainly shale, the presence of dolomite clasts, chert and the absence of sandstone and siltstone point to a facies change of the carbonates into shale, rather than a clastics environment of deposition. Therefore this well is described in the carbonate section.

Core

The core consists of a black debris flow with angular clasts of up to a few cm in size. The clasts are composed of dolomite, shale and a smaller amount of chert and pyrite. There are a few ghosts of fossils. On fracture planes, prismatic barite crystals can be found. The bedding appears to dip 50 degrees. Soft-sediment deformation in the black shales was caused by loading. The rocks are certainly not a chert, as is indicated on the Canstrat litholog. They can be described as one of the debris flows, found commonly in the area of facies change of the carbonates into shale.

Cuttings

The Esso well-history reports mention the presence of some wood and spores, between the depths 2790 m and 2985 m; this would indicate an age not older than Devonian. Underneath these levels there were no fossils. According to a geochemical report, the Paleozoic is overmature.

The cuttings consist of black shale with very little chert, if any, and black glossy shale partings, the gloss being caused by slickensides. Additionally, a dark coloured and fine grained, and also lighter to clear quartzite is present. Part of the milky quartz, and white spar of dolomite and calcite are probably fracture filling.

Except for the black shale, the Canstrat litholog does not describe the rocks very well, and although the abundant caved shales mask the actual rock types, there is a clastic succession with shales, breccia and well indurated quartzite underlying the Mesozoic. A Devonian age may be inferred from the report mentioned, but it is very questionable, due to the large amounts of caved Mesozoic shales.

Wagnark C-23

Comments: Dip measurements are for the Cretaceous 10-W; and the Paleozoic 12-S(?); the reconstructed pre-Mesozoic plane is 16-SE. The cuttings of the rocks were sampled for conodonts between the depths of 13720-13950. Top is picked at 13710', TD 13947'.

Cuttings

Near the top of the succession occur black, very glossy, indurated shales, with slickensides. White, coarse crystalline dolomite is present in the form of thin chips not thicker than 1 mm, but up to 15 mm wide, giving an impression of spar infill from fractures. At deeper levels, the amount of dolomite spar increases, but the cuttings remain thin. Quartz is represented by rounded, frosted, clear to red quartz grains. A minor amount of rounded, orange coloured chert pebbles is present, dissimilar to the chert usually associated with Ronning carbonates. Vugs are rare and small, and partially filled by dolomite spar. At the depth 13870', the first thicker dolomite cuttings appear. The coarse crystalline dolomite is white, although it contains a few thin, dark grey bands; otherwise it is featureless. The crystals are up to 1 mm in size. The shale is probably caved and of minor importance; it appears stained with hydrocarbon and there is a small amount of free bitumen present. Pyrite has not been observed.

In general, the rocks consist of a white, coarse crystalline dolomite with a few thin, darker bands, is otherwise featureless and devoid of any age indications.

WELL WITH REGULAR SECTION

The well in this section is:

Kiligvak I-29

Comments: No dipmeter log was run at the contact area between pre- and post-Mesozoic. The well is located to the southeast side of the Quartzite Ridge and contains carbonates and clastics. The regular succession in this well allows the picking of formation tops. The top of the pre-Mesozoic is picked at 650' (Imperial Formation), the top of the carbonate at 3454', TD is at 6447'. The core is too small to sample for conodonts. No cuttings are available from the succession below 5920'.

Core 5911'-5926'.

The core consists of a light grey limestone. Lower down in the core, the colour changes from light grey to dark buff. Near the top, some marl and a large (over 7 cm), oscillatory-zoned crystal of calcite are present. Locally, the limestone has been brecciated and healed. Vertical fractures were filled by clear calcite. The rock contains many stylolites, filled with argillaceous material, and fossils like Crinoidea, Thamnopora, Ostracods (identifications by the author). Parts of the microcrystalline limestone are pelletal, showing some bioturbation, others featureless mud.

This core was taken from the lower part of the Arnica Formation, or may belong in the Tatsieta Formation.

Cuttings

The cuttings are generally very small and therefore present a problem in recognizing fossil material. From the Hume Formation (top at 4354'), they are black to dark grey limestone with some possible crinoidea. The underlying Landry Formation (top at 4530') varies in colour. Near the top, it is a dark brown to dark grey limestone, changing to grey or even white near the bottom of the formation. It contains crinoidea, brachiopoda, ostrocoda and pelletal material. Arnica Formation dolomite beds (top tentatively at 5280'), fine to microcrystalline and brown to buff colour, underly the limestone. These are not the usual massive dolomites of this formation as found on the Northern Interior Plains, but limy dolomites and mainly dolomitic argillaceous limestones. In general, the carbonate is very fine grained. Accessory minerals are pyrite, and both euhedral and well rounded, clear quartz crystals. A colour change to lighter brown and buff can be observed at about 5600 feet depth. At the 5900' level, the gamma ray and sonic log become much noisier, the shale content increases, and the limestone is less dolomitic. Here the top of the Tatsieta Formation is tentatively picked.

In the interval for which no cuttings are available, the top of the Mount Kindle is tentatively picked at 6410', taking into account the sonic log response and the chert presence in samples from the junkbasket on the drill pipe at this depth.

The cuttings contain a minor amount of indurated sandstone; this is probably caved from the Imperial, because it does not contain any carbonate and is composed of bluish chert. Some shaly partings display slickensides as are common on stylolites, and were probably derived from them.

PARSONS AREA

The wells in this section are:

East Reindeer	G-04	Parsons	L-37	Parsons	P-53
Kamik	D-48	Parsons	L-43	Siku	A-12
Parsons	A-44	Parsons	N-10	Siku	C-11
Parsons	D-20	Parsons	O-27	Siku	E-21
Parsons	F-09	Parsons	P-41		

East Reindeer G-04

Comments: Top is picked at 11785′, TD is at 12250′. Dipmeter data are for the Cretaceous 20-W, Paleozoic 40-E with wide scatter in both values; the questionable, reconstructed pre-Mesozoic dip is about 60-E. The cuttings were sampled for conodonts between 11800-12100 and 12100 and 12250 feet.

Cuttings

The rocks consist in general of a mottled, light grey to white, but mainly buff, medium crystalline dolomite, containing small amounts of pyrite and clear quartz crystals. Part of the dolomite is fine crystalline and black, with white, fracture-filling spar. The dolomite locally contains brown chert and both may have ghosts of pellets. The more marly beds are limy. This carbonate is quite different from the other dolomites in this area, regarding colour and crystal size. A small amount of dolomitic, light grey siltstone is present.

No estimate of the age of the sequence in this well can be given.

Kamik D-48

Comments: Top is picked at 10540', TD is at 10614'. No dipmeter or logs were run for this interval. No conodont samples were collected, because the section is too thin to yield sufficient sample material.

Cuttings

The rocks consist of a light grey to grey, fine to medium crystalline, silty dolomite, which is laminated and contains minor amounts of pyrite and chert. The chert is brown or white. White dolomite spar fills vugs and fractures. There are a few thin laminae of dolomitic, (dark) grey siltsone with salt and pepper coloured grains.

The lithologic combination of chert and dolomite points again to an age equivalent to Ronning or Road River Formation, taking the lithologies in surrounding wells into account.

Parsons A-44

Comments: Dipmeter data at the contact are: Cretaceous 4-ESE; Paleozoic 16-ESE; the as reconstructed pre-Mesozoic dip is 12-ESE. The top of the pre-Mesozoic is picked at 11320', TD is at 11600'. Samples were taken for conodonts from depths 11330 to 11440 feet.

Cuttings

The samples contain abundant caved, black, micaeous shale. The Paleozoic shales do generally not contain identifiable mica and are called "micromicaeous". The pre-Mesozoic rocks consist of mainly dark grey limestone, with minor shale and limy dolomite. The carbonates are fine crystalline, the limestone is finely laminated with black and grey layers. There is a minor amount of grey chert and pyrite. Calcite is fracture filling and has a white colour. With the exception of one possible crinoid, no fossils have been observed in the carbonates.

The rocks are similar to those in the Kiligvak I-29 Gossage Formation, and a Paleozoic age is suggested.

Parsons D-20

Comments: Dipmeter data at the contact are: Cretaceous 24-NE, Paleozoic ?18-ESE, with a reconstructed pre-Mesozoic dip of 20-S. The top of the pre-Mesozoic is picked at 13465', TD is at 13550'. Because of the abundant caved shale and the short interval, this well has not been sampled.

Cuttings

The pre-Mesozoic consists of a light buff to white, fine crystalline, featureless dolomite. Pyrite and a few euhedral clear quartz crystals are present, but no chert. Dolomite spar is derived from vug fillings or fractures.

Taking into account the age of the pre-Mesozoic formations in surrounding wells, a Paleozoic age is suggested.

Parsons F-09

Comments: The dipmeter log was not run at the unconformity interval. The top of the pre-Mesozoic is picked at 10850', TD is at 11638'. Samples for conodonts were taken between 11000-11240 feet in dolomite and 11240-11450 and 11450-11650 feet in limestone.

Cuttings

The pre-Mesozoic section comprises from top to bottom 45 m of chert, 60 m of cherty dolomite and 135 m of limestone including a 15 m thick shale layer. The chert is laminated, white, tan or dark grey and contains minor amounts of pyrite and euhedral clear quartz grains, which line fractures and vugs. The dolomite is light to dark grey, fine crystalline, and contains chert and pyrite. Vugs are filled by dolomite spar. The lowermost dolomite has been brecciated and leached, while the spar there is calcitic. The dolomitic limestone intervals are located between 11230'- 11430' and 11480'-TD. It is dark grey, and microcrystalline at the top, fine crystalline near the TD. Most of it is featureless, except for a possible brachiopod shell imprint (A.W. Norris, 1987; pers. comm) at 11260 feet depth, a possible crinoid and a small amount of pellets deeper down. The limestone above the shale unit has the appearance of a mudstone. In the underlying limestone unit, calcite fills fractures, and pyrite and ghosts of fossils can be observed. No quartz crystals have been observed in the limestones. The shale is dark grey, contains pyrite, and is non-micaeous. It has a greasy appearance.

The complete succession appears somewhat like the one in the Kiligvak I-29 Landry Formation section. A Paleozoic age is suggested, based on this lithologic similarity.

Parsons L-37

Comments: Dipmeter log was not run at the unconformity interval. The unconformity is picked at 12940', TD is at 13010'. Sample quality is very poor, due to the very fine size of the cuttings.

Cuttings

The rocks in the short interval contain chert of brown, bluish and white colour, interbedded with a minor amount of light brown, fine crystalline dolomite and white calcite spar.

Parsons L-43

Comments: Dipmeter data: Cretaceous 4-NE, Paleozoic 29-NW, indicating an reconstructed pre-Mesozoic dip of 29-NW. The unconformity is picked at 10770', TD is at 10844'.

Cuttings

The rocks consist of light brown to blueish chert, with minor light brown fine crystalline dolomite and grey shale. The samples are heavily contaminated by cavings, and provide little information.

Parsons N-10

Comments: Dipmeter data: Cretaceous ?2-S; Paleozoic ??40-ESE; the reconstructed pre-Mesozoic dip is 39-ESE. The unconformity is picked at 10095', TD is at

10515'. The cuttings were sampled for conodonts from depths 10120 to 10515 feet.

Cuttings

The pre-Mesozoic rocks comprise chert and dolomite. The dolomite and chert occupy about equal amounts. The chert is of brown, tan, bluish or black colour, can have a pelletal structure and can be found in layers or laminae intercalated with the dolomite. The dolomite is dark grey to locally light grey, fine crystalline; coarse, white dolomite spar cement fills fractures and vugs. The dolomite can be laminated and contains small amounts of pyrite. It has a pelletal structure, indicated by a few white spar pellets; otherwise the dolomite is featureless. The rock changes to medium crystalline in size below 10200 feet depth and is darker in colour, like the chert. Only a few milky quartz grains are present. The few interbeds of siltstone have a grey colour, from salt and pepper colouring. No fossils have been found and only few quartz crystals.

This type of dolomite with abundant chert is reminiscent of the Franklin Mountain Formation; another equivalent is the Road River Formation, although black shales are absent in this well.

Parsons O-27

Comments: No dipmeter or logs were run for this interval. The pick of the top of the Paleozoic is based by Gulf on "the appearance of grey, grading into white, quartzitic chert". D. Myhr did not find evidence for Paleozoic rocks, according to his notes in the well-history report. The top is picked at 11705'; TD is at 11714'. The wireline logs are before First Reading in this interval, and thus of no assistance.

Cuttings

A few grey to brown and white chert cuttings were present in the sample from the lowermost interval (11710 feet). his lithology points, considering the presence of thick chert beds in surrounding wells, to a Road River or Ronning Formation equivalent age.

Parsons P-41

Comments: Dipmeter data are: Cretaceous dip is 27-E; Paleozoic ?29-E; the reconstructed pre-Mesozoic dip is a questionable 5-NNE. The unconformity op is picked at 11622'. TD is at 11665'. The sample quality is poor, due to minute size of the cuttings.

Cuttings

Very little evidence has been found of the rock types indicated on the CSS lithologs. A few brown chert grains, which could well be shattered chert pebbles from a Cretaceous conglomerate, and some limy material in very small grains or as cement were all that could be found. Thus the lithology is very questionable; the well operator describes grey- brown cryptocrystalline chert and limestone in the well history reports. The wireline logs are very close to First Reading, and therefore of no assistance.

Parsons P-53

Comments: Dipmeter data indicate as dips: Cretaceous 8-NE; Paleozoic 20-ESE and a reconstructed pre-Mesozoic dip of 17-SE. The unconformity is picked at 10450', TD is at 11270'. The cuttings were sampled for conodonts from 10450 to 10820 feet.

<u>Core</u> 11260'-11270'

The main rocks in the core, taken near Total Depth, are grey, laminated, bioturbated and fractured shales. They locally contain eye-shaped nodules of angular anhydrite and pyrite. The shale is faintly laminated, and displays severe soft-sediment deformation, caused by loading. Lower in the core, laminae of up to 2 cm in thickness appear, composed of dolomite or lime mudstone. These laminae are usually broken; a few have rounded courners and are folded. Locally, faulting resulted in boudinage structures, which were recemented before induration of the total rock. The anhydrite was fractured and recemented, and contains geopetal silt and shale in sheltered spots. At one spot, an anhydrite nodule is wedged between two of the laminated bands and has indented the limestone.

All of this indicates active tectonism during the formation of the carbonate sediments.

<u>Cuttings</u>

The sequence consists of an upper, 25 m thick dolomite, overlying a thick succession of chert with a few siltstones and shales. Part of the dolomite is buff coloured, but most of it is dark grey, and the bulk of the chert is (light) brown, although white colours do occur.

The chert is the main rock type in this succession. It occurs in thin bands or nodules and may display a pelletal character. Below 10700' depth, the rocks are principally chert.

The dolomite contains some coarse spar cement, although not as much as in other wells. Locally, the dolomite is laminated and silty and may contain pyrite. The rare vugs are coated with clear dolomite crystals. Clear, rounded quartz crystals are accessories. Below the 10800′ level, the colours turn darker.

The siltstone is brown or grey, resulting from salt and pepper coloured quartz grains, and is intercalated in the dolomite as thin layers.

The interbedded dolomite, black shales and the amount of chert point to a Road River or, less probable, Ronning Formation equivalent age.

Siku A-12

Comments: Dipmeter data at the contact are: Cretaceous 8-WNW, Paleozoic 20-ENE; the reconstructed pre-Mesozoic dip 75-ENE. The top of the pre-Mesozoic is picked at 10615′, TD is at 10787′. Because of the large amount of caved shale, this well was not sampled for conodonts.

Cuttings

Black shale and orange siltstone from formations overlying the pre-Mesozoic unconformity are abundant. The large amount of black shales is not reflected on the gamma ray logs, and is presumably caved. The pre-Mesozoic rocks are dolomite and chert. The dolomite is light grey to white, fine to microcrystalline; the chert white to blueish. A veinlet of lead-silver-zinc sulfides occurs at one interval. Coarser spar dolomite results probably from fracture cement.

The lithostratigraphic equivalents of a dolomite with with chert are the Ronning Group or Road River Formation, or possibly the Precambrian H1

Formation.

Siku C-11

Comments: Dipmeter data at the contact are: Cretaceous 10-W, Paleozoic 9-NW; the reconstructed pre-Mesozoic dip of 7-ESE. The contact is picked at 10550', TD is at 10810'. No samples were available.

No samples from below the 10350' levels are available, but the mudlog and CSS litholog describe the lithology as follows. The main rock type is a light grey chert, increasing in content to 100% below the depth of 10700. Above that level, there are also dark grey to black, bituminous (Cretaceous?) and waxy green shale present. Dolomite and pyrite are accessories.

Siku E-21

Comments: Dipmeter data at the contact are: Cretaceous 25-WNW, Paleozoic 26-WNW; the reconstructed pre-Mesozoic dip is 1-WNW. Top is picked at 11135', TD is at 11245'. Samples for conodonts were taken from the depths 11160 to 11245 feet.

Cuttings

The main rock type is dolomite with minor chert and shale. The dolomite is fine crystalline and dark grey, but may range to light grey or brown-grey in colour. Locally, the dolomite is marly. The chert is brown, the shale black. Pyrite and euhedral, clear quartz crystals are accessories.

The interbedding of black shales, dolomite and chert indicates a Road

River Formation age and equivalent depositional environment.

CAMPBELL UPLIFT AREA

The well in this section is:

Inuvik D-54

Comments: No diplog was run over the unconformity interval. The pre-Mesozoic unconformity is picked at 1050', TD is at 5126'. Previous attempts to recover conodonts from the core were unsuccessful. Samples collected for acritarchs were barren.

Core 2334'-2360'.

The core contains strongly mottled, dark grey, brecciated dolomite. The mottling shapes resemble geodes. Locally, the mottling has very sharp boundaries and could be a replacement of fossils there. Leaching created some vugs inside the first set of fractures, and they were later partially covered by coarse, clear dolomite spar. Many of the spar filled vugs have a reddish colour, due to a cover of rusty appearance over the spar. After this phase, another generation of darker, dirty dolomite spar was deposited in vugs lower down in the core. There, the dolomite is a finely laminated, tan to grey mudstone with a few bird's-eye textures.

Cuttings

In general, the complete succession in this well consists of a sequence of clastics, carbonate and again clastics. They will be treated by interval in some detail because of the obscure position of this well in relation to the age of the formations penetrated.

Clastics

Depth 1050'-1100': Pink and apple-green, waxy shales plus some brick red shales are interbedded and contain accessory pyrite and glauconite, which mineral indicates a marine origin. A few rounded, frosted quartz grains and white and bluish chert pebbles are present.

1100'-1135': Pink quartzite of silt size is composed of clear quartz grains, cemented by milky pink quartz.

1135'-1150': Red and green shales as above, but the green shales dominate.

1150'-1160': A pink, fine crystalline dolomite layer.

1160'-1180': Silt- and sandstone, of salt and pepper colour; their clear quartz grains have a black intergranular cement.

1180'-1200': Green shale with only a small quantity of pink and red shale.

1200'-1220': Pink to white sandstone, quartzitic.

1220'-1245': Interbedded quartzite, dolomite and red and green coloured shales similar to those described above.

1245'-1290': White quartzite containing pinkish chert.

Dolomite

1290'-1500': Brown-grey, micro to fine crystalline dolomite with large amounts of white chert is interbedded with white or salt and pepper grey, quartzitic sandstone, and green-grey shale. The sandstone is composed of rounded or angular, clear quartz grains with black cement. Clear quartz grains are suspended in the dolomite.

1500'-1860': Tan to pinkish dolomite with occasional interbeds of the sandstone as in the previous interval containing large amounts of white to buff chert. The dolomite is micro- to fine crystalline. Suspended quartz crystals and pyrite are accessories. The dolomite and part of the white chert are pelletal.

1860'-2300': Dark grey or brown-grey, fine crystalline dolomite, marly in some beds. The dolomite contains brown-blueish chert. The chert content decreases with depth, and the dolomite becomes again white to pink in colour. There are some black shale interbeds. The dolomite below the 2050' level is medium crystalline and contains dolomite spar cement in fractures and vugs, plus a few euhedral quartz crystals. The colour appears salt and pepper, due to highly reflecting crystal faces, but is actually very dark grey.

2300'-3750': The dolomite colour turns to lighter tan or grey with some pink. The crystal faces, as in the overlying interval are less abundant, i.e. the rock becomes finer crystalline. Coarse milky and clear dolomite spar can be found in vugs. Through some of the spar run pink to orange veins. There is hardly any chert. Part of the dolomite is finely laminated with alternating tan and white bands. This could indicate an algal origin. At the 2930' level, the black dolomite is generally fine, although locally medium crystalline. Milky coarse spar fills fractures. A few thin black shales are intercalated, around the depth 3100'. Between there and 3160' the dolomite colour is tan; the underlying rock is black again, until the 3470' level, below which the tan colour dominates again. The amount of spar cement increases. Lower down, the dolomite colour alternates between tan and black. Suspended, euhedral quartz crystals are common. The lowermost dolomite is grey, with salt and pepper coloured grains.

Clastics

3750'-3800': Below this level, the clastics dominate. The white quartzite, similar to the one described in the upper clastic succession, composed of fine, nearly silty, rounded and angular, clear quartz grains is present again. The cement is dolomitic.

3800'-3975': Quartzitic sandstone is interbedded with black to dark grey shale, and contains pyrite as an accessory.

3975'-4100': Quartzitic, fine, white sandstone, composed of clear quartzose grains; the cement no longer contains dolomite.

4100'-4110': Volcanic rocks, comparable to those in Eskimo J-07, are present. They have a dark green and maroon colour and contain pyrite. These rocks do not appear to be weathered, and were deposited directly on the sandstone in this interval, grains of which are imbedded in it. The volcanics, however, are a minor constituent in the sandstone.

4110'-4500': Indurated, black shale, with a few interbeds of dolomite and sandstone. In the shale a few beds are olive-green and contain circular concretions of a glassy, crystalline material, and the impressions of this same material. Each appears to be one single crystal. On cursory inspection these impressions have shapes like the small ostracods, as described by Yorath on the GSC litholog (see Wielens, 1987).

4500'-4650': Quartzite, white and composed of rounded and angular grains, cemented by dolomite.

4650'-4820': Interbedded brick-red (like the colour of the Little Dal Rusty Red Formation) and light olive'-green, micromicaeous, waxy shales; they grade into each other over intervals of about 1 mm.

4820'-5126': White quartzite with milky quartz cement, composed of mainly euhedral, and a few subrounded crystals of sandsize constitute the lowermost part of the succession.

The red and green colours of the shales point to a Cambrian or Precambrian age of the rocks. The amount of clastics above the dolomite section would be anomalous for the Franklin Mountain Formation. On the other hand, the possible fossil ghosts, as described in the core section, would point to a Paleozoic age.The ostracods described by Yorath are unlikely to be anything else than crystalline concretions.

<u>Short description of the carbonates in Wolverine H-34.</u>

Hume: Dark grey-brown limestone, fossilrich and microcrystalline

Landry: Brown, pelletal, fossiliferous limestone, microcrystalline, and fairly light coloured.

Arnica: Brown, very fine crystalline, vuggy, sucrosic dolomite; tan to light brown in the sample vial.

Tatsieta: Tan, microcrystalline, pelletal limestone with marly interbeds, of smooth appearance and with clear calcite crystals.

Peel: Brown grey, fine crystalline, limy dolomite, more grey than the formations above. Contains green shale partings and appears fine sucrosic.

Mt. Kindle: Medium crystalline, brown to light brown, mottled dolomite, containing white chert in small quantities. There is also coarse crystalline, lighter tan dolomite.

Franklin Mtn.: The top is picked by Williams at the Sandy Marker, which can be represented by only a few grains. This corresponds well with the author's pick, based on gamma'-sonic wirelinelog characteristics (quiet/noisy). Pugh's (1983) pick is quite different, and based on the colour change and coarseness, as was observed under the Mt. Kindle Formantion in this well. The rocks vary from fine to medium crystalline deeper down in the succession, to mainly coarse crystalline, light tan to nearly white dolomite containing large amounts of white chert.