TECTONIC STYLES OF NORTHERN YUKON TERRITORY AND NORTHWESTERN DISTRICT OF MACKENZIE

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ABSTRACT

A diversity of tectonic styles is displayed in northern Yukon Territory and northwestern District of Mackenzie. Some tectonic elements of the region, such as Barn and White Uplifts, for example, are basically fault-bounded, ovate domes, with cores of Paleozoic and possibly older carbonate and clastic rocks, isolated from one another by structural depressions largely filled with Mesozoic clastic sequences. Other elements are elongate and may trend parallel or subparallel to one another. Because some elements were tectonically deformed more than once there may be a stacking of styles, as in Romanzof Uplift, where open folds in Carboniferous and Permian carbonates and clastics rest with profound unconformity on acutely folded, faulted and cleaved rocks assumed to be no younger than Silurian. Each deformed body served as a platform for the next younger sedimentary succession and may have acquired cumulative structural features characteristic of the styles of all younger deformations.

The belt of Cretaceous, south-dipping thrust faults on the south flank of Brooks Range in Alaska is comparable in style to that along the eastern margin of the Canadian Cordillera about the latitude of the 49th Parallel. It continues southeastward into Canada, diminishing in number of faults and in net displacement towards Barn Uplift, southeast of which steep faults, some with demonstrable strike-slip, become major components of the structural

style. The latter faults, active at least locally into the mid-Tertiary, also served to transport differentially the northern Yukon tectonic complex towards Beaufort Shelf and Canada Basin. Beyond this complex in northwestern District of Mackenzie is Kugaluk Homocline, a gently northwest-dipping layered succession of Tertiary sediments flanked on the southeast by Campbell Uplift.

Campbell Uplift is the northeast continuation of Aklavik Arch, a composite structural high comprising individual, northeast trending uplifts arranged right-hand en echelon. The arch extends from northern Yukon to Beaufort Sea and may possibly be continuous with Minto Arch in the Arctic Archipelago. Carbonate accumulations on its flanks comparable to those seen in White Uplift and vicinity or penetrated by the drill in northern Eagle Basin may well occur beneath suitable cap rocks and greatly enhance the economic prospects of the Delta region and Beaufort Shelf.

INTRODUCTION

The rocks of northern Yukon Territory and northwestern District of Mackenzie display a diversity of tectonic elements (Fig. 1) ranging in style from simple, gently dipping, layered successions such as Kugaluk Homocline, east of Mackenzie Delta; to uplifts and depressions cut by steeply dipping faults such as White and Rat Uplifts, and Rapid Depression; to thrust and fold belts comparable in style with the eastern Cordillera about the Forty-Ninth Parallel and seen on the south flank of Brooks Range; to acutely folded and reverse-faulted, mildly metamorphosed, sedimentary rocks intruded by porphyritic granites as in Romanzof and Barn Uplifts; to composite arches comprising elongate uplifts arranged en echelon and exemplified by Aklavik Arch (redefined).

Consequent upon a most complicated orogenic and epeirogenic history, some regions have undergone more than one period of compression and uplift, followed by denudation, depression to receive additional sedimentary load, and further compression. Each eroded, deformed segment of the crust served as a platform or basement for the next younger sedimentary succession and may have acquired cumulative features characteristic of the styles of all younger deformations. In general, the youngest styles are the simplest because they have been derived by the least number of distinct, orogenic episodes, whereas progessively older styles are the result of superposition of successive deformations.

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STRATIGRAPHIC FRAMEWORK AND TECTONIC HISTORY

Northern Yukon Territory and northwestern District of Mackenzie is underlain mainly by sedimentary rocks, mildly metamorphosed in some regions, locally intruded by basic igneous dykes or by porphyritic granites, and in the extreme western part of the area, overlain by volcanic agglomerates with thin, discontinuous, basic lavas. The crystalline, igneous rocks of the Precambrian Basement are not known in outcrop in the region.

The stratigraphic succession and structural history of the Inuvik-Campbell Lake area (see Table 1) is revealed in outcrop on Campbell Uplift, in Caribou Hills and in the subsurface in the Inuvik D-54 bore hole. The oldest known rocks there comprise interbedded grey to pale red, silty dolomites dated by paleomagnetism (Norris, D.K. and Black, 1964, p. 50) as Late Precambrian, grey and green shale, and light grey quartzite. The succession is possibly slightly older than the Purcell System of the eastern Cordillera. Folding or tilting along northeast structural trends marked the early stages of Campbell Uplift. These Proterozoic rocks are overlain unconformably by essentially flat-lying white quartzites and grey shales, Cambrian (?) in age and possibly equivalent to the Old Fort Island Formation, in turn overlain by grey shales (Road River Formation?), and grey to black, fine- to crypto-crystalline dolomite at least in part equivalent to the Vunta Formation. Recent biostratigraphic studies by A. W. Norris (1968a, p. 769 and pers. comm., 1971) would indicate a hiatus between these dolomites which are known to be as young as Middle Silurian and the fine- to crypto-crystalline limestones of late Lower and possibly early Middle Devonian Ogilive Formation. Dark grey, silty shales of the Imperial Formation mark the top of the Devonian System.

Campbell Uplift was again active sometime from the Late Devonian to the Early Cretaceous because the whole of this Middle and Early Paleozoic and Late Proterozoic succession was uplifted, tilted and eroded at least once prior to the deposition of the Early Cretaceous Series. Some of this activity was undoubtedly linked to the major orogenies which took place in the Devonian and Mississippian Periods west of Mackenzie Delta.

With the sinking of Campbell Uplift in the Albian, porous sandstones of the Lower Cretaceous "Silty zone" were overstepped by black shales of the "Bentonitic zone" on the northwest flank of Kugaluk Homocline. Evidence for this overstepping may be seen near the mouth of Kugaluk River (Yorath and Balkwill, 1969; 1970, p. 3). There, soft, rusty weathering shales of the "Bentonitic zone" rest unconformably on the Upper Devonian Imperial Formation. The "Silty zone" is missing and is presumed to exist down-dip to the northwest. A similar pinching out of the porous sandstones of the "Silty zone" is inferred on the southeast flank of the uplift and the hydrocarbon potential of such stratigraphic traps should not be overlooked.

In mid-Cretaceous the region was again tilted, loaded with clastics, then folded and possibly faulted prior to the deposition of the largely non-marine sequences of the Reindeer and Beaufort Formations. An angular unconformity identifying this latest tectonic activity may be seen on the right bank* of an unnamed creek flowing into Campbell Lake from the southeast, about 13 kilometres above the mouth of the creek. There, dark grey shales below the unconformity and near water level are dated by D. C. McGregor (1971) as Jurassic or younger and are assumed by the writer to be the Albian "Bentonitic zone". The overlying, unconsolidated silts and sands are assigned to undifferentiated Tertiary Reindeer and Beaufort Formations.

In northeast Richardson Mountains the sedimentary succession ranges in age through the Phanerozoic and probably into the Proterozoic. Disconnected exposures, especially of the older rocks allow the piecing together of some of the stratigraphic and tectonic history of the region. The oldest beds, presumed to be Late Proterozoic in age comprise a faulted succession of foliated argillites, limestones, dolomites and conglomerates exposed 10 kilometres south of Rat Pass. The next younger rocks, exposed 13 kilometres north of the Pass, are limestones of late Early Cambrian age (Norford, 1963) structurally conformable with younger sediments but presumed to rest with pronounced unconformity on the Proterozoic at depth. Early Devonian graptolitic shales have been recognized by geologists of Shell Canada Limited (Norford, 1970), immediately south of Rat Pass and confirm the presence of this facies as lateral equivalents of part of the great carbonate accumu-

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* right and left banks are as one faces downstream.

lation seen in White Uplift 35 kilometres to the northwest.

Northeast-trending folding and faulting of Upper Devonian Imperial shales and siltstones identify a latest Devonian or Mississippian orogeny which affected the region. The angular unconformity between Imperial Formation and unnamed sandstones and conglomerates of Early or Middle Permian age on the left bank of Sheep Creek 3 kilometres above its mouth attest to this. In Aklavik Range Permian clastics are overlain by a structurally conformable succession of shales, sandstones and conglomerates representing parts of the Mesozoic and Cenozoic Systems, punctuated with disconformities and commonly representing near-shore and shoreline facies. Of prime importance among these unconformities is that representing mid-Valanginian uplift of the "Aklavik Arch" (Jeletzky, 1961, p. 538) and recognized by the erosional gap in the Lower Sandstone Division.

The whole of the stratigraphic assemblage of northeast Richardson Mountains was buckled and cut by north- and northeast-trending, near-vertical faults, some with right-lateral, strike-slip displacement, active in the Late Cretaceous and very probably in the Tertiary as well.

White and Cache Creek Uplifts also expose rocks of Phanerozoic and probable Late Proterozoic ages, deformed by the same Late Precambrian, mid-Paleozoic, Late Cretaceous and Tertiary orogenies which affected the rocks of northeast Richardson Mountains. Notable differences in the succession are the presence of highly sheared, basic igneous dykes in probable Proterozoic rocks on the north flank of White Uplift, thick limestone and dolomite accumulations representing much of Early and Middle

Paleozoic time, mid-Pennsylvanian dolomitic limestones demonstrating the presence of Lisburne-equivalent rocks, a thick clastic-carbonate succession of Early and Middle Permian age in part equivalent to the principal reservoir rocks at Prudhoe Bay, the apparent absence of Triassic rocks, and the presence of a wedge of Late Cretaceous (Chamney, 1971a) syntectonic clastics (Moose Channel Fm.) thickening seaward on Beaufort Shelf at the mouth of Fish River.

The stratigraphic assemblages in and around Barn and Romanzof Uplifts (Barn and British Mountains respectively) are represented by the three columns to the left on Table 1. The Blow Pass succession portrays the rocks encountered at the surface immediately east and southeast of Barn Uplift, and includes grey, fine-crystalline, oolitic limestones in fault contact with olive grey, slaty argillites of the Neruokpuk exposed on the northwest flank of a small, dome-shaped structure at the headwaters of Blow River. If these limestones are correlative with limestones near the base of the exposed Neruokpuk in Romanzof Uplift, and they underlie the slaty argillites in normal stratigraphic succession, a major, near-vertical, pre-Mississippian fault must be present in the dome. It trends northeast parallel to Dave Lord and Cache Creek Uplifts and its northwest side has been displaced relatively upwards with a stratigraphic separation in excess of 1,800 metres, the exposed thickness of the argillites.

The dating of the Neruokpuk in Barn Mountains is based on the recovery of Ordovician and Silurian graptolites from an acutely folded and faulted assemblage of dark grey to black shales, black and green chert, and red and green shales (Martin, 1959, p. 2414; Norford, 1964, p. 137; and Norris, A. W., 1971, pers. comm.). It would appear that the Neruokpuk here is at least in part laterally and temporally equivalent to the Road River Formation and that this Early and Middle Paleozoic graptolite sequence was very widespread in northern Yukon Territory.

Light grey and yellowish grey, porphyritic granites which intrude the Neruokpuk in Barn and Romanzof Uplifts have radiometric ages of 370 and 355 m.y. determined in the laboratories of the Geological Survey of Canada (Wanless et al, 1965, pp. 22-23). They would appear to have originated in the Middle or Late Devonian Epochs. Because they are foliated and hydrothermally altered, however, it is entirely possible that they may be somewhat older, perhaps genetically and temporally equivalent to granites dated as Early Silurian (430 m.y.) (Brosgé, 1970, p. 2473) in northeast Brooks Range.

The Neruokpuk Formation in Romanzof and Barn Uplifts and at Blow Pass was acutely faulted, folded, uplifted and peneplaned prior to the Mississippian Period. Detritus shed from this uplift was most probably a source of the Upper Devonian Imperial Formation (Martin, 1959, p. 2442). Overlying the Neruokpuk with profound unconformity are rocks ranging in age from Jurassic to Mississippian and possibly Late Devonian. In Romanzof Uplift on both sides of the International Boundary, is a thick succession of volcanic agglomerates comprised in part of boulders and cobbles of amygdaloidal basalt but also containing light grey, recrystallized limestone phenoclasts. The age of these agglomerates is uncertain but they are believed to be younger than the Middle or Late Devonian orogeny because they appear to rest with angular unconformity on deformed Neruokpuk. Grey, undated, fine-crystalline limestones occur as erosional remnants on top of the agglomerates in British Mountains and may belong to the Carboniferous Lisburne Group.

The Carboniferous succession in British and Barn Mountains has been dealt with at length by Mamet and Mason (1970) and by Bamber and Waterhouse (1971). These authors recognize the black, calcareous shales of the Kyak Formation and the more resistant grey, skeletal, cherty limestones of the Alapah and Wahoo of the Lisburne Group. Collectively the Kyak, Alapah and Wahoo form a northeast-tapering wedge along with the quartz sandstones of the Permian and Triassic Sadlerochit Formation. The transgressive siltstones and limestones of the Upper Triassic Shublik Formation overstep these Carboniferous and younger formations of the wedge to rest with angular unconformity on deformed Neruokpuk on the northeast flank of British Mountains (see Plate 1) and locally on the north flank of Barn Mountains. The Jurassic shales of the Kingak Formation in turn ~~appear to~~ overstep the Shublik to rest unconformably on the Neruokpuk northwest of Babbage River.

On the flanks of Barn Mountains and on the dome-like structures immediately east and southeast of there, a coarse chert and quartzite pebble-conglomerate intervenes between the deformed Neruokpuk and non-marine Kyak. This is the Mississippian Kekiktuk Formation, highly variable in thickness but locally up to 250 feet thick, and resting with strong angular unconformity on the Neruokpuk.

The Jurassic and Lower Cretaceous sandstone and shale succession in the region of Blow Pass continues westward to Barn and British Mountains but with noteworthy decrease in content of coarser clastics in the lower part. The unnamed Middle and Upper Jurassic sandstones of Blow Pass are not recognized westwards from Barn Mountains. The Lower Cretaceous Lower Sandstone Division, however, persists as a prominent marker and the shales and siltstones normally overlying it between Barn Mountains and Mackenzie Delta are replaced by sandstones. Still younger deposits in the region comprise a thick succession of upturned shales, lithic sandstones and chert, quartzite and lithic pebble-and cobble-conglomerates (identified only as conglomerates in Table 1) dated as Albian (Chamney, 1971b) and doubtless recording tectonism and erosion of Jurassic and older rocks of Romanzof Uplift. These syntectonic deposits were in turn deformed as this last great episode of tectonism spread northeastwards across northern Yukon Territory and northwestern District of Mackenzie. Sediments derived from this episode were shed onto Beaufort Shelf and are recognized as Moose Channel Formation along their southwestern limit on Arctic Coastal Plain. The dying phases of this orogeny may be recognized in the vertical beds of conglomerate and coal of the Moose Channel near the northwest extremity of Mackenzie Delta.

STRUCTURAL STYLES

Two contrasting styles characterize the rocks of British Mountains, the older being an acutely folded succession of mildly metamorphosed sediments and intrusions cut and repeated by high-angle reverse faults and the younger a belt of Late Paleozoic and younger, non-metamorphosed, layered sediments repeated by a family of overlapping, low-angle (thrust) faults with associated folds.

In the core of British Mountains along the canyons of Firth River may be seen flexural-slip, cylindrical folds in bedded sedimentary rocks; axial surfaces are vertical or dip steeply to the southwest or northeast and the folds are cut by high-angle reverse faults, whole outcrops mimicking on the mesoscopic scale the grand style of the Neruokpuk assemblage. On the northeast flank of British Mountains (Plate 1 and Figure 2) may be seen one of the southwest-dipping, reverse faults repeating part of a panel of Neruokpuk and overlain with strong angular unconformity by gently inclined Shublik Formation. The Neruokpuk, deformed, eroded and bevelled prior to the deposition of the Kyak and further eroded before the Late Triassic, has served as the basement for younger Phanerozoic rocks. The unconformity separating the Neruokpuk from the Kyak and younger rocks is one of the most profound in the Canadian Cordillera and corresponds with that at the base of the Sverdrup Basin of the Arctic Archipelago (Thorsteinsson and Tozer, 1960, p. 3).

On the southeast plunge of British Mountains (Plate 2) this stacking of the younger style on top of the older may be seen to advantage. There the upturned and foliated Neruokpuk, intruded by porphyritic granites of the Sedgwick stock, are overlain with angular unconformity by conglomeratic sandstone of the Kekiktuk, recessive marine shales of the Kyak, and resistant carbonates of the Lisburne Group. These Late Paleozoic rocks, in conjunction with the overlying recessive Kingak shales and ridge-forming Lower Sandstone Division are buckled and thrust-faulted by a Cretaceous orogeny and display a style which contrasts with that of their Neruokpuk basement.

Although the Neruokpuk doubtless sustained additional deformation in this orogeny, it would not appear to have been involved intimately in the thrusting because the Kyak shales commonly occur at the base of many of the plates in the imbricate structure of the thrust belt in northeastern Brooks Range (see Lathram, 1965). The Kyak was doubtless a major detachment zone comparable to the Kootenay Formation of the eastern Cordillera or to the Chattanooga Shale of the western Appalachians in dictating the style of the deformation.

The imbricate thrust belt on the southwest flank of British Mountains continues southeastward from Alaska, diminishes in number of faults and in stratigraphic separations, and turns southwards on the west flank of Barn Mountains as it gives way to a region dominated by elongate structural highs and depressions cut by near-vertical faults between there and Sitidgi Lake east of Mackenzie Delta. Two repeats of the Kyak and Lisburne are clearly exposed on the west flank of Barn Uplift (Plate 3) and, in association with the thrusting on the north flank (Fig. 2), marks the southeastward termination of the thrust belt. It will be noted that the sense of motion required for these faults as they turn southwards is right-lateral, and is mechanically congruent with that determined for some of the major north-and northeast-trending, transcurrent faults immediately to the east.

From Barn Mountains eastward to Campbell Uplift, the style comprises a series of domes and depressions commonly elongate and arranged right-hand en echelon (see Fig. 1). One of the more prominent of these structural highs is Cache Creek Uplift (Plate 4), an open structure plunging gently northeast beneath Mackenzie Delta, exposing Lower and Middle Permian clastics and carbonates on its flanks and massive Middle Pennsylvanian limestones in its core. Domes like this as well as the juxtaposed structural depressions are commonly cut by north-and northeast-trending faults such as the one, with its southeast side relatively depressed identified in Cache Creek Uplift (Fig. 2). Another is observed to truncate Gilbert anticline (Plate 5), a prominent, more closely appressed structure in Rapid Depression. There, ridge-forming clastics of the Aptian Upper Sandstone Division have been displaced right-laterally into line with the Valanginian Lower Sandstone Division.

The best known and one of the more prominent strike-slip faults cuts longitudinally through Aklavik Range (Plate 6) as it trends north and northeast to Mackenzie Delta. This is the Donna River fault (Jeletzky, 1960, p. 25), traceable southwards along the east flank of Richardson Mountains for more than 100 kilometres. Orientation of minor structures such as thrusts and drag-folds led Jeletzky (1961, p. 548) to conclude that the principal displacement on the fault was right-lateral but that the actual amount of horizontal movement could not be determined with any degree of certainty without additional field study. Intrusions of gypsum may be seen along the trace of the fault on lower Willow (Donna) River as well as at the edge of the Delta (Kent and Russell, 1961). Fragments of altered basic intrusives contained in the gypsum suggest derivation from Late Proterozoic? rocks like those seen on the north flank of White Uplift and comparable with those reported from the Late Precambrian (Thorsteinsson and Tozer, 1962, p. 38, 39) on Victoria Island. The fault may, therefore, cut the sedimentary veneer at least locally as deep as the Proterozoic.

Gravity surveys over the lower Mackenzie Basin (Hornal et al, 1970) provide some understanding of the structural and stratigraphic framework beneath Mackenzie Delta. Of special interest is the continuity of Dave Lord-Cache Creek, Rat and Campbell Uplifts and structures such as the Donna River fault. As indicated above, Cache Creek Uplift trends northeast and plunges beneath the Delta. Because saddles similar to that observed between Dave Lord and Cache Creek Uplifts appear to be part of the structural habit, it is assumed that Cache Creek Uplift is in fact plunging northeast into another saddle and that the next culmination along trend is that identified by the relatively positive 30 milligal Bouguer anomaly (Hornal et al, 1970, p. 9) surrounding the location of the Tununuk H-10 bore hole (Fig. 3). Similarly Campbell Uplift is identified in the gravity field by the positive 10 milligal Bouguer contour near the south end of Sitidgi Lake and its northeast trend is clearly evident from adjacent gravity contours. Rat Uplift cannot be identified as easily nor can the continuation of Donna River fault although the latter may well be continuous with structures interpreted to exist at depth beneath Liverpool Bay more than 200 kilometres to the northeast (see below). Of prime importance is the fact that the gravity contours trend northeast parallel to the long direction of the individual, en echelon, structural highs identified on both sides of the delta and there is no suggestion that these en echelon uplifts form one structurally continuous high from Porcupine River east-northeast to Liverpool Bay.

Campbell Uplift is the most prominent structural feature flanking Mackenzie Delta on the northeast. Late Proterozoic dolomites are exposed at its crest and Paleozoic, Mesozoic and Tertiary clastics dip gently to the northwest and southeast at less than five degrees on its flanks (see Figs. 3 and 4). Several steeply dipping faults, possibly with some strike-slip displacement, are clearly exposed in the core of the uplift and still others probably exist but are masked by glacial deposits. The stratigraphic separation on those postulated for the northwest flank of the uplift, however, would have to compensate one another because such faults would not appear to modify significantly the gentle but progressive northwest dip of the succession as it may be projected down dip to the levels at which they are encountered in the D-27 bore hole (Chamney, 1971c, Fig. 6). Of special interest is the possibility that the rocks immediately above the Paleozoic sequence in the Inuvik well may be Albian and hence that the Lower Cretaceous "Silty zone" encountered in the Reindeer well (Chamney, idem) has been overstepped. Its feather edge has been interpreted to occur in the vicinity of the Gulf Reindeer wells in the structure section (Fig. 4).

Near the mouth of Kugaluk River in southwestern Stanton map-area, Yorath and Balkwill (1969; 1970, p. 3) have observed that the

Albian "Bentonitic zone" rests unconformably on the Upper Devonian Imperial Formation and that the "Silty zone" is missing because of overstepping on a paleotopographical, north-trending high which they termed "Kugaluk arch". The writer would prefer to interpret this overstepping as occurring on the northeast extension of Campbell Uplift, in which case the feather edge of the "Silty zone" would trend northeast rather than north and occur at relatively shallow drilling depths beneath the gently northwest-dipping panel of Tertiary shales and coarser clastics of Kugaluk Homocline.

Kugaluk Homocline is clearly expressed in the outcrop distribution of these youngest Phanerozoic rocks in eastern Aklavik (Fig. 3) and adjacent Stanton (Fig. 5) map-areas. There the Tertiary sedimentary rocks form a thin, southeast-tapering wedge which dips beneath a cover of Quaternary sands and gravels in the direction of Beaufort Shelf. The seaward thickening of this wedge of marine and non-marine sediments may possibly be responsible for the large gravity low over Kugmallit Bay and Richards Island at the northern extremity of the modern delta of Mackenzie River. The low has been explained by Hornal et al (1970, p. 9) as a basin of Cretaceous and Tertiary clastic sediments which, under specified assumptions of density contrasts, is calculated to attain a thickness of 21,000 feet (640 metres). They further suggest the probability that this sequence thins out gradually to the north on the continental (Beaufort) shelf, an hypothesis consistent with the models prepared by Wold et al (1970, p. 854) for profiles across the southern margin of Beaufort Sea between Barrow, Alaska and Banks Island of the Arctic Archipelago.

Approximately 1,000 metres below Liverpool Bay, continuous profile, marine seismic reflection surveys (Accurate Exploration Ltd., 1960) reveal a system of northeast- and east-trending, steep faults with associated folds that may be interpreted to link right-hand en echelon, and suggest strike-slip components consistent with that inferred on some of the principal faults in northern Richardson Mountains. This deformation underlies Kugaluk Homocline and occurs on the northeast projection of Donna River fault. There is, therefore, the possibility that these or similar structures continue diagonally southwestward beneath Caribou Hills and Mackenzie Delta.

AKLAVIK ARCH

The term "Aklavik Arch" was first used by Jeletzky (1961, p. 538 and Figs. 22, 24) for a "mid-Valanginian anticlinal structure" which he interpreted to extend from Bell Basin (northeastern Eagle Basin of this paper) across Mackenzie Delta to the vicinity of Sitidgi Lake. He, therefore, linked Rat and Campbell Uplifts as one physically continuous structural high. Jeletzky (idem) applied the name "Dave Lord Creek Arch" (Dave Lord Arch of this paper) to one of the late Middle Devonian "broad anticlinal arches"(Martin, 1959, p. 2442, and Fig. 12b) recognized by Martin (idem) and identified by Knipping as "Dave Lord Ridge ..... the general location of the late Paleozoic orogenic belt" (Knipping, 1960, p. 1 and Fig. 5). The term "ancestral Aklavik Arch" was subsequently introduced by Jeletzky (1963, p. 66) for a regional arch which he interpreted to be the predecessor of the "Dave Lord Creek" and "Aklavik" arches. According to Jeletzky (idem) "It could be that these two arches ..... only arose in Cretaceous time, perhaps because of the lateral offset of parts of ancestral Aklavik Arch by north-trending strike-slip faults". He, therefore, linked Dave Lord, Rat and Campbell Uplifts as one physically continuous structural high prior to Cretaceous time.

Structural studies by the writer, supported by recent stratigraphic and biostratigraphic data from several sources both published and unpublished, would now suggest that the northeast-trending Dave Lord-Cache Creek, Rat and Campbell Uplifts may be one integrated system of structural highs. Collectively they may be termed Aklavik Arch. They are arranged right-hand en echelon, the structural grains within them are approximately parallel to one another, they are separated by structural depressions, and they responded individually to the tectonic forces in the region. For example, Dave Lord and Rat Uplifts were actively deformed in the Middle or Late Devonian orogeny of northern Yukon Territory whereas the region of Campbell Uplift was receiving sediments, possibly derived from that orogeny. Tilting, faulting and buckling in the Cretaceous and Tertiary, on the other hand, appears to have affected all three uplifts and intervening depressions.

The arching and some faulting of this region east of Barn Mountains would appear to be most easily explained by a simple system of stresses active spasmodically but with consistent orientation at least since Middle or Late Devonian time. The right-hand, en echelon arrangement of these parallel uplifts is analogous to the fold patterns produced experimentally by Tokuda (1927, p. 60) and further analyzed by Campbell (1958, p. 449). Their experiments and conclusions notably clarify our understanding of the forces at work in the development of natural, right- and left-hand, en echelon folds and suggest Dave Lord-Cache Creek, Rat and Campbell Uplifts and associated steeply dipping faults with right lateral displacements could be the product of similarly oriented compressive stresses active at different times and places along the arch but oriented consistently more or less in a northeast direction. Mobilization and transport of Proterozoic (?) salt to the cores of the uplifts would facilitate force folding and account for the extension (?) faulting suggested for example, in White and Campbell Uplifts. The principal, en echelon structures of northern Yukon Territory and northwestern District of Mackenzie may then be the product of the same or similar stress systems, but some (e.g. Dave Lord-Cache Creek and Rat Uplifts) are not necessarily one and the same feature cut and offset by a major, strike-slip fault.

Aklavik Arch is postulated as a persistent, composite, structural feature comprising a system of uplifts, depressions and faults, in a specific geometric pattern. It appears to have persisted as a northeast-trending, curvilinear feature at least since the mid-Paleozoic and is possibly traceable in Canada from the Alaska border to Beaufort Sea. It may also be the structural link between Minto Arch (Thorsteinsson and Tozer, 1960, p. 6) in central Victoria Island of the Arctic Archipelago and the Yukon-Porcupine Lineation (Tailleur, 1969, p. 2) in Alaska. By its very nature, seaways could exist at times in the (en echelon) structural depressions. At other times more than one of the uplifts was sufficiently depressed that great stretches of the arch may no longer have served as barriers to sedimentation. There is, therefore, no reason to anticipate wholesale differences in facies or faunas to the north and south solely because of it. Thick Paleozoic carbonate accumulations appear to have developed on its flanks or crests as suggested, for example, in the core of Cache Creek Uplift (Middle Pennsylvanian and Early Permian), Dave Lord Arch (Pennsylvanian), and Campbell Uplift (Ordovician-Silurian and Middle Devonian). In Peel Plateau Eagle Plains No. 1 well, on the southwest projection of Rat Uplift, A. W. Norris (1968b, Fig. 5) reports limestones and dolomites ranging in age from Silurian to Middle Devonian. Lateral equivalents of some of these carbonates may be seen for example in erosional remnants of Early Devonian, graptolitic shales reported by D. K. Norris (1970, p. 231) on the northwest flank of Dave Lord Arch and near the crest of Rat Uplift by geologists of Shell Canada Ltd. (Norford, 1970). The possibility of other carbonate accumulations and their lateral transitions to shales buried beneath suitable cap rocks along and adjacent to Aklavik Arch greatly enhances the prospects for natural hydrocarbons in the region.

This ancient, gently sinuous, composite feature, apparently more than 1,400 kilometres long, may possibly provide a major link between the structures and stratigraphy of the northern mainland and the Arctic Archipelago. The Franklinian miogeosyncline and Sverdrup Basin lie to the north of it and head seaward to Canada Basin (see Thorsteinsson and Tozer, 1960, Fig. 2). It would appear rather unlikely, therefore, that these basins were continuous with Richardson Trough and other tectonic elements south and east of Aklavik Arch at least since the Middle or Late Devonian orogeny. The fact that the arch is so nearly linear would suggest, moreover, that it is extremely fortuitous that it once curved back on itself in the form of a giant U, as would be required if the north slope of Alaska and adjoining parts of Canada were at one time in contact with the western margin of the Archipelago. Geological and geophysical data suggest that Canada Basin may be a true oceanic feature (see, for example, Churkin, 1969, p. 553, and most recently Berry and Barr, 1971, p. 360) and the possibility that Aklavik Arch was never significantly bent through rotation about a vertical axis would suggest, moreover, that the Basin has been in existence at least since the mid-Paleozoic.

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FIGURE AND PLATE CAPTIONS

Figure 1. Index map showing principal tectonic and physiographic elements in northern Yukon Territory and northwestern District of Mackenzie.

2. Simplified geological map of parts of northern Yukon Territory and northwestern District of Mackenzie (NTS 117). Quaternary geology after Rampton, 1969.

3. Simplified geological map of Aklavik area (NTS 107B), northwestern District of Mackenzie.

4. Structure section and Bouguer anomaly profile through Reindeer D 27 and Amoco D 54 wells, Aklavik map-area, District of Mackenzie.

5. Simplified geological map of Stanton area (NTS 107A), with faults and folds beneath Liverpool Bay superposed.

Table 1. Correlation of representative lithostratigraphic units identified in selected tectonic elements in northern Yukon Territory and northwestern District of Mackenzie. Differential uplift ( ), folding ( ), strike-slip faulting ( ) and reverse faulting ( ). Data from Operation Porcupine and other sources as acknowledged in text.

Plate 1. Southwest-dipping Neruokpuk Formation (NE) cut by reverse faults and overlain with angular unconformity by gently inclined, Triassic Shublik Formation (SH). NAPL Oblique Photo T13L-42.

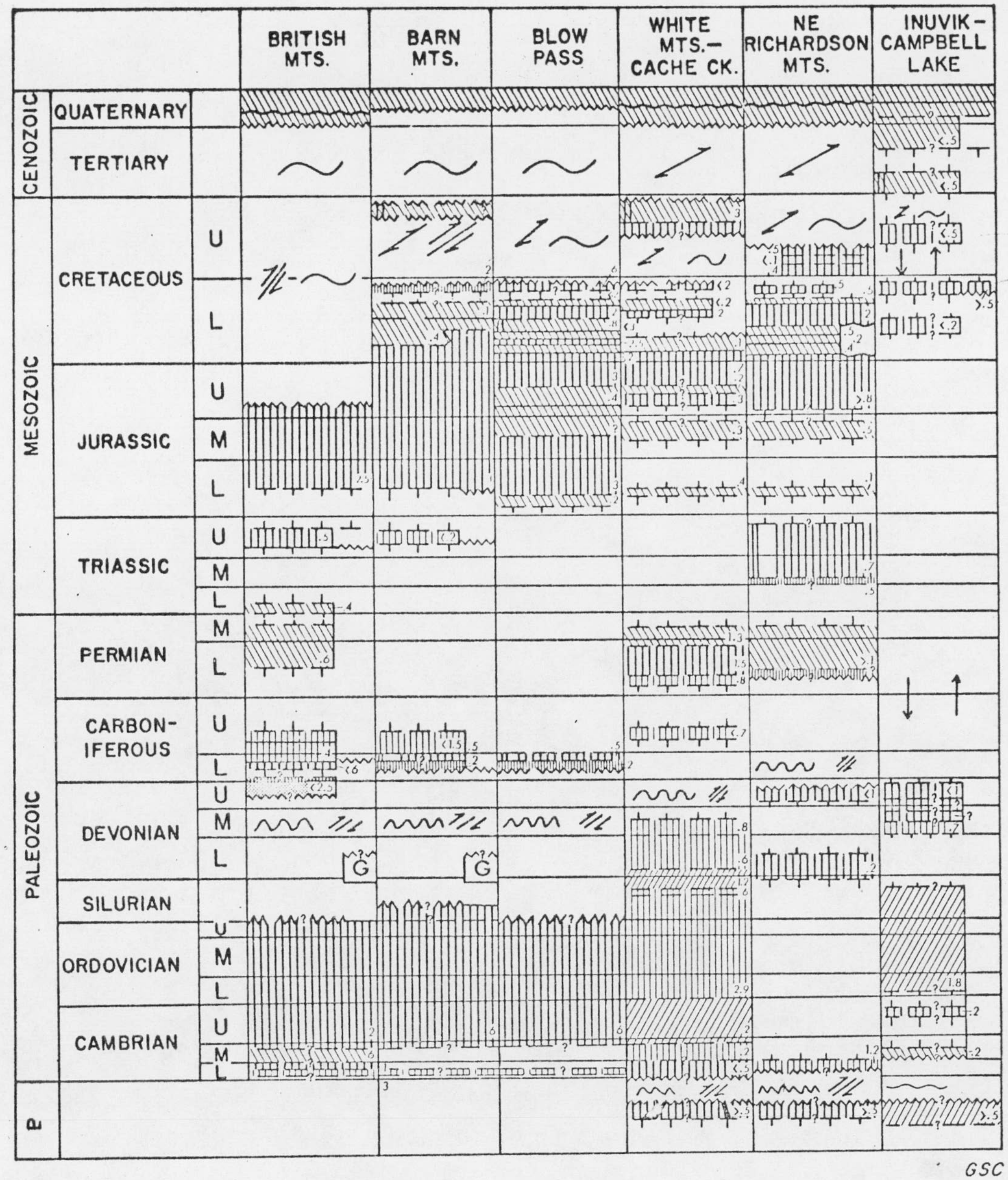
2. Neruokpuk Formation (NE) intruded by Sedgwick granite (G) at southeast extremity of British Mountains and overlain with angular unconformity by folded and faulted Kekiktuk-Kyak Formations (KK), Lisburne Group (LL), Kingak-Shublik Formations (KI), and Lower Sandstone Division (KS). NAPL Oblique Photo T15L-52.

3. Mississippian Lisburne Group (LL) repeated by thrust faulting on west flank of Barn Uplift. NAPL Oblique Photo T13L-105.

4. Northeast-trending Cache Creek Uplift exposing Middle Pennsylvanian dolomitic limestones (PL) in its core and Lower and Middle Permian shales (PS), sandstones and limestones on its flank. Ridge-forming sandstone which outlines the uplift in the lower right corner of photo is Lower Jurassic Bug Creek Formation (BC). NAPL Oblique Photo T3-23R.

Plate 5. South-plunging Gilbert anticline exposing Upper Jurassic and Lower Cretaceous shales and sandstones and truncated northwards by right-lateral, strike-slip faults. NAPL Oblique Photo T6-17L.

6. South-trending Aklavik Range cut longitudinally by Donna River fault. NAPL Oblique Photo T3-15L.



BRITISH MTS.
BARN MTS.
BLOW PASS
WHITE MTS.—CACHE CK.
NE RICHARDSON MTS.
INUVIK-CAMPBELL LAKE
CENOZOIC
QUATERNARY
TERTIARY
MESOZOIC
CRETACEOUS
JURASSIC
TRIASSIC
PALEOZOIC
PERMIAN
CARBON-IFEROUS
DEVONIAN
SILURIAN
ORDOVICIAN
CAMBRIAN
P
U
M
L
G
GSC

FACIES

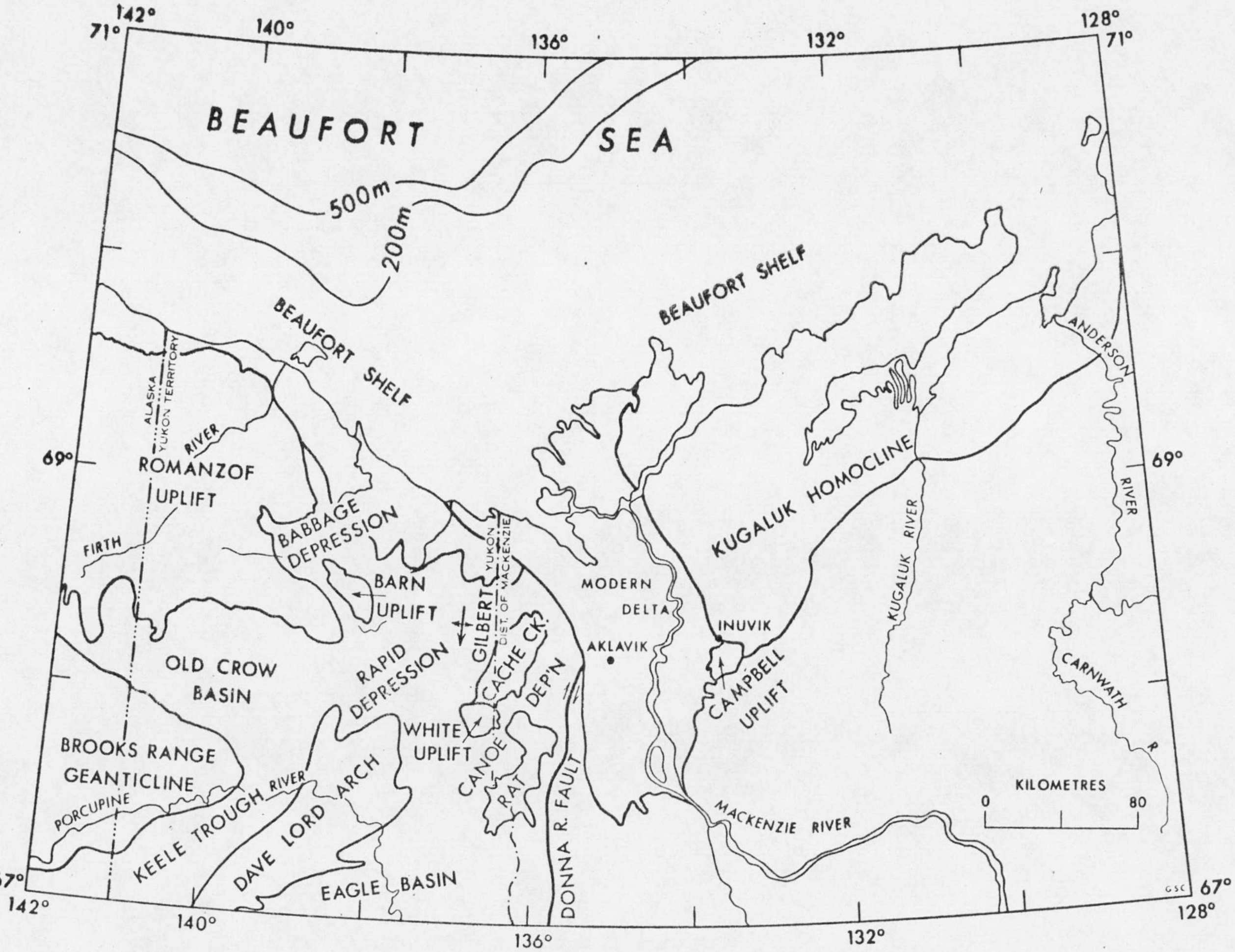
- LIMESTONE
- DOLOMITE
- SHALE, MUDSTONE, SILTONE
- ARENITE
- CONGLOMERATE
- PYROCLASTICS & ASSOCIATED EXTRUSIONS
- BASIC IGNEOUS INTRUSIONS
- G ACIDIC IGNEOUS INTRUSIONS

NON-MARINE.................................‖

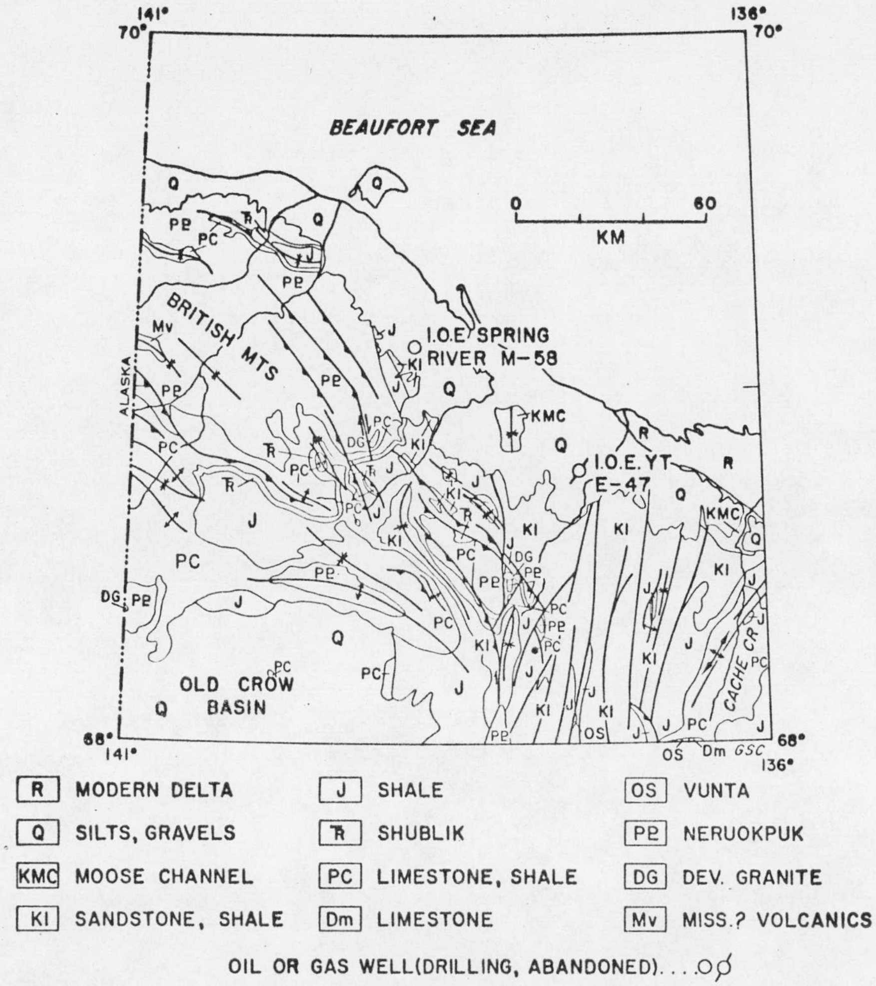
THICKNESS(THOUSANDS OF FEET)...............2.5

CONTACTS

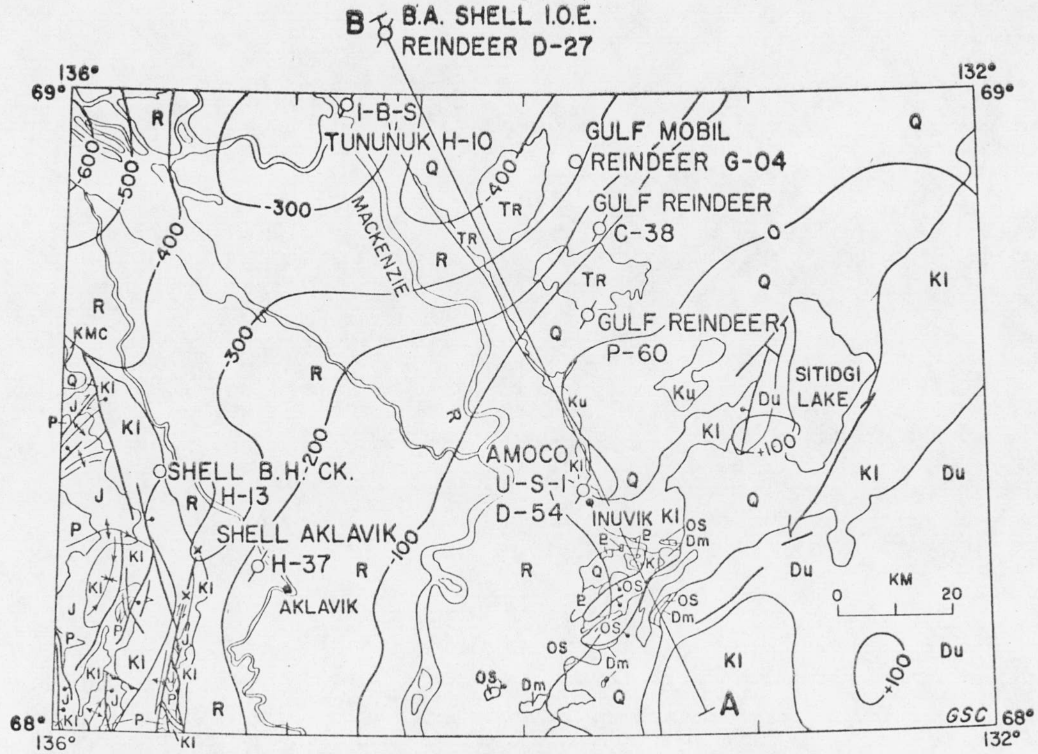
	ESTABLISHED	UNCERTAIN	UNKNOWN
CONFORMABLE	————	— — — — —	— — ? — —
UNCONFORMABLE (UNDIFFERENTIATED)	~~~~~~		
DISCONFORMABLE	┬┬┬┬┬┬┬┬┬┬	┬ ┬ ┬ ┬ ┬	— — ? — —
NONCONFORMABLE OR ANGULAR UNCONFORMABLE	ΛΛΛΛΛΛΛ	ΛΛΛ ΛΛΛ	ΛΛΛ?ΛΛΛ



D. K. Norris, Fig. 1



D. K. Norris, Fig. 2

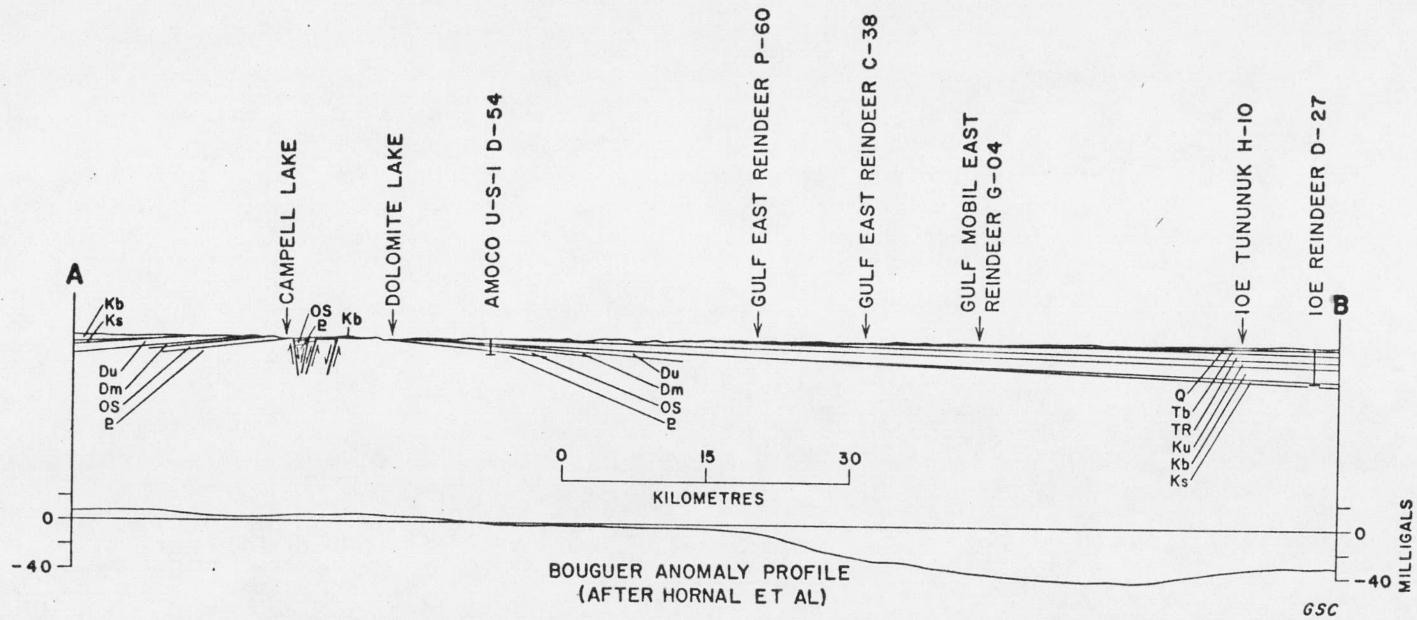


R	Modern delta	Ku	Shale and siltstone	Du	Imperial
Q	Glacial drift	Kl	Shale and sandstone	Dm	Ogilvie
TR	Reindeer	J	Shale and sandstone	OS	Dolomite
KMC	Moose Channel	P	Permian shale and sandstone	Ꞓ	Shale, dolomite, sandstone

Gypsum intrusion. . . . . × Oil or gas well (drilling, abandoned). . . . . ○ ⌀

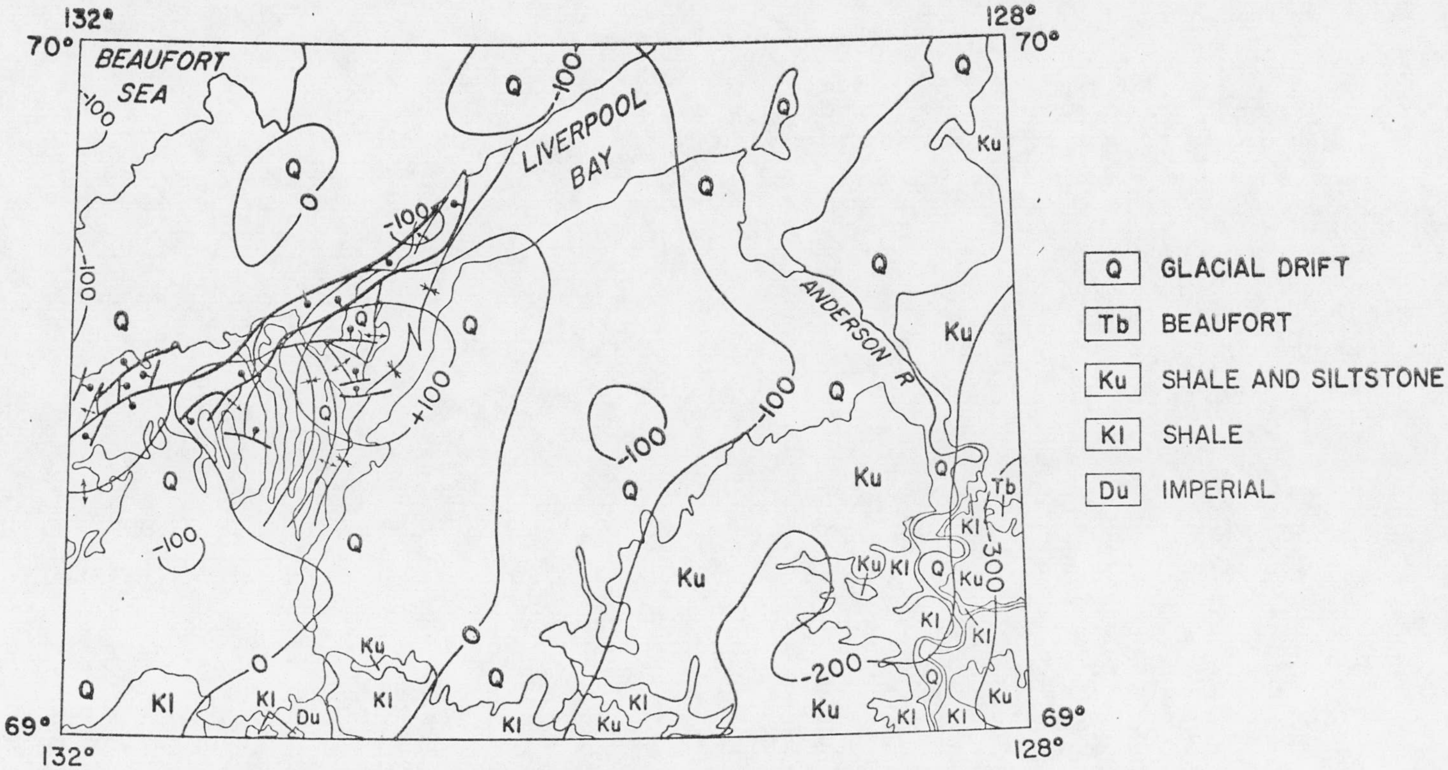
Bouguer anomalies in tenths of milligals after R. W. Hornal et al . . . . —-300—

D. K. Norris Fig. 3



Q	GLACIAL DRIFT
Tb	BEAUFORT FORMATION
TR	REINDEER FORMATION
Ku	UNNAMED SHALE
Kb	BENTONITIC ZONE
Ks	SILTY ZONE
Du	IMPERIAL FORMATION
Dm	OGILVIE & GOSSAGE FM.
OS	DOLOMITE
Ꞓ	SHALE, DOLOMITE, SANDSTONE

D. K. Norris, Fig. 4



Bouguer anomalies in tenths of milligals after R. W. Hornal et al. . . . —-300—

Geology after Yorath et al (1970), Accurate Exploration Ltd. (1960)

Kilometres

0 24

GSC

D. K. Norris Fig. 5