TECTONICS AND STRUCTURE, MACKENZIE CORRIDOR, NORTHWEST TERRITORIES

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INTRODUCTION

The meanings of *structure* and *tectonics* overlap to some extent, but *tectonics* generally applies to the broader, more regional features and includes at least some inquiry into the dynamics (change through time) as well as the causes or forces involved. As used herein *structure* applies to the static (on a human time scale) configuration of rocks whereas *tectonics* applies to features, large or small, whose dynamics (through time in the geological scale) is distinctive. In this report it is mainly the dynamics that are of concern, with little reference to the fundamental forces that caused the movement (rifting, collision, thermal events. . .).

The present structure of the Interior Plains of the Mackenzie Corridor is shown on Figure 1 (Hume) and Figure 2 (Precambrian). These were constructed from well markers without recourse to seismic data, they are, therefore, lacking in detail. Within the synclinoria west of the plains no contouring is attempted, first because detail would be impractical on these small maps but more importantly, seismic data are essential in such areas. Likewise no contours are drawn in the Colville Hills area (Fig. 2) where many of the wells are located on large folds with a structural relief up to hundreds of metres.

Present structure is primarily a consequence of the most recent intense tectonic history which was compression caused by the Columbian – Laramide Orogenies, plus cratonic uplift and warping that accompanied and followed those events. However, present structure also bears a relation, sometimes obvious, more often subtle, to past tectonic events. Figures 3 to 10 are graphic summaries of the main tectonic elements that affected the Mackenzie Corridor and adjacent areas. Each of these maps represents a long time span, sometimes several periods; it must be stressed that tectonic features of any given map were not necessarily active throughout the entire time represented on that map. Figures 11 and 12 show physiography and stylized structure on the same scale as the tectonic maps.

Terms that are commonly used for tectonic elements often have precise meanings. In this report more attention is paid to precedent or common usage than to the dictionary definition; often there is not enough information to offer a precise description. Thus, the terms *arch*, *high*, *uplift* or *platform* may be used for what, strictly speaking, should simply be called a *positive element*, which means (Bates and Jackson, 1980). "A structural feature or area, characterized by conspicuous upward movement (uplift, emergence), by relative stability, or by subsidence that is less rapid or less frequent than that of adjacent *negative elements*." Conversely, the terms *basin*, *embayment* or *trough* signify a negative tectonic element, with no genetic or geometric constraints. *Hinge*, as used herein, denotes a linear belt between areas of markedly different rates of subsidence or uplift. *Ridge* is used as a topographic term for a feature whose relief is not a consequence of differential uplift.

This report is a summary of tectonic history as revealed by a series of Institute of Sedimentary and Petroleum Geology Open File reports (listed at the end of the References). Documentation for the various tectonic features consists mainly in a set of isopach maps accompanying the Open File reports; these maps incorporate surface and subsurface data; most Open File reports contain extensive references. Because this present report is a summary, few references are cited except for those tectonic elements that are not adequately described in the Open File reports.

Precambrian (Figure 3)

There are many more Precambrian tectonic features, either known or postulated, than appear on Figure 3. Those shown are ones that appear to have had some effect on Phanerozoic history.

The Great Slave Lake Shear Zone (Hoffman, 1987) has been interpreted as a continental transform structure related to an oblique collision (about 1.9 Ga) between the Slave and Churchill provinces. Several minor basement faults are mappable within and north of this zone, some of which are associated with paleotopographic irregularities manifest by onlap of Phanerozoic sediments. Examples are the Rabbit Lake and Tathlina Fault zones and the metaquartzite hills associated with the Hay River Fault Zone (Figs. 1, 2).

The nature and significance of the north-south trending junction of the Shield with unmetamorphosed Proterozoic sediments has yet to be determined. Northeast of Great Bear Lake the relationship is, in most places, an unfaulted unconformity (Kearns et al., 1981). At Leith Ridge, which is the southernmost exposure of the contact, it is a set of northeast trending, northwest-side-down normal faults with a calculated throw of at least two kilometres (McGrath and Hildebrand, 1984). Pre-Lower Cambrian erosion left a topographic ridge astride the fault zone which was onlapped by early Paleozoic sediments (Balkwill, 1971). Exposures in this area are too poor to document any later fault movement but some is suspected (unpublished, but can be deduced from Balkwill's map). Bulmer Ridge (Bulmer Lake High or Arch of Meijer Drees, 1975) may be a similar phenomenon, also the quartzite paleo-hills in the Celibeta area (Williams, 1977). The subcrop trace of the Shield/Proterozoic contact coincides approximately with a postulated feature termed the Johnny Hoe suture (Hoffman, 1987), an ancient collision zone (ca 1.86 Ga) deduced from gravity and magnetic data (Hoffman et al., 1982; Hildebrand et al., 1987).

The postulated zone of weakness extending from the 60th parallel to the Colville Hills is almost entirely hypothetical. Northerly trending wrench faults have been deduced in the Colville Hills area (Davis and Willot, 1978) and below the Northern Franklin Mountains (Cook, 1983). For the remainder of the belt the only justification for the postulate is that this belt has been the focus of some pronounced vertical movements, as later maps will show.

The Liard Line is a tectonic element of uncertain nature, it marks a transverse kink in the Cordillera whereby the northern belt is offset to the east (see Aitken and Pugh, 1984, Fig. 4). The nature, or even the orientation of the Liard Line is unknown.

As outlined on Figure 3, the Mackenzie Arch (Aitken, et al., 1973) is defined by the paleogeology at the sub-Paleozoic erosion surface. Within the patterned area erosion was down into the Katherine Group; a minimum of two kilometres of strata are estimated to have been removed. The time (or times) of erosion extends from Late Proterozoic (pre-Windermere) into Late Cambrian. An eastern flank is only mappable for about 150 km, as shown; beyond these limits this feature may have been an arch, or merely a down-to-the-southwest hinge belt.

Strata of the Windermere Supergroup are only preserved in the area west of the Mackenzie Arch. They were deposited in narrow, northwest trending troughs (shown schematically on Fig. 3) during a Late Proterozoic extensional event (Young et al., 1979; Eisbacher, 1981).

Early and Middle Cambrian (Figure 4)

The dominant feature is the sinuous, north-south trending positive belt along the west side of the Mackenzie Corridor. Lower and Middle Cambrian strata are missing over this belt. Over the Mackenzie and Redstone segments of the positive belt the missing section is a consequence of both syndepositional uplift and pre-Late Cambrian erosion. Similar conditions probably prevailed over the Peel and Eskimo Lakes segments; however, Pre-Late Cambrian erosion cannot be demonstrated. Data from the Eskimo Lakes area are too sparse to determine whether this was a linear arch or merely a southeast sloping monocline.

West of the Peel-Mackenzie-Redstone Arch the Selwyn and Richardson basins are thought to have been extensional features; this has been demonstrated in the case of the Misty Creek Embayment (Cecile, 1982). These basins may have been linked in Early Cambrian time but they were separated by the Bonnet Plume Arch through parts of Middle and Late Cambrian time (*ibid*).

Extensional conditions also seem to have prevailed east of the Mackenzie-Redstone Arch, because the Mackenzie Trough is a fairly narrow, deep, graben- or half-graben-like feature, bounded on the east by the sharp, St. Charles-McConnell down-on-the-west Hinge. The Colville Hills Basin is a much larger, broader and shallower feature than the Mackenzie Trough; it's southeastern limit, at present poorly known, may have been a fairly sharp, down-on-the-northwest hinge, an early manifestation of the Brackett Fault (Figs. 1, 2).

The Mackenzie Trough probably extended farther south than shown and connected with the Selwyn Basin in Lower Cambrian time. However, by late Middle Cambrian time there must have been a circulation blockage in the Camsell Bend area that isolated the inland saline sea. Whether this blockage was caused by a tectonic sill or some other factor is unknown.

East of the St. Charles-McConnell Hinge, so far as is known, was a broad mildly positive platform with a thin veneer of Cambrian sediments. However, there is room between control points for another north-northwest trending trough as some have speculated (e.g. AGAT, 1977). Leith Ridge and, possibly, Bulmer Ridge remained as islands.

There is no preserved sedimentary record in the south. The Tathlina Arch may not have been a discrete entity but merely a north-jutting promontory of that much larger feature - the Peace-Athabasca Arch; how far south Cambrian seas extended is unknown.

Late Cambrian-Middle Ordovician (Figure 5)

The western chain of arches was still a prominent feature. Although positive, this chain was flooded in Late Cambrian time. Middle Ordovician was a time of regression; most of the map area other than the Selwyn and Richardson basins was above sea level. Deep erosion occurred over the southern end of the Redstone Arch and over the McConnell Arch.

Middle Ordovician strata are thick in the southern part of Root Basin and there was a connection with the Selwyn Basin to the west. Hence if there had been a tectonic sill in the Camsell Bend area (Fig. 4), it had foundered by Middle Ordovician time. Similarly, there was a connection between the Selwyn Basin and Richardson Trough over the former Bonnet Plume Arch.

A down-on-the-west hinge can be traced farther south than previously (Liard Hinge). The area east of the hinge remained relatively featureless but there was a discernible east limb of the McConnell Arch, evident from the extent of Middle Ordovician erosion.

Middle Ordovician strata have been recognized in three wells in the Eskimo Lakes area (Wielens, 1988). This find confirms the existence of a northern seaway, hence the *Eskimo Lakes Arch* (Fig. 5) instead of the noncommittal *Eskimo Lakes area* (Fig. 4).

There is no preserved record in the Tathlina area, presumably a shoreline traversed the area.

Late Ordovician through Middle Devonian (Figure 6)

Aside from the continuance of the Richardson, Selwyn and Root basins, the switch from negative to positive, and vice versa, of several tectonic elements is quite remarkable. The switchover appears to have been gradual, with the main contrast developing through Late Silurian-Early Devonian time.

There is very little control for the area adjacent the Richardson Trough but the Peel Arch had apparently ceased to exist, except perhaps as a hinge belt along its former western flank. The Mackenzie Arch was much subdued, perhaps nonexistent except for a hinge belt along its western limb. The Twitya Uplift (Cook and Aitken, 1978) on the eastern limb of the former Arch is expressed by local but deep pre-Late Silurian erosion. Of the former arch chain, only the southern end of the Redstone Arch had a distinct eastern limb expressed by pre-Late Ordovician erosion. By Middle Devonian time even this feature was subdued or inert.

The Colville Basin evolved into a broad mildly positive area – the Norman Wells High (Williams, 1975). The Keele Arch (Cook, 1975), on the southern end of this high, was a broad, northerly plunging half-dome; it was deeply eroded in Late Silurian-Early Devonian time. The junction of this dome with the still strongly negative Root Basin is assumed to have been a deep-seated transcurrent fault zone, of which the Brackett Fault

(Fig. 1) is one manifestation. The Keele Arch and Norman Wells High, although flooded, remained mildly positive through Middle Devonian time.

The pre-Middle Devonian history of the Liard Basin is virtually unknown; previous maps (Figs. 4, 5) imply that it may have been a platformal area. By Middle Devonian time the Liard Basin was clearly negative, and probably continuous with the Root Basin. The eastern limb of these features was the still active, down-on-the-west McConnell-Liard hinge belt.

East of the McConnell-Liard Hinge most of the area was stable. The Great Bear Basin is, probably, mainly a basin of preservation (from pre-Middle or late Middle Devonian erosion). The Great Slave Lake Graben, whose earlier history is unknown, contains an anomalous thickness of Lower Devonian evaporitic strata. Middle Devonian sediments confirm that the Tathlina Arch was a distinct tectonic cell at this time; its behavior in Early Devonian time is uncertain but probably positive. The Cordova Embayment was a mild indentation in the Middle Devonian Arch.

Late Devonian - Early Carboniferous (Figure 7)

Late Devonian - Early Carboniferous sediments have been removed from most of the Mackenzie Corridor. From those that remain, in the northwest and in the south, it can be deduced that most of the area east of the mountains was a relatively stable platform. Trend lines suggest that the Norman Wells High may have been mildly positive.

Most of the clastics were delivered via the Franklinian Trough from northeastern Canada and Greenland; however, orogenic highlands were emerging northwest and north of the Mackenzie delta (Ellesmerian Orogeny) and shedding clastics southward, filling the Richardson Trough.

In the south the Tathlina Arch remained mildly positive through most, perhaps all, of Devonian time. By Carboniferous time this feature was no longer positive; it may have been slightly negative.

The Liard Basin (Gabrielse, 1967) was strongly negative, separated from the eastern platform by the Liard-Bovie Hinge. Meagre evidence suggests that the hinge extended farther north (McConnell Hinge) and that the Root Basin, like the Liard Basin, was strongly negative.

There is no available evidence concerning the area of the former Mackenzie-Redstone Arch. There was at least local uplift and erosion in the Bonnet Plume Area near the Devonian-Carboniferous boundary.

Pre-Cretaceous Lacuna (Figure 8)

Figure 8 depicts the geology of the pre-Cretaceous erosion surface (pre-Jurassic in the far northwest). The lacuna varied from several hundred million years in the east to several tens of millions of years in the west. Over much of the Mackenzie Corridor the gap is from Late Devonian to Albian, or about 250 million years. Consequently, the timing of any structural anomalies can be known only within a very broad range.

Carboniferous, Permian and Triassic strata occur only in the southwest and northwest and it is impossible to say how much farther east any of these units may have extended before erosion.

The Mackenzie Corridor probably experienced several cycles of deposition and erosion during the lacuna. This is known to be the case in western areas from several factors: a) Missing Pennsylvanian strata in the Liard Basin (1), indicating non-deposition and/or erosion. (b) Pre-Permian erosion in the northern Yukon; there was considerable pre-Permian tectonism in the Northern Yukon associated with the Ellesmere Orogeny (Douglas et al., 1970). (c) A patch of Triassic is preserved east of the Richardson Anticlinorium (11) indicating pre- as well as post-Triassic erosion.

For most of the Mackenzie Corridor the paleogeology indicates a very large, gentle, half-dome, with the apex in the vicinity of Great Bear Lake. Gentle homoclines sloped westward and southwestward with a discordance at the unconformity measurable in metres or fractions of metres per kilometre. Topography was subdued.

Apart from general uplift and westward tilt, several more local tectonic features are apparent. In the southwest, the Liard Basin (1) was mildly negative, as was the Tathlina Syneclise (2), which coincides approximately with the former Tathlina Arch. Between the Liard Basin and the Syneclise the down-on-the-west hinge must have been active during the lacuna; the Liard segment (3) had a gentle east limb; the Bovie segment, south of the 60th parallel, is manifest by the truncated limits of the Permian and Mattson sandstones (Williams, 1977).

The complexities southwest of Great Bear Lake are partly consequences of tectonic movements before and after the lacuna. The dextral offset along the Brackett Fault (6) is mainly a post-Paleocene phenomenon. The pattern of the South Keele Arch (4) was largely inherited from Devonian uplift and erosion. The apparent anomaly northwest of Norman Wells (7) is caused by thickness and facies changes in the Kee Scarp and Hare Indian formations. The removal of Devonian strata over the North Keele Arch and the crest of the Norman Wells High (8) occurred during the lacuna. Preservation of Devonian strata within the Great Bear Basin (5) suggests down-on-the-south movement along the Brackett Fault. Along the Norman Range (7) and the southwest limb of the South Keele Arch (4) the band of Lower and Middle Devonian subcrop is narrow, in contrast to broad subcrop bands to the north and south. The discordance at the unconformity here is about 5°, in contrast to a few metres per kilometre elsewhere. Prior to being offset by the Brackett Fault this feature was a single, linear hinge. Most of the down-on-the-southwest flexing occurred during the lacuna.

Leith Ridge (9) was probably inherited, and was exhumed during the lacuna. However, some movement along the Leith Fault during the lacuna (in this area, Late Ordovician to Late Cretaceous) can be anticipated.

In the area of the Richardson Anticlinorium (10 & 11) the lacuna spans Late Carboniferous to Albian time (~185 million years). At some time during this span the former trough was uplifted, folded, cut by a series of longitudinal, dextral wrench faults, and bevelled. A hint of when the uplift began may be the presence, in the Bonnet Plume area (10), of an unconformity near the Devonian-Carboniferous boundary. The growth of the anticlinorium was no doubt an amalgam of several erosional events, with the main uplift and erosion being, probably, a Late Carboniferous-Permian (Ellesmerean) event.

The Eskimo Lakes Arch (12) is much more complicated than Figure 8 suggests (see Wielens, 1988). Several episodes of erosion are known to have affected this area from pre-Permian to pre-Late Cretaceous (Young et al., 1976; Dixon, 1986).

The paleogeology in the Darnley Bay area (13) shows a fairly tight syncline. This fold may be a hint that there is an as yet undiscovered deep seated tectonic feature in this area.

Albian (Figure 9)

The pattern in the part of Figure 9 representing the northwest is generalized from Young et al., 1976, and Dixon, 1986. The highland belt includes the Romanzoff, Dave

Lord, Keele, and Cache Creek uplifts; the foredeep includes the Blow, Keele – Kandik and Kugmallit troughs. This plethora of names is, of itself, sufficient to indicate a complex tectonic history in this area. Pre-Albian Cretaceous strata are thick only in this northwestern trough and in the Liard Basin. Elsewhere, the bulk of Lower Cretaceous sediments are Albian.

Because of deep post-Cretaceous erosion it is not possible to compile meaningful isopach maps. However, from the fact that only relatively fine grained, marine shelf deposits are known (apart from a basal sandstone) it can be deduced that the Mackenzie Corridor was the northern end of an extensive foreland basin with no preserved proximal deposits, with the possible exception of in the Liard Basin (Stott, 1982). Most of the nearshore Albian deposits, which would have lain southwest of the great arc of the Mackenzie Mountain Front (Fig. 1), would have been cannibalized in the late stages of the Columbian-Laramide orogeny.

Note that in this scenario there was no Peel Trough or Keele Arch, as per Yorath and Cook, 1981. The former is merely a late Laramide syncline, the latter feature arose in latest Albian at the earliest.

Mid-Cretaceous (Figure 10)

The ambiguous term mid-Cretaceous is used intentionally to cover two events that may or may not be related in time or by cause. For various reasons the mid-Cretaceous history is not, probably cannot be, well known except in the Mackenzie delta area. The reasons include lack of preserved strata and poor outcrop. Figure 10 shows the only two areas where mid-Cretaceous tectonic uplifts are known or suspected. Over a part of the

Eskimo Lakes Arch pre-Late Coniacian erosion removed all earlier Cretaceous strata (Dixon, 1986).

The other feature, west of Great Bear Lake, is an area over which most or all Albian strata are missing, presumably because of pre- or Early Cenomanian erosion. This area is the Keele Arch of Yorath and Cook (1981). As interpreted herein, it was not strictly speaking an arch but a fold belt, the ancestral Franklin Mountains. This resulted from a compressive event, either a late Columbian or early Laramide pulse. The uplifted belt affected at least the northern part of the former Root Basin, the ancient Keele Arch, and may have extended northward to include the Colville Hills.

Late Cretaceous to the present (Figures 11 and 12)

Uplift and compression of the Laramide Orogeny produced the present structural configuration; the major structural elements exert a dominant influence on physiography. The most intensive deformation occurred in the western cordillera, including the Mackenzie Mountains. Less intense but still significant expressions of Laramide compressive events are the Franklin Mountains, the folds of the Liard Plateau, the Mackenzie Plain, the Richardson Mountains and, probably, some upthrusting within the Eskimo Lakes Fault Zone (section AB, Fig. 1, the latter left no physiographic expression). The Colville Hills are also probably a consequence of Columbia-Laramide compression; however, in this case, the folding may be more directly related to reactivation of deep seated faults than to compressive shortening. All of the above structural features overlie the more restless tectonic elements featured in the previous maps. It is especially noteworthy that the major folds of the Southern Franklin Mountains coincide with the ancient McConnell-Liard Hinge Belt. Note that the Mackenzie Plain, the Northern Franklin Mountains and the Colville

Hills coincide with the ancient Mackenzie Trough – Root Basin; this is the main reason for postulating an underlying zone of weakness in Precambrian strata (Fig. 3).

Following (and probably concurrent with) the final stages of deformation in the Cordillera, Tertiary sediments were deposited over much of, if not the entire area of the Interior Plains, these sediments have largely been removed by late Tertiary-Recent erosion. Remnants of Paleocene strata occur in two late Laramide downwarps – the Brackett and Bonnet Plume basins. The former basin owes its existence to about two kilometres of post-Paleocene down-on-the-south movement across the Brackett Fault.

The plateau areas (Fig. 11) bear little, if any, relation to tectonic cells, although the Peel Plateau (as shown, only the northern part of the Peel Plateau of Bostock, 1970) may be high in part because of continuing uplift of the Richardson Mountains. The Trevor Plateau (informal name) is held up by relatively resistant, nearly flat-lying Cretaceous sand layers (Trevor Formation). Both the Peel and Trevor plateaus occur over major synclinoria (Fig. 12).

Plateau areas farther east are erosional remnants of flat-lying Cretaceous strata. Those in the south (Horn Plateau, Cameron Hills, and Trout Lake Highlands) are dissected by deep pre-glacial valleys filled by glacial deposits.

The Brackett and Bonnet Plume basins are both late-Laramide structural downwarps. The former basin owes its existence to about 2 kilometres of down-on-the-south movement on the Brackett Fault.

Discussion

This review of tectonic features has reinforced an ancient truism: zones of crustal weakness remain weak, seemingly forever. The best example is the Richardson lineament;

a second example is the Mackenzie Trough-Keele Arch – Root Basin-Mackenzie Plain feature.

Within the map area are several examples of arches becoming basins, and vice versa. Again the Richardson lineament is a good example: a trough, an anticlinorium, a bevelled peneplain, presently a low mountain range. The history of the Mackenzie Trough is more complex; one section evolved into the Keele Arch whereas the southern segment, the Root Basin, remained a trough. Presently both Keele Arch and Root Basin comprise the physiographic or structural entities known as the Mackenzie Plain or Mackenzie Synclinorium. The Colville Hills Basin was mildly negative through earliest Paleozoic time, then it evolved into the Norman Wells High, perhaps as early as Late Ordovician but certainly by Late Silurian time; this feature has remained mildly positive to the present and forms a physiographic as well as a structural high. The Devonian Tathlina Arch, whose pre-Devonian history is unknown, became mildly negative and remains a syneclise.

The profound structural inversion (negative-positive) so evident between Figures 5 and 6 must indicate equally profound changes in the stress regime. The time of this change is uncertain. The change first shows in isopachs of the Mt. Kindle Formation (Late Ordovician-Early Silurian) but this could have been caused by Late Silurian-Early Devonian erosion. Probably the change in the stress field occurred in Late Silurian-Early Devonian time.

Aside from the northeast trending Eskimo Lakes feature there are other obvious transverse tectonic features. The Great Slave Lake Shear Zone is most obvious from magnetic data (Hildebrand et al., 1987) but it is also manifest by basement structure (Fig. 2), not as a single fault but as a series of basement irregularities (including the Steen

River 'astrobleme'). Other influences of this feature are hard to demonstrate, it may somehow be related to the growth and death of the Tathlina Arch, the Great Slave Lake Graben, as well as the development of the Keg River – Slave Point carbonate complex.

A second obvious transverse feature is the Brackett Lineament: the northern end of the St. Charles-McConnell Hinge and platform to the east (Cambrian), the northern limits of the Great Bear and Root Basins (Silurian-Devonian), preservation of the Brackett Basin and post-Paleocene dextral movement.

Another possibly profound transverse lineament is an extension of the Leith Fault trend (Fig. 2) southwestward to the vicinity of the Liard Line (Fig. 3) as proposed by Aitken and Pugh, 1984. Note that this line passes through the Camsell Bend area (Fig. 4) where there may have been a tectonic sill in Cambrian time that sank by Middle Ordovician time (Fig. 5).

Where the transverse Brackett Fault trend intersects with the dominant northwesterly trend (i.e. the Mackenzie Trough, Fig. 4) is an area particularly prone to "yo-yo" tectonics: a part of a Cambrian into Ordovician trough, a part of a Silurian to Devonian arch, a part of a pre-Cretaceous Hinge and, finally a post-Paleocene downwarp. An area with a similar, or even greater "yo-yo" history is the Bonnet Plume Basin; as yet no deep-seated transverse feature is known to underlie this area.

The Fort Norman structure (Aitken and Pugh, 1984), shown on Figure 2, is based on tentative identification of Precambrian formations in the subsurface. If the identifications are correct, a northwesterly dip in the order of 5° is indicated. This could be a continuation of the Coppermine Homocline (Fig. 3).

The general structural configuration of the Interior Plains (Figs. 1, 2, 12) was obviously inherited from earlier times; Pre-Cretaceous geology (Fig. 8) shows an almost identical geometry. North of the Brackett Fault the pattern is even more ancient, going back at least to Devonian time (Fig. 6).

Some unused tectonic names

Several well known names are not used in this review. In some cases they were deemed unsuitable, in other cases they were omitted because they apply to features either not detected, or peripheral to, this study. Following is a partial list.

Aklavik Arch

As used by Norris, 1974, this is a composite of several positive elements which, as a whole, trends northeasterly and extends (in Canada) from the Alaska border to east of the Mackenzie delta. In the report area the term *Eskimo Lakes Fault Zone or Arch* is used for what is the northeastern end of the Aklavik Arch complex. The Cambell Uplift (Fig. 2) is part of this complex. To the southwest, the edge of the positive complex coincides with the eroded southeastern limit of Permian strata, Figure 8.

Bulmer Lake Arch (Bulmer Ridge, Figure 3)

This was considered to have been a paleotopographic as well as a tectonic feature by Meijer Drees, 1975. Only two wells have been drilled in the Bulmer Lake area; there is an anomaly, but its nature is uncertain. Strata tentatively identified as Proterozoic (e.g., C-35 and F-72, contour map, Fig. 2) may actually be Cambrian sandstone, in which case the anomaly is stratigraphic, rather than tectonic. If the Proterozoic strata are indeed Proterozoic then the anomaly may be mainly topographic, like the Leith Ridge. Several geologists have used the term *Bulmer Arch* to denote a large area to the north-northwest, including the McConnell Arch (Fig. 5). This usage links, under one name, two discrete elements with very different histories, i.e. the McConnell Hinge and the Leith-Bulmer-Celibeta line.

Coppermine Arch

As used by Douglas et al., 1970, the Coppermine Arch extends north from the Brock Inlier (Fig. 2) to the southern end of Banks Island. The distribution of Proterozoic formations within the Brock Inlier, as shown on Figure 2 of Yorath and Cook, 1981, indicates a much-faulted anticline or south plunging dome. Contours on the Proterozoic (Fig. 2) indicate a structural high. The time of origin of this feature cannot be determined.

Fort Rae Arch (Douglas and Norris, 1960)

This is the basement high northwest of the Great Slave Lake Graben (Figs. 2, 6). When this arch was named, the Devonian redbeds of the graben were thought to be Cambrian, hence it was conceived to have been an arch in Cambrian time, and, it was speculated, an extension of the then unnamed Tathlina Arch.

MacDonald Platform (Gabrielse, 1967)

This is a positive belt southwest of the Liard Basin; most of the belt lies in British Columbia. By extension northward the term could be used for the area south of the Liard Line (Fig. 3).

Mackenzie Basin

This term usually means the Mackenzie River Drainage Basin. However, some writers use the term to mean the seaward shaly facies equivalent to and overlying the Devonian Keg River to Slave Point carbonate complex, i.e., the area northwest of the Slave Point edge, Figure 1. In this sense the basin would extend as far as the Arctic coast, and have no tectonic meaning.

Mackenzie Shelf (Morrow, 1984)

This is an area from the northeastern rim of the Selwyn Basin eastward to the McConnell-Liard Hinge. The term denotes the mountainous area wherein Lower Paleozoic shallow water shelf carbonate deposition was dominant, in contrast to a basinal facies in the Selwyn Basin. The Mackenzie Shelf includes the Mackenzie-Redstone Arch and the Root Basin.

Meilleur River Embayment (Bassett and Stout, 1967)

This term denotes an area that includes the southeastern end of the Selwyn Basin and the southwestern part of the Root Basin wherein Devonian basinal strata are rimmed to the east and south by shelf carbonates, i.e., an embayment into the Mackenzie Shelf of Morrow, 1984. Ordovician and Silurian sediments display a similar configuration and facies change.

Peel or Peel-Carcajou Trough (Gabrielse, 1967)

This is a belt immediately north of the northern (or west to east trending) segment of the Mackenzie Mountains. This area was conceived to have been a tectonic trough in

Cretaceous time by Yorath and Cook, 1981; it is herein considered to be merely a Laramide downwarp in which thick Cretaceous shelf sediments are preserved.

Willow Lake Basin (Law, 1971)

Devonian sediments thicken northward from the Tathlina Arch (Fig. 6) and then thin northeastward toward the outcrop belt. Much of the northeastward thinning is due to leaching of Devonian evaporites.

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GEOLOGICAL SURVEY OF CANADA OPEN FILE REPORTS
MACKENZIE CORRIDOR, NORTHWEST TERRITORIES
BY G.K. WILLIAMS, I.S.P.G., CALGARY

Open File 761
1981

MIDDLE DEVONIAN CARBONATE, BARRIER-COMPLEX OF WESTERN CANADA

A set of six maps (1:1 000 000) and two cross-sections illustrating the setting and development of the barrier from British Columbia to the Great Slave Lake area; brief notes.

Open File 762
1981

SUBSURFACE GEOLOGICAL MAPS, SOUTHERN NORTHWEST TERRITORIES (NTS 85, 95)

This open file consists of a set of 11 geological maps at a scale of 1:500 000 showing: isopachs of Upper Devonian and younger units (Maps 1 to 5); structure on the Paleozoic Jean Marie, and Slave Point-Hume (Maps 6 to 8); Fort Vermilion facies (Map 9); and drill stem tests north of 60° (Map 10).

Open File 793
1981

GEOLOGICAL WORKSHEETS, SUBSURFACE AND SURFACE DATA, LOWER AND MIDDLE DEVONIAN STRATA, SLAVE-REDSTONE MAP AREAS, YUKON AND NORTHWEST TERRITORIES

This unedited map compilation consists of two geological worksheets of the Slave-Redstone map areas (NTS 85 and 95) at a scale of 1:500 000 comprising subsurface and surface data of Lower and Middle Devonian strata.

Map No. 1: Isopachs, top of Slave Point Fm. to base of Devonian or top of Lonely Bay Fm. to base of Devonian or top of Nahanni Fm. to base of Delorme Fm.; markers, top and base of isopached interval; references regarding measured outcrop sections.

Map No. 2: Facies transition belts, or mappable limits of Camsell breccia, Mirage Point redbeds, Ernestina Lake carbonate, Cold Lake-Bear Rock salt, Chinchaga-Bear Rock anhydrite, Sombre to Nahanni carbonates. Western half (NTS 85) shows generalized lithology and drill stem test results at the Headless-Manetoe-Ebbutt level.

Open File 818
1981

DOLOMITIZATION PATTERN OF THE KEG RIVER BARRIER COMPLEX

Four maps, 1:500 000, southern Northwest Territories and southeastern Yukon, southern halves of NTS 85 and 95.

Maps 1 and 2 show well markers, thickness, dolomitization pattern and drill stem test results for the Keg River platform and approximately equivalent strata north of the barrier. Maps 2 and 3 pertain to the Keg River barrier carbonate and homotaxial strata; they show thickness, dolomitization pattern, drill stem test results and the main facies belts. Some features that may have influenced the path of the dolomitizing fluids are shown: nature of enclosing strata, basement faults, highs or arches, and the extent of Watt Mountain karsting.

Open File 1273
1985

PROTEROZOIC GEOLOGY OF THE MACKENZIE CORRIDOR (85, 95-97, 105-107)

Map (1:1.5 million), strip logs, correlation charts and brief text.

Open File 1228
1985

KEE SCARP PLAY, NORMAN WELLS AREA, NORTHWEST TERRITORIES

This unedited open file consists of three 1:50 000 maps, three semi-diagrammatic cross-sections, and a graphic illustration of some concepts regarding depositional history. The maps cover an area between latitudes 65° to 68°N and longitudes 125° and 132°W, and present: 1) well markers Canol to Hume formations; 2) isopachs, Kee Scarp Formation; and 3) a prospecting guide. A brief text dealing mainly with concepts completes the file.

Open File 1336
1986

HUME FORMATION, LOWER MACKENZIE RIVER AREA, DISTRICT OF MACKENZIE (96, 97, 106, 107)

Two maps (1:1 000 000), 65°N to the Arctic coast showing isopachs and nature of the Hume Formation, 8 p.

Open File 1353
1986

MIDDLE DEVONIAN FACIES BELTS, MACKENZIE CORRIDOR, DISTRICT OF MACKENZIE (85, 95, 96, 97, 105, 106, 107)

One map (1:1 300 000), 60°N to the Arctic coast showing facies belts and isopachs of the Horn River and equivalent formations, 10 p.

Open File 1401
1986

MAP OF UPPER DEVONIAN AND YOUNGER PALEOZOIC ROCKS, MACKENZIE CORRIDOR, DISTRICT OF MACKENZIE

One map (1:1 270 000) 60°N to the Arctic coast showing facies belts and isopachs of the Imperial Formation, 12 p.

Open File 1429
1987

CAMBRIAN GEOLOGY OF THE MACKENZIE CORRIDOR, DISTRICT OF MACKENZIE

Four maps (1:2 000 000), 60°N to the Arctic coast, showing distribution of the basal sandstone, of the salt, and isopachs of total section below the Franklin Mountain Formation, 58 p.

Open File 1742
1988

A REVIEW OF THE BONNET PLUME AREA, EAST-CENTRAL YUKON TERRITORY (INCLUDING SNAKE RIVER, SOLO CREEK, NOISY CREEK AND ROYAL CREEK AREAS)

This report reviews the stratigraphic and tectonic complexities of the area, 70 p. (including 19 Figs.).

Open File 2045
1989

TECTONIC EVOLUTION OF THE FORT NORMAN AREA, MACKENZIE CORRIDOR, NORTHWEST TERRITORIES

The report area includes the Keele Arch and it's junction with the Root Basin, tectonic evolution is illustrated using isopach maps and cross-sections, 98 p. (including 44 Figs.).

Open File 2129
1989

THE ROOT BASIN

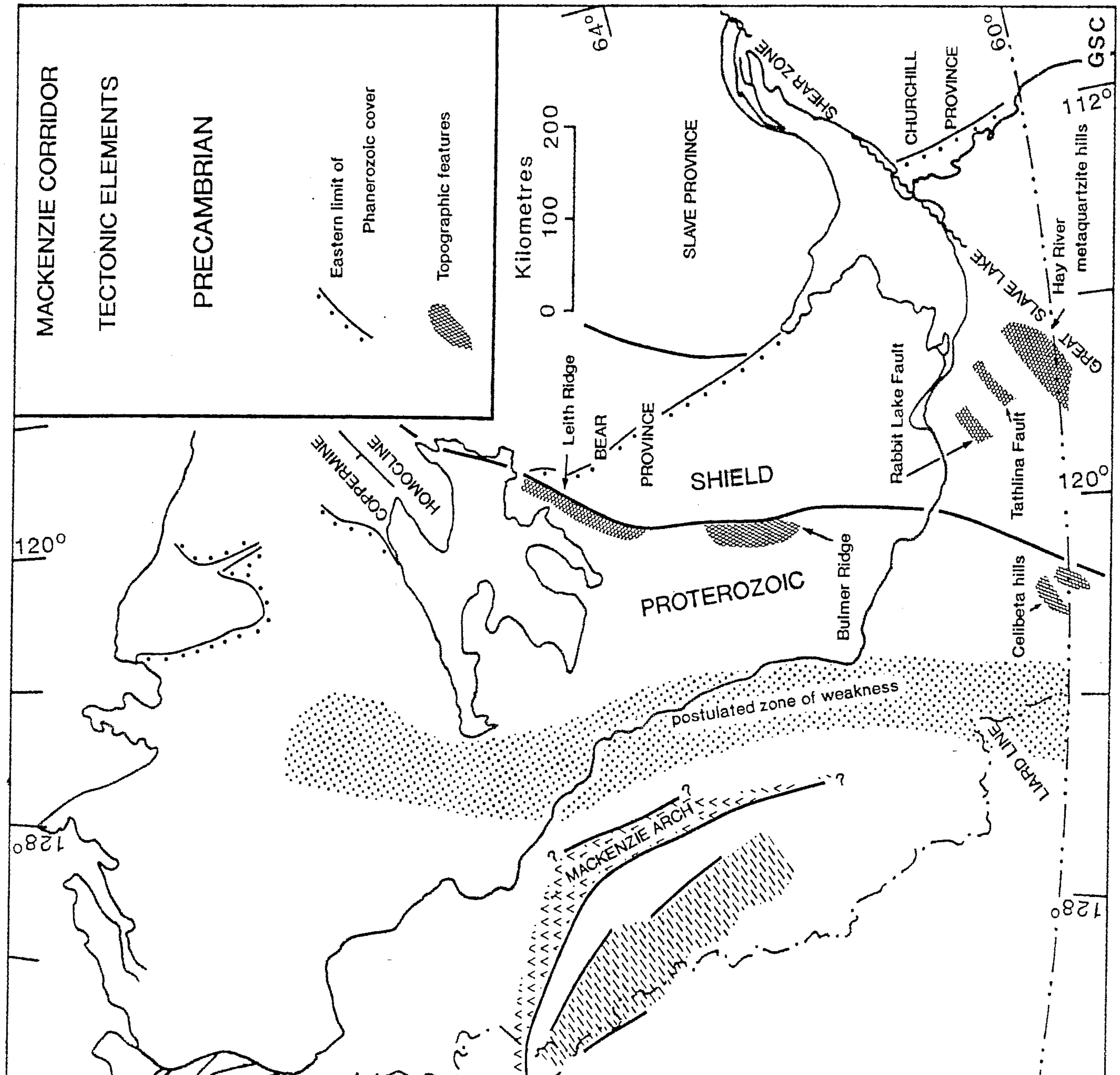
This report reviews the stratigraphy, emphasizing correlation and stratigraphic problems. Isopach maps illustrate the basins' architecture and the role of syndepositional faulting is investigated 73 p. (including 21 Figs.).

Open File
in prep.

THE RONNING AND DELORME GROUPS, MACKENZIE CORRIDOR

This report will include 5 maps (1:2 000 000) from 60°N to the Arctic coast: isopachs of the Franklin Mountain, Mt. Kindle formations and of the Delorme Group, a sub-Franklin Mountain and a sub-Mt. Kindle paleogeological map.

Figure 3



MACKENZIE CORRIDOR
TECTONIC ELEMENTS
PRECAMBRIAN
Eastern limit of
Phanerozoic cover
Topographic features
Kilometres
0
100
200
SLAVE PROVINCE
SHEAR ZONE
CHURCHILL
PROVINCE
GREAT SLAVE LAKE
Hay River
metaquartzite hills
Rabbit Lake Fault
Tathlina Fault
Leith Ridge
BEAR
PROVINCE
SHIELD
COPPERMINE
HOMOCLINE
PROTEROZOIC
Bulmer Ridge
Celibeta hills
postulated zone of weakness
LIARD LINE
MACKENZIE ARCH
Windermere rifts
GSC
64°
60°
112°
120°
128°
136°
68°

Figure 4

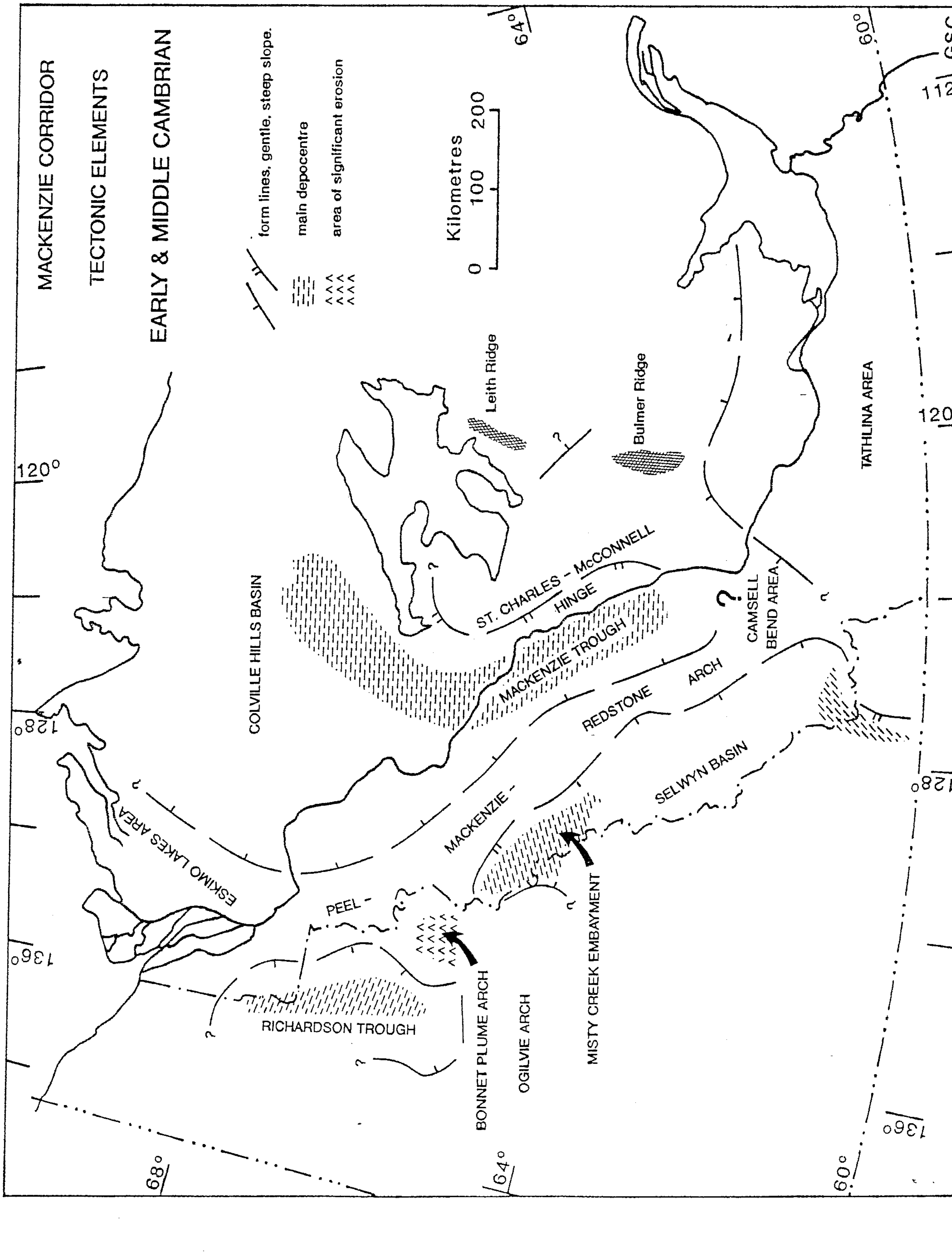
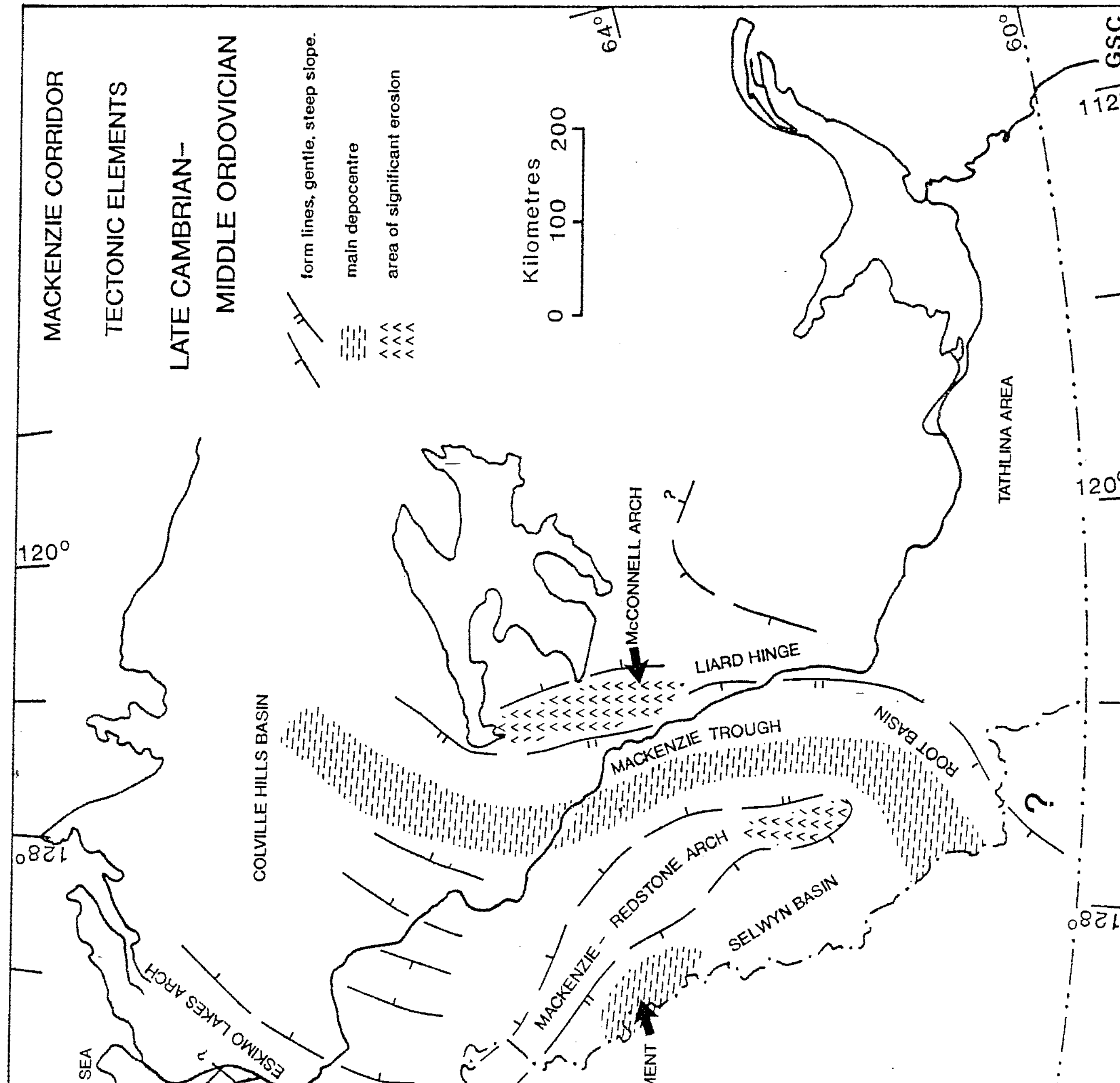

MACKENZIE CORRIDOR
TECTONIC ELEMENTS
EARLY & MIDDLE CAMBRIAN
form lines, gentle, steep slope.
main depocentre
area of significant erosion
Kilometres
0
100
200
Leith Ridge
Bulmer Ridge
COLVILLE HILLS BASIN
ST. CHARLES - McCONNELL HINGE
MACKENZIE TROUGH
CAMSELL BEND AREA
TATHLINA AREA
REDSTONE ARCH
MACKENZIE
SELWYN BASIN
ESKIMO LAKES AREA
PEEL
RICHARDSON TROUGH
BONNET PLUME ARCH
OGILVIE ARCH
MISTY CREEK EMBAYMENT
68°
64°
60°
120°
128°
136°
112°
GSC

Figure 5



MACKENZIE CORRIDOR
TECTONIC ELEMENTS
LATE CAMBRIAN–
MIDDLE ORDOVICIAN
form lines, gentle, steep slope.
main depocentre
area of significant erosion
Kilometres
0
100
200
64°
60°
112°
120°
128°
136°
68°
GSC
TATHLINA AREA
McCONNELL ARCH
LIARD HINGE
COLVILLE HILLS BASIN
MACKENZIE TROUGH
ROOT BASIN
REDSTONE ARCH
MACKENZIE –
SELWYN BASIN
ESKIMO LAKES ARCH
BEAUFORT SEA
PEEL
MISTY CREEK EMBAYMENT
RICHARDSON TROUGH
OGILVIE ARCH

Figure 6

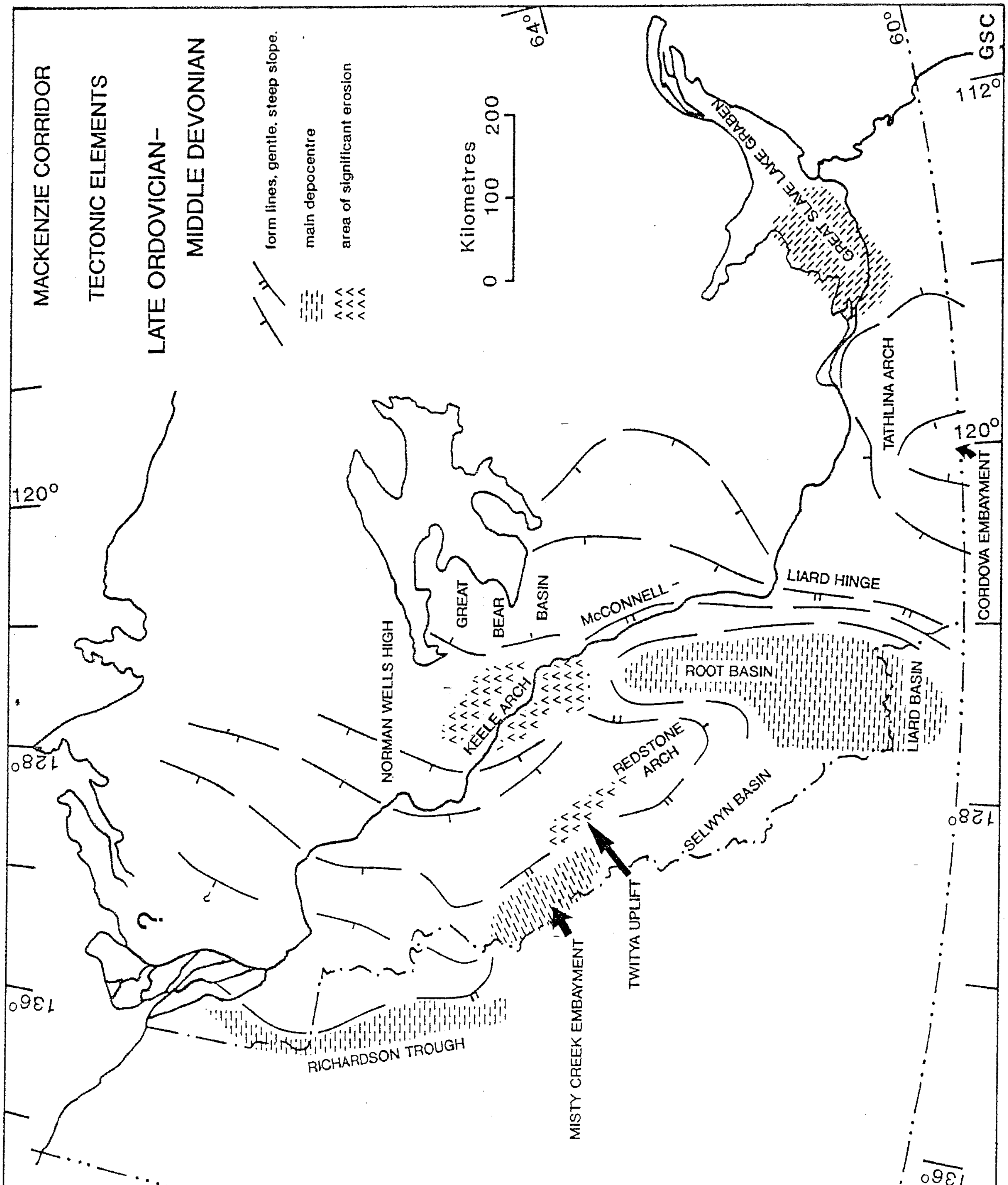
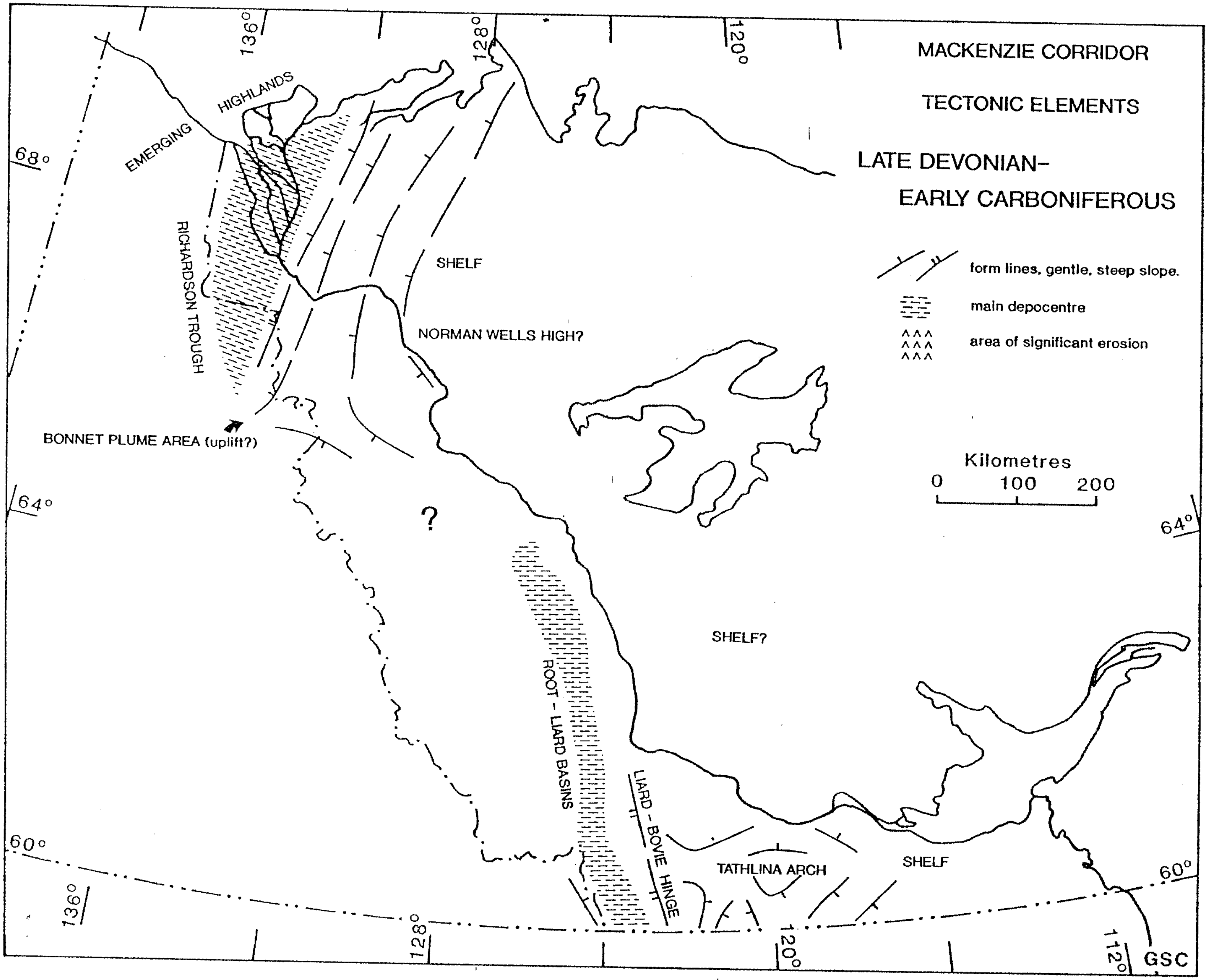

MACKENZIE CORRIDOR
TECTONIC ELEMENTS
LATE ORDOVICIAN–
MIDDLE DEVONIAN
form lines, gentle, steep slope.
main depocentre
area of significant erosion
Kilometres
0
100
200
GREAT SLAVE LAKE GRABEN
TATHLINA ARCH
CORDOVA EMBAYMENT
LIARD HINGE
McCONNELL
GREAT
BEAR
BASIN
NORMAN WELLS HIGH
KEELE ARCH
ROOT BASIN
LIARD BASIN
REDSTONE
ARCH
SELWYN BASIN
TWITYA UPLIFT
MISTY CREEK EMBAYMENT
RICHARDSON TROUGH
?
64°
60°
68°
112°
120°
128°
136°
GSC

Figure 7


MACKENZIE CORRIDOR
TECTONIC ELEMENTS
LATE DEVONIAN-
EARLY CARBONIFEROUS
form lines, gentle, steep slope.
main depocentre
area of significant erosion
Kilometres
0
100
200
68°
64°
60°
136°
128°
120°
112°
64°
60°
136°
128°
120°
EMERGING
HIGHLANDS
RICHARDSON TROUGH
SHELF
NORMAN WELLS HIGH?
BONNET PLUME AREA (uplift?)
?
SHELF?
ROOT - LIARD BASINS
LIARD - BOVIE HINGE
TATHLINA ARCH
SHELF
GSC

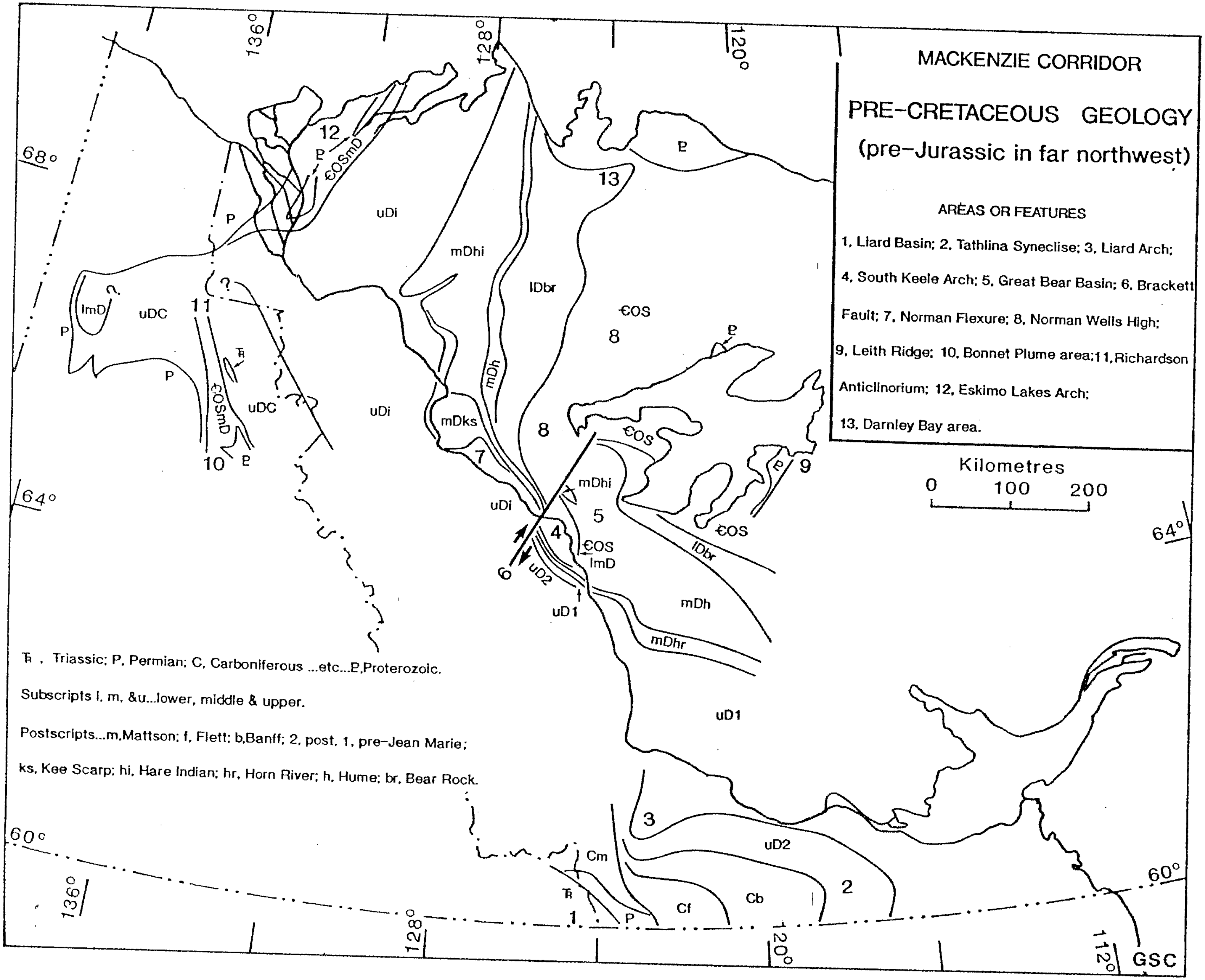
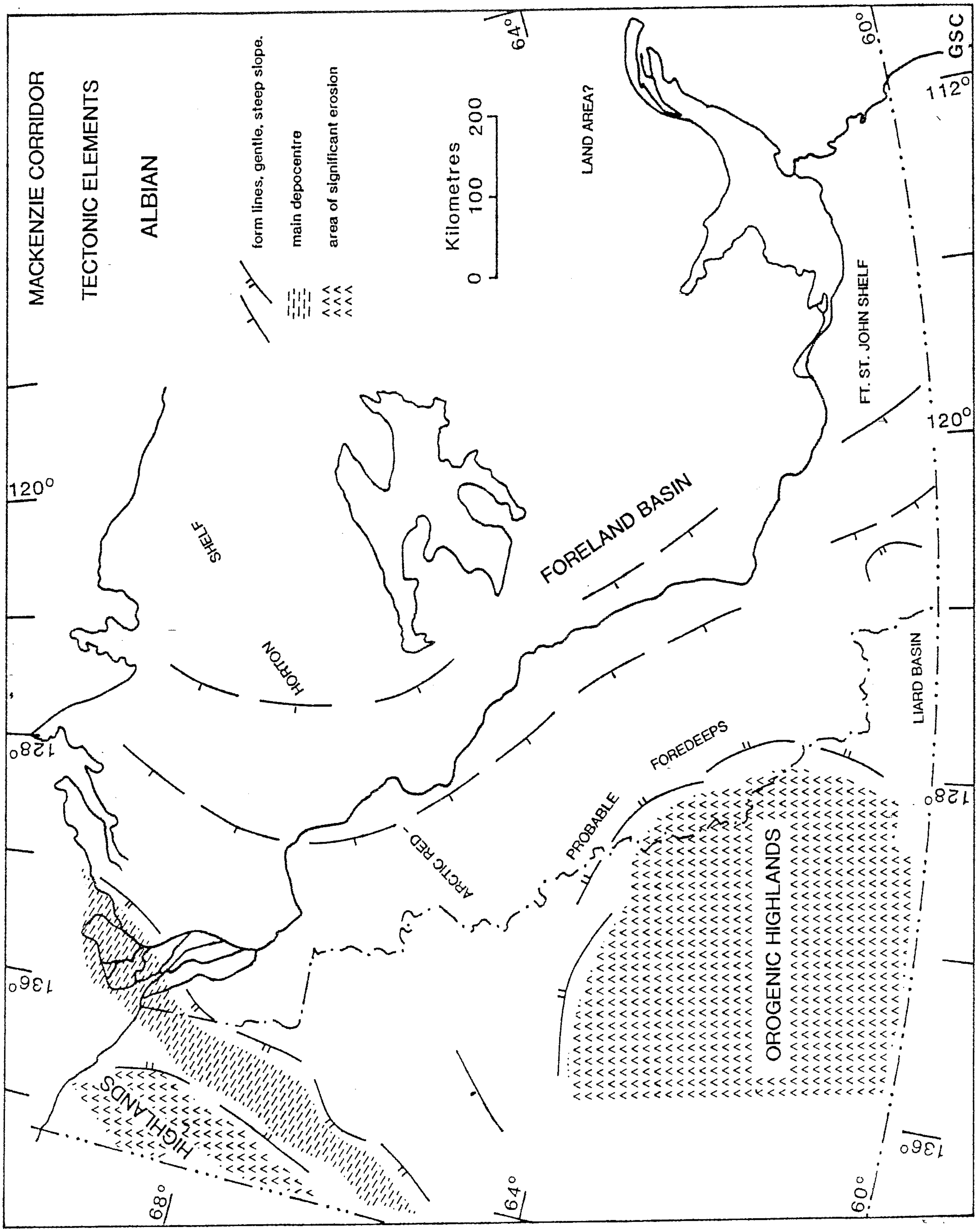

MACKENZIE CORRIDOR
PRE-CRETACEOUS GEOLOGY
(pre-Jurassic in far northwest)
AREAS OR FEATURES
1, Liard Basin; 2, Tathlina Syneclise; 3, Liard Arch;
4, South Keele Arch; 5, Great Bear Basin; 6, Brackett
Fault; 7, Norman Flexure; 8, Norman Wells High;
9, Leith Ridge; 10, Bonnet Plume area;11,Richardson
Anticlinorium; 12, Eskimo Lakes Arch;
13, Darnley Bay area.
Kilometres
0 100 200
Ꞧ, Triassic; P, Permian; C, Carboniferous ...etc...Ᵽ,Proterozoic.
Subscripts l, m, &u...lower, middle & upper.
Postscripts...m,Mattson; f, Flett; b,Banff; 2, post, 1, pre-Jean Marie;
ks, Kee Scarp; hi, Hare Indian; hr, Horn River; h, Hume; br, Bear Rock.
136°
128°
120°
112°
68°
64°
60°
uDi
mDhi
lDbr
mDh
mDks
€OS
€OSmD
uDC
lmD
uD1
uD2
mDhr
Cm
Cf
Cb
GSC

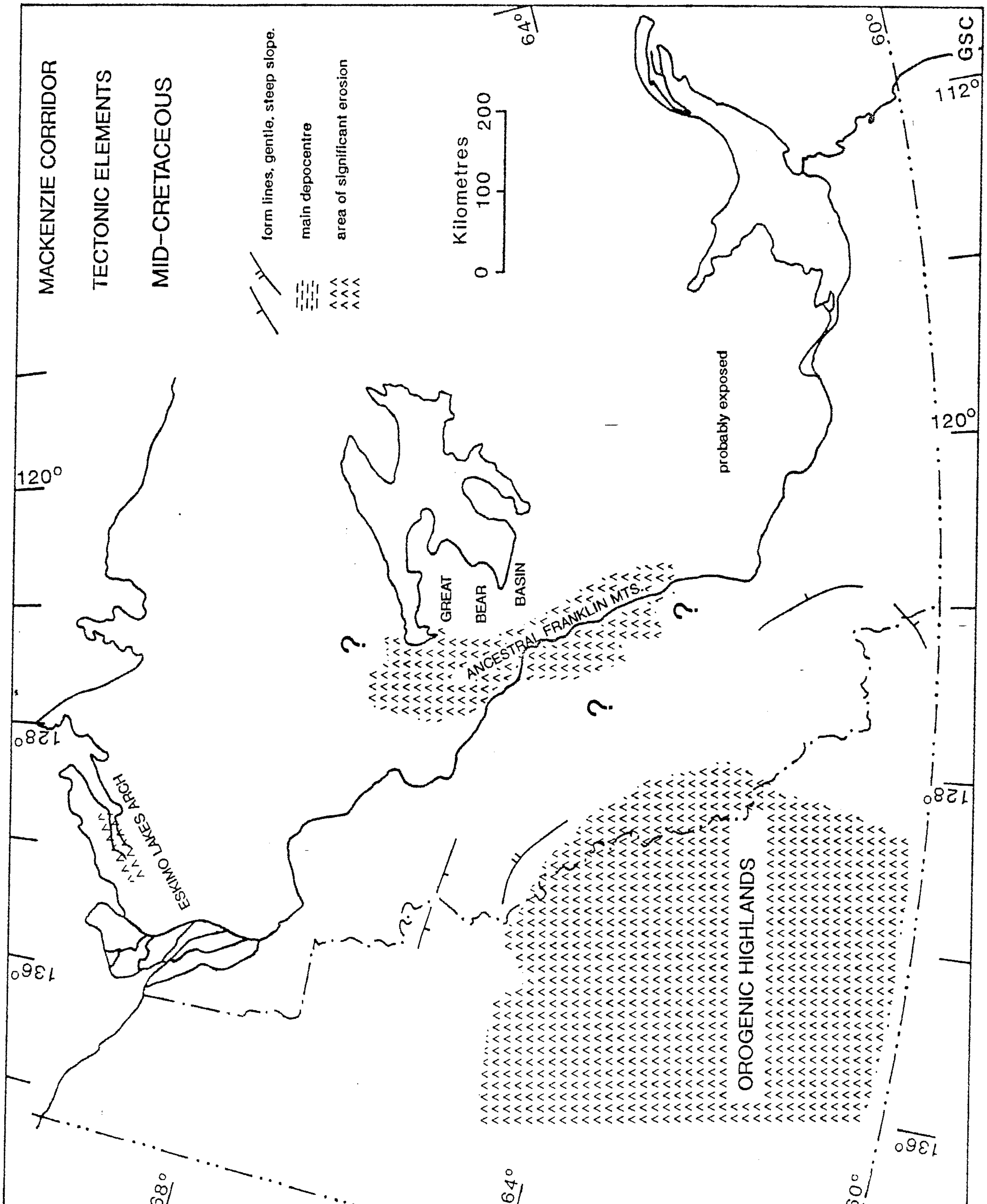
Figure 8

Figure 9



MACKENZIE CORRIDOR
TECTONIC ELEMENTS
ALBIAN
form lines, gentle, gentle, steep slope.
main depocentre
area of significant erosion
Kilometres
0 100 200
LAND AREA?
SHELF
HORTON
FORELAND BASIN
FT. ST. JOHN SHELF
LIARD BASIN
PROBABLE FOREDEEPS
ARCTIC RED
OROGENIC HIGHLANDS
HIGHLANDS
GSC
64°
60°
68°
112°
120°
128°
136°

Figure 10


MACKENZIE CORRIDOR
TECTONIC ELEMENTS
MID-CRETACEOUS
form lines, gentle, steep slope.
main depocentre
area of significant erosion
Kilometres
0
100
200
GREAT
BEAR
BASIN
ANCESTRAL FRANKLIN MTS.
probably exposed
ESKIMO LAKES ARCH
OROGENIC HIGHLANDS
GSC
64°
60°
112°
120°
128°
136°
68°

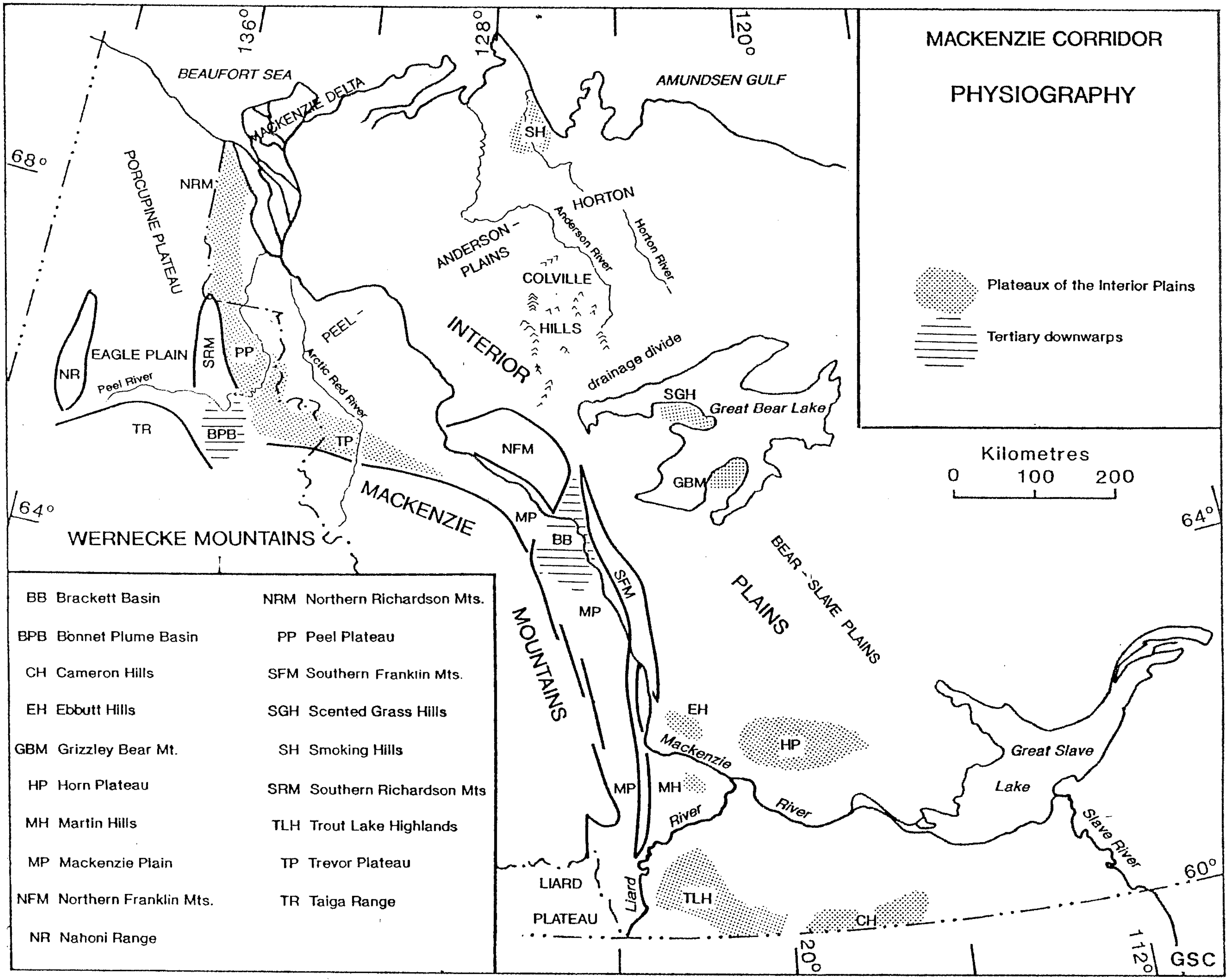
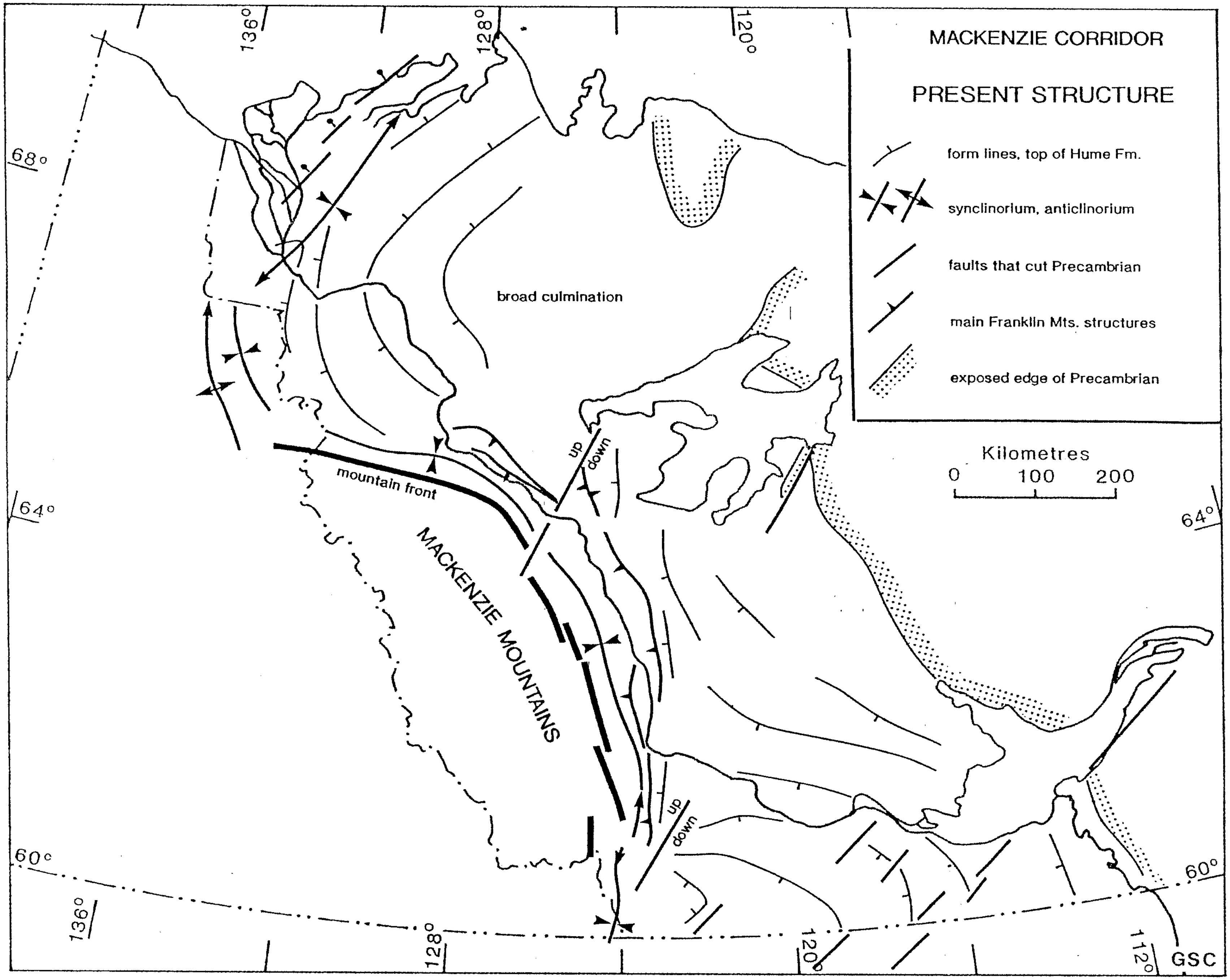

MACKENZIE CORRIDOR
PHYSIOGRAPHY
Plateaux of the Interior Plains
Tertiary downwarps
Kilometres
0 100 200
BEAUFORT SEA
AMUNDSEN GULF
MACKENZIE DELTA
136°
128°
120°
112°
68°
64°
60°
PORCUPINE PLATEAU
EAGLE PLAIN
Peel River
NR
NRM
SRM
PP
TR
BPB
TP
PEEL
Arctic Red River
SH
HORTON
Horton River
Anderson River
ANDERSON - PLAINS
COLVILLE
HILLS
INTERIOR
drainage divide
SGH
Great Bear Lake
GBM
NFM
MP
BB
SFM
MACKENZIE
MOUNTAINS
WERNECKE MOUNTAINS
PLAINS
BEAR - SLAVE PLAINS
EH
HP
MH
Mackenzie
River
Great Slave
Lake
Slave River
Liard
LIARD
PLATEAU
TLH
CH
GSC
BB Brackett Basin
BPB Bonnet Plume Basin
CH Cameron Hills
EH Ebbutt Hills
GBM Grizzley Bear Mt.
HP Horn Plateau
MH Martin Hills
MP Mackenzie Plain
NFM Northern Franklin Mts.
NR Nahoni Range
NRM Northern Richardson Mts.
PP Peel Plateau
SFM Southern Franklin Mts.
SGH Scented Grass Hills
SH Smoking Hills
SRM Southern Richardson Mts
TLH Trout Lake Highlands
TP Trevor Plateau
TR Taiga Range

Figure 11


MACKENZIE CORRIDOR
PRESENT STRUCTURE
form lines, top of Hume Fm.
synclinorium, anticlinorium
faults that cut Precambrian
main Franklin Mts. structures
exposed edge of Precambrian
Kilometres
0
100
200
broad culmination
mountain front
MACKENZIE MOUNTAINS
up
down
up
down
68°
64°
60°
64°
60°
136°
128°
120°
136°
128°
120°
112°
GSC