FACIES RELATIONSHIPS AT THE MISSISSIPPIAN CARBONATE PLATFORM MARGIN, WESTERN CANADA

by

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Abstract

In the Eastern Cordillera and western Plains of Canada, the Mississippian succession consists of an eastern belt of thick, platform carbonates and detrital clastics that grade laterally into a western belt of thin, basinal shale across a transitional platform margin with a very low depositional slope. This facies change is accompanied by marked stratigraphic condensation. The eastern facies belt consists almost entirely of carbonates in the southern Canadian Rockies. There, neither the shale belt nor the westernmost part of the carbonate-clastic belt is preserved. Within the preserved part of the carbonate-clastic belt, near-shore to open marine facies migrated toward the west through time, producing a shallowing-upward succession indicating major regression. Terrigenous clastics became widespread in latest Mississippian time. In northeastern British Columbia, southwestern District of Mackenzie, and southeastern Yukon Territory, facies distribution within the carbonate-clastic belt is similar to that in the south, but terrigenous clastics became dominant by early Late Viséan time. The westward transition to shale, exposed in this area, begins with the oldest carbonate units in the east and progresses upward through the succession, such that the youngest carbonate and clastic units extend farthest west into the shale basin. In southwestern District of Mackenzie, turbidite features, such as graded bedding and channel fillings, occur in carbonates adjacent to the eastern edge of the shale belt. In the northern Yukon Territory, Upper Mississippian near-shore clastic deposits and shallow-marine carbonate facies show a progressive northeastward migration toward the craton, in contrast to the basinward progression farther south. The deepening-upward succession of the northern Yukon Territory indicates marine transgression during Late Mississippian time (Middle Viséan to Early Namurian) with deposition of thinner slope sediments and basinal shale to the southwest.

INTRODUCTION

The Mississippian succession in the Eastern Cordillera and western Plains of Canada occurs in two major facies belts - a thick, eastern facies of platform carbonates and shallow marine to continental detrital clastics, and a correlative, thin, basinal shale facies deposited to the west. These two incompletely preserved facies belts form part of the Proterozoic to Mesozoic miogeosynclinal platform wedge (Wheeler et al., 1972) and extend from southern Alberta and British Columbia northwestward to the northern Yukon Territory (Fig. 1). The western part of the platform carbonate facies is dominated by impure limestone, dolomite, chert and spiculite. This sequence grades westward into the basinal shale facies across a broad, transitional zone that varied in position through time and had a maximum original depositional width of approximately 30 miles (48 km). The western margin of the carbonate platform is therefore indistinct and difficult to define. Its original depositional slope was extremely low.

Preservation of the upper part of the succession is incomplete in the central part of the study area(Fig. 2, Banff-Jasper area to southwestern District of Mackenzie), where Bashkirian and Permian rocks rest disconformably on rocks ranging in age from Early Viséan to ?latest Viséan. Farther north, in the area between the southwestern District of Mackenzie and the north-central Yukon Territory (Fig. 1, 2), Mesozoic rocks rest disconformably on Devonian rocks, and the Mississippian marine record is almost entirely lacking. Sub-Mesozoic truncation also occurs toward the east along the entire length of the western Plains. The sinuous trend of the two major facies belts cuts obliquely across the northwesterly structural grain of the Eastern Cordillera, with the result that the basinal shale facies is incompletely preserved (Fig. 1) and the platform facies is exposed more completely in some areas than in others.

This summary paper is based on data from published regional papers combined with additional information from more than 150 surface stratigraphic sections and subsurface wells. Lateral facies relationships and thickness variations within the platform and basinal sediments are illustrated on seven cross-sections (Figs. 3 to 9) located along the outcrop belt to show all aspects of the succession, from shallow marine carbonates and clastics, through open marine platform carbonates, into basinal shale. Illustrations and environmental interpretations for the main carbonate rock types represented on the cross-sections have been presented by Mamet (1976). Well-established, detailed temporal relationships are based on regional zonations of Foraminifera (Mamet and Skipp, 1970) and corals (Sando and Bamber, 1979), supplemented by age determinations from occurrences of brachiopods, ammonoids and spores. The writers wish to thank D. Campbell, M. Mangin, and B. Hodgson, who drafted the illustrations.

Southwestern Alberta and southeastern British Columbia (Fig. 3)

The Mississippian of this area is most completely preserved in the Front Ranges of the southern Rocky Mountains. Platform carbonates and terrigenous clastics are well represented, but the western basinal shale facies is almost entirely absent. The succession consists of Tournaisian shale, siltstone, and argillaceous carbonates (Exshaw and Banff Formations) overlain by Tournaisian and Viséan carbonates and minor terrigenous clastics of the Rundle Group (Fig. 2). Eastward into the Foothills and Plains the younger part of the section has been progressively removed by post-Mississippian erosion. To the west, in the Rocky Mountain Main Ranges, the present level of erosion is beneath the Mississippian, except in isolated areas (e.g. Connor Lakes, Figs. 1, 3).

Important and well-documented facies changes take place within the platform succession. Eastern peritidal sequences, primarily composed of mudstone and wackestone or packstone in which non-skeletal grains (intraclasts, lumps, pelletoid grains, ooids) are most abundant, pass westward into more open-marine sequences dominated by skeletal, echinoderm-bryozoan grainstone and packstone, which accumulated closer to the platform margin. These facies relationships can be seen at all levels of the succession (Figs. 2, 3). Through time, there was a general migration of near-shore to open-marine facies toward the west, producing a shallowing-upward succession indicating major regression. The microscopic character of some of the coarser-grained representatives of these rocks may be seen in Mamet (1976).

Lower Tournaisian shale, spiculite, and radiolarian chert of the upper Exshaw and lower Banff Formation are the only basinal facies rocks known in the area. They occur at Connor Lakes (Fig. 3; Mamet and Mason, 1968), and near Canal Flats (Fig. 1) in southeastern British Columbia (Leech, 1954). At higher levels , the Banff shows impure carbonates indicating the transition from slope environments to platform environments characteristic of higher stratigraphic units. In more easterly exposures, the middle and upper parts of the Banff contain skeletal packstone and wackestone indicating local development of banks and shoals within the transitional zone between basin and platform (see above). True basinal facies rocks at all levels of the Mississippian above the lower Banff appear to have been located farther west than the most westerly preserved Mississippian rocks of the Rocky Mountains and thus have been removed by erosion.

Overlying the Banff Formation is the Tournaisian and Viséan Rundle Group, in which a diversity of lithological units and facies has led to recognition of a number of formations and members (Fig. 2). Although these units are all part of the platform assemblage, some of the facies relationships that they exhibit indicate an approach toward the platform margin, which apparently was located farther west than any of the presently preserved sections.

Within the lower Rundle Group, Macqueen and Bamber (1967) recognized an eastern, peritidal facies and a western, open-marine facies. The eastern facies consists of three formations: the Pekisko, Shunda, and Turner Valley in ascending order (Fig. 3). The Pekisko is made up of thick-bedded, cliff forming, echinoderm-bryozoan grainstone with subordinate amounts of ooid, compound grain, and intraclast grainstone. Dolomitization is local. In contrast, the overlying recessive-weathering Shunda Formation contains birdseye and pelletoid grain packstone, wackestone, and mudstone, generally very rich in calcispheres and locally rich in calcareous algae. Persistent interbeds of microcrystalline to very finely crystalline dolomite are widespread. Evaporite solution breccia, closely associated with these dolomite beds, is common in the Foothills belt. Some localities show cyclic alternations of limestone and dolomite, or of limestone, dolomite, and solution breccia. Such alternations are interpreted to represent intertidal and supratidal environments (Macqueen,1966). In the Rocky Mountains, the overlying, thick-bedded, resistant-weathering Turner Valley Formation contains echinoderm and bryozoan grainstone or packstone with minor amounts of ooid or intraclast grainstone. These rock types are partly replaced by microcrystalline dolomite. In the Foothills and subsurface of western Alberta the Turner Valley Formation is more completely replaced by macrocrystalline dolomite, and is an oil and gas reservoir in a number of fields.

The Pekisko, Shunda, and Turner Valley Formations grade laterally into very thick-bedded and resistant-weathering pelmatozoan and bryozoan grainstone and packstone (or their dolomitized equivalents) of the Livingstone Formation (Fig. 3). In a westerly direction, toward the platform margin, grainstone and packstone of the Livingstone Formation become finer-grained, and the formation contains more chert and is less thickly bedded. These changes are obvious from Tunnel Mountain in the east, through Brewster Creek-Mount Bourgeau, to Connor Lakes in the west (Fig. 3).

Higher in the section, facies relationships between the upper Livingstone Formation and the overlying Mount Head Formation also indicate a westward transition toward the platform margin. In the Rocky Mountain Front Ranges a rhythmic sequence of shallow-marine limestone and peritidal dolomite forms the six members of the Mount Head Formation (Fig. 3). Toward the west, the lower four members pass laterally into temporally equivalent echinoderm and bryozoan grainstone included in the upper Livingstone Formation, beginning with the lower two members in the east and progressing upward through the succession toward the west (Macqueen and Bamber, 1968, p. 269). The upper two members of the Mount Head Formation, a peritidal assemblage in the Front Ranges, exhibit a westward change to a thicker, shallow water, open-marine facies with abundant calcareous foraminifers (Mamet, 1976). Platform carbonates of the Mount Head Formation are overlain by those of the Etherington Formation, which change facies from dolomite and shale in the eastern Front Ranges of southern Alberta to lime-grainstone and packstone at the western limit of Etherington preservation.

In general, the Mississippian sequence of the Rocky Mountains and Foothills thickens westward toward the platform margin, reaching a maximum known thickness at Connor Lakes, where Mamet and Mason (1968) recorded over 8600 feet (2623 m) of Mississippian rocks (Fig. 2). This anomalously thick carbonate-shale sequence may indicate rapid and continuous local subsidence, or it may represent an eastward salient of miogeosynclinal sedimentation.

Northeastern British Columbia - south of Pine Pass (Fig. 4)

Both the carbonate platform facies and the western basinal shale facies are exposed in this area, where northwesterly structural trends cut obliquely across more northerly facies trends. The shallowing-upward platform succession is similar to that in southwestern Alberta, but the upper part of the carbonate section and the overlying detrital clastics are absent by truncation beneath the sub-Bashkirian and sub-Permian disconformities (Fig. 2). In the southeastern part of the area, the eastern part of the platform facies is exposed. Calcareous and dolomitic shale, siltstone, and argillaceous carbonates of the Lower and Middle Tournaisian Banff Formation are overlain conformably by carbonates of the Rundle Group similar to those of the eastern facies of Macqueen and Bamber (1967) to the south. The open-marine echinoderm packstone and grainstone of the Pekisko Formation is separated from the dolomite and dolomitic echinoderm grainstone of the Turner Valley Formation (Fig. 4) by lagoonal to supratidal birdseye limestone and dolomite of the Shunda Formation (Bamber and Macqueen, 1971, p. 194). The Banff and Pekisko Formations extend well into the northwestern part of the area, near Pine Pass (Fig. 1), but the Shunda Formation is restricted to the southeastern part of the area. It passes laterally into the lower part of a north trending, coarse-grained carbonate bank deposit lying immediately to the west and cutting obliquely across the outcrop area for approximately 30 miles (48 km) (Fig. 1; Bamber and Macqueen, 1971, p. 193). The extent of this bank deposit into the adjacent subsurface has not been determined. It grades westward, toward the platform margin, into unnamed, finer-grained, partly argillaceous limestone provisionally referred to as the "Shunda" Formation (Bamber and Mamet, 1978, p. 5). The lower part of the Turner Valley Formation also passes westward into the bank facies. Farther to the northwest, beyond the carbonate bank, the coarse-grained Turner Valley carbonates change facies into finer-grained packstone and grainstone of the Debolt Formation. Thus, in the central part of the area, west of the carbonate bank facies, the entire platform succession of the Rundle Group consists mainly of open-marine, partly argillaceous, relatively fine-grained carbonate rocks.

Toward the gradational western margin of the platform, exposed in the northwestern part of the area, there is a marked change in the nature of the carbonates of the Rundle Group. All units become cherty, dolomitic, and pyritic as they grade westward into a facies transitional between basin and platform. They also show an overall decrease in grain size and become interbedded with shale. Sponge spicules become the dominant skeletal constituent as other grains derived from organisms such as echinoderms, bryozoans, foraminifers, and algae, decrease in abundance. This compositional change is best expressed in the upper part of the section, where the Debolt Formation passes westward into highly cherty, calcareous, and dolomitic spiculite of the Prophet Formation (Fig. 4).

Beyond the platform margin, the entire Mississippian succession grades westward into non-calcareous, pyritic, basinal shale of the Besa River Formation, beginning with the Banff Formation in the east and progressing upward through the Pekisko, "Shunda", and Prophet Formations toward the west. Thus, the platform margin migrated through time, with the youngest carbonate units extending farthest west (Fig. 4). Within the basinal shale there are rare dolomite and limestone lenses containing radiolarians. Spicules are absent.

The major facies changes described above are accompanied by stratigraphic condensation in both the platform and basinal successions (Fig. 4). Tournaisian and Lower Viséan carbonaterocks thin from 2000 feet (610 m) in the east to approximately 1200 feet (365 m) at the western platform margin. Within the basin, temporally equivalent shale is approximately 600 feet (183 m) thick.

Northeastern British Columbia - north of Pine Pass (Fig. 5)

In the outcrop area between Pine Pass and the British Columbia-Yukon border (Figs. 1, 2) the upper part of the Mississippian succession is more completely preserved than to the south. Middle and Upper Viséan carbonates and clastics are present at the top of the succession beneath the sub-Permian disconformity. Because of the continued northwest structural trend, however, only the basinal shale belt and the western, transitional part of the carbonate-clastic belt are exposed, with the shallow-marine central and eastern parts in subsurface to the east (Bamber et al., 1968, p. 6; Bamber and Mamet, 1978; Macauley et al., 1964). In the northern third of the area, which lies west of the carbonate-shale facies boundary, only the shale belt and the westernmost Upper Viséan detrital clastics are present (Fig. 1).

Facies distribution in the southern part of the area shows the influence of the Peace River embayment, an eastward extension of the Besa River shale basin, developed during Mississippian time (Fig. 1). The embayment is marked by stratigraphic thickening and increase in shale content within the carbonate-clastic belt, both in outcrop and in the subsurface of the Fort St. John area. In the vicinity of Pine Pass, Tournaisian and Lower Viséan open-marine carbonates and calcareous shale, typical of the shelf margin, grade northwestward into shale of the Besa River Formation. A parallel facies change occurs in subsurface to the northeast, where the Pekisko and "Shunda" carbonates pass northward into shale toward the Fort St. John area (Bamber and Mamet, 1978, p. 507; Macauley et al., 1964, p. 96, 97), near the axis of the Peace River embayment. Thus the basinal shale facies extends eastward into the embayment and the platform margin swings toward the east along its southern margin (Fig. 1).

The thickness of the Mississippian succession in the outcrop belt increases toward the northwest, from 800 to 1000 feet (245 - 305 m) at Pine Pass to a maximum of more than 6000 feet (1830 m) approximately 20 miles (32 km) north of the Peace River. This thickening results partly from an increase in the rate of Mississippian sedimentation toward the axis of the Peace River embayment, and partly from preservation of widespread younger Mississippian carbonates and clastics beneath the sub-Permian disconformity (Fig. 2). North of the embayment the maximum thickness of the total Mississippian section decreases to approximately 3000 feet (915 m).

Within the Peace River embayment and throughout the northern outcrop area, east of the basin margin (Fig. 1), the Tournaisian and Lower Viséan shale of the Besa River Formation is overlain gradationally by the Prophet Formation, a shallowing-upward succession of spiculite and cherty carbonates (Bamber and Mamet, 1978, p. 17). The lower part of the Prophet Formation (Member A) is cherty, pyritic, argillaceous spiculite and mudstone containing radiolarians. The middle part of the formation (Member B) is mainly spicular, cherty wackestone and dolomite in its lower part, grading upward into less cherty packstone and grainstone containing echinoderms, bryozoans and foraminifers, with fewer spicules. Member C, at the top of the formation, contains less chert than below and is mainly coarse-grained packstone and grainstone. Echinoderms, bryozoans, foraminifers and calcispheres are abundant, and spicules are absent in some eastern sections. The three members of the Prophet Formation grade westward into basinal shale of the Besa River Formation (Fig. 5), beginning with Member A in the east and progressing upward through Members B and C toward the west (Bamber and Mamet, 1978, p. 8; Bamber et al., 1968; Pelzer, 1966, Fig. 6), with the youngest carbonate units extending farthest west, as in the area south of Pine Pass. Within the Prophet Formation there is a westward increase in chert, spicules, and argillaceous material toward the basin margin, with a corresponding decrease in echinoderms, bryozoans, and other skeletal grains.

Widespread accumulation of Viséan carbonates was followed by an influx of Upper Viséan terrigenous clastics (Stoddart Group) that blanketed the entire platform area and extended into the shale basin beyond the western limits of the Prophet Formation (Fig. 5). The lower part of the Stoddart Group consists of partly calcareous shale with minor amounts of argillaceous limestone, dolomite, and sandstone (Golata Formation). Coal and anhydrite occur locally in the Golata Formation to the east in the subsurface of Alberta. The shale becomes pyritic and non-calcareous in western outcrop sections, where it passes laterally into the Besa River Formation (Fig. 5). Above the Golata Formation, the Stoddart Group consists of a variable, prograding succession of sandstone, shale, limestone, and dolomite assigned to the Kiskatinaw and Taylor Flat Formations. In outcrop sections, where sandstone and shale predominate and carbonate rocks are rare, no formations are distinguished within the upper Stoddart. This succession becomes finer grained and more argillaceous toward the west, as it grades laterally into basinal shale of the Besa River Formation. The youngest sandstone beds extend farthest to the west (Fig. 5).

As in the area south of Pine Pass, the facies change in the northern area, from the carbonates and clastics of the platform into the western shale succession, is accompanied by considerable stratigraphic condensation. In the western sections, the pyritic, cherty, Besa River shale is approximately one-fifth as thick as equivalent carbonates and clastics in eastern outcrop sections.

Southwest District of Mackenzie, southeastern Yukon Territory (Figs. 6, 7)

In this region, the carbonate-clastic belt and the western basinal shale belt are exposed in the southern Mackenzie fold belt, from the British Columbia-Yukon border to the area immediately north of the South Nahanni River

(Fig. 1). Within the carbonate-clastic belt, the lower part of the succession (Yohin, Clausen, and Flett Formations, in ascending order) is dominated by limestone and shale (Harker, 1961, 1963) of Tournaisian to early Late Viséan age. Of this succession, only the platform margin and transitional facies are exposed. Shelf carbonates occur mainly in subsurface to the east. The upper half of the succession (Mattson Formation) consists of Upper Viséan and ?Lower Namurian terrigenous clastics with minor carbonate rocks and coal. As in northeastern British Columbia, the entire carbonate-clastic succession passes westward into shale of the Besa River Formation. The degree of stratigraphic condensation across this facies change cannot be determined, because no complete Mississippian sections are available through the basinal shale facies beyond the western limit of the Mattson Formation. The Yohin Formation, at the base of the succession, is a heterogeneous unit consisting of fine to very fine grained sandstone and siltstone with subordinate shale, mudstone, limestone, and spiculite. Sandstone and siltstone dominate eastern sections of this formation. West of Jackfish Gap (Fig. 6) these clastics grade into a succession of silty spiculite, lime packstone, and cherty spiculite that Harker (1963) provisionally assigned to the Yohin. The limestone in eastern sections is mainly sandy lime grainstone and sandy lime packstone containing echinoderm fragments, sponge spicules, and intraclasts. Interbeds of silty shale and mudstone occur throughout the formation. Much of the Yohin comprises turbidites, and intraformational truncation surfaces are locally abundant. Sediments of this unit were deposited chiefly in basin-slope environments. The Yohin conformably overlies and grades westward into dark grey basinal shale of the Besa River Formation.

The overlying Clausen Formation thickens westward and comprises shale with subordinate mudstone, spiculite, limestone, siltstone, and radiolarite. South of the South Nahanni River, dark grey noncalcareous shale is the main lithology, but northward these shales grade into silty calcareous mudstones with subordinate interbedded siltstone. Intervals of laminated cherty spiculite are moderately common at most locations. Turbidites consisting of intraclast-skeletal lime packstone occur near the base of this formation north of the South Nahanni River, but southward limestone is a minor lithology. In westernmost exposures of the Clausen, cherty radiolarite is interbedded with the shale. The Clausen consists mainly of basinal facies deposited in moderately deep water on the east side of the shale basin.

The Flett Formation, which is the only thick, widespread Mississippian carbonate unit outcropping in the area, consists of interbedded skeletal limestone, spiculite, and fine-grained, terrigenous clastics. Thin intervals of cross-stratified sandstone and minor siltstone are confined to two levels in the upper Flett within the northern part of the outcrop area. Most of the formation is skeletal lime packstone and calcareous to dolomitic and siliceous spiculite, but significant amounts of skeletal lime grainstone and calcareous to noncalcareous spicular shale occur. The packstone and grainstone occur mainly in the upper Flett and are most common in eastern sections (Fig. 6). They contain abundant echinoderms and bryozoans, and fewer brachiopods, calcispheres and foraminifers, all of which decrease in abundance westward. In contrast, the abundance of spicules and clay-sized terrigenous clastics increases westward as the limestone of the Flett grades into a spicular facies that resembles the Prophet Formation of northeastern British Columbia and is interbedded with tongues of Besa River Shale. Much of the Flett Formation consists of turbidites. Megascale intraformational truncation surfaces (Cook and Enos, 1977, p. 1), interpreted to be mainly corrasion surfaces of submarine channels, are locally common (Richards, 1978, p. 478). The Flett Formation was deposited as a basin slope facies transitional between the western basinal shale facies and the platform carbonate facies to the east. Throughout much of the area the carbonates of the Flett are overlain by a thin interval of shale, dolomite, and argillaceous sandstone that appears to be the northward extension of the Golata Formation from northeastern British Columbia.

The overlying Mattson Formation is a thick cyclic delta complex composed of northerly derived sandstone with subordinate shale, dolomite, limestone, chert, and coal. As in the Stoddart Formation to the south, the youngest beds extend farthest west into the basin. Three informal members are recognized in the Mattson. The lower member consists mainly of sandstone and shale deposited in delta-front to delta-slope environments. It thickens westward as the delta-front facies grade into thin-bedded turbidites deposited in delta-slope environments, which in turn grade westward into prodelta facies of the upper Besa River Formation. The middle member is dominated by sandstone deposited by braided streams on a delta plain, but intervals of shale and sandstone deposited in shoreline and delta-front environments are locally present. The proportion of marine facies increases westward as this member grades laterally into the lower member (Fig. 7). The heterogeneous upper member comprises terrigenous clastics and carbonate rocks deposited in delta-plain, delta-front, and marine platform environments. Sandstone deposited by braided streams dominates the delta-plain facies. Delta-front facies are dominated by coarsening-upward sequences of sparsely fossiliferous sandstone and shale. Intervals ofmarine platform facies consist mainly of fossiliferous sandstone, carbonates, and shale. Eastern sections are dominated by delta-plain facies, but marine facies become predominant westward as the member thickens.

Northern and north-central Yukon Territory (Figs. 8, 9)

The Mississippian of the northern Yukon Territory, north of the Porcupine River (Fig. 1, Latitude 67°30'N), consists of a deepening-upward succession of diachronous, onlapping, continental and shallow-marine facies that migrated toward the northeast through time (Fig. 9). This time-transgressive succession ranges in age from Middle Viséan to Early Namurian and becomes younger toward the east and northeast. A regional, angular unconformity separates the Mississippian from underlying Proterozoic rocks.

Discontinuous continental?, quartzose sandstone and conglomerate of the Kekiktuk Formation (Norris, 1974, p. 30, 32, Table 1; Bamber and Waterhouse, 1971, p. 74) rest on the erosional surface at the base of the Mississippian (Fig. 9). At many localities, coal seams occur between the clastic rocks of the Kekiktuk Formation and overlying marine shale and minor limestone of the Kayak Formation. Sandstone beds occur near the base of the latter, and limestone increases toward the top. The contact between the Kayak Formation and the overlying carbonate rocks of the Alapah Formation becomes progressively younger from southwest to northeast (Bamber and Waterhouse, 1971, p. 75), so that the lowest beds of the Alapah in southwestern sections change facies toward the northeast into shale and limestone of the upper Kayak Formation (Fig. 9). The Alapah Formation, which is the youngest Mississippian unit in the northern Yukon, comprises a great variety of platform carbonates. The lower part of the formation is mainly lime mudstone and wackestone. Packstone and grainstone dominate the upper part of the formation and are particularly abundant in the southwestern part of the area, where coarse-grained, high energy carbonate bank deposits are developed. Toward the northeast, fine grained, terrigenous clastics are present, and the carbonates show a general decrease in grain size and an increase in dolomite throughout the formation.

Temporal and facies relationships outlined above indicate a northeastward marine transgression in the northern Yukon Territory, beginning in approximately Middle Viseân time and continuing throughout the Mississippian. This transgression also was postulated for northeastern Alaska, where Mississippian facies relationships are similar to those in the northern Yukon Territory (Brosgê et al., 1962, p. 2185; Reed, 1968, p. 37-39; Bamber and Waterhouse, 1971, p. 95, 96).

To the south, in the north-central Yukon (Figs. 1, 8 , the Mississippian marine succession consists of unnamed dark grey shale of Tournaisian? to Late Visêan age, overlain by Upper Visêan and Lower Namurian laminated, spicular limestone of the Hart River Formation (Bamber and Waterhouse, 1971; Martin, 1972; Graham, 1973). Several tongues of sandstone and conglomerate (e.g. Chance Sandstone Member, Fig. 8) extend into these units from a thick, deltaic complex of Tournaisian and Visêan plant-bearing, terrigenous clastics bordering the marine succession on the east. The marine shale below the Hart River Formation is underlain by Upper Devonian shale, with no definite evidence for a sedimentary break such as that found at the base of the Mississippian in the northern Yukon (Fig. 9). Limestone and dolomite nodules containing Middle and early Late Visêan ammonoids are abundant in the upper part of the shale unit. Within the overlying Hart River Formation, Graham (1973, p. 167, 175, 177) has distinguished a thick, northern platform succession and a thinner, southern slope and basinal succession, on the basis of stratigraphic and seismic evidence. The platform succession is best expressed in the northeastern part of the area (Figs. 1, 8), where it is mainly cherty, laminated, skeletal and micritic, spicular limestone with abundant organic matter, and minor siltstone and sandstone beds. Echinoderm, brachiopod, and mollusc fragments are locally abundant, but there appears to be no development of coarse-grained, high energy carbonate bank deposits, such as those in the Alapah Formation to the north. Toward the southwest, the Hart River Formation thins and grades into the slope and basinal succession, which consists of pyritic, calcareous shale and calcareous siltstone interbedded with fine-grained, highly spicular limestone beds rich in organic matter (Graham, 1973, p. 166, 167). Increase in shale content and decrease in thickness continue toward the south and southwest as the entire Mississippian succession passes into an unnamed basinal shale facies (Fig. 1).

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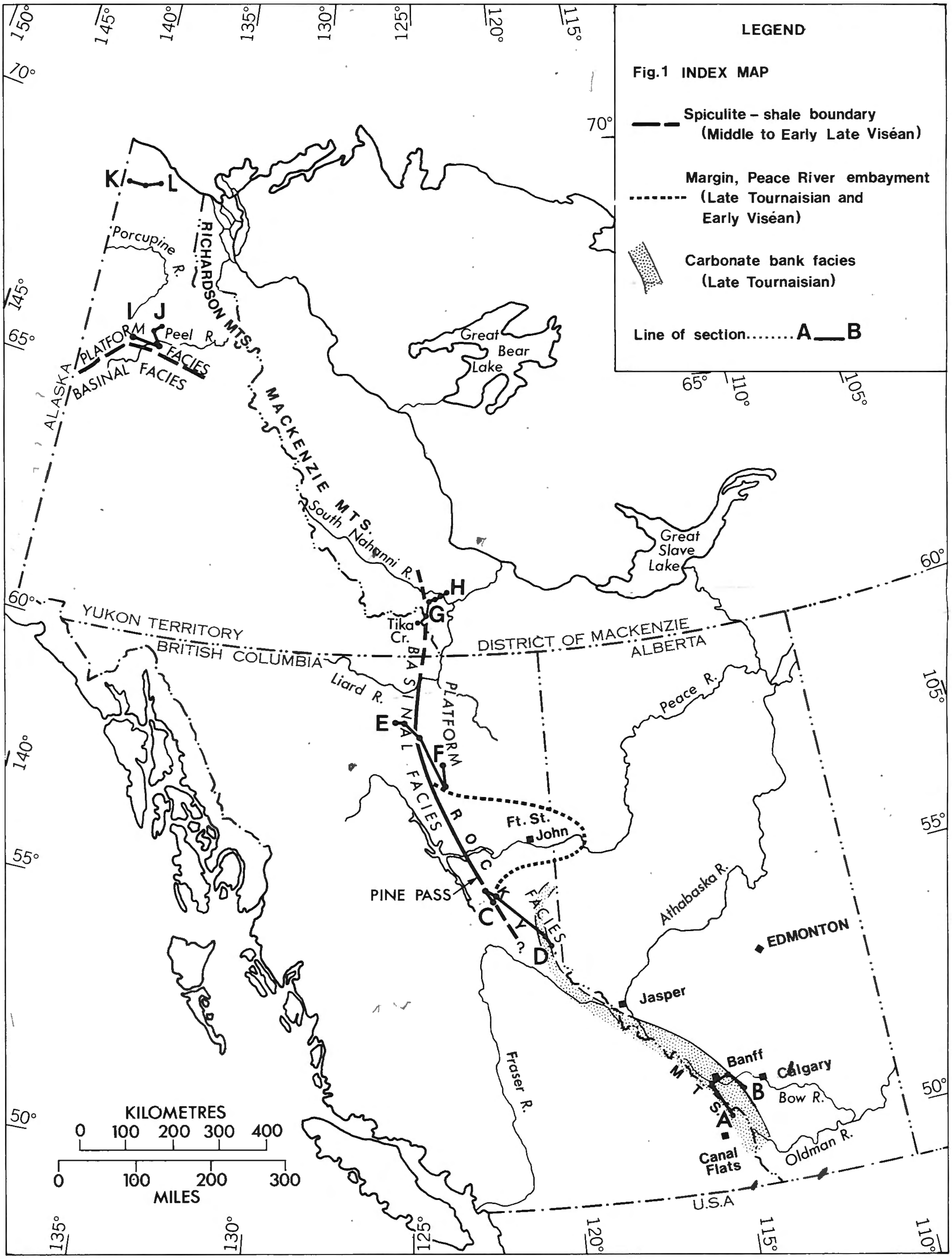


Fig.1 INDEX MAP

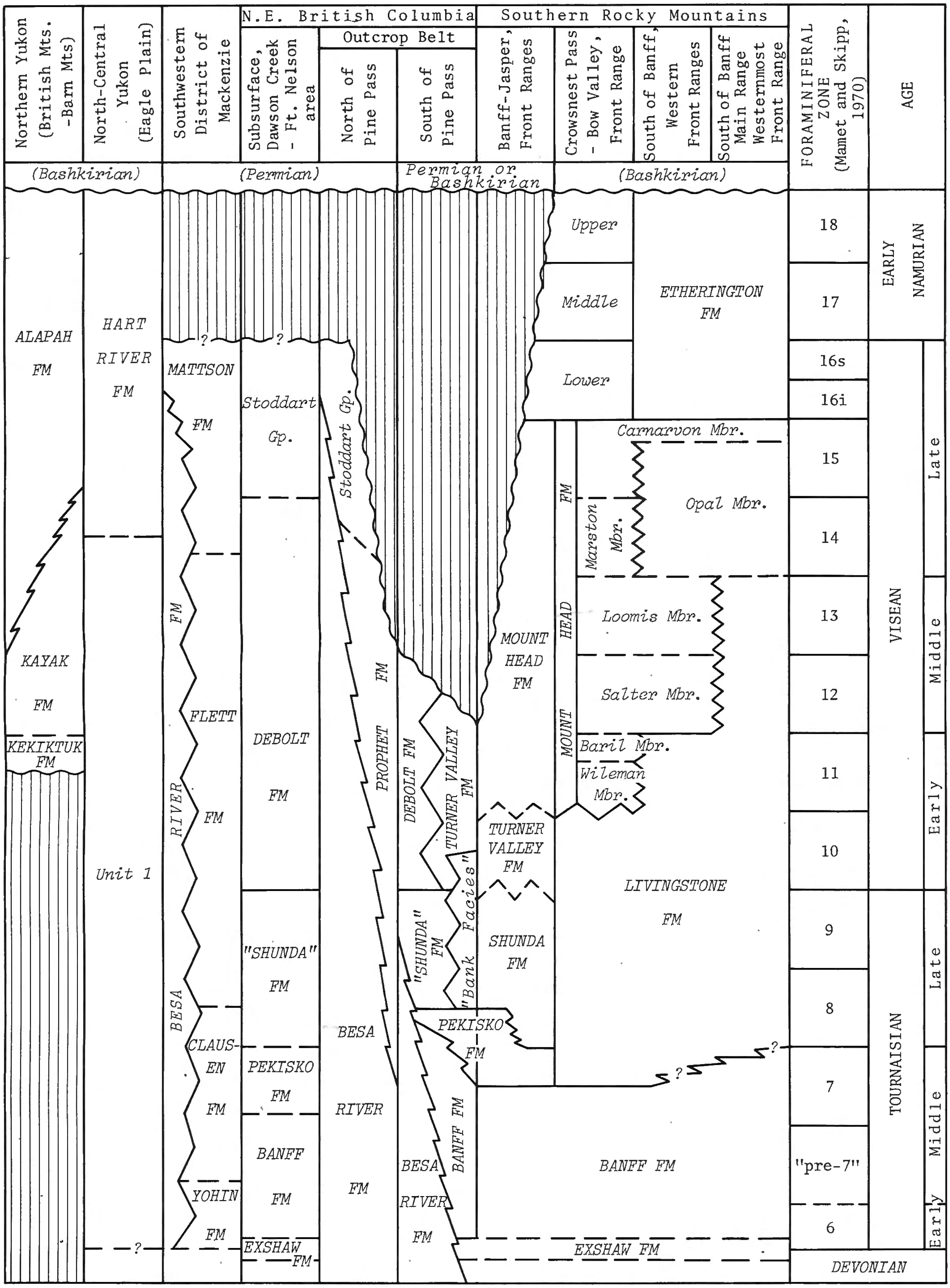


Figure 2. Correlation of Lower Carboniferous formations, eastern Cordillera and western Plains

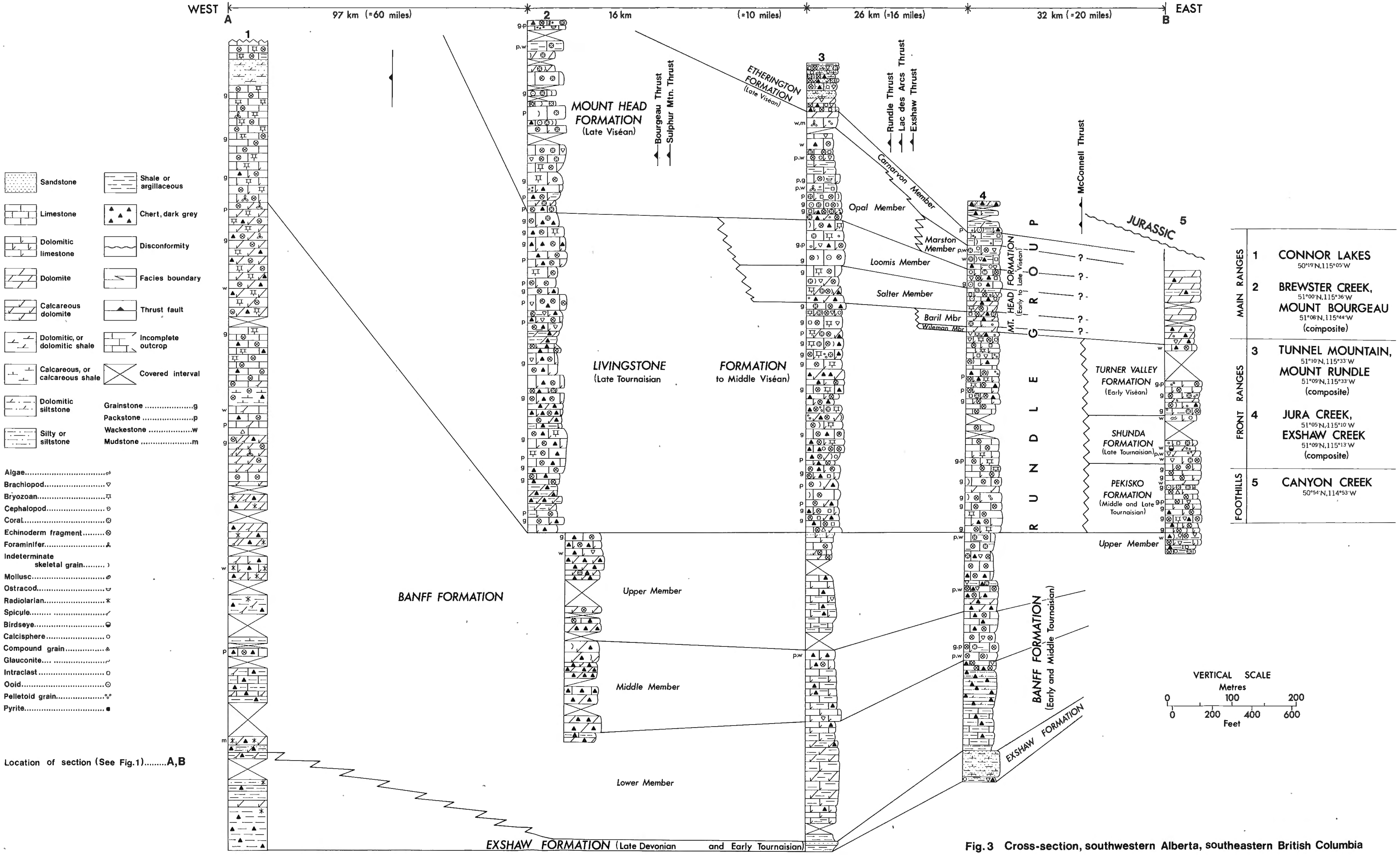
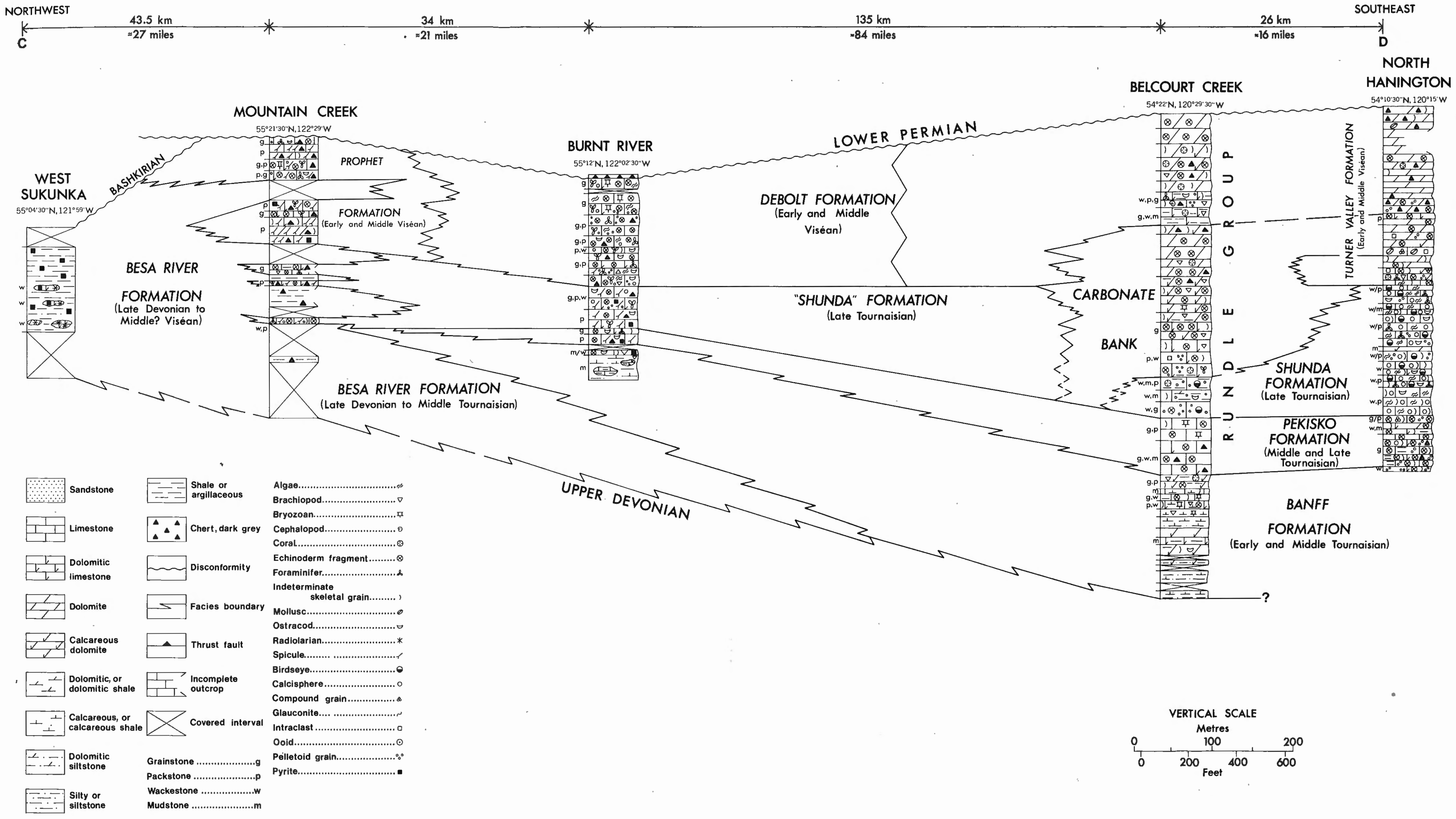


Fig. 3 Cross-section, southwestern Alberta, southeastern British Columbia



Location of section (See Fig. 1)................C, D

Fig.4 Cross-section south of Pine Pass, northeastern British Columbia

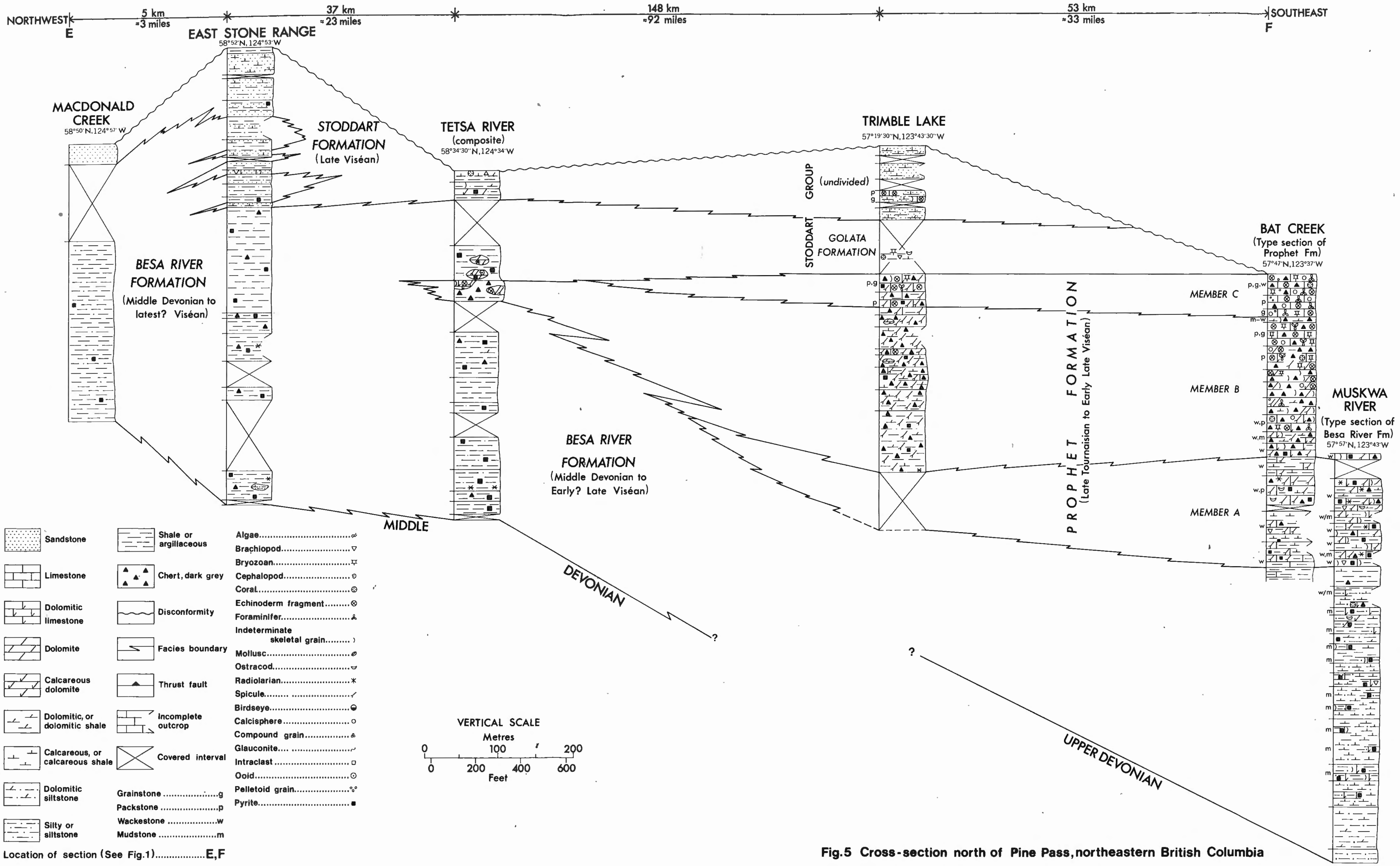


Fig.5 Cross-section north of Pine Pass, northeastern British Columbia

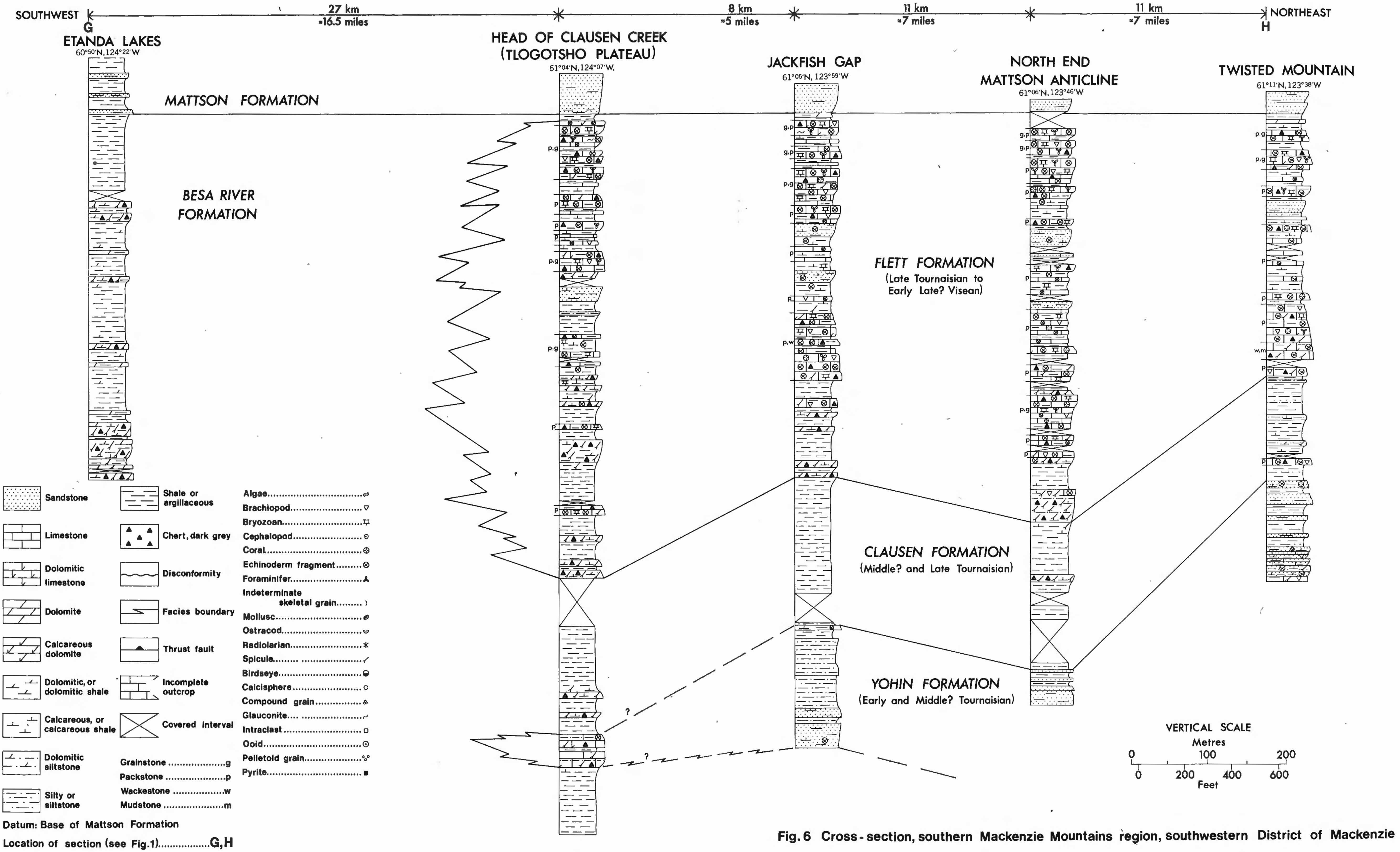


Fig. 6 Cross-section, southern Mackenzie Mountains region, southwestern District of Mackenzie

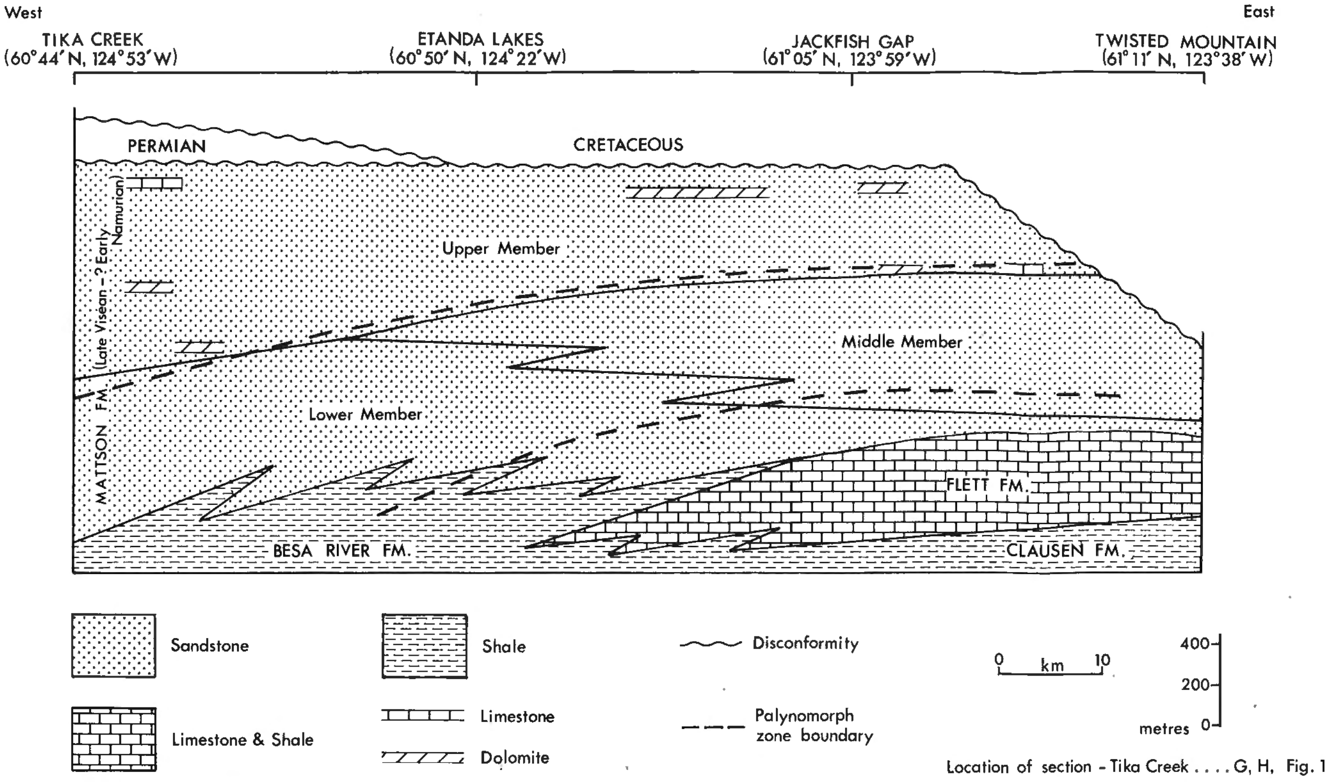


Fig. 7 Diagramatic cross section, southern Mackenzie Mountain region, southwestern District of Mackenzie, southeastern Yukon

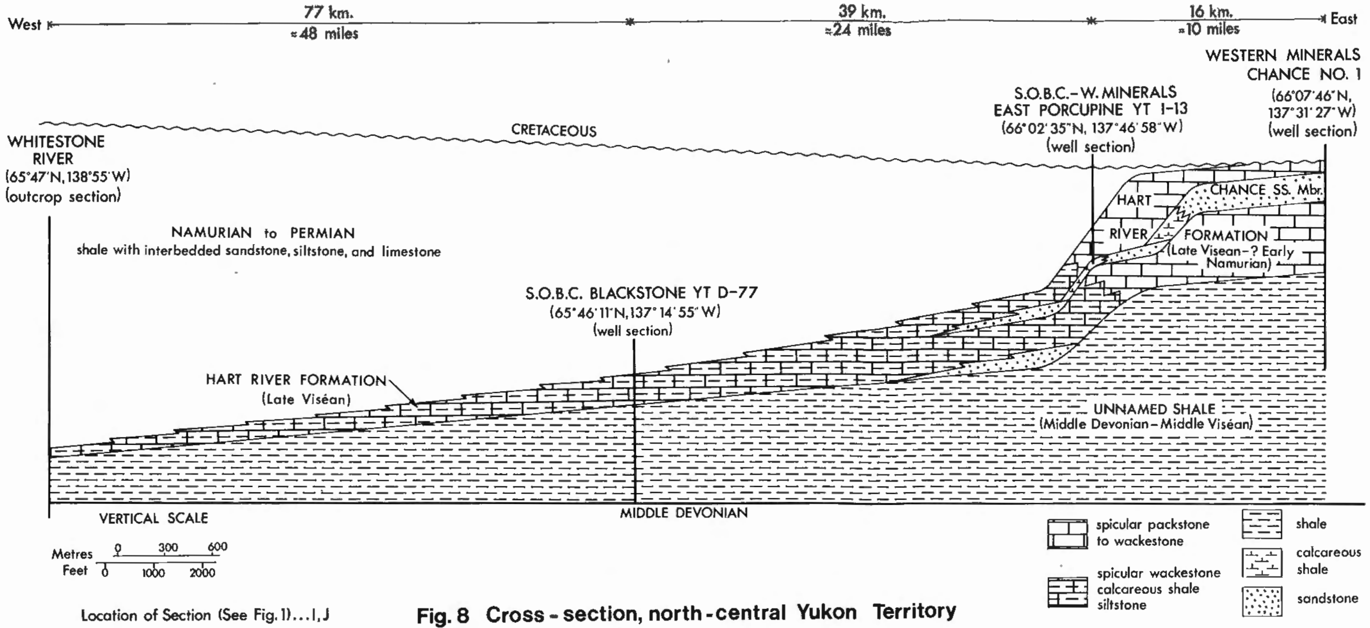


Fig. 8 **Cross-section, north-central Yukon Territory**
(after Graham, 1973, Fig. 4)

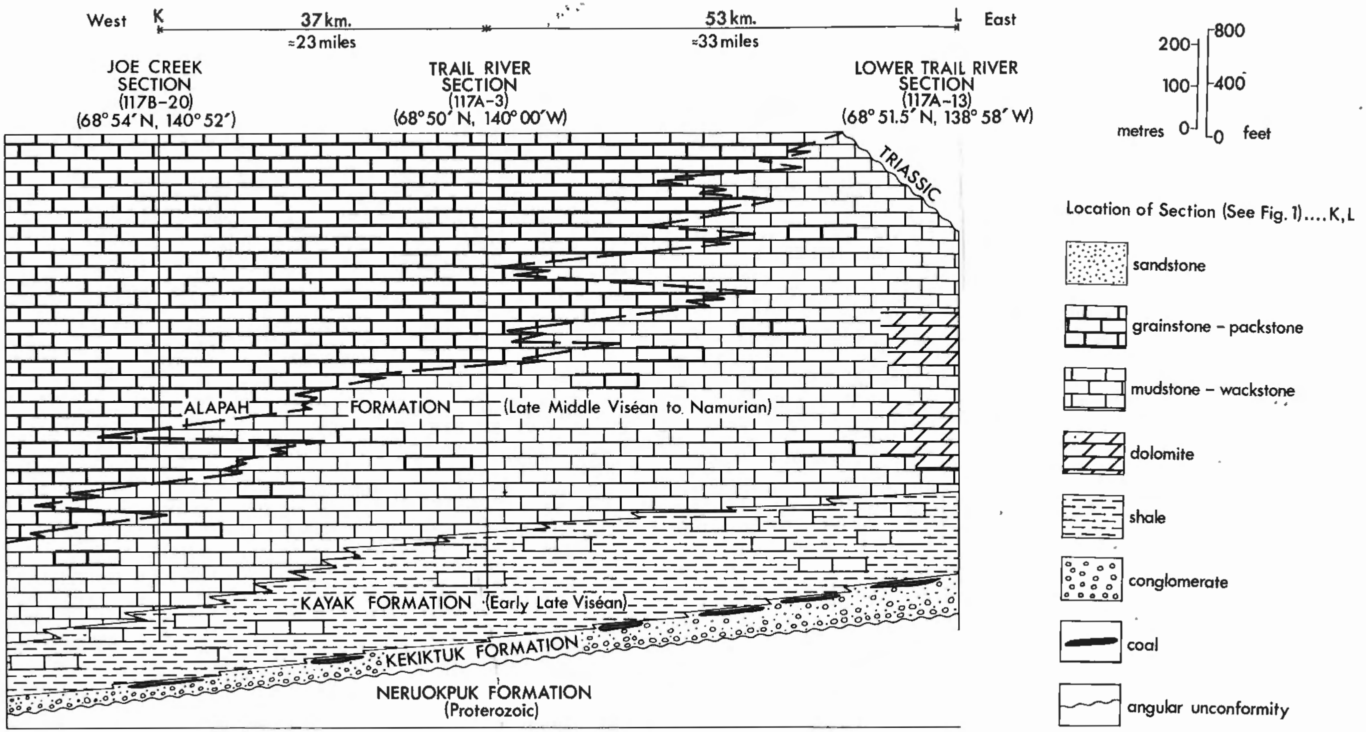


Fig. 9 Cross-section, northern Yukon Territory
(after Bamber and Waterhouse, 1971, Fig. 9)