OPEN FILE 333

LOWER CAMBRIAN STRATIGRAPHY

MACKENZIE MOUNTAINS, NORTHWESTERN CANADA

W.H. FRITZ

Geological Survey of Canada, Ottawa K1A 0E8

LOWER CAMBRIAN STRATIGRAPHY

MACKENZIE MOUNTAINS, NORTHWESTERN CANADA

W.H. FRITZ
Geological Survey of Canada, Ottawa K1A 0E8

ABSTRACT--Lower Cambrian strata deposited on a carbonate shelf, unstable slope, and deep basin are described from four stratigraphic sections in eastern Yukon Territory and western Northwest Territories. Underlying the sections are predominantly barren late Precambrian(?) and early Cambrian quartzite and siltstone that were deposited under shallow subtidal and intertidal conditions. The base of each section is believed to be near the top of the Fallotaspis Zone. Near the close of Fallotapis Zone time a carbonate shelf began forming in the east. Contemporaneously, shallow subtidal siltstone was deposited at the outer margin of the shelf. Shortly thereafter a basin formed to the west in early Nevadella Zone time. Dark limestone in thin, platy beds covered a wide area in the basin and extended eastward to the outer margin of the carbonate shelf. Silt then poured into the basin near the basin-shelf contact and formed an unstable slope. Shelf carbonate prograded over the shallow portion of the slope extending the shelf westward. Carbonate sedimentation ceased on the shelf near the end of Nevadella Zone time; this completed grand cycle A consisting of late Precambrian(?) and early Lower Cambrian clastics (lower half-cycle, A1) and shelf carbonates (upper half-cycle, A2).

In late Nevadella and earliest Bonnia-Olenellus Zone time clastics from the inner detrital belt blanketed the shelf and poured into the basin to form a second unstable siltstone slope. This clastic blanket on the shelf constitutes the lower half (B1) of the second grand cycle (B). The

upper half-cycle (B2) began over the former shelf and shallow slope with deposition of shelf limestone in thin and medium beds that continued until the end of the second grand cycle. In part of this area, medium and thick bedded dolomite was deposited until it attained a great thickness within the upper half-cycle.

In the basin, dark, platy limestone continued to accumulate beyond the margin of the second unstable slope during the lower half-cycle (B1) and part of the upper half-cycle (B2). Then in late middle and early upper Bonnia-Olenellus Zone time, shale and thin bedded limestone were deposited on a third unstable slope. This was covered by shallow-water limestone and, in latest(?) Bonnia-Olenellus Zone time, by dark siltstone that initiated a major, regional transgression. Deposition of the same dark siltstone unit over the shelf ended the second grand cycle there during late medial to late Bonnia-Olenellus Zone time.

A regional facies analysis that includes facies data from seven other nearby sections shows that the basin protruded eastward forming a re-entrant into the carbonate shelf. It is suggested that the thick succession of dolomite in the upper half of the second grand cycle was deposited on the down-current side of this re-entrant. Here clear shallow waters may have provided optimum conditions for the rapid deposition of carbonate.

INTRODUCTION

The present study illustrates a lateral change in Lower Cambrian strata from a carbonate shelf depositional environment to a slope and basin environment. Four stratigraphic sections (Text-fig. 1) positioned across the depositional strike are used to demonstrate this facies change. Additional regional data are provided in Text figure 2 by integrating the facies information from these four sections with that known from seven other sections in the area. This Text-figure shows the localities of the sections; their map co-ordinates are given in Table 1. Two or three sets of co-ordinates listed for one section indicate a composite section measured on two or three adjacent mountains.

Most of these Lower Cambrian strata are within the Sekwi Formation, the type section of which was originally described by Hanfield (1968). The present writer also studied that section (Text-fig. 1, sect. 10), and used the fossils he collected there to establish a Lower Cambrian trilobite zonation for the North American Faunal Province (Fritz, 1972). A map showing the geology in the vicinity of the type section and five of the other sections has been prepared by Blusson (1972).

The Lower Cambrian strata considered here have been assigned to three depositional belts (Text-figs. 1, 2) following the procedure initiated in Great Basin Cambrian studies by Palmer (1960) and Robison (1960). In the Mackenzie Mountains, strata assigned to the outer detrital belt consist of medium brownish gray weathering shale and siltstone, and dark gray, platy limestone. In the middle carbonate belt, the strata are, as the name suggests, mainly carbonate.

The limestone is in thin wavy beds that commonly weather medium gray. A subordinate amount of limestone is in thick beds that weather medium or light gray. Some of the dolomite is in thin and medium beds that weather light yellowish orange. In the thick dolomite units, where the bedding is between 4 and 16 inches, the predominant weathering color is medium light gray and medium brownish gray. In large to small units containing thick bedded to massive dolomite the weathering color is cream to light orange. Most of the strata in the inner detrital belt consists of thin and medium bedded dolomite that is platy and weathers light yellowish orange, quartzite that weathers light brown, and siltstone that weathers yellowish orange, light green, maroon, or light brown.

In addition to depositional belts, some of the strata described in this paper are assigned to grand cycles as defined by Aitken (1966) in Cambrian and Lower Ordovician strata of the Canadian Rocky Mountains. Aitken states (p. 405) that grand cycles are "depositional cycles..., each comprising 300 to 2,000 feet of strata and two or more fossil zones....Each... commences at an abrupt basal contact, and consists of a lower, shaly half-cycle gradationally overlain by a carbonate half-cycle." The writer (1975, p. 538) has suggested that three grand cycles may be present in Lower Cambrian strata of the North American Cordillera, but only two cycles can be recognized in the Mackenzie Mountains. In the present paper, grand cycle A and the lower half-cycle of grand cycle B in the Mackenzie Mountains are considered to be equivalent to strata given those designations farther south. The upper half-cycle of grand cycle B in the Mackenzie Mountains is considered to include that half-cycle to the south and part, and perhaps locally all, of grand cycle C to the south. The recognition of grand cycle C, and a subsequent restriction of the upper half-cycle of B in the Mackenzie Mountains, is dependent upon the future recognition of a

regional clastic unit that is equivalent to the lower half-cycle of C to the south.

In the following discussion the strata will be described in ascending order as they occur in each of the four sections shown in Text-figure 1. It can be assumed that strata assigned to the lower (clastic) half-cycles belong to the inner detrital belt, and that strata assigned to the upper (carbonate) half-cycles belong to the middle carbonate belt. Grand cycles cannot be easily traced into the outer detrital belt, and hence the use of the heading "outer detrital strata" for these rocks.

SECTION 10 (TYPE SEKWI)

Grand cycle A, lower half-cycle (A1).--Underlying the Sekwi Formation at the type section and at section X are two unnamed formations that Blusson (1971, 1972) called map-units 12 and 13. These formations are here assigned to the lower half-cycle of grand cycle A. Map-unit 12 consists of buff weathering, fine grained sandstone that Blusson (1971, p. 9) assigned to the "Cambrian and/or Precambrian". Map-unit 13, comprised of brown weathering siltstone and very fine grained sandstone, is 500 feet thick below section 10. Handfield (1968, p. 5) found an olenellid trilobite 30 feet below the top of this unit, and Blusson assigned the unit to the Lower Cambrian. Blusson's map (1972) shows that these two clastic units grade westward into a dark gray or brown slate unit (map-unit 10a) that underlies section 7. None of these older units was seen by the writer below the base (covered) of the Sekwi at section 6.

Grand cycle A, upper half-cycle (A2).--At section 10 the boundary between the lower and upper half-cycle of grand cycle A is situated at the boundary

between the Sekwi Formation and map-unit 13. The upper, carbonate half-cycle consists of a basal 389-foot unit of mainly thin, wavy bedded limestone, a 377-foot unit of platy, dark gray limestone, and a 291-foot unit of orange weathering, thick-bedded dolomite. No penecontemporaneous breccias or slump features were seen in strata assigned to the upper half-cycle. An abundance of pagetiid trilobites, a predominance of dark, platy limestone, and the presence archaeocyathid bioherms at two horizons suggest that strata in the 377-foot interval may be close to or within the outer detrital belt. The assignment of these last mentioned strata to the middle carbonate belt (Text fig. 1) is therefore tentative until further work is accomplished near the section.

Fossils belonging to the Fallotaspis Zone were collected six feet above the base of the Sekwi Formation. A collection 155 feet above the base and all of the other collections from this half-cycle belong to the Nevadella Zone. The 291 feet of barren dolomite at the top of the half-cycle could not be dated directly, but a fossil collection above this unit in section 8 belongs to the Nevadella Zone.

Grand cycle B, lower half-cycle (B1).--Above the dolomite unit in section 10 is 113 feet of light brown quartzite, light brown dirt weathering from siltstone(?), and orange weathering, thin to thick bedded dolomite, all of which are assigned to the lower half-cycle. Numerous intervals within the quartzite contain distinctive quartz grains that are poorly sorted, well rounded, and have frosted surfaces. Similar grains were found scattered ("floating") thoughout the dolomite matrix in the 291-foot dolomite unit in the underlying half-cycle.

Fossil collections in sections 3 and 8 prove that the boundary between the Nevadella Zone and the Bonnia-Olenellus Zone lies within the lower half-cycle in those sections. This half-cycle or immediately overlying strata in sections 1-5 and 8-10 contains fossils (cont).

belonging to the lower portion of the Bonnia-Olenellus Zone, which, taken together with the Nevadella occurrences, suggests that the lower half-cycle is approximately the same age over the study area.

Grand cycle B, upper half-cycle (B2)--Medium gray weathering limestone in thin, wavy beds predominates in the 1,139 foot succession constituting this half-cycle at section 10. Fossils from the uppermost beds are assigned to a high position in the Bonnia-Olenellus Zone. The species Bonnia columbensis Resser, Piaziella pia (Walcott), and Olenellus puertoblancoensis (Lochman) from this horizon are also present in the Peyto Limestone of Alberta and British Columbia.

Post-Sekwi dark siltstone and limestone.--Above the Sekwi formation in section 10 is a covered interval 67 feet thick. Float suggests that the underlying strata consist of black siltstone and interbedded limestone in dark gray, platy beds. Local float from 10 feet above the base of the interval contains fossils from the Bonnia-Olenellus Zone. An unmeasured succession of dark, platy limestone overlies the covered interval. A faunule belonging to the late Middle Cambrian was found 3 feet above the base of the platy limestone and 70 feet above the top of the Sewki Formation.

SECTION X

Grand cycle A, lower half-cycle (A1).--At section X this half-cycle consists of the same map-units (12, 13) that are present at section 10, plus an informal stratigraphic unit which Green and Roddick (1961) have called the "Swiss cheese limestone". The latter unit in section X is comprised of medium gray, light brownish gray weathering limy siltstone
Within the siltstone are dispersed limestone nodules that are locally recessive weathering. Dark gray burrows (?) one-eighth inch wide are common. At section X the "Swiss cheese" siltstone is 337 feet thick, and the base of the Sekwi

Formation is placed between the limy siltstone of this unit and the non-limy siltstone and very fine grained quartzite of underlying map-unit 13.

Fossils found in the "Swiss cheese" siltstone belong to the Nevadella Zone. As the lowest locality, 72 feet above the base, contains an undescribed trilobite known to be near the base of the zone, it is possible that additional fossil finds will locate the Fallotaspis-Nevadella Zone boundary in the lower beds of this unit.

Outer detrital strata.--Two units of outer detrital strata overlie the "Swiss cheese" siltstone in section X. The lower is a 123-foot unit composed of dark, platy limestone in thin beds and in thick beds of penecontemporaneous breccia. Some "exotic" blocks of light gray, thick bedded limestone, orange dolomite, and quartzite are present in the breccia beds. The upper unit consists of 680 feet of dark gray, limy siltstone that weathers to medium brown flakes. Sparse interbeds of light brown, very fine grained quartzite outline medium and large scale penecontemporaneous slump structures that might be overlooked in a more uniform siltstone. Three localities in the siltstone unit contain Judomia? sp., a Nevadella Zone genus that is common in outer detrital strata in the area but rare elsewhere.

Grand cycle A, upper half-cycle (A2).--Only a portion (350') of this half-cycle is represented in the western segment of section X, the remainder having been displaced by the two outer detrital units just mentioned. This portion is comprised of thin to very thick bedded limestone that weathers medium to light gray and is finely crystalline. At various horizons in the western segment the limestone has been replaced by orange weathering dolomite. Above the eastern segment of section X (one mile to the east) 255 feet of equivalent strata are composed of fine grained limestone in medium beds that exhibit cross bedding. Fossils from this limestone unit at both localities

belong to the Nevadella Zone.

Grand cycle B, lower half-cycle (B1).--The 160-foot interval containing this half-cycle is occupied by light brown weathering quartzite and siltstone that weathers light brown and light greenish gray. Skolithos sp. was the only fossil found but, from regional data given earlier, it is assumed that the boundary between the Nevadella Zone and the Bonnia-Olenellus Zone lies within the half-cycle. In the eastern segment of section X, a fossil locality containing a Nevadella Zone faunule was located 33 feet below the half-cycle. In the western segment a locality belonging to the Bonnia-Olenellus Zone was found 132 feet above the half-cycle.

Grand cycle B, upper half-cycle (B2).-- Four units in which carbonate predominates are present in this half-cycle. The lower unit (796') contains mainly gray weathering limestone in thin wavy beds. Also present are olive-gray shale, and light greenish gray siltstone that weathers light yellowish orange. Strata in the next overlying unit (1,034') consists mainly of medium light gray and medium to medium dark brownish gray dolomite in medium and thick beds. Medium and light gray dolomite in the following unit (355') resembles that in the unit below, but is mainly thin and medium bedded. At the top of the half-cycle is 88 feet of medium gray weathering limestone in thin, wavy beds. All of the localities within this half-cycle belong to the Bonnia-Olenellus Zone. The uppermost fossil locality, located 15 feet below the top, contains Bonnia sp., Olenellus paraoculus Fritz, and Wanneria logani (Walcott), and is considered to occupy a position high in the medial portion of the zone.

Post-Sekwi dark siltstone and limestone.--Overlying the Sekwi Formation is at least 167 feet (faulted?) of black siltstone that weathers rust to black. This in turn in overlain by thin bedded, platy limestone that weathers dark gray, and light orange. Protospongia sp., a sponge that is locally common in

the Middle Cambrian, was found in float 286, 457, and 485 feet above the top of the Sekwi Formation.

SECTION 7

Grand cycle A, lower half cycle (A1).--Map unit 10A, and an overlying 429 feet of "Swiss cheese" siltstone constitute this half-cycle at section 7. Fossils collected from the medial portion of the latter unit belong to the Nevadella Zone (Fritz, 1973). Until fossils are found in the lower "Swiss cheese" beds, it is assumed that they belong to either the Fallotaspis or Nevadella Zone.

Outer detrital strata.--Two units of outer detrital strata in section 7 have laterally displaced the upper half-cycle of grand cycle A and the lower half-cycle of grand cycle B. The lower unit (353') contains two subunits of of dark gray, platy, laminated limestone and a medial subunit (162') of brown weathering, limy siltstone. The limestone contains penecontemporaneous slump structures and breccias, and also contains some "exotic" blocks of light gray weathering limestone. Medium gray, limy siltstone predominates in the upper unit (783'). Sparse interbeds of very fine grained sandstone outline medium and large penecontemporaneous slump folds.

Small (1') limestone bioherms containing archaeocyathids are involved in some of the slumping, and near the base of the unit are two horizons of archaeocyathid bioherms that attain a maximum thickness of 33 and 94 feet. The boundary between the Nevadella Zone and the Bonnia-Olenellus Zone is tentatively placed just below 15 feet of quartzite at the base of this unit. Fossils belonging to the Nevadella Zone were found 53 feet below this horizon, and fossils belonging to the Bonnia-Olenellus Zone were found 135 feet above.

Grand cycle B, upper half-cycle (B2).--The lower, 370-foot unit in this half-cycle consists of fine grained, cross bedded limestone with Girvanella sp.

80 feet above the base, and of burrowed siltstone that weathers light brown and orange. Interbedded with the siltstone is some (10 per cent) fine grained sandstone. In the upper unit (1867') medium light gray and medium light brownish gray dolomite predominates. Within the lower 650 feet of the dolomite succession are numerous beds containing oolite and pisolite sized carbonate grains. Most of the dolomite is thick and medium bedded. A limestone interbed near the top of the unit contains Bonnia sp., Labradoria? sp. and Salterella sp. which are assigned to the late medial or upper third of the Bonnia-Olenellus Zone.

Post-Sekwi dark siltstone and limestone.--Overlying the Sekwi Formation at section 7 is a succession of unfossiliferous dark gray siltstone interbedded with medium light brown, limy siltstone. No fossils were found above the Sekwi Formation.

SECTION 6

Grand cycle A, lower half-cycle (A1).--Only a small portion of this half-cycle, consisting of 238 feet of "Swiss cheese" siltstone, is exposed at section 6. Here the "Swiss cheese" unit closely resembles the same unit at sections 7 and X, and contains fossils of the same age.

Outer detrital strata.--In section 6 the upper half-cycle of grand cycle A, the lower half-cycle of grand cycle B, and most of the upper half-cycle of grand cycle B are displaced by outer detrital strata. The lowest detrital unit consists of 541 feet of mainly dark gray, platy limestone similar to the limestone overlying the "Swiss cheese" siltstone in sections X and 7. In section 6, the boundary between the Nevadella Zone and the Bonnia-Olenellus Zone lies between fossil horizons located 92 and 470 feet above the base of the platy limestone unit. An intermediate collection of Bonnia-Olenellus Zone fossils found 353 feet above the base is in float, and therefore is of questionable use in restricting the boundary interval.

Above the platy limestone is a 821-foot unit in which shale predominates. The lower 630 feet consists of brownish gray weathering, limy shale with two intervals containing dark, platy limestone; penecontemporaneous limestone breccia is present in the upper interval. The upper 191 feet of the shale unit weathers silvery light yellow.

At the top of the outer detrital succession are three limestone units totaling 904 feet in thickness. In ascending order, they consist of an argillaceous limestone that weathers orange and medium gray (224'), a thin, wavy bedded limestone that weathers dark blue-gray and contains some penecontemporaneous breccias and slump structures (145'), and a thin bedded, platy limestone that weathers dark gray and exhibits penecontemporaneous folds at several horizons (535'). Numerous trilobite exoskeletons are preserved intact in the upper limestone unit.

Grand cycle B, upper half-cycle (B2).--The platy limestone just mentioned grades upward into this half cycle that consists of 275 feet of thin, wavy bedded limestone with disarticulated trilobite exoskeletons and burrows. The limestone is medium dark gray and weathers medium gray. A fossil locality 135 feet from the top contains Olenellus puertoblancoensis?(Lochman), which is tentatively assigned to the upper portion of the Bonnia-Olenellus Zone.

Post-Sekwi dark siltstone and limestone.--Overlying the Sekwi Formation at section 6 is 385 feet of medium brownish gray weathering, dark gray siltstone that contains some (5 per cent) interbeds of bright orange weathering limestone. No fossils were found in this unit. The next overlying unit, which is composed of black, brittle shale, contains Lower Ordovician graptolites 55 feet above the base.

INTERPRETATION OF STRATIGRAPHIC SECTIONS

The light colored quartzite in map-unit 12, the thin bedded, burrowed sandstones and siltstones in map-unit 13, and the siltstone and slate equivalent of these two map-units to the west (map-unit 10a) are considered to have been deposited under intertidal and shallow subtidal conditions at the sites of the 11 sections studied. The following discussion will bear mainly on Lower Cambrian strata above these map-units.

In section 10, one of the thinnest of the 11 sections measured, there is an abundance of thin, wavy bedded limestone and numerous fossil horizons, suggesting that here deposition took place at a relatively slow, even rate under shallow subtidal conditions. Shallower, intertidal conditions may have prevailed during the deposition of the medial 291-foot dolomite unit and the overlying 113-foot unit containing quartzite, siltstone, and orange weathering dolomite. At the top of the Lower Cambrian succession, the 67-foot interval covered by dark platy siltstone and dark silty limestone may contain strata representing an increase in water depth. The overlying dark, platy limestone bearing a late Middle Cambrian faunule, including agnostids, provides a more definite indication of the deeper conditions. If a deeper water environment is accepted for both units, it seems reasonable to assume an extremely slow rate of sedimentation to account for the close proximity of the late Lower Cambrian fossil locality (local float) 10 feet above the base of the covered interval and the late Middle Cambrian locality 60 feet higher.

At section X deposition of the 337-foot "Swiss cheese" siltstone is believed to have taken place under quiet, shallow subtidal conditions. The overlying 123 feet of platy limestone may represent deposition under deeper conditions at a time when clastics were being held in check eastward by a carbonate reef between section X and 10. A thick dolomite unit that may be part of this

reef is present at section 8. Rapid filling of the proposed "off-reef deep" is suggested in section X by the 680 feet of overlying siltstone with penecontemporaneous slump structures. These strata are interpreted as having accumulated on an unstable slope. Once shallower depths were attained, the proposed reef to the east may have prograded basinward over the slope deposits, as is suggested by the overlying 350-feet of thin to thick bedded, archaeocyathid bearing limestone. The close of carbonate deposition at the top of this interval, and at the top of the 291-foot dolomite unit in section 10 as well, marks the end of grand cycle A in both sections. The overlying 160 feet of quartzite and siltstone in section X is but part of the widespread clastic unit that maintains its relatively thin, uniform thickness (Text-fig. 2, B1) wherever it overlies strata of the middle carbonate belt. It is believed that this unit represents a regional regression caused by a pause, or a least a great reduction, in the rate of subsidence. Thin, wavy bedded limestone and interbedded siltstone in the succeeding 796-foot unit probably represent a return to the former rate of subsidence, and a resumption of shallow subtidal deposition. Dolomite in the overlying 1,034-foot and 355-foot intervals may have accumulated at an equivalent rate, but under very shallow, restricted conditions. Later, during medial Bonnia-Olenellus Zone time, normal marine seas transgressed over the dolomite to deposit 88 feet of thin, wavy bedded limestone under shallow subtidal conditions. At the location of section X, and probably concurrently at section 7 as well, the seas then deepend to mark the close of grand cycle B at these two sections, while at section 10 the cycle continued with shallow subtidal deposition until almost the end of Bonnia-Olenellus Zone time.

At section 7, the environmental history is nearly the same as at section X for the closing phase of the lower half-cycle of grand cycle A and the following early deposition in the outer detrital belt. Deposition of the "Swiss cheese"

siltstone (429') represents the closing phase under shallow, subtidal conditions and the overlying platy limestone marks an abrupt change to deeper water (outer detrital) conditions. The reader will recall that the next two events interpreted at section X were siltstone accumulation on an unstable shelf and prograding of a carbonate reef. At section 7 medial siltstone of the 353-foot unit, equivalent at the 680-foot unit at section X, is only 162 feet thick. Dark platy limestone (deep slope deposits) 97 feet thick in the upper part of the 353-foot unit at section 7 is thought to be the lateral equivalent of the 350-foot carbonate reef at section X. The difference in thickness between the mentioned siltstone and limestone pair at section X and the equivalent pair at section 7 is 771 feet. Although this figure cannot be taken as the exact difference in water depth between sections X and 7 after the pairs were deposited (because of compaction, etc.), it gives a general idea of the local relief between the sections, and adds weight to the next intrepretation - that the overlying 783' of siltstone in section 7 was deposited on an unstable slope.

Fossils date most (lower 135 feet barren) of the 783-foot siltstone unit of section 7 as belonging to the Bonnia-Olenellus Zone. Because this 783-foot siltstone unit seems to be separated from the 680-foot siltstone unit in section X by a deep to shallow water limestone, and as the 680-foot siltstone unit can be dated as being well within the Nevadella Zone, the two units are considered to be the product of two discrete events. The event that triggered deposition of the 680-foot siltstone unit is unknown. Deposition of the 783-foot siltstone unit took place during a period when inner detrital clastics were being deposited at sections X, 10 (Fig, 1, B1) and elsewhere (Fig. 2, B1). It therefore seems likely that the 783-foot siltstone unit is composed of that fraction of the clastics that bypassed the carbonate platform during the proposed

regression and formed a thick unstable prism just oceanward of the middle carbonate belt.

The succession of Lower Cambrian strata (370') overlying the 783-foot siltstone unit in section 7 is similar to the 796-foot unit exposed in section X. However, it contains a considerable amount of cross bedded, fine grained limestone and siltstone that may have been deposited under intertidal as well as the shallow subtidal conditions which were suggested for the 796-foot equivalent unit in section X. The 1,867 feet of overlying dolomite recalls the same restricted environment as proposed for the dolomites at section X, and the overlying dark siltstone and platy limestone suggest the same rapid transgression and rapid change to deeper water conditions.

At section 6, the 238 feet of "Swiss cheese" siltstone above the covered base of the Sekwi Formation and the overlying 541 feet of dark platy limestone are believed to represent a shallow subtidal environment abruptly followed by a much deeper environment, which is the same interpretation given for those lithologies near the base of the Sekwi Formation at sections 7 and X. Fossils from the platy limestone unit in section 6 indicate that it belongs not only to the Nevadella Zone, but to the lower half of the Bonnia-Olenellus Zone as well. Except for the rare beds of penecontemporaneous breccia, all other evidence indicates that the 541-foot unit was deposited at a point within the deep basin that was beyond the outer margin of the unstable slope. Overlying the 541-foot unit is 821 feet of shale and a minor amount of limestone with penecontemporaneous breccia. In general, resistant interbeds are lacking, and it was not possible to confirm the

presence or absence of penecontemporaneous slump structures. The 821-foot shale unit and the overlying three limestone units (224', 145', 535') are tentatively considered to be part of a third generation of unstable slope deposits, the other two having been described at sections X and 7. Penecontemporaneous slump structures and breccias in the limestone units suggest the slope environment, and fine planar laminae and trilobite exoskeletons intact indicate deposition below wave-base. The 275-foot limestone unit above the three limestone units, and at the top of the Sekwi Formation, contains burrows, disarticulated trilobite exoskeletons, and wavy bedding surfaces suggestive of shallow, subtidal environment. No evidence (granule sized limestone clasts, algal mounds, etc.) were seen to suggest the near proximity of a limestone bank. It is uncertain as to whether the 275-foot limestone unit represents an extension of the middle carbonate belt or simply an area of isolated shoaling. Olenellus puertoblancoensis? found near the top of this unit suggests a high position in the Bonnia-Olenellus Zone that is younger than the localities at the top of grand cycle B in section 7 and X. The overlying 385 feet of dark, limy post-Sekwi siltstone probably indicates an increase in water depth, although a thin bed of oolite and some burrows were found 40 feet above the base. The late Lower Cambrian age tentatively assigned the immediately underlying limestone and the presence of Lower Ordovician graptolites 55 feet above the siltstone unit suggests either slow deposition or an unconformity at the top of the unit.

REGIONAL INTERPRETATION OF SECTIONS

In Text-figure 2, eleven sections distributed over nearly 200 miles are placed in a regional facies fence diagram. The diagram shows a large re-entrant of outer detrital strata centered near section 6 and extending eastward into the middle carbonate belt. Near the margin of the re-entrant, the thickness of upper half-cycle A2 and lower half-cycle B1 remain relatively constant. Strata assigned to upper half-cycle B2 and the post-Sekwi Lower Cambrian dark siltstone and platy limestone are thicker northwest of the re-entrant. There sections 1-3 contain a higher proportion of siltstone in half-cycles A2 and B2 than do sections 8-10 on the southeast side of the re-entrant. The Sekwi Formation in the sections mentioned on the northwest and southeast sides of the re-entrant is comprised predominantly of thin, wavy bedded limestone that is thought to have been deposited under shallow, subtidal conditions. The medium and thick bedded dolomite present in half-cycle B2 at sections 7 and X is not present elsewhere, except for some dolomite of this type and age in section 4.

The following tentative explanation for the distribution of Lower Cambrian strata in the study area is based on an assumption that the Lower Cambrian longshore current ran from what is now north to south along the present eastern margin of the Cordillera. Allowing for regional curvature in the Cordillera, the current in the study area should have flowed southeast (following the present depositional strike) and parallel to a line drawn through sections 1-3 and 6-8. Along this line, and upcurrent from the earlier mentioned re-entrant, the rate of deposition at the sites of sections 1-3 was high, being half again the rate to the south at the sites of sections 8-10. Within the re-entrant, subsidence was equal to that upcurrent, but the "normal" rate of sedimentation was less because the main detrital load had already been deposited. Here the tendency was toward a relative deepening of waters because of starvation, but

this was interrupted by brief periods of rapid sedimentation on unstable slopes. Downcurrent from the re-entrant, where subsidence was slower (sections 8-10), shallow-water deposition took place at an even rate. Because detritus was dropped upcurrent at the sites of sections 1-3 during "normal" periods of deposition, and in the re-entrant (section 6, part of sections 5, 7, X) during "abnormal" periods of deposition, the longshore current carried very little detritus to the sites of sections 8-10. Some clastics undoubtedly reached these sections after travelling around the landward margin of the re-entrant, and other probably moved across the carbonate shelf from the east. The clearest shallow waters in the area were upcurrent from sections 8-10 and at the southeastern margin of the re-entrant. This was the deposition site for the relatively rare carbonates that are clean and thick-bedded (sections X, 350', 1,034', 355' units; section 7, 1,867' unit).

REFERENCES CITED

Aitken, J.D. 1966. Middle Cambrian to Middle Ordovician cyclic sedimentation, southern Rocky Mountains of Alberta. Bull. Canadian Petrol. Geol. 14: 405-441.

Blusson, S.L. 1971. Sekwi Mountain map-area, Yukon Territory and District of Mackenzie. Geol. Surv. Canada Paper 71-22, 17 p.

_____ 1972. Sekwi Mountain, Northwest Territories-Yukon Territory. Geol. Surv. Canada map 1333A.

Fritz, W.H. 1972. Lower Cambrian trilobites from the Sekwi Formation type section, Mackenzie Mountains, northwestern Canada. Geol. Surv. Canada Bull. 212, 58 p.

_____ 1973. Medial Lower Cambrian trilobites from the Mackenzie Mountains, northwestern Canada. Geol. Surv. Canada Paper 73-24, 43 p.

_____ 1975. Broad correlations of some Lower and Middle Cambrian strata in the North American Cordillera. Geol. Surv. Canada Paper 75-1, Part A: 533-540.

Green, L.H. and J.A. Roddick. 1961. Nahanni, Yukon Territory and District of Mackenzie. Geol. Surv. Canada map 14-1961.

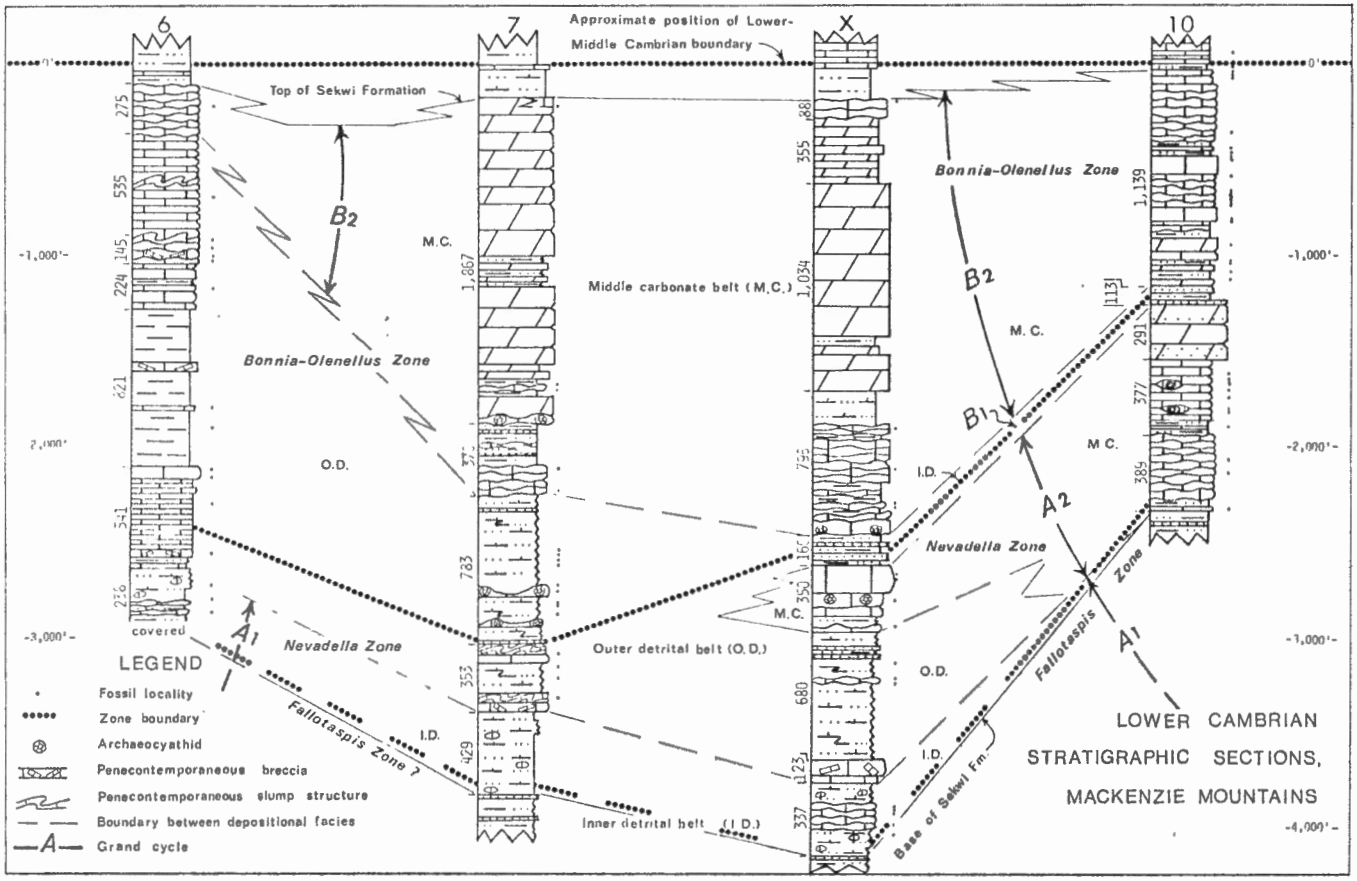
Handfield, R.C. 1968. Sekwi Formation, a new Lower Cambrian formation in the southern Mackenzie Mountains, District of Mackenzie. Geol. Surv. Canada Paper 68-47, 23 p.

Palmer, A.R. 1960. Some aspects of the early Upper Cambrian stratigraphy of White Pine County, Nevada and vicinity. Intermountain Assoc. Petroleum Geol., Eleventh Ann. Field Conf.: 53-62.

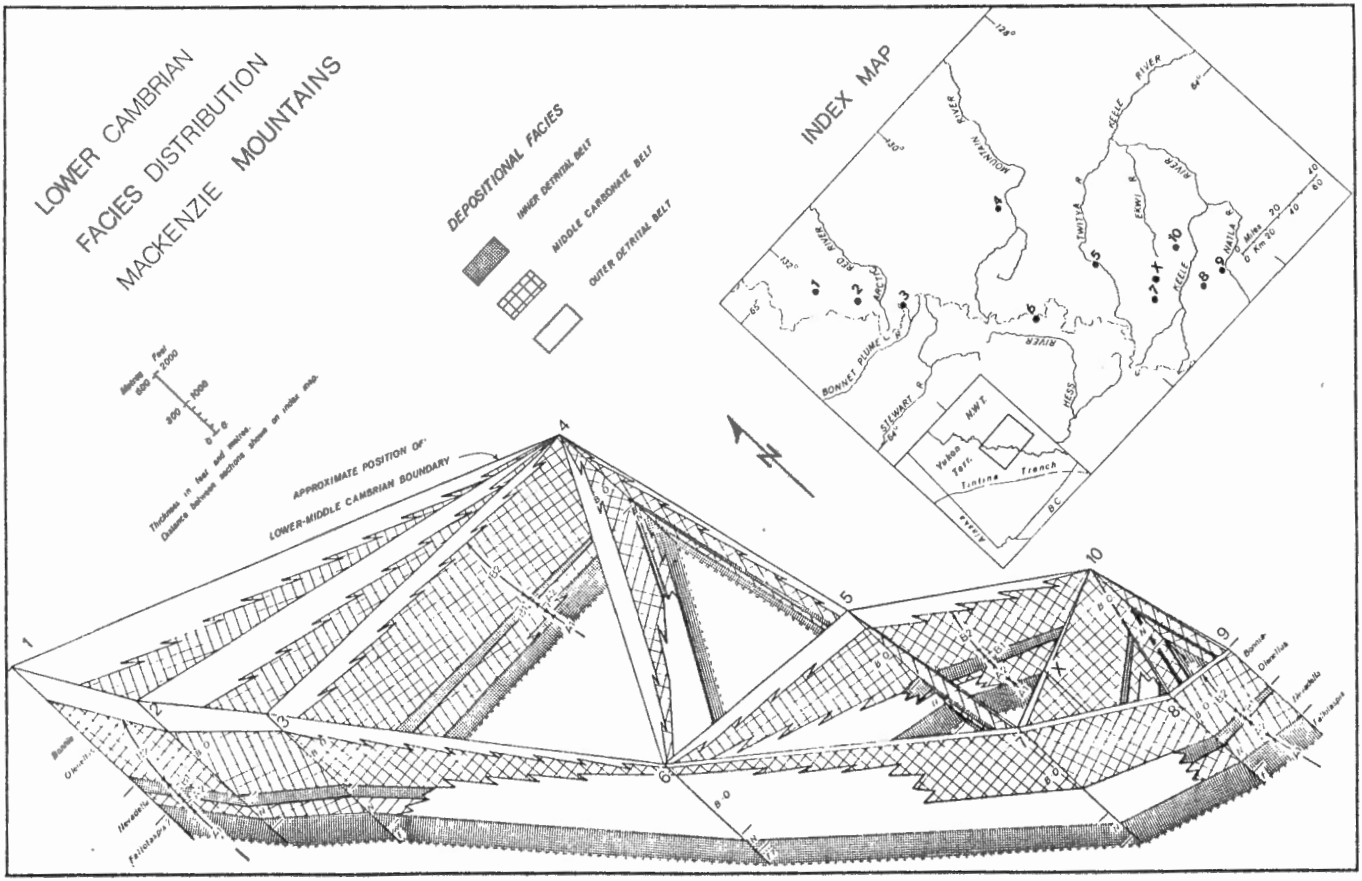
Robison, R.A. 1960. Lower and Middle Cambrian stratigraphy of the eastern Great Basin. Intermountain Assoc. Petroleum Geol., Eleventh Ann. Field Conf.: 43-52.

Table 1 - Map coordinates for stratigraphic sections

SECTION	THICKNESS OF SEKWI FM. (0' = BASE)	LATITUDE	LONGITUDE
1	3,802'	64° 49 1/2' - 50'	131° 58 3/4' - 132°
2	3,434'	64° 37' - 37 3/4'	131° 43' - 45'
3	3,381'	64° 26' - 27 1/2'	131° 22' - 24'
4	2,552'+	64° 22 3/4'	129° 43' - 44'
5	0' - 3,355'	63° 42 3/4' - 43'	129° 27 2/3' - 29 1/4'
	3,355' - 3435'	63° 42 1/4'	129° 29 1/4'
6	0' - 292'	63° 53 1/4'	130° 26 1/2'
	292' - 1,824'	63° 53 1/2'	130° 25 1/4'
	1,824' - 2,779'	63° 51 1/2' - 52'	130° 26' - 27'
7	0' - 1,975'	63° 26 1/3' - 26 2/3'	129° 21' - 23'
	1,975' - 3,802'	63° 28 1/2'	129° 27'
8	2,322'+	63° 16 3/4'	128° 50 1/2' - 51 1/2'
9	2,202'	63° 15 2/3'	128° 35 1/2' - 37'
10	2,309'	63° 31 2/3'	128° 41 3/4'
X	0' - 460'	63° 29 2/3'	129° 9' - 10'
	460'-3,923	63° 28 2/3' - 29'	129° 11 1/2' - 13'



TEXT-FIG. 1 - Lower Cambrian stratigraphic sections from the Mackenzie Mountains. The geographic location of the sections is given on an index map in Text-figure 2.



TEXT-FIG. 2 - Fence diagram showing Lower Cambrian facies distribution in the Mackenzie Mountains.