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ABSTRACT

Three major facies belts occur in the northeastern Bowser Basin of British Columbia. The Middle to Upper Jurassic Duti River – Slamgeesh Facies (A_1-A_5) represents delta – prodelta – sub-sea fan – turbidite – shale basin environments, with deposition of chert-pebble conglomerates being deposited by southwesterly flowing paleocurrents. The Upper Jurassic (to possibly Lower Cretaceous) Gunanoot – Groundhog Facies (B) represents an alluvial fan – coal swamp setting with southerly flowing paleocurrents. The possibly Lower Cretaceous Jenkins Creek Facies (C) is made up of deposits that were laid down by westerly flowing streams on a low-gradient alluvial plain; it does not contain any coal.

RÉSUMÉ

Le bassin Bower dans le nord-est de la Colombie-Britannique présente trois faciès principaux. Le faciès Slamgeesh (A_1 - A_5) – Duti River, du Jurassique moyen à supérieur représente des milieux de delta, de pro-delta, de cône d'alluvions sous-marins, de turbidite et de bassin schisteux avec dépôt de conglomérats de cailloux de chert laissés par d'anciens courants à direction sud-ouest. Le faciès Gunanoot – Groundhog (B) du Jurassique supérieur (s'échelonnant peut-être au Crétacé inférieur) représente un milieu à cône d'alluvions et à marais carbonifères avec anciens courants à direction sud. Le faciès Jenkins Creek (C) appartenant possiblement au Crétacé inférieur est formé de dépôts laissés par des cours d'eau coulant en direction ouest sur une plaine alluviale à faible pente; on n'y trouve pas de charbon.

DELTAIC SEDIMENTATION IN THE NORTHEASTERN BOWSER BASIN, BRITISH COLUMBIA

Introduction

Field work carried out in conjunction with a study of the late-orogenic continental Sustut and Sifton Basins of north-central British Columbia during the field seasons of 1969 to 1972, led the author into a reconnaissance survey of the adjoining northeastern part of the predominantly marine Bowser Basin (Eisbacher, 1973). The Bowser Basin (Fig. 1) includes a large area of clastic sedimentary rocks known informally as the Bowser Assemblage (Souther and Armstrong, 1966); the sediments predominantly form a non-volcanic 'successor basin' of Middle Jurassic to Lower Cretaceous age and overlie older volcanic complexes of the Cordilleran eugeosynclinal belt (Eisbacher, in press).

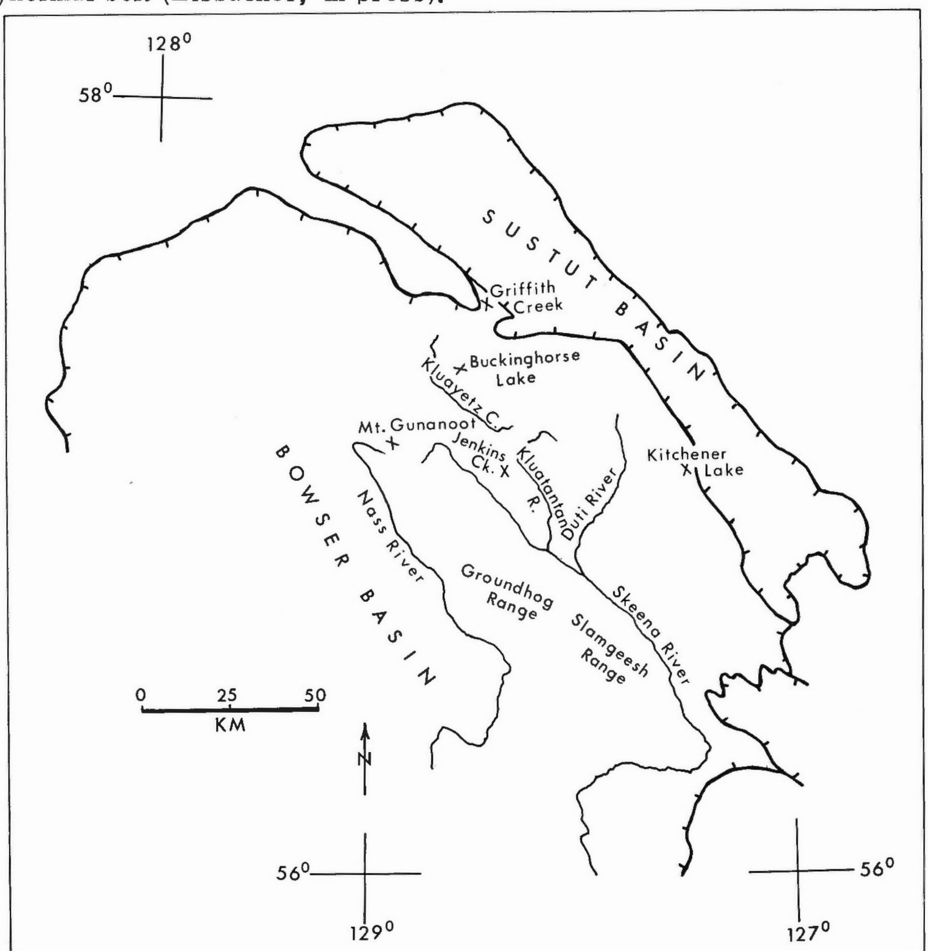

Figure 1. Index map of the northeastern Bowser Basin and adjacent Sustut Basin.

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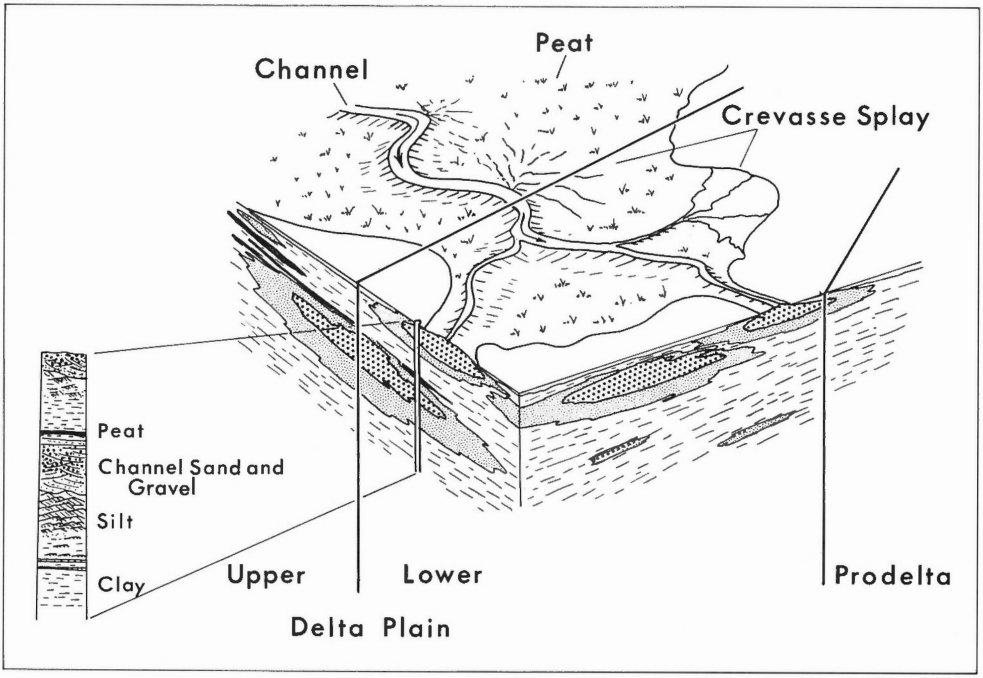

Figure 2. Generalized model of a constructional delta (after Fisher).

A preliminary outline of the Bowser Basin was obtained during Operation Stikine (Geol. Surv. Can., 1957), and most of the fossil collections from marine sedimentary rocks indicate a Late Jurassic age (Frebold and Tipper, 1970). The known occurrence of coal in the Groundhog Range, and occurrence of Upper Jurassic - Lower Cretaceous plant fossils nearby (Buckham and Latour, 1950), suggest that deltaic deposition must have played a significant part in the filling of the basin during at least some of its history.

Deltaic Depositional Model

Delta systems grow along shorelines that are fed by sediment bearing rivers, and therefore record in their sedimentary evolution the interaction between rivers and the sea. Comparative work on many recent examples shows that delta systems can be classified into constructive (or river-dominated) and destructive (or wave-dominated) delta systems (Fisher et al., 1972). The difference between their deposits is the widespread occurrence of fluvial deposits in the first, and the predominance of reworked barrier bar, beach and lagoonal deposits in the latter. Figure 2 illustrates a typical constructive delta and its internal sedimentary structure. Deltaic deposits are generally characterized by a vertical succession of 'coarsening-upward' cycles originating from the slow progradation of distributary channels over fine-grained deposits of the prodelta environment and the termination of this progradation by abrupt relocation of the channels into 'crevasse splays'

(Coleman and Gagliano, 1964). During seaward progradation of the delta surface the lower parts of the delta are buried by clays and fine sands. In the upper parts of the delta sediment is transported in meandering channels. A lower rate of subsidence and rich growth of indigenous plant material in the inter-channel region of the upper delta commonly leads to the formation of peat which represents the starting material for coal. Progressive shoaling of the sea eventually causes deposition of continental sediments on top of the older marine deposits. Along steep coasts coarse channel material may reach the shelf edge where it may flow through submarine channels or canyons into deeper water. At the mouth of such canyons, aprons of sediment, or 'sub-sea fans', form thick wedges of coarse clastic sediment (Normark, 1970).

Northeastern Bowser Basin

The Bowser Assemblage in the northeastern part of the basin was deformed into numerous closely spaced anticlines and synclines during uplift of the Coast Crystalline Belt in Late Cretaceous and Early Tertiary time, contemporaneously with deposition of the nonmarine Sustut Group (Eisbacher, in press).

Folding and thrust faulting, and the absence of stratigraphic marker beds makes mapping of individual rock-units within the Bowser Assemblage very difficult, and most measureable sections are floored by thrust faults. Therefore only minimum values for stratigraphic thicknesses can be given in most places. In spite of these difficulties, the character of partial sedimentary sections and sparse paleontological evidence indicates the presence of several distinct facies belts in the northeastern Bowser Basin. These 'facies' can be considered as informal rock-stratigraphic units. Should future work show that they are mappable regionally they may gain the rank of formations. Past experience with other complex marine and nonmarine intercalations, however, has shown that 'facies' (channel, prodelta, etc.) are easier to map in three dimensions than the classical 'formations' and 'members', mainly because of the lensoid or linear nature of most sandstone bodies in this depositional setting.

The names attached to the facies in northeastern Bowser Basin are meant to apply only to their principal outcrop areas. The boundaries between the three major facies belts shown in Figure 3 have not been investigated during this reconnaissance; they follow drift covered valleys and may be faults and/or unconformities.

Facies Belt A (Duti River - Slamgeesh)

The most northeasterly belt of facies A (A_1) unconformably overlies older volcanic rocks of the Takla-Hazelton Assemblage. Above a basal shale-siltstone sequence the beds become richer in coarse clastics and the facies is characterized by numerous conglomeratic sheets and lenses. Fossils collected from near the unconformity south of Griffith Creek by E. F. Roots in 1957 (GSC loc. 41050, 41051, 41052, 41053), were identified by H. Frebold as Kepplerites, Cobbanites, Pleuromya, Cadoceras, Trigonia, and Pholas, indicating a Callovian age. Small collections made by the author from other

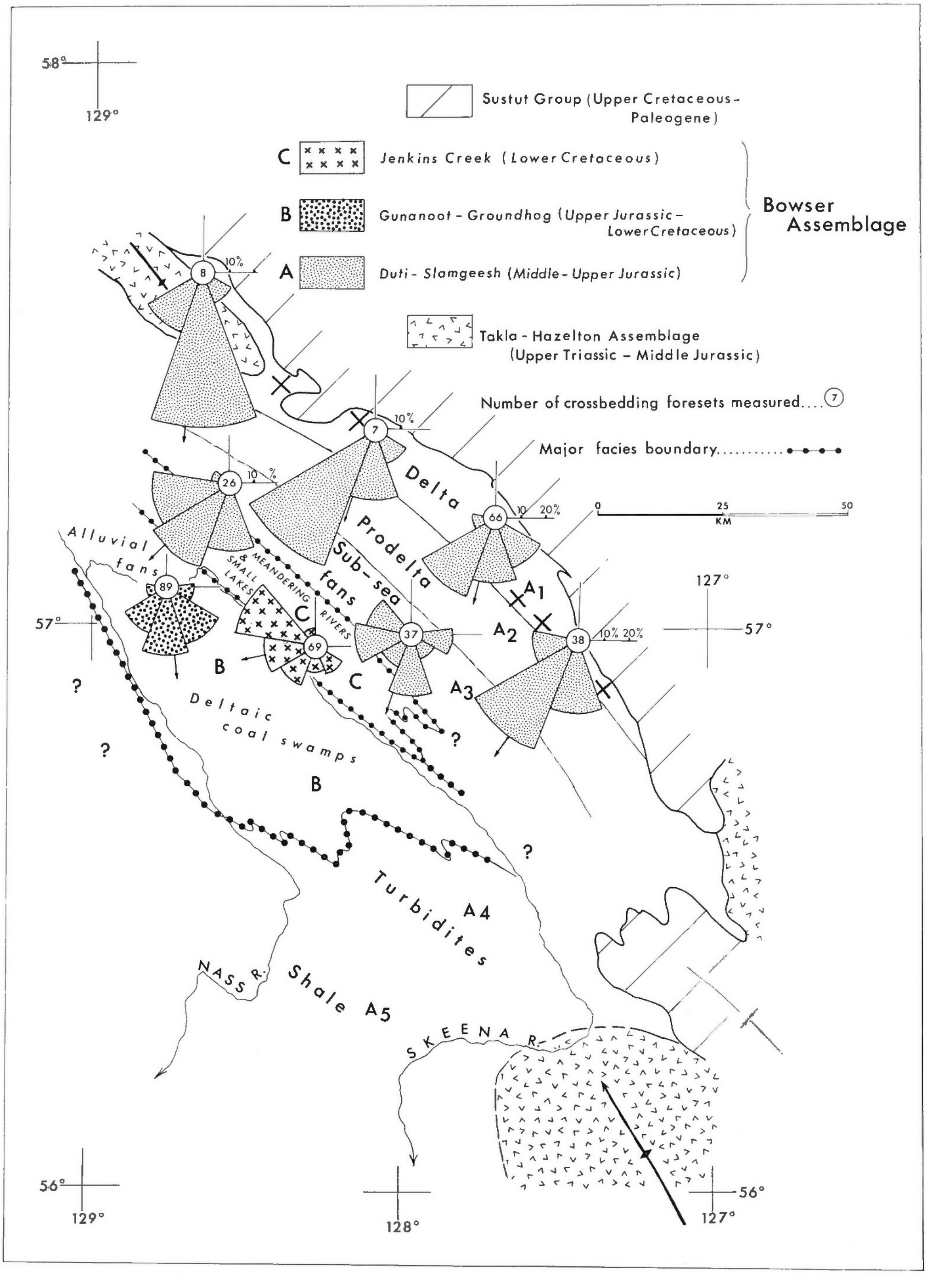

Figure 3. Sketch map of the principal facies belts in the north-eastern part of the Bowser Basin.

Figure 4. View of part of the section shown in Figure 5, looking south from Kitchener Lake. GSC Photo No. 202314.

parts of the A_1 - facies were considered by H. W. Tipper (pers. comm.) to contain Cardioceras and Buchia concentrica, indicating an Oxfordian age. One of the thickest, structurally unbroken, sections, was measured south of Kitchener Lake (Fig. 4). The most obvious feature of this section, and of many sections exposed along trend, is the repetitive nature of shale-sandstone-conglomerate sequences, displaying very sharp breaks between the conglomerate and the overlying marine shale (Fig. 5). Overall, the section reveals a gradual decrease in shale towards the top and the appearance of thin lenses of coal in the highest part. Conglomerate and sandstone bodies commonly display large-scale crossbedding, and measurement of 119 foresets indicates southwesterly flowing paleocurrents (Fig. 3). Fragments of silicified wood are common in the conglomeratic units. A comparison of the vertical sequences displayed in A_1 with those of the delta model suggests strongly that this facies represents the alternation between plant-bearing crossbedded channel deposits and marine shales of the lower delta plain of a 'constructive delta'. Coarseness of the channel deposits and absence of reworking possibly indicates rapidly subsiding high-gradient coastal plain. Conglomerate clasts are mainly subrounded chert and silicified tuff fragments and must have been brought into the basin from the northeast, prior to unroofing of high-grade metamorphic terrain of the Omineca Crystalline Belt (Eisbacher, in press). The measured section illustrates the progradation of the delta plain over the prodelta to the southwest.

A common feature in the A_1 - facies are intraformational unconformities in which basin-ward dipping strata are overlain by beds of gentler dip (Fig. 6); five unconformities within the facies are plotted as crosses on Figure 3.

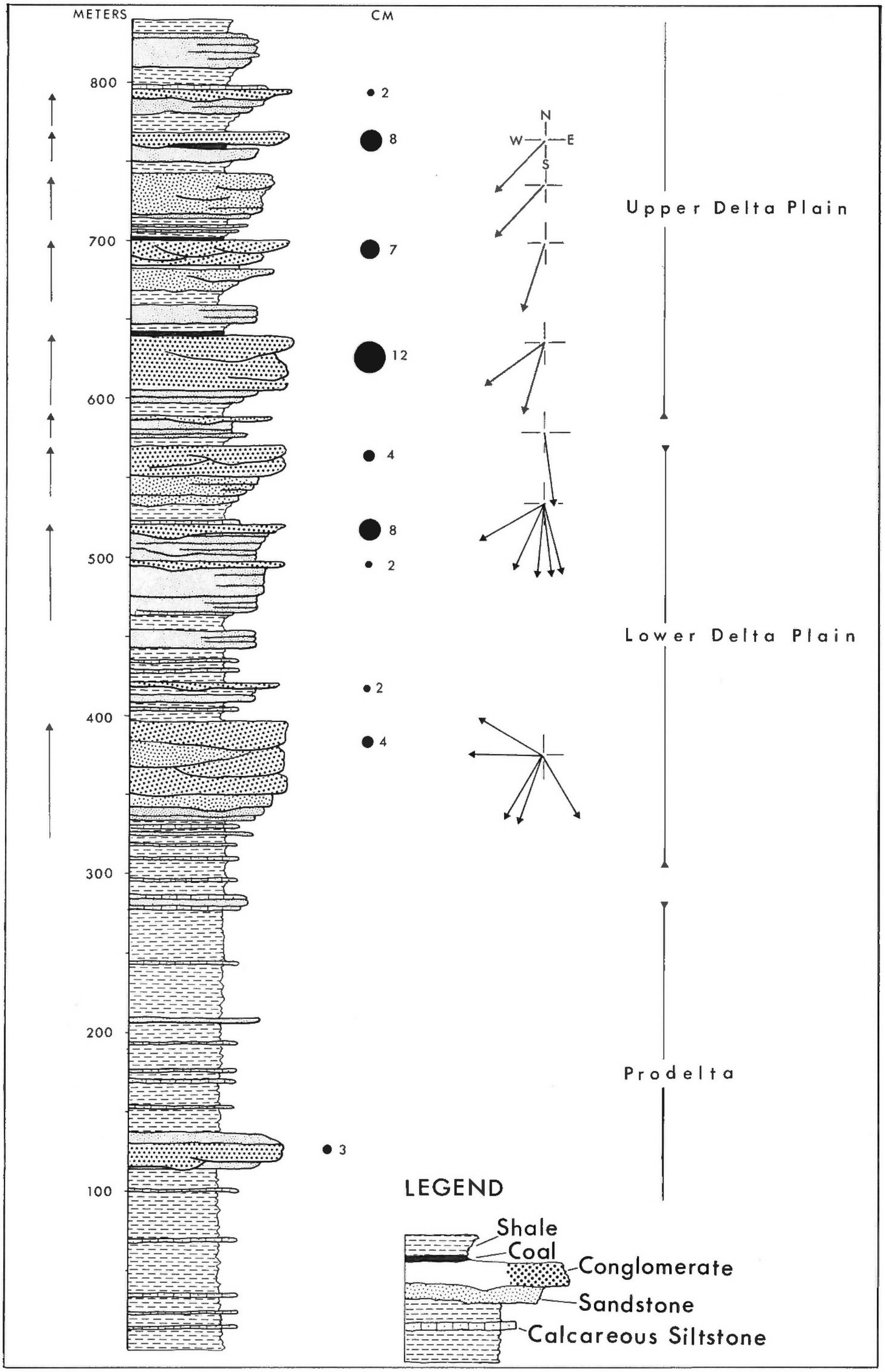

Figure 5. Columnar section of facies A near Kitchener Lake, illustrating coarsening-upward cycles, maximum clast size of conglomerates (in cm), direction of facing of foresets in crossbedded units, and environmental interpretation.

Figure 6. Interformational unconformity south of Kitchener Lake looking to the southeast. GSC Photo No. 202314-A.

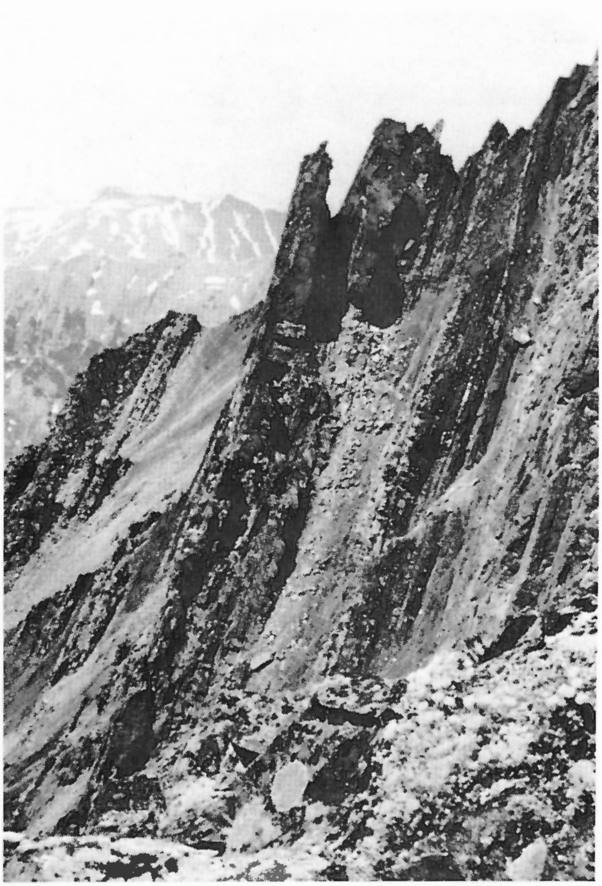

Figure 7.

Steeply dipping beds of facies A_3 near Buckinghorse Lake looking to the northwest. GSC Photo No. 202314-B.

Facies belt A_2 is predominantly shale and siltstone; conglomerate is rare. The parallel alignment of A_2 and A_1 suggests that A_2 represents the prodelta of the principal delta complex A_1 (Fig. 3).

Thick sheets of conglomerate reappear in facies belt A_3 where they are intercalated with well-bedded thin sandstone and fossiliferous calcareous siltstone (Fig. 7), but the conglomerates are distinctly different from those of A_1. Internal sedimentary structures are rare and sorting is poor. Nevertheless occasional low-angle crossbedding can be seen and indicates southwesterly-directed paleocurrents (Fig. 3). A comparison between parts of measured sections for facies A_1 and facies A_3 is shown in Figure 8 and the differences between the two facies are indicated. The parllel alignment of A_3 relative to A_1 and A_2, similar paleocurrent trend, and identical conglomerate composition suggest that A_3 represents the deposits of a sub-sea fan

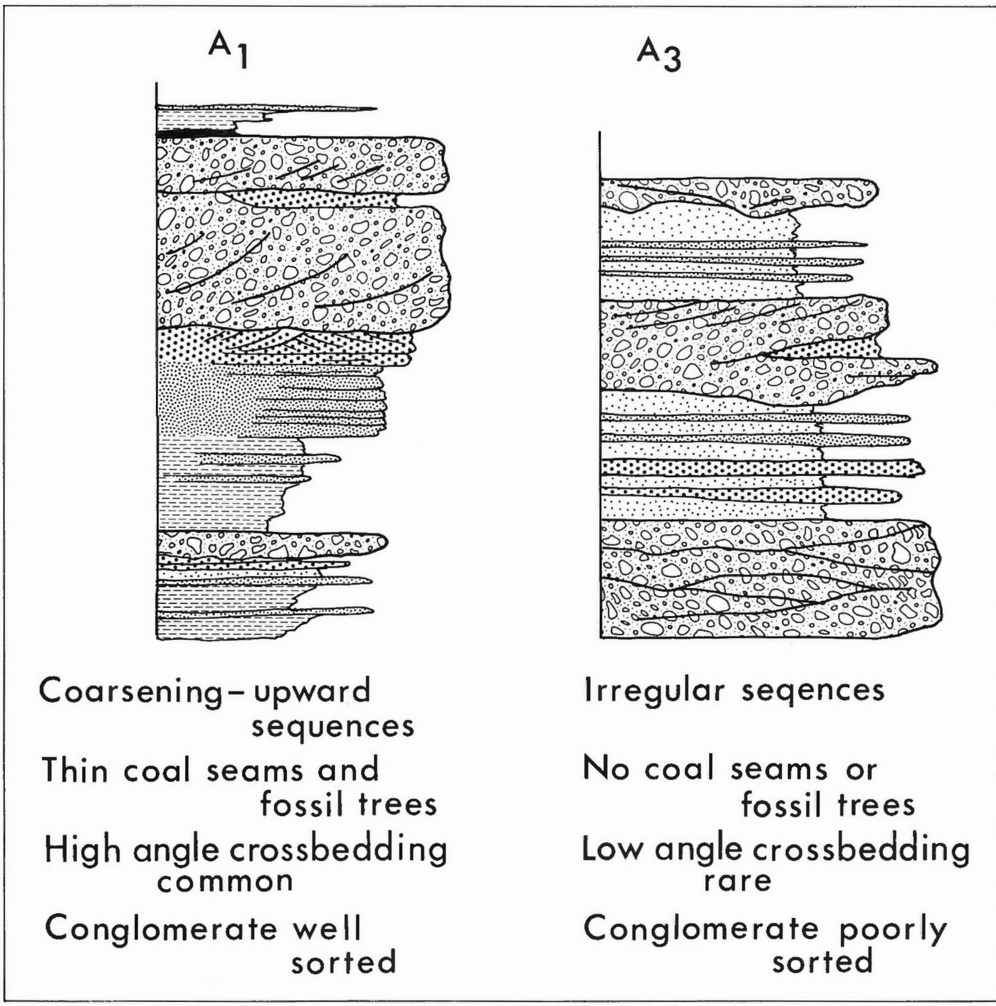

Figure 8. Comparison of sedimentological characteristics in facies belts A_1 and A_3.

Figure 9. Massive alluvial fan conglomerate overlying thin beds of sandstone and coal, south of Mount Gunanoot. GSC Photo No. 202314-C.

system which had formed in front of the prodelta (A_2) and was fed by the distributary delta channels of A_1.

Facies $\underline{A_4}$ and $\underline{A_5}$ of the Duti River - Slamgeesh complex also seem to overlie Takla-Hazelton volcanics directly. The two belts, however, contain thin graded beds (A_4) and shale (A_5), and are possibly turbidites or even more distal products of sedimentary transport processes active on the delta - prodelta - sub-sea fan complex to the northeast.

Facies Belt B (Gunanoot - Groundhog)

The ranges between Skeena River and Nass River valleys are underlain by a sequence of conglomerate with intercalated crossbedded sandstone units and coal seams (Fig. 9). In the north this facies seems to be entirely continental (Mount Gunanoot), towards the south grain size of the clastics decreases and marine shale intercalations are common (Groundhog Range). A minimum thickness of this facies appears to be about 500 metres (1,500 feet). In the Groundhog Range marine fossils indicate a Kimmeridgian age (Frebold and Tipper, 1970).

Crossbedding in the sandstones of the northern part of this facies belt indicates southerly flowing paleocurrents (Fig. 3). The Groundhog - Gunanoot Facies probably represents an uppermost Jurassic - Lower Cretaceous alluvial fan and coal-swamp setting that prograded over the delta and sub-sea fan of the Duti River - Slamgeesh Facies during gradual regression of the sea towards the south.

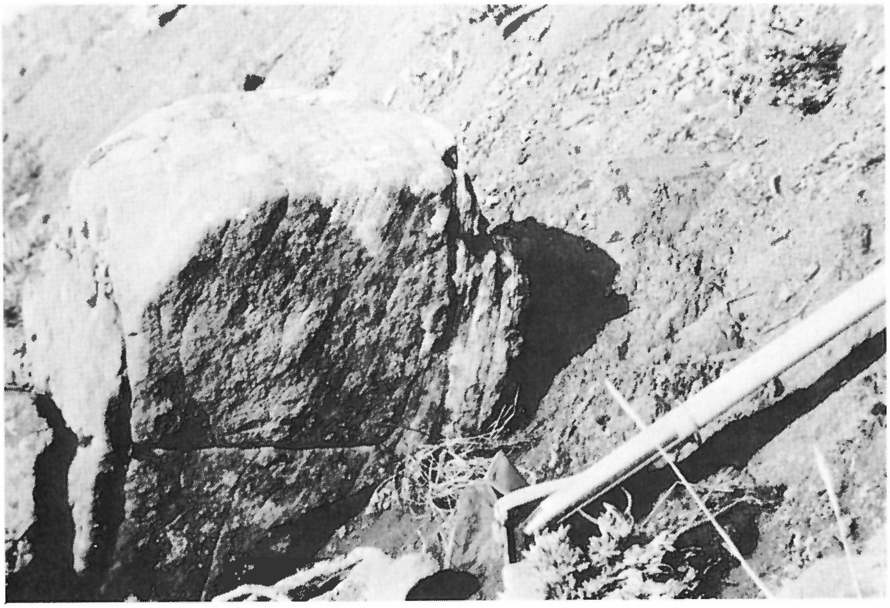

Figure 10. Crossbedded channel sand-stone overlying argillite and thinly laminated calcareous lens near Jenkins Creek (ice axe for scale.) GSC Photo No. 202314-D.

Facies Belt C (Jenkins Creek)

The range between Skeena River and Kluatantan River - Kluajetz Creek valleys is made up entirely of continental, fine-grained clastics and numerous thin beds and lenses of laminated or concretionary limestone (Fig. 10). A measured section north of Jenkins Creek displays a repetition of distinctly fining-upward sequences consisting of crossbedded sandstone channels which grade upwards into siltstones, mudstones, argillite or laminated carbonate lenses (Fig. 11). A minimum thickness of 200 metres (600 feet) is suggested for this section. Crossbedding indicates westerly directed paleocurrents.

The fining-upward sequences are probably the result of sedimentation on a low-gradient alluvial plain with meandering river channels (coarser grain size) being laterally overlapped by overbank deposits (Allen, 1970). The carbonate lenses probably represent deposition in small temporary lakes or ponds. No coal was encountered in the Jenkins Creek Facies.

Discussion

The basal unconformity, the intraformational unconformities, and the general regression of the Mesozoic sea to the southwest during deposition of the Bowser Assemblage suggests that the facies belts outlined above may be diachronous and progressively younger from A to C. The Jenkins Creek Facies could represent an early western phase of the Sustut Group to the east. Paleocurrents in the basal Sustut Group flowed to the west-southwest (Eisbacher, in press).

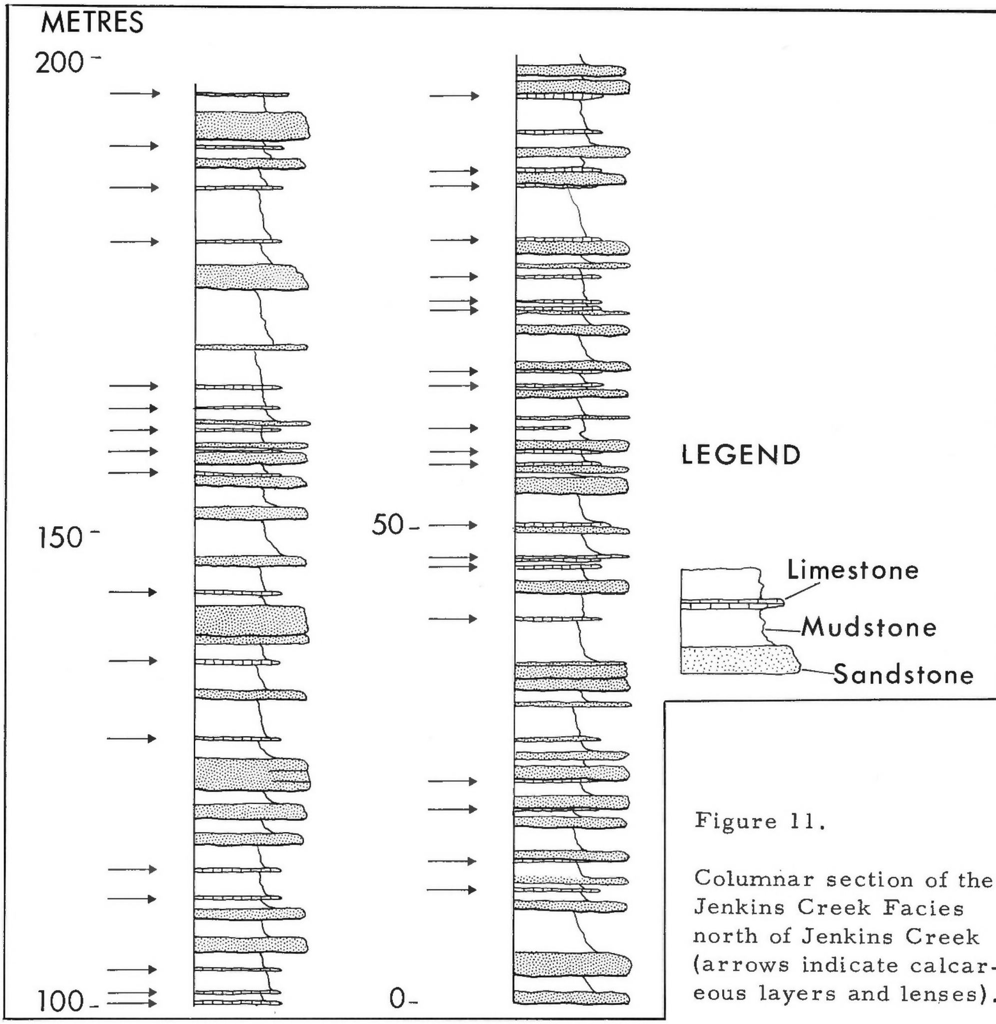

Figure 11.

Columnar section of the Jenkins Creek Facies north of Jenkins Creek (arrows indicate calcareous layers and lenses).

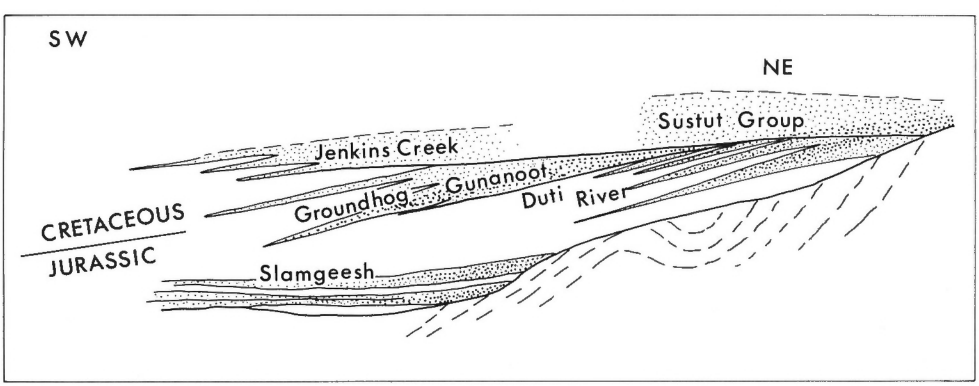

Figure 12. Restored schematic cross-section through the northeastern Bowser Basin.

A hypothetical restoration of the facies belts is attempted in Figure 12, but should be critically evaluated by future biostratigraphic, structural and sedimentological work in order to obtain an adequate understanding of the coal deposits in the Groundhog Range.

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