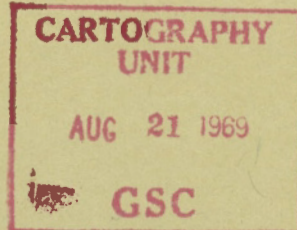


GEOLOGICAL
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CANADA

DEPARTMENT OF ENERGY,
MINES AND RESOURCES



PAPER 68-28

THE GETHING FORMATION AT PEACE RIVER CANYON,
BRITISH COLUMBIA

(Report and 1 figure)

D. F. Stott

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Price \$1.50

Catalogue No. M44-68-28

Price subject to change without notice

ROGER DUHAMEL, F.R.S.C.

Queen's Printer and Controller of Stationery

Ottawa, Canada

1969

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ABSTRACT

The Gething Formation is described in a well-exposed and easily accessible section along the western cliffs of the upper part of the Peace River Canyon. The formation is shown to be at least 1,600 feet thick in the type region and possibly may be as much as 1,800 feet. Columnar sections show the relationship of this section to earlier descriptions of the Gething Formation from Moosebar and Aylard Creeks, and along the north shore of the lower reaches of the canyon.

THE GETHING FORMATION AT PEACE RIVER CANYON

INTRODUCTION

The Gething Formation was described recently (Stott, 1968) in a report on the Bullhead and Fort St. John Groups between Smoky and Peace Rivers. The description of the type section of the Gething at Peace River Canyon was based mainly on a composite section comprising exposures along the north shore of the lower canyon and along Aylard Creek on the south bank. The canyon sections were examined by the writer in 1961 while the Peace River was discharging its normal flow of water, thus limiting access to parts of the river banks. Since then, the excellent Gething section on the west side of the river at the head of the canyon has become accessible owing to the construction of the W.A.C. Bennett dam which reduced, at least temporarily, the flow of water through the canyon. The western section was measured and described during the field season of 1968 by the writer who found that the total thickness of the Gething Formation in that area is considerably greater than previously believed. As the canyon exposures constitute the type section of the formation, it is desirable at this time to present a revised description based on the more reliable and continuous section of the western cliff. Although this revision does not seriously affect the conclusions of the writer's previous report, it does provide a remarkable record of Gething sedimentation and emphasizes the marked increase in thickness of Gething sediments in the immediate vicinity of Peace River.

Acknowledgments

Permission to work within the construction area of the W.A.C. Bennett dam-site was kindly granted by the British Columbia Hydro and Power Authority and its sub-contractor, Kiewit, Dawson and Johnson. The writer is grateful to Mr. P. Huong and Mr. J. Reilly, safety engineers, for making the necessary arrangements.

The fossil flora of the Bullhead Group was identified by D.C. McGregor and W.A. Bell of the Geological Survey of Canada.

The sections were measured and sampled in 1961 with the capable assistance of M.L. Larson, and in 1968, of J. Irish.

Access

The Peace River canyon may be reached by a paved road that connects the dam-site and the nearby town of Hudson Hope with Chetwynd on the John Hart Highway. A gravel road between Hudson Hope and Fort St. John on the Alaska Highway is being rebuilt and paved.

Manuscript received: December 18, 1968

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Geological Survey of Canada, Calgary 44, Alberta

Many parts of the canyon were accessible during low-water stages before the construction of the W.A.C. Bennett dam but a stretch of the river near the head of the canyon, particularly the western wall, was bounded by steep cliffs which prevented any traverses. Prior to the construction of the dam, the north shore between Grant Flat and Fossil Tree Point provided good exposures of the lower part of the Gething Formation; the basal portion of the formation was also well exposed at the head of the canyon. Some of the exposures in the upper canyon are now covered by the dam and power house. Exposures in the lower part of the canyon have not been affected by recent work at the dam-site.

The upper part of the formation is exposed in several creeks that empty into Peace River along its south bank. Although almost continuous sections occur on Aylard, Gething and Moosebar Creeks, that on Moosebar Creek is probably the best. The south shore was accessible previously only by boat or helicopter, but Moosebar Creek can now be reached from a road along the south shore and Gething Creek is easily reached now by a short walk from the dam-site.

The section along the west bank is at present accessible along a road built from the materials excavated from the diversion tunnels. Parts of the road are already washed out and it is likely that the release of a larger flow of water with the commencement of power generation will result in the gradual erosion of the dumped material and the rock wall may once again become inaccessible.

Some of the power generators were started in late September, 1968, and others will be placed in service within the next few years. The increased flow of water may cover many exposures at river level and prevent easy access to the canyon below Gething Creek. Consultation with the British Columbia Hydro and Power Authority at the dam-site is recommended before any work is attempted along the river because the water levels are subject to rapid fluctuations.

Field Work

The original work by the writer in the vicinity of Peace River was done in 1961 when sections along the north shore, Moosebar and Aylard Creeks, and the head of the canyon were examined. At that time, the writer traversed Gething Creek in order to examine the overlying Moosebar shales but did not study the Gething strata in any detail.

The section along the western wall, downstream from the dam-site, was examined and sampled during four days in August, 1968. Measurements were begun at the first rock outcrops at the toe of the dam and were continued downstream along the southwestern bank, past Gething Creek to a point where a vertical cliff and deep water prevented any further advance. The point represented about the highest stratigraphic level accessible along the river, the beds rising stratigraphically away from it both up and down stream. An attempt was made in 1968 to ascend Gething Creek in order to measure continuously to the top of the formation but high water conditions related to an early and heavy snowfall prevented continuation upstream. The previous traverse up Gething Creek revealed several waterfalls that are difficult to climb.

GETHING FORMATION

Distribution and Lithology

Coal-bearing rocks occurring in Peace River canyon were originally assigned by McLearn (1923, p. 4B) to the Gething Member of the Bull Head Mountain Formation. Subsequently, the formation was raised to group status, the name shortened to Bullhead by Wickenden and Shaw (1943, p. 2), and the Gething gained formational rank. Although the definition of the Bullhead Group was modified recently (Stott, 1968a), the Gething, as originally defined by McLearn, has proved to be a useful map-unit and is widely distributed in northeastern British Columbia (see Stott, 1967, 1968). It is recognized in the Foothills from near Smoky River in the south almost to Muskwa River in the north.

The well-exposed sections along the lower part of the canyon were measured and described as type by McLearn (1923, secs. C1-C2, E1-E3, and Fig. 2). He spent two months in the area, undertaking a detailed study of the coal seams and describing the rocks between Grant Flat and Milligan Point on the north shore; exposures on Moosebar and Aylard Creeks, on the east side of the river at the head of the canyon; and isolated occurrences of coal seams on Johnson, Mogul, and Gething Creeks. McLearn presented columnar sections showing the correlation of coal seams and indicating his interpretation of relationships of the successions occurring on the north and south sides of the canyon. Additional studies of coal seams in the area were made by McLearn and Irish (1944). Those reports were incorporated later in a more complete summary on the geology of northeastern British Columbia (McLearn and Kindle, 1950). The type exposures on the north shore and on Aylard Creek were redescribed by the writer (Stott, 1968, pp. 23-30 and Fig. 9). The section is a composite one, as the river prevents the beds being traced directly across from the north shore into Aylard Creek.

The Gething Formation was described previously (Stott, 1968) from numerous sections between Peace and Smoky River. In general, it comprises inter-bedded mudstone, coal, and sandstone. The repetition of numerous thin units is a characteristic feature of the Gething in this region. Sandstones in the canyon area are dominantly fine-grained, silty to argillaceous, and are commonly carbonaceous. They are brown to grey on a fresh surface and weather brown. Only a few units exceed 25 feet in thickness and many are channel structures. The mudstones are mainly brownish grey to green and most are carbonaceous.

McLearn, when he measured the canyon sections, determined from his columnar sections that the thickness from the top of the formation to the Riverside seam was 1,250 feet. He anticipated some errors in measurement, however, and suggested that 1,125 feet would be a reasonable thickness. McLearn considered that about 300 feet of unexposed basal strata occurred between the Riverside seam and the underlying conglomerates and, therefore, estimated that the total thickness of the Gething in the vicinity of Peace River was somewhat more than 1,400 feet.

The writer, in the course of his initial studies in the canyon, suggested an alternate interpretation, thereby reducing the thickness of exposed Gething strata to 1,000 feet which gave, using McLearn's estimate of the covered interval at the base, a total thickness of about 1,300 feet.

The thickness of the Gething Formation, as presently indicated by the composite sections, is in the order of 1,600 feet, assuming the occurrence of a fault in the west bank section. If the postulated fault is not present, the total thickness of the Gething Formation approaches 1,800 feet. Some 500 feet of beds should be present between the Riverside seam and the Cadomin Formation in the lower canyon, as the Riverside seam is correlated with a coal bed lying about 500 feet above the base in the west bank section. However, there is some possibility that the base of the Gething at the head of the canyon is not drawn at the same stratigraphic level as it is in the lower part of the canyon.

The thickness of the Gething Formation in Peace River canyon is remarkable in comparison to its thickness elsewhere. Only 843 feet of sediments were assigned to the Gething in the West Canadian Moberly Lake 11-36-80-25, W6 well which is only 15 miles east of the canyon (Stott, 1968, p. 22). Farther south, the Gething is 677 feet at Wolverine River, decreasing to only 260 feet at Mount Torrens (Stott, 1968). North of Peace River, the greatest known thickness is at Fiddes Creek where it is about 1,300 feet (Stott, 1967). As shown by the writer (Stott, 1968, Fig. 10), the isopachs for the combined Cadomin, Gething and Bluesky rocks indicate a marked eastward decrease in thickness and a pronounced lobe of maximum deposition more or less parallel to Peace River. The revised estimate makes this lobe even more pronounced with the locus of maximum deposition being in the region of the present canyon.

Within the canyon area, the lower contact of the Gething Formation is placed at the top of the uppermost thick conglomerates and coarse-grained sandstones of the Cadomin Formation. The lower contact is not exposed at the east end of the canyon. At the toe of the dam, the contact lies above massive medium-grained to coarse-grained sandstone. Some gradational features are evident as a unit of channel sandstone grades laterally into silty mudstone. As shown in the previous report (Stott, 1968), the Gething-Cadomin contact forms no persistent horizon but lies above different sandstones from one locality to another.

The upper contact with the overlying Moosebar is exposed at Moosebar, Aylard, and Gething Creeks. At Gething Creek, gritty sandstone with pebbles is overlain by six inches of argillaceous sandstone with pebbles, and then by dark grey to black mudstone. At Aylard Creek, one-eighth to one-half inch chert pebbles are scattered over the surface of the upper Gething sandstone. At Contact Point at the lower end of the canyon, thick-bedded argillaceous sandstone of the Gething Formation is overlain by one foot of dark fine- to medium-grained sandstone with disseminated small chert pebbles. That bed is in turn overlain by silty dark grey Moosebar mudstone with reddish brown-weathering concretions. The boundary is distinct at each locality and is probably slightly disconformable throughout the region.

One new collection of flora, obtained during the recent study and identified by W.A. Bell, includes (GSC loc. 8025)

Cladophlebis virginiensis Fontaine emend. Berry

Sagenopteris williamsii (Newberry) Bell

Ginkgo pluripartita (Schimper) Heer

Pterophyllum rectangulare Bell

Nilssononia curvifolia (Dunker) Nathorst

Nilssononia yukonensis Hollick

Pityophyllum cf. P. nordenskioldi (Heer) Krystofovich

The age, flora, and correlation of the Gething Formation is outlined in an earlier report (Stott, 1968). As discussed there, flora similar to that of the Gething ranges into beds equivalent to strata containing middle Albian marine fossils, and dating on the basis of the flora is somewhat inconclusive. The Gething flora is considered by Bell to be the same age as that of the Luscar and lower flora of the Blairmore Group which Bell now dates as Aptian and/or early Albian. An assemblage of plant microfossils obtained from the Gething at the canyon was dated by D.C. McGregor as Valanginian to Aptian. Because the Cadomin-Gething beds lie unconformably on beds dated as Valanginian, and below Moosebar shales of early to middle Albian age the Gething can be dated, on the basis of stratigraphic position, as Hauterivian to early Albian.

Correlation of sections

Current work shows that considerable variation occurs within each individual coal seam, that thicknesses may change rapidly, and that both coal seams and sandstone units are lenticular and have limited extent. It is obvious from McLearn's original discussion that he, too, recognized that the coal seams were not uniform and that he, also, had difficulty in tracing them throughout the canyon area. It is, therefore, understandable that different interpretations have been made. The discrepancies that still exist between the sections described by McLearn and those described by the writer can be attributed, in large degree, to disagreement as to the correlation of main seams from one locality to another. It is apparent also that measurements of intervals between major seams are not the same. This can be explained, in part, by different estimates of the thickness of beds involved in small folds occurring in inaccessible cliffs, and to errors inherent in outcrop measurements. It should be realized, also, that McLearn's work was done some 45 years ago and rocks outcropping at that time may be covered and that previously covered intervals may be exposed now.

The section along the west bank, which is most complete, is considered as the standard for correlation purposes. The description of the Gething at that locality is given in the appendix and depicted in Figure 1. At least 80 to 110 feet of exposed but inaccessible beds occur above the uppermost beds described in the west bank section. The contact with the overlying Moosebar shales, according to the present interpretation, should be about 150 feet above the top of the described beds.

Beds within the Gething Formation are truncated at several places along the west bank. Although truncation in most cases is related to large channel structures, the possibility of faults can not be ruled out entirely. The writer experienced considerable difficulty in correlating coal seams and concluded that the section on the west bank must be disrupted by a fault lying a short distance upstream from Gething Creek, about 1,000 to 1,100 feet above the base of the formation. The dip of the fault is probably only a few degrees different from that of the bedding as its trace is not obvious. A feature interpreted originally as a channel structure may actually be a fault. It is only by assuming such a fault that an acceptable correlation was established. If a fault is not present, very little similarity exists between the lower parts of the north shore and west bank sections.

North Shore Section

The lower part of McLearn's and the writer's descriptions of the north shore exposure are reasonably similar and it appears that coal beds as high as the Ferro Point seam can be matched. Above that, the beds are folded and the normal succession is somewhat distorted. McLearn continued his description farther upstream than did the writer, and that part of his section is equivalent to the basal part of the Aylard Creek section. The Milligan seam may not be represented in the writer's section but a seam equated with the Milligan is exposed at Aylard Creek.

Aerial photographs show clearly that beds occurring at Fossil Tree Point strike across the river and should appear at Island Creek; it is also evident that the beds at Fossil Tree Point are stratigraphically higher than those exposed at Gething Creek. The uppermost seams of McLearn's section at Fossil Tree Point are equated, therefore, with the Mogul series of the Aylard Creek and west bank sections. The resulting relationships in the upper parts of the sections are then almost the same as those originally proposed by McLearn. However, unless a fault occurs in the west bank section upstream from Gething Creek, it is virtually impossible to match any of the lower seams there with the north shore section. If coal seams about 950 feet above the base of the west bank section are considered to be repeated in a fault slice about 1,150 feet above the base, several seams occurring stratigraphically lower correspond very closely with some in the north shore section, the most notable being those equated with the Grant and Riverside seams. The Riverside seam (2 feet 10 inches) and the Grant seam (more than 5 feet) form the base of the north shore exposures. According to McLearn, the Grant seam, the thickest one known within the Gething, was about 1,200 feet below the top of the Gething Formation and, as indicated by the present interpretation, it is slightly more than 1,100 feet below the top. McLearn indicated that the seam extended "to the upper part of the canyon far beyond Milligan Point" but no record of its occurrence there is found in his upper canyon section. It is reasonable to expect that those two thick seams have considerable distribution and they are believed to be represented in the west bank section by two seams lying between 500 and 550 feet above the base of the formation. The apparent absence of similar seams in McLearn's east-bank upper canyon section suggests that the seams may not have been exposed there.

The Ferro Point seam, 2 feet 2 inches thick in the north shore exposures according to McLearn, has a similar thickness at Aylard Creek. It has about the same thickness in the lower sequence of the west bank section but, in the upper sequence, apparently increases in thickness to 4 feet.

Aylard Creek Section

Although the section on Aylard Creek as described by McLearn (1923, sec. E1-E3) does not coincide precisely with that of the writer (1968, p. 23), the two descriptions are sufficiently similar to permit the recognition of most of the major coals seams and McLearn's terminology is used.

The Superior seam, lying about 25 feet below the Moosebar contact, is 2 feet thick. McLearn (1923, p. 10B) suggested that the seam may be present at the upper falls on Gething Creek, but no measurements were made there during the course of the present study. The Trojan seam, consisting of coal with interbedded sandstone, and lying some 110 feet below the top of the formation, was considered by McLearn to extend as far as Gething Creek, ranging there from 5 feet 6 inches to 8 feet 4 inches. At Aylard Creek, he reported an aggregate thickness for the Trojan of 4 feet 8 inches but only 3½ feet were observed by the writer. Although the Superior and Trojan were not described in the west bank section, they are recognized at Moosebar Creek and aid in establishing a good correlation of the upper beds of the Gething Formation. At least two major coal seams are visible above measured beds of the west bank section and, presumably, one is the Trojan seam.

It is apparent at river level that the lower beds at Aylard Creek overlap, at least to some extent, the highest beds of the west bank section. It is on that basis that one can begin to establish relationships between the two sections. Two major coal seams, Falls and Titan, appear common to both sections, forming the uppermost beds measured in the western section. Several smaller seams between Falls and Little Mogul on Aylard Creek probably extend into the west bank section but there are some differences in the thickness of coal seams and intervening beds.

The Little Mogul and Mogul form a pair of seams that should be easily recognized. The Mogul seam, reported at Earl Narrows and Aylard Creek by McLearn, was not observed at Aylard Creek by the writer but is assumed to occur within a covered interval below one considered to be the Little Mogul. McLearn considered that the Little Mogul had only local distribution although he did believe it could be recognized on the north shore. It may be represented in the west bank section by a coaly zone consisting of two thin seams.

Another pair of seams, the Castle Point and Milligan, were recognized at Aylard Creek by McLearn. He indicated that the Castle Point was 3 feet 9 inches thick and that the Milligan was 3 feet thick. The Castle Point was not observed by the author but it may lie in a covered interval above a seam correlated with the Milligan. In the west bank section, the seam equated with the Castle Point is thinner, being only 2 feet thick, which coincides with McLearn's statement that the Castle Point was thinner at Milligan Point. The Milligan seam has increased in thickness to 4 feet in the west bank section from 2 feet 9 inches at Milligan Point.

McLearn's section at Aylard Creek includes about 125 feet more strata at the base than were measured by the writer. Presumably McLearn continued his measurement on beds exposed downstream along the south shore. That succession includes three additional coal zones that can be matched with similar beds in the west bank section. Two concretionary seams, 3 feet 11 inches and 3 feet thick, overlying a 2-foot thick seam correlated with the Ferro Point, are believed to be represented in the west bank section. The Ferro Point seam increased in thickness from 2 feet at Aylard Creek to 4 feet in exposures farther upstream.

Moosebar Creek Section

Moosebar Creek, about 3 miles below Aylard Creek and lying opposite the exposures of the north shore, provides the best and most easily accessible exposures of the upper Gething beds in the canyon region. The contact with the overlying Moosebar shales is well exposed.

As previously indicated, the Superior and Trojan seams are readily recognized. The prominent Titan seam is also present, the thickness of beds between it and the higher Trojan seam increasing slightly from Aylard Creek to Moosebar Creek. McLearn reported that the Falls seam was 2 feet 10 inches thick at Moosebar Creek but such a seam was not observed by the writer, and it is assumed to covered now.

A seam, 3 feet 4 inches thick, occurring just above the "third or high falls" was correlated by McLearn with the Mogul seam and that correlation is followed in the present report. One of the most marked differences in measured thickness is found in the interval occurring between that seam and the Titan; the writer's description indicates a much smaller interval than that outlined by McLearn. The reason for the discrepancy is not immediately apparent. However, the description of a major seam above the "third" falls by both workers leads to the conclusion that no other relationship can be proposed. If the writer's measurement is correct, the Falls-Mogul interval thins between Aylard and Moosebar Creeks.

Some slight variation of thickness between the Mogul and Milligan seams can be attributed to differences in estimating the inaccessible beds exposed at the falls. The number of lower seams that correspond between the two descriptions indicates that relationships of the lower part of the section are essentially correct.

East bank, upper canyon section

The exposures along the eastern cliffs of the upper canyon were not described in detail by McLearn. However, he did give the thicknesses of major coal seams and outlined their stratigraphic position. Although the east bank and west bank sections are only separated by a few hundred yards, the coal seams do not appear to be very uniform.

The Murray seam, reported to be 5 feet thick on the eastern side, is only 3 feet thick on the west bank. The Boring seam, 3 feet 6 inches thick on the west bank, may be only 1 foot thick across the river. The lower of the Twin seams is slightly thinner on the west bank. The upper part of the section outlined by McLearn is not readily matched.

Conclusions

The Gething Formation of the Peace River canyon region is at least 1,600 feet thick and may be as much as 1,800 feet. The west bank section is the most continuous and complete one available for study, recording a most remarkable development of the coal-bearing beds.

No similar section of the Gething Formation is known; all those in the region to the south and east described previously by the writer (Stott, 1968) are much thinner and contain fewer coal seams. To the north, the maximum thickness of the combined Gething-Cadomin succession is in the order of 1,300 feet (Stott, 1961) and the sediments consist dominantly of near-shore marine sandstone. The type section of the Gething is, therefore, anomalous to some extent but shows that the locus of maximum subsidence and deposition was centered in the present area of Peace River canyon. As previously stated (Stott, 1968, p. 116), the Gething of that region is interpreted as being composed of deltaic sediments deposited by a major river system.

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APPENDIX

Section 68-18. Gething Formation, west bank of upper Peace River canyon, Halfway River and Pine Pass map-areas, British Columbia, 56° 01' N, 121° 14' W.

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
GETHING FORMATION			
	Overlying beds are inaccessible. Eighty to one hundred feet of beds are exposed and include at least two coal seams		
223	Coal	2.5	1,660.5
222	Mudstone, grading upward into fine-grained sandstone	19	1,658
221	Sandstone, fine-grained, laminated, brownish grey	5	1,639
220	Mudstone	2	1,634
219	Coal and coaly shale	2	1,632
218	Mudstone	10	1,630
217	Mudstone, grading upward into argillaceous sandstone	12	1,620
216	Sandstone, fine-grained, laminated, concretionary, yellowish brown-weathering	3	1,608
215	Mudstone, olive-brown	2	1,605
214	Coal, with large sandy concretionary bodies; lenses of mudstone	3	1,603
213	Mudstone, blocky, sandy	16	1,600
212	Mudstone, sandy at top; rusty brown-weathering	7	1,584
211	Sandstone, fine-grained, argillaceous; platy in part, flaggy to thin-bedded; some silty carbonaceous beds	17	1,577

Unit	Lithology	Height	
		Thickness (feet)	Above Base (feet)
210	Partly covered. Coal at 15'. Appears to be mainly mudstone with some sandstone	18	1,560
209	Coal	1.5	1,542
208	Mudstone, carbonaceous in part	3	1,540.5
207	Sandstone, fine-grained, laminated, brownish grey, slightly calcareous; flaggy to thin-bedded	10	1,537.5
206	Mudstone, dark grey to black, rubbly to blocky	10	1,527.5
205	Sandstone, fine-grained, grey, laminated; flaggy	3	1,517.5
204	Mudstone	2	1,514.5
203	Coal	1	1,512.5
202	Sandstone, fine-grained, grey, laminated; flaggy	7	1,511.5
201	Siltstone, argillaceous, sandy, laminated; brownish grey; platy to flaggy	10	1,504.5
200	Coal; thin layer of sandstone in middle	1.5	1,494.5
199	Mudstone, carbonaceous, black; thin lenses of coal	3	1,493
198	Sandstone, fine-grained, brown, calcareous, brown-weathering	5	1,490
	Shear		
197	Mudstone, carbonaceous in part	7	1,485
196	Sandstone, fine-grained, laminated, grey	4	1,478
195	Mudstone, dark grey, blocky	2	1,474
194	Coal; 6" mudstone at base	2	1,472

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
193	Sandstone, fine-grained, argillaceous, carbonaceous; flaggy to medium-bedded; brownish grey-weathering; ripple-marks	7	1,470
192	Siltstone, sandy, argillaceous, brownish grey, flaggy	10	1,463
191	Mudstone, silty; blocky; 6" lenticular coal near base	3	1,453
190	Sandstone, fine-grained, laminated, slightly calcareous, grey; interbedded mudstone; few thin lenses of coal	13	1,450
189	Sandstone, fine-grained, laminated, slightly calcareous, grey; medium-bedded; rusty brown-weathering	12	1,437
188	Siltstone, argillaceous, brown, blocky	1	1,425
187	Coal	1.5	1,424
186	Mudstone, silty; blocky; grading into argillaceous sandstone	3	1,422.5
185	Coal	1	1,419.5
184	Partly covered. Mudstone and some sandstone	7	1,418.5
183	Mudstone, blocky; thin coal at base	2	1,411.5
182	Sandstone, fine-grained, laminated, grey; flaggy	3	1,409.5
181	Coal	1	1,406.5
180	Mudstone, dark grey; blocky	1	1,405.5
179	Sandstone, fine-grained, grey, laminated; recessive at base; thin-bedded to massive	9	1,404.5
178	Siltstone, sandy to argillaceous; grading into argillaceous sandstone, laminated, grey-weathering; cleaner sandstone at top; ripple-marks	27	1,395.5

Unit	Lithology	Height	
		Thickness Above	Base
		(feet)	(feet)
177	Sandstone, fine-grained, laminated, brownish grey, slightly calcareous; medium-bedded; brown-weathering; dinosaur tracks	5	1,368.5
176	Mudstone, splintery; black at base, becoming brownish grey and blocky; thin coal at base	20	1,363.5
175	Sandstone, fine-grained, laminated, calcareous; ripple-marks	3	1,343.5
174	Mudstone, carbonaceous, coaly	1	1,340.5
173	Sandstone, fine-grained, laminated, calcareous, brownish grey; medium-bedded; brownish grey-weathering	3	1,339.5
172	Mudstone, carbonaceous, blocky; thin seam of coal in middle	3	1,336.5
171	Sandstone, fine-grained, laminated, calcareous, brownish grey; medium-bedded; brownish grey-weathering	6	1,333.5
170	Mudstone, brownish grey; blocky	1.5	1,327.5
169	Coal, black	2	1,326
168	Mudstone, carbonaceous, brown to black; flaky	2	1,324
167	Siltstone, argillaceous, sandy, laminated, brown; brown-weathering	5	1,322
166	Mudstone, brown; blocky	3	1,317
165	Sandstone, fine-grained, laminated, grey, calcareous, flaggy to thin-bedded; brownish grey-weathering; ripple-marks	8	1,314
164	Coal; few sandy lenses	4	1,306
163	Sandstone, fine-grained, laminated, grey; flaggy	2	1,302
162	Mudstone, blocky; argillaceous siltstone, brown	6	1,300

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
161	Sandstone, fine-grained, laminated, slightly calcareous, argillaceous; brownish grey; medium-bedded; brownish grey-weathering	12	1,294
160	Siltstone, argillaceous; becoming very sandy and grading into overlying beds	4	1,282
159	Coal, black, bituminous	1	1,278
158	Mudstone, dark grey to black; rubbly to blocky; three sub-units with argillaceous sandstone at top	20	1,277
157	Sandstone, fine-grained, laminated, brownish grey; flaggy to thin-bedded; light rusty brown-weathering	11	1,257
156	Mudstone, dark grey to black; platy at base, becoming sandy at top; 6 inches of coal about 2 feet above base	5	1,246
155	Sandstone, argillaceous, fine-grained, laminated, calcareous, carbonaceous; flaggy, ripple-marks	3	1,241
154	Sandstone fine-grained, grey, laminated, carbonaceous; medium-bedded; brownish grey-weathering; few beds of mudstone (20%); ripple-marks; thin coaly bed near top	11	1,238
153	Mudstone, silty; platy to blocky; 6 inch coaly bed near base	8	1,227
152	Sandstone, fine-grained, laminated, grey, slightly calcareous; crossbedded; flaggy to thin-bedded; grey-weathering	5	1,219
151	Mudstone, silty, grey, carbonaceous in part; blocky	14	1,214
150	Coal, with thin coaly mudstone in middle	1	1,200
149	Mudstone, brownish grey, silty; grading into argillaceous, laminated siltstone; argillaceous sandstone at top	7	1,199

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
148	Sandstone, fine-grained, laminated, argillaceous, brownish grey; poorly bedded; brownish grey-weathering	5	1, 192
	(section continues on north side of Gething Creek)		
147	Mudstone, black, carbonaceous; platy; 4 inches of coal near top and thin seam near base, thickens along slope	4	1, 187
146	Concretionary sandy layer, yellow-weathering	1	1, 183
145	Mudstone, dark grey to black, silty, thin coal at top	4	1, 182
144	Sandstone, concretionary, rusty brown- weathering	1	1, 178
143	Mudstone, dark grey	3	1, 177
142	Coal, black, bituminous; carbonaceous mudstone in middle	4	1, 174
141	Mudstone, grey silty; argillaceous carbon- aceous sandstone	2	1, 170
140	Sandstone, fine-grained, laminated, calcareous, brownish grey; flaggy to thin-bedded, massive appearance; brownish grey-weathering; wavy bedding; 1 foot of brown mudstone in middle	4	1, 168
139	Sandstone, very argillaceous, laminated, grey, poorly bedded; thin beds of mudstone	5	1, 164
138	Mudstone, brown to olive-brown, blocky; brownish grey-weathering; few thin beds of argillaceous, silty sandstone	4	1, 159
137	Sandstone, fine-grained, laminated, carbon- aceous, brownish grey; flaggy to thin-bedded; 1"-2" beds of olive-brown mudstone	5	1, 155
136	Talus covered	10	1, 150

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
135	Sandstone, fine-grained, grey, calcareous, carbonaceous in part; flaggy to thin-bedded, brownish grey-weathering; massive appearance; cross-laminated; plant fragments on bedding surfaces	11	1, 140
134	Mudstone, silty, brownish grey; blocky; some interbedded argillaceous siltstone; few large oval concretions; less sandy at base with thin concretionary beds	15	1, 129
133	Coal and coaly mudstone	1	1, 114
132	Talus covered	4	1, 113
131	Sandstone, fine-grained, laminated, brownish grey; flaggy to thin-bedded; some cross-bedding and channel structures	13	1, 109
	Fault?		
130	Mudstone, dark grey; rubbly to blocky; few concretions; some carbonaceous mudstone and thin coal seam at base	10	1, 096
129	Mudstone, dark grey, carbonaceous; rusty weathering, thin 1" to 2" coal seam at base	5	1, 086
128	Sandstone, fine-grained, laminated, slightly calcareous; flaggy to medium-bedded; light brownish grey; grading into underlying unit	5	1, 081
127	Mudstone, silty, brownish grey, brown-weathering; some interbedded argillaceous siltstone; becoming sandier at top	9	1, 076
126	Sandstone, fine-grained, laminated, brownish grey; thin-bedded, rusty brown-weathering	5	1, 067
125	Mudstone, dark olive-brown; blocky; platy at base; some thin beds of sandstone	8	1, 062

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
124	Sandstone, fine-grained, laminated, brownish grey; flaggy to thin-bedded; brown-weathering	7	1,054
123	Mudstone, black, carbonaceous; blocky to platy and flaky	4	1,047
122	Coal; mudstone at base	1.5	1,043
121	Sandstone, fine-grained, laminated, grey, siliceous; thick-bedded, light brownish grey-weathering; cross-laminated, some crossbedding	9	1,041.5
120	Mudstone, olive-brown to black; blocky; concretionary layer in middle	5	1,032.5
119	Sandstone, fine-grained, laminated, argillaceous; flaggy to thin-bedded; brown-weathering; interbedded mudstone	10	1,027.5
118	Covered	5	1,017.5
117	Partly covered. Sandstone, fine-grained, laminated, argillaceous in part, carbonaceous in part, grey; interbedded silty mudstone (25%)	10	1,012.5
116	Sandstone, fine-grained, laminated, cross-laminated, carbonaceous; thin- to medium-bedded; light brownish grey-weathering	7	1,002.5
115	Mudstone, silty, dark olive-brown to grey; brown-weathering; small concretions	3	995.5
114	Coal, black, bituminous	4	992.5
113	Mudstone, argillaceous, dark brownish grey, sandy at base; concretionary at base	2	988.5
112	Sandstone, argillaceous, laminated, dark grey, poorly bedded; grey-weathering	8	986.5
111	Mudstone, dark grey; rubbly at base blocky toward top; brown-weathering	3	978.5
110	Coal, black, bituminous	2	975.5

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
109	Mudstone, dark grey to black, carbonaceous; two coal seams, 2" to 3"	4	973.5
108	Sandstone, fine-grained, laminated, cross- laminated, grey; medium-bedded; rusty brown-weathering	8	969.5
107	Siltstone, argillaceous, laminated; interbedded silty mudstone (30%); covered in lower half	14	961.5
106	Sandstone, fine-grained, grey; poorly bedded to massive; grey-weathering	7	947.5
105	Mudstone, very silty; 3" coal at top	1	940.5
104	Sandstone, fine-grained, laminated, argillaceous, grey; medium-bedded to massive; brownish grey-weathering; more argillaceous and shaly toward base	20	939.5
103	Coal; some mudstone at top	1.5	919.5
102	Mudstone, dark brownish grey; blocky; argillaceous siltstone to sandstone at top; reddish brown-weathering concretionary layer in middle	10	918
101	Mudstone, dark grey; siltier at top; rusty weathering	8	908
100	Sandstone, fine-grained, laminated; flaggy to thin-bedded; brown- to rusty weathering	3	900
99	Siltstone, argillaceous and mudstone, thinly interbedded; few concretionary layers; thin coal seam at base	6	897
98	Sandstone, fine-grained, lenticular; mudstone; some lenses of coal	6	891
97	Sandstone, fine-grained, laminated, grey; flaggy	3	885

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
96	Mudstone, dark grey; some sandy siltstone; concretionary layer	15	882
95	Mudstone, dark brown; rubbly to blocky; sandstone, fine-grained, laminated, argillaceous, grey, carbonaceous (40%)	15	867
94	Coal and coaly shale	0.5	852
93	Sandstone, fine- to medium-grained; thick-bedded; grey-weathering; large channel sandstone, crossbedded	31	851.5
92	Sandstone, fine-grained, laminated; channel sandstone with 6" coal and coaly shale at top	6	820.5
91	Coal; mudstone at top	3	814.5
90	Mudstone, silty; laminated sandstone (25%)	8	811.5
89	Mudstone, silty, brownish grey; blocky to rubbly; two beds of argillaceous sandstone, brownish grey, laminated, carbonaceous	20	803.5
88	Sandstone, fine-grained, calcareous brownish grey; crossbedded; flaggy	4	783.5
87	Mudstone, blocky	1.5	779.5
86	Coal and coaly shale	1	778
85	Sandstone, fine-grained, grey, laminated; flaggy; interbedded mudstone (30%)	6.5	777
84	Sandstone, fine-grained, argillaceous, carbonaceous, brown; brownish grey-weathering	1	770.5
83	Mudstone, brownish grey; blocky to rubbly	2	769.5
82	Partly covered. Mainly mudstone, dark olive-brown to grey; some coal about 20 feet above base; concretionary bed at top	34	767.5

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
81	Sandstone, fine- to medium-grained, grey; thick-bedded; grey-weathering; large channel sandstone	24	733.5
80	Partly covered. Mainly mudstone, dark brown to grey; two beds of sandstone, 2' to 4', and 1 foot of coal near middle	51	709.5
79	Sandstone, fine-grained, laminated, argillaceous, carbonaceous	2	658.5
78	Mudstone, silty, brownish grey; some fine- grained sandstone	5	656.5
77	Sandstone, argillaceous, brownish grey; flaggy to thin-bedded, brown-weathering	4	651.5
76	Sandstone, fine-grained, grey; grey-weathering	3	647.5
75	Mudstone, dark brown; sandstone (30%), fine- grained, laminated, argillaceous	12	644.5
74	Mudstone, dark brown to brownish grey; blocky; few thin beds of sandstone	15	632.5
73	Sandstone, fine-grained, laminated; interbedded mudstone (40%); some crossbedding	9	617.5
72	Mostly covered, recessive. Mudstone	17	608.5
71	Mudstone, dark brownish grey	2	591.5
70	Sandstone, fine-grained, laminated, brownish grey; crossbedded	3	589.5
69	Mudstone; some platy sandstone	4	586.5
68	Sandstone, fine-grained, laminated, grey; grey-weathering	3	582.5
67	Mudstone. Partly covered	7	579.5
66	Sandstone, fine-grained, interbedded mudstone (25%)	10	572.5

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
65	Sandstone, fine-grained, laminated; flaggy; some crossbedding; interbedded mudstone, silty, block (40%)	11	562.5
64	Mudstone, silty; blocky	2	551.5
63	Coal; coaly shale at top	3	549.5
62	Mudstone, dark brown, carbonaceous; sandstone (30%) in 1' to 2' beds	8	546.5
61	Mudstone, brown; grading into sandstone at top	8	538.5
60	Coal; some mudstone	1.5	530.5
59	Mudstone, brown; blocky to rubbly; carbonaceous in part; sandstone at top	3	529
58	Sandstone, fine-grained, argillaceous; interbedded mudstone (40%)	4	526
57	Coal	1	522
56	Sandstone, fine-grained, laminated, argillaceous, carbonaceous; some mudstone at top	5	521
55	Coal	3.5	516
54	Mudstone, brownish grey; blocky to rubbly	9	512.5
53	Sandstone, fine-grained, argillaceous, carbonaceous; flaggy to poorly bedded	5	503.5
52	Mudstone, dark brown to olive-brown, very carbonaceous at top; argillaceous, carbon- aceous sandstone (20%), rusty weathering	39	498.5
51	Sandstone, fine-grained, laminated, grey; upper part of channel sandstone which replaces underlying mudstone along slope; total thickness of channel sandstone is 10 feet	3	459.5

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
50	Sandstone, fine-grained, argillaceous, laminated; interbedded mudstone in 6" to 1' beds	15	456.5
49	Sandstone, argillaceous, laminated, fine-grained; brownish grey-weathering	2	441.5
48	Mudstone, dark brown to brownish grey; blocky to rubbly; few harder sandy beds at top	25	439.5
47	Sandstone, argillaceous, laminated, fine-grained; flaggy to thin-bedded	4	414.5
46	Mudstone, black, carbonaceous; coal, lenticular	2	410.5
45	Mudstone; talus covered	4	408.5
44	Sandstone, argillaceous, laminated, fine-grained, dark brownish grey; large yellow-weathering concretionary bodies at base	5	404.5
43	Mudstone, dark brown; blocky to rubbly	3	399.5
42	Sandstone, argillaceous, carbonaceous, brownish grey; poorly bedded; some mudstone	3	396.5
41	Mudstone, dark brown to olive-grey; blocky to rubbly; sandier at top	5	393.5
40	Sandstone, fine-grained, laminated, brownish grey; brownish grey-weathering	3	388.5
39	Mudstone, to argillaceous siltstone, olive-grey to black	4	385.5
38	Sandstone, fine-grained, laminated, carbonaceous, calcareous, brownish grey; cross-bedded; mudstone at base	4	381.5

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
	GSC loc. 8025 (talus, may have come from higher beds) <u>Cladophlebis virginiensis</u> Fontaine emend. Berry <u>Sagenopteris williamsii</u> (Newberry) Bell <u>Ginkgo pluripartita</u> (Schimper) Heer <u>Pterophyllum rectangulare</u> Bell <u>Nilssonia curvifolia</u> (Dunker) Nathorst <u>Nilssonia yukonensis</u> Hollick <u>Pityophyllum</u> cf. <u>P. nordenskioldi</u> (Heer) Krystofovich Age: Aptian and/or early Albian		
37	Mudstone, dark brownish grey; interbedded sandstone (20%) with 1' to 2' sandstone at top, lenticular, fine-grained	4	377.5
36	Mudstone, dark brownish grey; blocky to platy	7	373.5
35	Sandstone, fine-grained to argillaceous siltstone	8	366.5
34	Mudstone, dark brownish grey; few thin beds of sandstone	4	358.5
33	Sandstone, fine-grained, argillaceous, laminated; flaggy to thin-bedded; rusty weathering; interbedded mudstone (25%)	6	354.5
32	Mudstone, dark brownish grey; blocky to rubbly	5	348.5
31	Coal, black, bituminous	2	343.5
30	Sandstone, fine-grained, argillaceous, carbonaceous, brown, laminated; some mudstone, with thin lenticular coal seams	10	341.5
29	Coal; some mudstone at base	1.5	331.5

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
28	Sandstone, argillaceous, brown, cross-laminated; thin-bedded; some mudstone	4	330
27	Mudstone, silty, olive-grey; blocky; interbedded argillaceous siltstone; becoming sandier at top with laminated sandstone	10	326
26	Sandstone, fine-grained, laminated, slightly calcareous, argillaceous, grey; thin-bedded to massive; few thin coaly lenses	19	316
25	Mudstone; 6" coal at top	1	297
24	Sandstone, fine-grained, silty, argillaceous, laminated; thick-bedded to massive; grey-weathering; 4" coal at 6 feet, 2" coal at 7 feet	10	296
23	Mudstone, olive-brown, carbonaceous; rubbly; 10" coal near base and 1' seam 6 inches from top	19	286
22	Sandstone, argillaceous, laminated; cross-bedded, thin-bedded; grey- to brown-weathering; channel structure; some mudstone	12	267
21	Partly covered. Mainly mudstone with few thin beds of sandstone	50	255
20	Sandstone, fine-grained, laminated, slightly calcareous, grey, carbonaceous; brownish grey-weathering	5	205
19	Mudstone, silty, dark grey	7	200
18	Siltstone, argillaceous, dark brown, laminated; thin-bedded, wavy bedded; thin coal layer in middle	4	193
17	Mudstone, dark brown, silty; some argillaceous siltstone	5	189

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
16	Siltstone, argillaceous, to sandstone, argillaceous, laminated; brown-weathering	5	184
15	Mudstone, dark brownish grey, silty; argillaceous, laminated sandstone in middle	10	179
14	Mudstone, carbonaceous, olive-brown to brownish grey; 1' coal seam in middle	3	169
13	Mudstone, dark brown to olive-grey; blocky to rubbly; some beds of fine-grained and laminated sandstone, 6" to 12" (35%); few thin lenses of coal; some channel structure	13	166
12	Talus covered	33	153
11	Sandstone, fine-grained, laminated, cross-laminated, brownish grey, flaggy to thin-bedded; some interbedded siltstone; mudstone, blocky (30%)	7	120
10	Sandstone, medium-grained, grey, slightly calcareous, laminated, some cross-laminated; small coal lenses; some channel structure with mudstone	8	113
9	Mudstone, grey; rubbly to blocky; coaly lenses in basal 2'; some argillaceous siltstone	11	105
8	Mudstone, dark brownish grey; rubbly to blocky; sandstone (40%), fine-grained, laminated; thin-bedded; some coaly mudstone	9	94
7	Siltstone, argillaceous, brown; sandstone, argillaceous, laminated; mudstone, blocky (25%)	31	85
6	Sandstone, very argillaceous, to siltstone, brown; poorly bedded to flaggy; brownish grey-weathering	8	54

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
5	Mudstone, dark olive-brown; argillaceous siltstone at base; thin lenticular coal	2	46
4	Coal	3	44
3	Mudstone, dark brownish grey; rubbly to blocky; partly talus covered	15	41
2	Mudstone, dark brown to olive-grey; blocky; sandstone, fine-grained, laminated; flaggy to thin-bedded	15	26
1	Sandstone, fine- to medium-grained, grey; channel structure; grades into mudstone and shale	11	11

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
CADOMIN FORMATION			
15	Sandstone, medium-grained, calcareous, grey; massive; brownish grey-weathering; becoming somewhat finer grained toward top	43	186.5
14	Sandstone, fine- to medium-grained, laminated, cross-laminated, grey; topped by 4" to 6" mudstone	1.5	143.5
13	Mudstone, dark olive-brown, carbonaceous at base; rusty brown-weathering sandstone in middle	3	142
12	Coal, 9" to 1' at base, 6" at top; carbonaceous mudstone to siltstone in middle	2.5	139
11	Sandstone, fine-grained, laminated, grey, cross-laminated; thin- to medium-bedded; grey-weathering; interbedded rubbly to blocky grey mudstone (30%) in 1" to 4" beds	17	136.5
10	Sandstone, coarse-grained to conglomeratic at base, becoming medium-grained at top, grey, laminated, cross-laminated; thick-bedded to massive; grey-weathering; some channel structure	26	119.5
9	Sandstone, fine-grained, laminated, grey; thin- to medium-bedded; grey-weathering; interbedded mudstone in 1' to 2' beds, silty, blocky; 6" coal seam at top	18	93.5
8	Mudstone, dark grey; blocky	2	75.5
7	Sandstone, fine-grained, laminated, grey; thick-bedded to massive, grey-weathering	14	73.5
6	Sandstone, fine-grained, laminated, grey, calcareous; grey-weathering; interbedded silty, blocky mudstone (25%)	9	59.5

Unit	Lithology	Height	
		Thickness	Above Base
		(feet)	(feet)
5	Sandstone, medium-grained, calcareous, laminated, cross-laminated, grey; crossbedded, medium- to poorly bedded; grey-weathering; thin, cross-bedded sandstone at base	30	50.5
4	Sandstone, fine- to medium-grained, laminated, cross-laminated, calcareous, grey; thin-bedded to poorly bedded; grey-weathering	15	20.5
3	Sandstone, fine- to coarse-grained; streaks of small chert pebbles; poorly bedded to crossbedded; rusty brown-weathering	3	5.5
2	Mudstone, dark grey to black, carbonaceous; 2" to 3" coal at top	0.5	2.5
1	Sandstone, fine-grained, grey, argillaceous in part; grey-weathering	2	2
End of exposed beds at toe of dam			