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P. Kabanov, S.A. Gouwy, and W.C. Chan

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Cover photo: Double rainbow over the upper part of the Hume Formation at Powell Creek, summer 2016.

Contents

APPENDICES

A. SGR data for Rumbly Creek west ridge section
B. SGR data for Powell Creek Lower Devonian section
C. SGR data for Powell Creek Landry-Hume section
D. SGR data for Powell Creek West section
E. SGR data for Rumbly Creek tributary waterfall section
F. SGR data for Rumbly Creek Canol section
G. SGR data for Powell Creek Canol section
H. SGR data for Turnabout Creek section
I. Measured sections (poster)

SUMMARY

This report provides illustrated descriptions, lithologs, and spectral gamma-ray (SGR) surveys of eight Devonian stratigraphic sections measured in 2016 in the northern Mackenzie Mountains (NTS map areas 106G and 106H). The measured sections intersect the sub-Devonian unconformity and cover Peel, Tatsieta, Arnica, Bear Rock, Landry, Hume (basal and uppermost parts), Hare Indian, Ramparts, Canol formations, and the basal beds of the overlying Imperial Formation.

RESUMÉ

Ce rapport offre des descriptions illustrées, des colonnes lithologiques et des études de spectrométrie gamma de huit coupes stratigraphiques de roches dévoniennes mesurées en 2016 dans le nord des Mackenzie Mountains (régions des cartes 106G et 106H du SNRC). Les coupes mesurées croisent l'inconformité sub-dévonienne et comprennent les formations de Peel, Tatsieta, Arnica, Bear Rock, Landry, Hume (partie basale et partie supérieure), Hare Indian, Ramparts et Canol et la partie inférieure de la Formation d'Imperial.

INTRODUCTION

This report presents illustrated descriptions, lithologs, and spectral gamma-ray (SGR) surveys of Devonian stratigraphic sections measured in the northern Mackenzie Mountains during the field work of July 12-August 05, 2016. The methodology and rationale of the *Devonian stratigraphic framework* research of the Mackenzie Project of GEM Program are discussed in (Kabanov et al., 2016a,b; Kabanov and Gouwy, in press). Additional information on the field party operation and bedrock mapping within NTS map areas 106G and 106F is available in (Fallas et al., 2016). Field stations pinning bases, tops, and intermediate points of measured sections are listed in Table 1, and their location is shown on Figure 1.

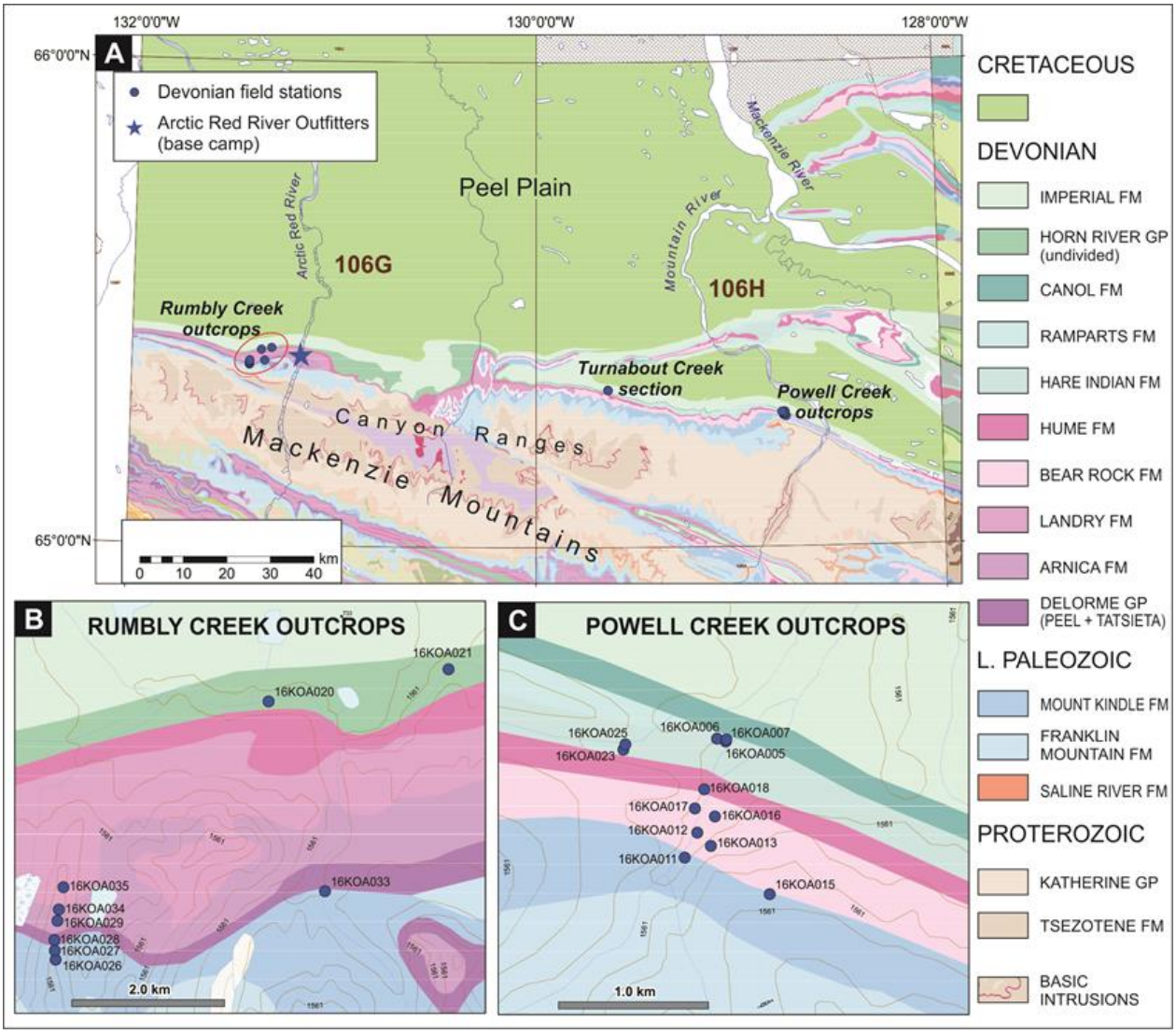

Figure 1. Study area and field stations on measured Devonian outcrops put on the bedrock geological map (A). GEM Mackenzie project updates and structural information not included. (B and C) Two close-ups with 250k base map topography. The GIS bedrock basemap is courtesy of K.M. Fallas.

SECTION NAME	STATIONID	VISITDATE	LAT	LONG	ELEV	PDOP	SATSUSED	NOTES
Powell Creek Canol	16KOA005	2016-07-17	65.2775	-128.7736	351	3	7	Base of section
Powell Creek Canol	16KOA006	2016-07-17	65.2776	-128.7749	346	5	3	Units 4-6 of type Canol section
Powell Creek Canol	16KOA007	2016-07-17	65.2776	-128.7736	345	3	3	Units 6-10 of type Canol section
fly camp site	16KOA008	2016-07-18	65.2730	-128.7774	369	4	5	fly camp site
Powell Creek L. Devonian	16KOA011	2016-07-19	65.2706	-128.7798	378	8	4	Base section. LP-03 section in NWT OR 2007-004
Powell Creek L. Devonian	16KOA012	2016-07-19	65.2720	-128.7780	368	3	6	Unit 26 at creek terrace.
Powell Creek L. Devonian	16KOA013	2016-07-21	65.2712	-128.7761	445	4	6	Units 26-27 along side gully
Powell Creek L. Devonian	16KOA015	2016-07-21	65.2683	-128.7678	373	4	3	Contact of units 28 and 29 along side gully
Powell Creek L. Devonian	16KOA016	2016-07-21	65.2730	-128.7754	351	8	4	End of measured section, top of unit 29
Powell Creek Landry-Hume	16KOA017	2016-07-21	65.2735	-128.7782	354	3	7	Base of section
Powell Creek Landry-Hume	16KOA018	2016-07-21	65.2746	-128.7769	352	2	4	Top of section
Rumbly Creek tributary waterfall	16KOA020	2016-07-23	65.4034	-131.3597	660	3	3	Base of section
Rumbly Creek Canol*	16KOA021	2016-07-23	65.4076	-131.3091	570	0*	0*	Base of section
Powell Creek West	16KOA023	2016-07-28	65.2771	-128.7883	415	4	5	Hume-Bluefish contact. Base of section
Powell Creek West	16KOA025	2016-07-28	65.2774	-128.7880	458	3	7	Base of silty grey shales and top of section
RumblyCreek west ridge	16KOA026	2016-07-28	65.3725	-131.4180	1191	6	4	Sub-Devonian unconformity, base of section
RumblyCreek west ridge	16KOA027	2016-07-28	65.3736	-131.4183	1173	2	7	Peel-Tatsieta contact
RumblyCreek west ridge	16KOA028	2016-07-28	65.3748	-131.4185	1193	4	7	Tatsieta-Arnica contact
RumblyCreek west ridge	16KOA029	2016-07-30	65.3771	-131.4178	1165	4	4	Unit 33 in Arnica Fm., 197 m from base of Peel Fm.
Turnabout Creek	16KOA030	2016-08-01	65.3237	-129.6443	508	3	6	Base of section, upper Bell Creek Mbr.
Turnabout Creek	16KOA031	2016-08-01	65.3246	-129.6457	512	2	7	Canol-Imperial transitional beds, end of section
upper Rumbly Creek station	16KOA033	2016-08-02	65.3813	-131.3426	697	2	4	Peel Fm. in anticline hinge zone
Rumbly Creek west ridge	16KOA034	2016-08-02	65.3784	-131.4174	1160	2	7	Arnica-Landry contact
Rumbly Creek west ridge	16KOA035	2016-08-02	65.3811	-131.4163	1119	4	6	End of section inside Landry Fm.

Table 1. List of field stations made by Devonian stratigraphy team. ELEV is barometric elevation above sea level in meters; coordinates are given in NAD83 (LAT is latitude, LONG is longitude). *Manual station entry

	Powell Creek Canol	Powell Creek West	Powell Creek Lower Devonian	Powell Creek Landry-Hume	Rumbly Creek tributary waterfall	Rumbly Creek Canol	Turnabout Creek	Rumbly Creek West Ridge	Rumbly Creek Station
Station at section base	16KOA005	16KOA023	16KOA011	16KOA017	16KOA020	16KOA021	16KOA030	16KOA026	16KOA033
Latitude, longitude, (NAD83), ASL	65.27746N, 128.77364W, 351 m	65.27709N, 128.78831W, 415 m	65.27056N, 128.77983W, 378 m	65.27349N, 128.77824W, 354 m	65.40341N, 131.35967W, 660 m	65.40765N, 131.30914W, 570 m	65.32369N, 129.64431W, 508 m	65.37253N, 131.41802W, 1191 m	65.38127N, 131.34261W, 697 m
Imperial Fm. (lower)						93.5 m			
Canol Formation	8 sampl. 54.0 m					8 sampl.	2 sampl. 74.0 m		
Ramparts Fm. (platform)	4 sampl.						6 sampl.		
Hare Indian Fm.		5 sampl. 14.0 m			5 sampl. 31.0 m				
Hume Fm. (upper)	4 sampl.	9 sampl.			6 sampl.				
Hume Fm. (lower)				104.7 m					
Landry Fm.				2 sampl.				1 sampl.	
Bear Rock Fm.			6 sampl.						
Arnica Fm.								5 sampl.	
Tatsieta Fm.								374.0 m	
Peel Fm.			229.0 m					3 sampl.	1 sampl.
Mt. Kindle Fm. (top)									

Table 2. Measured Devonian sections. Green boxes indicate lithostratigraphic units captured in the description; yellow boxes indicate samples taken for conodont biostratigraphy.

Lithostratigraphy of the Devonian of central and northern Mackenzie Mountains is in common with adjacent Peel and Mackenzie plains (Figure 2). New data include eight stratigraphic sections covering the Lower Devonian shallow-marine carbonate succession up to the base of Hume Formation, and the Horn River Group from its base (including uppermost several meters of Hume Formation) through the basal beds of the Imperial Formation (Table 2). Seventy-five samples were taken for conodonts (Table 2), and one bentonite seam was collected for absolute dating. Results of the study will be provided in further publications.

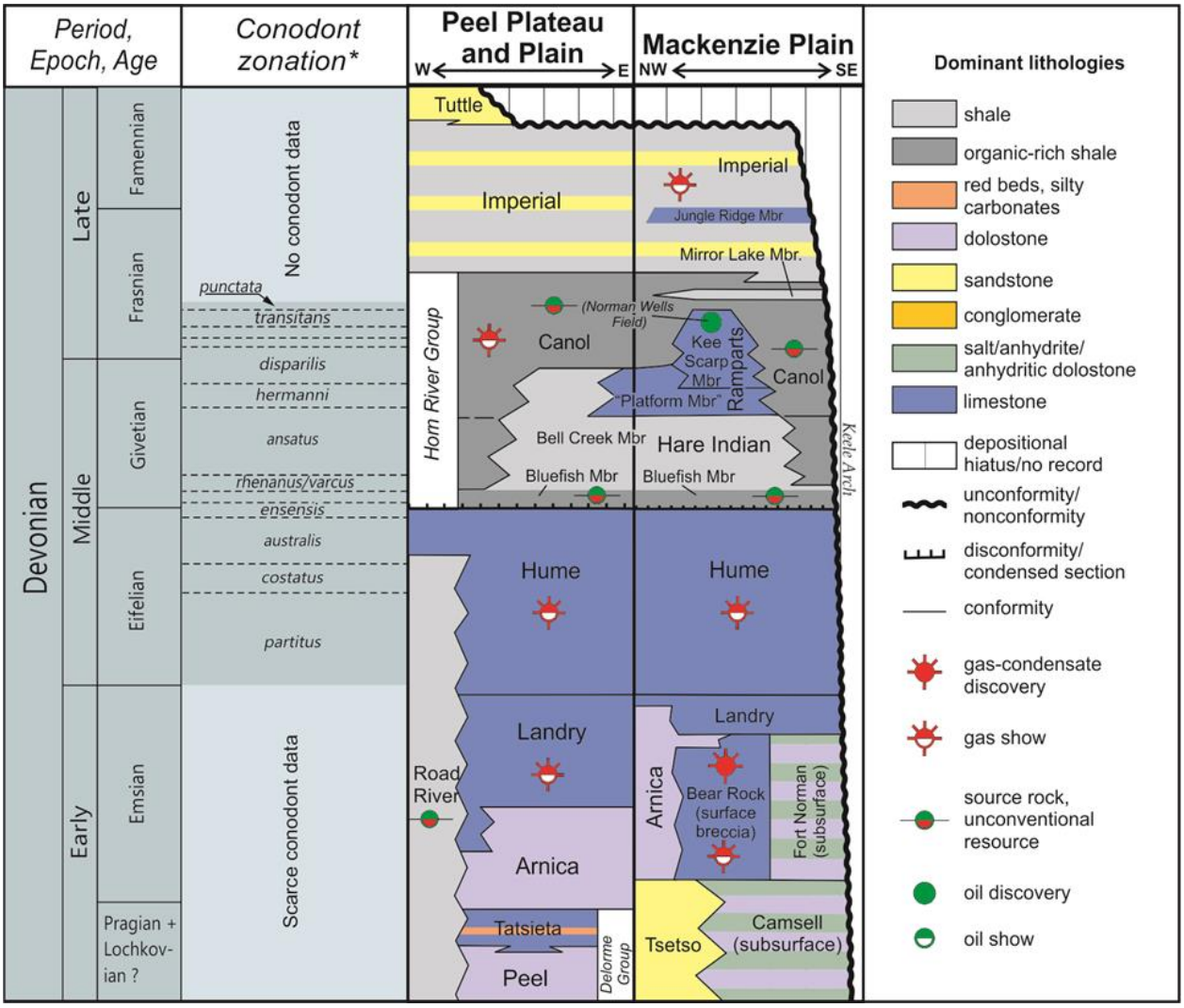

Figure 2. Devonian table of formations for the study area. Devonian stratigraphy of the field area 2016 is described by Peel Plateau and Plain subdivisions. Conodont zonation refers to the eastern Peel area and Mackenzie Plain (Kabanov and Gouwy, in press). Lower Devonian stratigraphy adapted from Rocheleau and Fiess (2014).

METHODOLOGY AND SAMPLING PROCEDURE

Section measurements and their presentation

Outcrops selected for stratigraphic sections were georeferenced with field stations (Fig. 2 and Table 1) made on a Trimble Nomad 900 series handheld computer. Geological information for each field station was entered in GanFeld, a GSC custom application built on ESRI ArcPad mobile system. Stratigraphic thicknesses were measured with 1.6 m tall Jacob's staff graduated in 10 cm increments. Zero datums were chosen at recognizable horizons in basal parts of sections (e.g., lithological contacts, paleokarst tops at unconformities, or thin carbonate beds in mudrocks), but usually did not coincide with the bases of sections. Meterage was marked with flagging tape that was removed after measurement and sampling were finished. Dip and strike was captured with right-hand rule on one or more reliable bedding planes in each section. Bed-by-bed section descriptions were accompanied with macro-photographing of key textures and structures presented in this report as protoplate figures.

Not all figures in this Open File are called out in the text; they are meant to illustrate the particular measured sections within which they are included. The scale of the pictures is indicated by the field hammer (35 cm) or by a ruler subdivided in centimeters and millimeters. Thicknesses in the descriptions are given as a running tally for each section instead of as interval thicknesses.

Gamma-ray spectrometry

Measured outcrops were surveyed with the RS-230 BGO scintillometer of Radiation Solutions Inc. SGR logs were made mostly at 0.5 m step in mudrock-dominated sections and with 1.0 m step in carbonate sections. Measurements across stratigraphic contacts and intraformational disconformities were made with more frequent increments. Signal acquisition time was set to 90 seconds. Decomposition of gamma radiation into U, Th and K spectra is widely used to interpret lithology and depositional environments. Potassium and thorium are relatively stable and mostly bound in detrital siliciclastics, whereas uranium is more soluble and tends to be trapped by organic matter. Hence K and Th are usually better correlated to each other than K/U and Th/U, and are often used together as K-Th gamma ray proxy for siliciclastic supply, also known as the computed gamma ray (CGR). Potassium is more involved in weathering mineral transformations than thorium and therefore tends to be bound in clays. Thorium is relatively stable near the Earth surface and preferentially resides in detrital grains. The contribution of K, U, and Th series to the total gamma radiation (GR) is described by the empirical formula (Ellis and Singer, 2008):
GR[API] = 4Th[ppm] + 8U[ppm] + 16K[%]

The gamma-ray spectrometry is based on the fact that natural radioactivity in pre-Cenozoic rocks mostly results from three isotopes, ^{232}Th, ^{40}K, and ^{238}U, having half-lives comparable to the age of the Earth crust. Other radioactive isotopes decay faster with diminutive significance back in the pre-Quaternary geological record. Thorium and uranium both decay through two different series of a dozen or more intermediate isotopes to a stable isotope of lead. These decays produce complicated gamma-ray spectra with energy emission lines characteristic for each series. Radioactive potassium ^{40}K decaying to stable ^{39}K has only one characteristic gamma energy of 1.46 meV (Ellis and Singer, 2008).

SECTION DESCRIPTIONS

Rumbly Creek West Ridge

Base of section: 16KOA026	
DATUMZONE	NAD_1983_UTM_Zone_9N
ELEVATION	1190.6
LATITUDE	65.372527
LONGITUDE	-131.416312
PDOP	6.3
SATS USED	4
VISITDATE	2016-07-28
Top of section: 16KOA035	
DATUMZONE	NAD_1983_UTM_Zone_9N
ELEVATION	1119.3
LATITUDE	65.381055
LONGITUDE	-131.416312
PDOP	3.9
SATS USED	6
VISITDATE	2016-08-02

Zero datum at 4.0 m below the sub-Devonian unconformity.

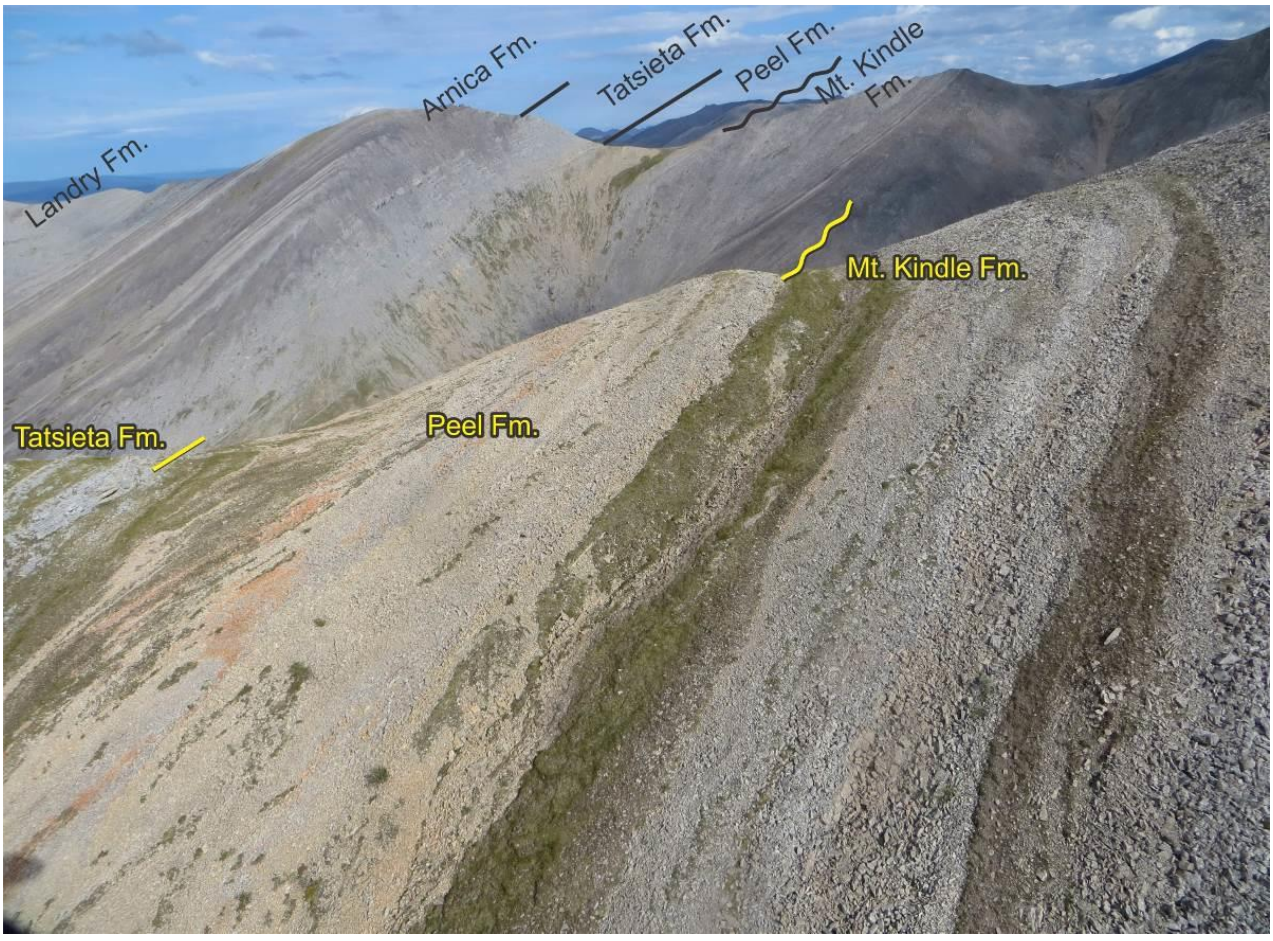

Figure 3. Basal part of measured section in the foreground (marked by yellow lines) and formations on the Rumbly Creek east ridge in the back (marked by black). Easterly view. Note felsenmeer preservation of rock.

MOUNT KINDLE FORMATION

Only the uppermost 4.0 m of Mt. Kindle Formation were measured.

1. Dolostone: grey colored, finely to coarsely crystalline, with an upwards increasing amount of rubbly blocks; weathered into felsenmeer and forming a shallow saddle (indication of recessive lithology). Bedrock ribs are rare and small. Poorly preserved remains of large stromatoporoids, corals, decimeter-sized tubular biomolds (calcisponges?). Rubbly blocks retain the fabric of packbreccia with patches of floatbreccia. Curved pebble-like fragments in breccia, likely curved short cracks around them and thick lighter-colored filling (matrix) between blocks are characteristic of upper portions of paleokarst profiles with developed paleosol. However, delicate textures that would verify interpretation have been obliterated by dolomitization. Top at 4.0 m.

Figure 4. Top of Mount Kindle dolostone: (A and B) blocks with preserved texture of pack- to floatbreccia, probably a paleokarst/paleosol; (C and D) Poorly preserved macrofossils indicative of Mount Kindle Formation; (str) is a large bulbous stromatoporoid.

PEEL FORMATION

2. Dolostone: weathering characteristically peach-colored and pinkish (Figure 3), beige grey on fresh surfaces, finely crystalline, with biomolds of macrofossils at 5.3 m: convex-up brachiopod shells (probably forming coquina) and gastropods (Figure 4). Lamination is not observed except for weak wavy laminations in bed top. The unconformity surface at the base of this unit is buried under felsenmeer and was not observed. Conodont sample 16KOA026/5.5. Top at 7.0 m. Bed dip: 27/282

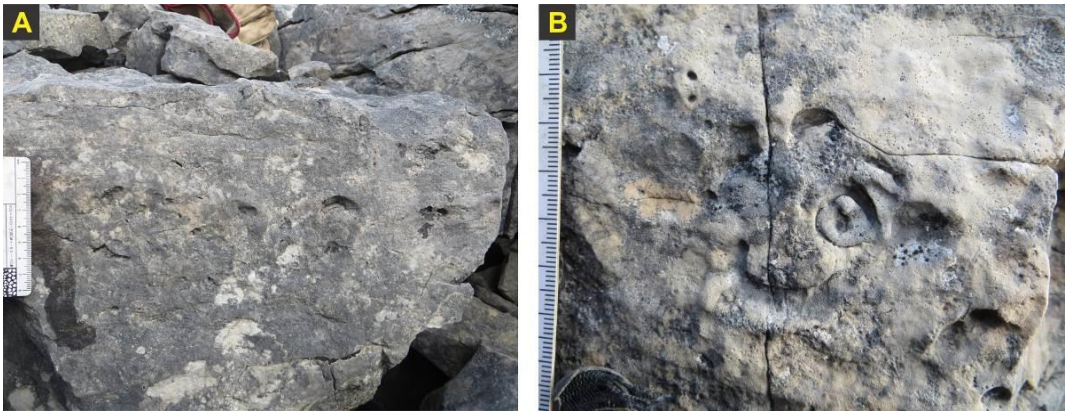

Figure 5. Biomolds of brachiopods (A) and gastropods (B) at 5.0-5.5 m above the base of Peel Formation.

3. Dolostone: light grey with pinkish patches on weathered surface; more coarsely crystalline (0.1-0.2 mm) than unit 2; traces of buckled microbial lamination and small stromatolite heads. The rock is darkening towards the top and obtains a more pinkish weathering. Top at 13.5 m.

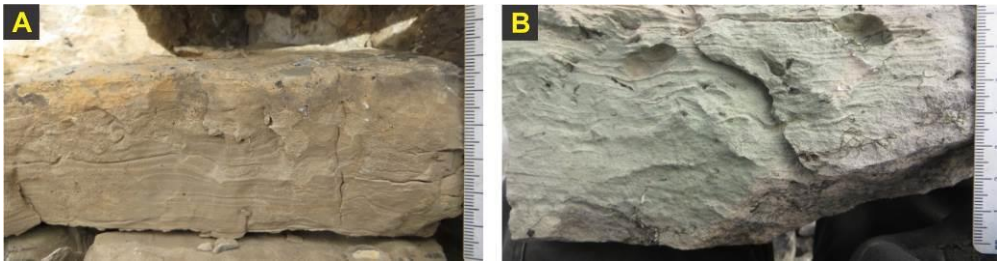

Figure 6. Buckled microbial lamination in unit 3.

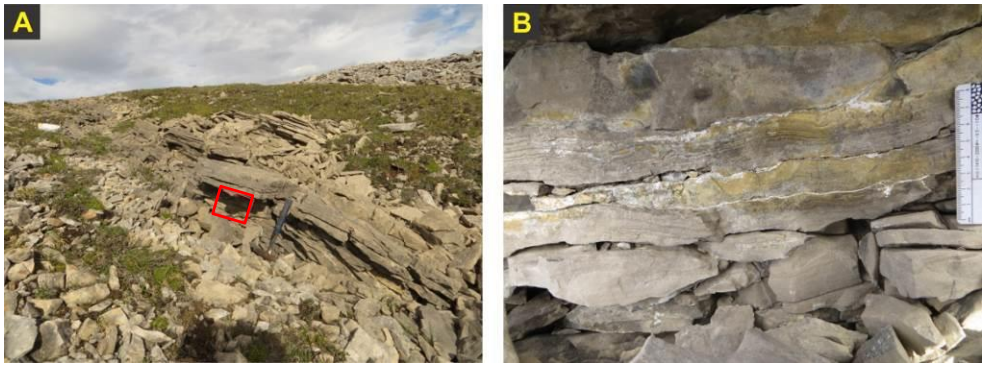

Figure 7. Low resistant rib of unit 4 (A) and buckled lamination in it (B); red rectangle on (A) shows area on (B).

4. Dolostone: finely crystalline (0.1-0.2 mm), brownish grey, darker than underlying units, weathers to peach color; forms low resistant rib; preserves sedimentary features: wavy lamination, teepee structures, desiccation cracks, and rip-up breccias. Top at 15.3 m.

5. Dolostone: recessive soil-covered interval with small and rounded boulders; the boulders are yellowish pale grey, with massive medium crystalline (0.2-0.25mm) fabric and marly stringers between patches of crystalline dolomite; this interval may represent sandy or silty lithology. Top at 17.0 m.

6. Dolostone: yellowish grey, tight, finely crystalline, with admixture of very fine-grain sand, retaining lamination; bedding planes show abundant shrinkage patterns, probably desiccation cracks. Top at 21.0 m.

7. Dolostone: pale beige (almost white) on fresh surfaces and weathering yellow; slightly coarser crystalline than unit 6; base by disappearance of shrinkage patterns and lighter color; shows texture of wavy lamination and low-relief stromatolites. Top at 23.4 m.

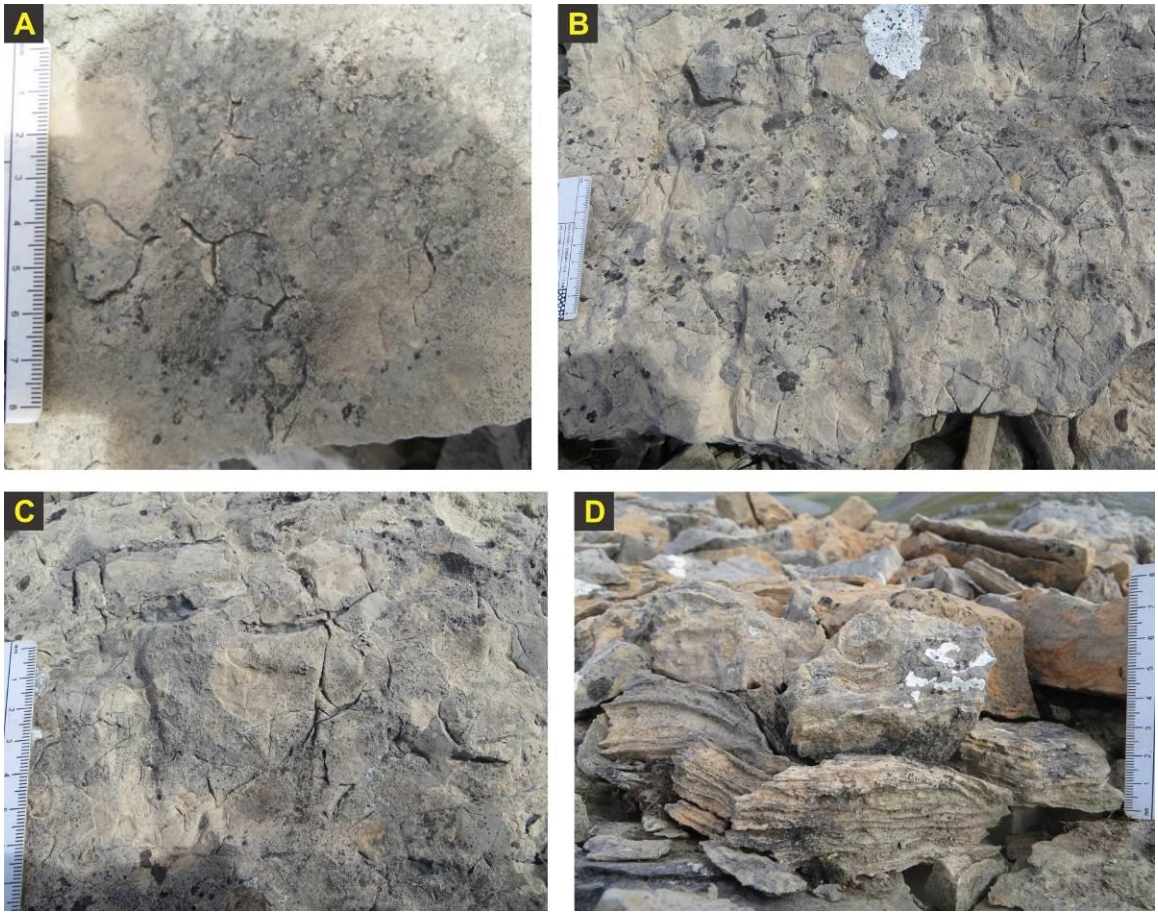

Figure 8. (A-C) Shrinkage-crack fabric in unit 6; (C) is the close-up of (B); (D) a stromatolite in Unit 7.

8. Dolostone: interbedding of finely crystalline rocks weathered to bright orange and pale orange; main bright-orange level in the basal bed; mostly massive dolostones with rare and poorly preserved lamination. Brachiopod biomolds with random orientation were observed in one block; laminar features are more common in the lowermost part. Top at 28.5 m.

9. Dolostone: recessive, forming a shallow saddle; weathering pale yellow to grey (in contrast to orange in unit 8). Lower part is mostly massive, upper part is preserving fine lamination; very poorly preserved biomolds in the lowermost part. Conodont sample 16KOA027/29. Top at 31.0 m.

TATSIETA FORMATION

Figure 9. Northerly view onto the contact of pinkish Peel dolostone and dull pale grey tower-forming Tatsieta limestone. Geologist for scale is arrowed.

10. Limestone: pale grey, thick-bedded (0.1-1.0 m), intensely fractured, resistant and forming the tower (Figure 9). The basal 0.4-0.7 m is dominated by laminar facies. Above, there are massive grainstones intercalated with micritic facies (wackestones and calcimudstones) with birds-eye fabric. Grainstones are fine-grained, with ooidal, peloidal and aggregate-grain composition. Grainstones tend to be more resistant and bench forming, whereas micritic interbeds are slightly more recessive. Fossils: small *in-situ* brachiopods and bryozoans in micritic facies. Common intervals with admixture of fine quartzose sand. Some micritic intervals show signatures of automicrite facies (early syngenetic lithification, intensive birds-eye and lacy fabrics). Minor bioturbated bioclastic packstones on recessive interbeds. Micrites with clotted texture and buckled lamination are common in upper 5 to 6 m. Top at 56.5 m.

10A. Sandstone: A recessive saddle with cobbles of greenish yellow calcareous sandstone between 48.5 and 49.5 m.

11. Dolostone-limestone alternation: limestones are grey, rib-forming; dolostones are pale yellow, recessive in the lowermost half and more resistant in the upper half. Three main dolostone-limestone couplets can be distinguished. Limestones are partly recrystallized and strongly stylolitized, retain dismicrite texture, contain ostracods and rare thin-shelled brachiopods. Top at 60.0 m. Bed dip: 24/285

12. Limestone: pale grey, partly yellowish and partly dolomitic, with minor patches of dolostone; dominated by laminar fabrics (buckled and disrupted microbial lamination). A recessive massive dolostone in the middle. Patches of porous sucrosic dolomite at 66.5 m (Figure 10C & D). A prominent laminated and stromatolitic bed at base (Figure 10B). Top at 67.5 m.

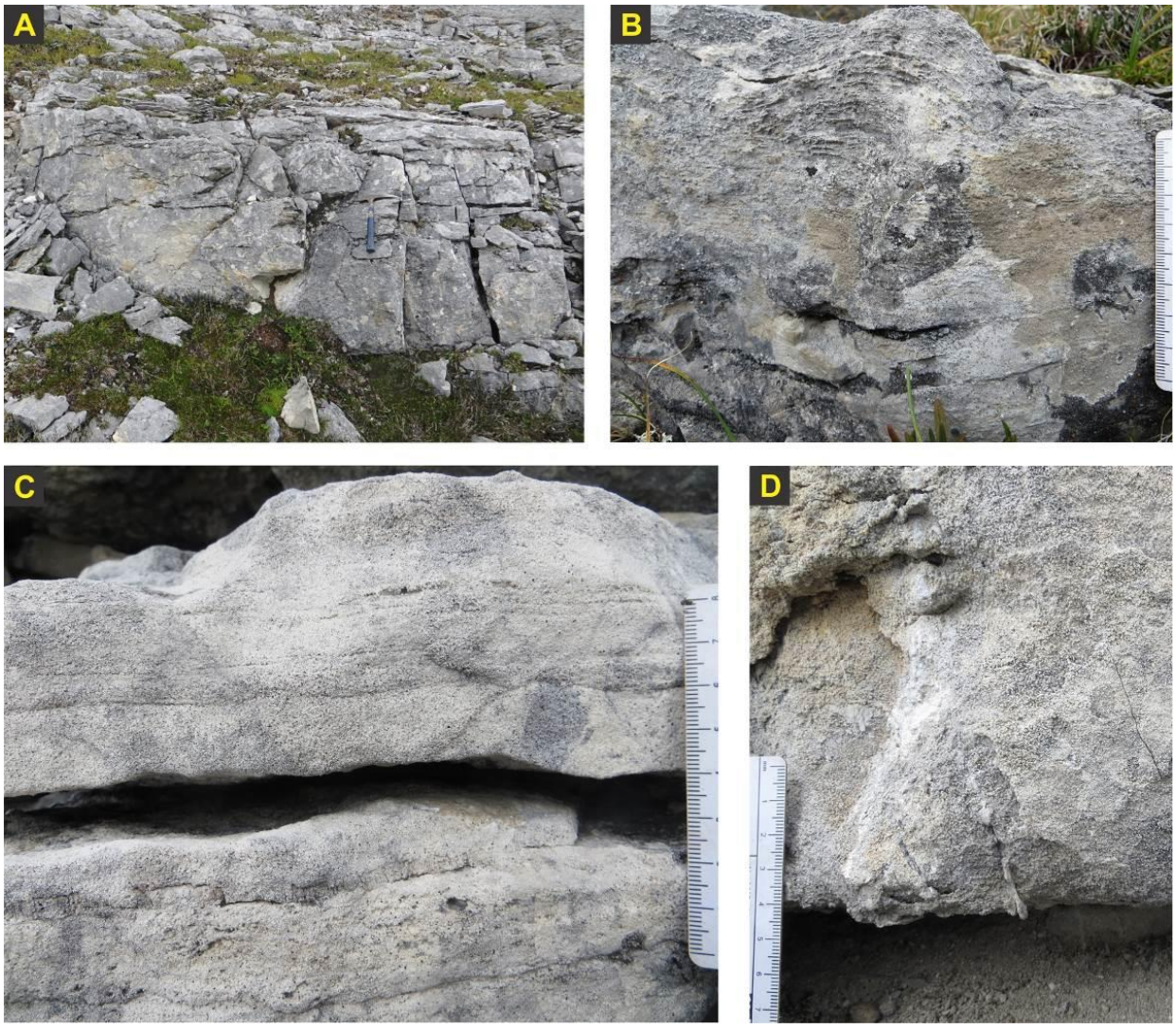

Figure 10. Tatsieta Formation: (A) Massive bench-forming limestone (grainstone) at 32.0-33.5 m; (B) stromatolite at base of unit 10; (C and D) patches of porous sucrosic dolostone at 66.0 m.

13. Limestone: very thick-bedded (0.5-2.0 m), resistant, forms tower on the ridge, with rare silty horizons. Textures: alternation of dismicrites, calcimudstones, and fine-medium grained peloidal grainstones; thin interbeds with buckled microbial lamination; dismicrites and calcimudstones are dominant textures starting from 75.0 m upward. A large (over 1.0 m tick) domal stromatolite at 97.0 m. Admixture of coarse (up to 0.5 mm) idiotopic dolomite crystals in limestones and rare patches of coarsely crystalline sucrosic dolomite. Macrofossils not encountered. Top at 111.7 m.

14. Limestone: grey, thick-bedded and nodular calcimudstone, progressively thinner bedded and darker grey to the top. Ostracods in basal 1.0 m. No macrofossils detected. Enhanced recrystallization into sparry calcite at top. Top at 114.0 m.

ARNICA FORMATION

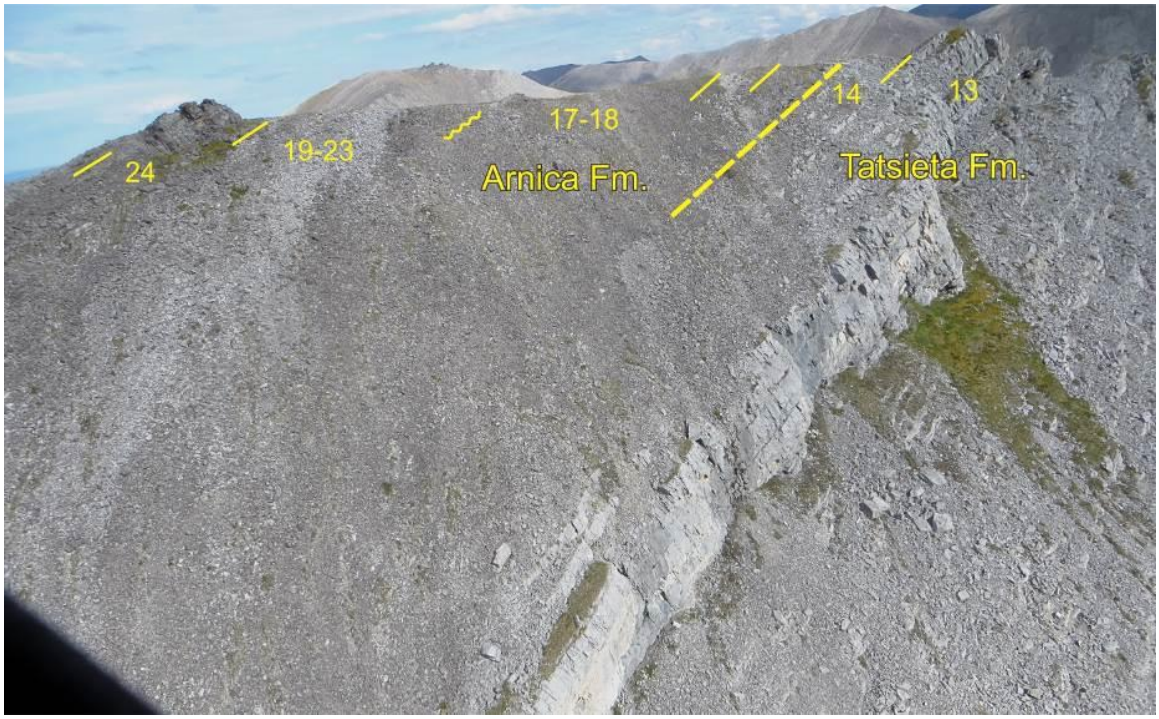

Figure 11. Tatsieta-Arnica contact with partly traced units; disconformity on top of unit 18 is marked by wavy line

15. Dolostone: brownish grey, darker than the rock below, vuggy; moderately recessive. The lower half is massive, the upper half is vaguely laminated. Mass tubular biomolds in the middle part (*Amphipora*) of the unit. Conodonts 16KOA028/144.5. Top at 116.8 m.

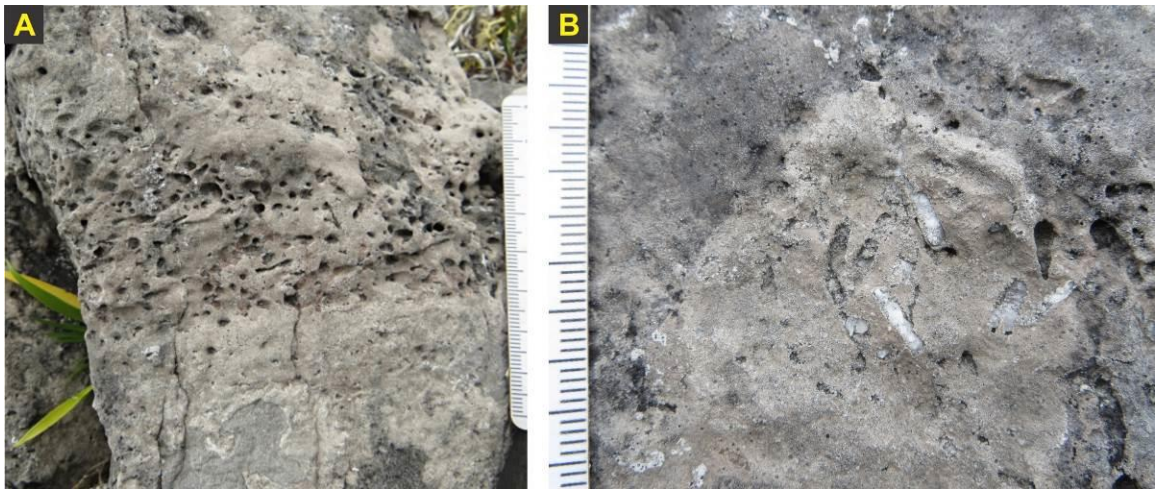

Figure 12. (A and B) tubular biomolds, probably mostly *Amphipora*, in unit 15.

16. Dolostone: pale grey to almost white, tight, finely crystalline; retains poorly preserved lamination. Top at 119.0 m.

17. Dolostone: low-contrast alternation of darker and paler grey-colored dolostones; rare patches of crystalline limestone; breccia horizons (paleosols?) in the unit base and in the top. No recognizable macrofossils. Top at 128.0 m.

18. Dolostone: calcareous, grey to brownish grey, with rubbly fabric (breccia) and patches of crystalline limestone. Patches of pack- to floatbreccia in upper part; this breccia with variously rounded fragments is cemented by bluish cherty or argillaceous material – dissolution fabric characteristic of subaerial exposure profiles (Figure 13). The upper part is resistant, forming a small tower. Top at 133.0 m.

19. Dolostone to limestone: pink-weathering, limestone patches are recrystallized; with ghosts of mm-sized rounded carbonate pebbles; onlapping unconformity on top of unit 18. Top at 133.4 m.

20. Dolostone to limestone: medium grey, finely to medium crystalline, vaguely laminar top, massive at the base and preserving gently buckled lamination in upper half. Top at 137.7 m.

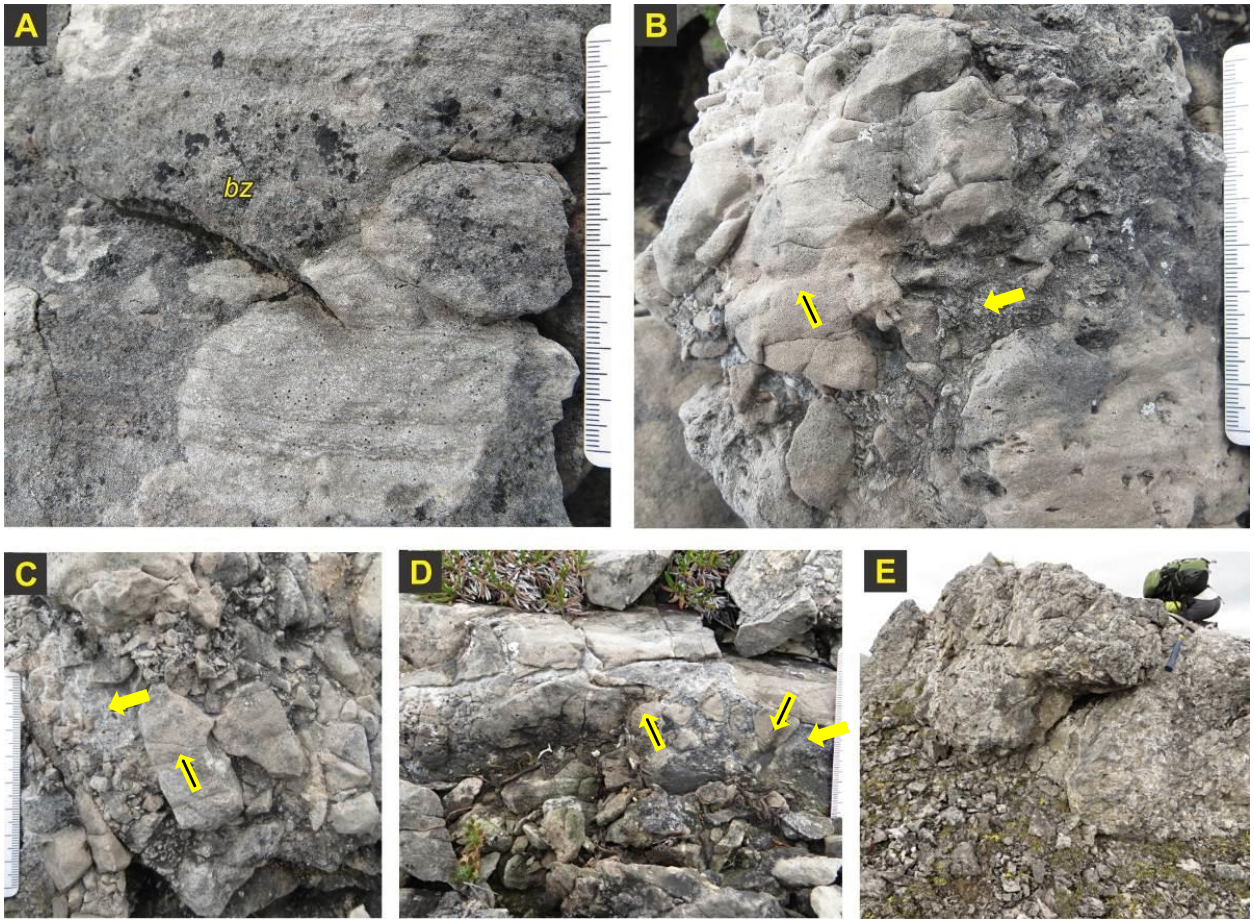

Figure 13. (A) Lamination in unit 17 at 121.0 m; note brecciated zone (*bz*) interpreted as deeply penetrating paleokarst. (B-D) Breccia fabric in unit 18, black arrows point at solution fragments and yellow arrows show cementing matrix. (E) Resistant top of breccia at 133.0 m.

21. Dolostone: calcareous, pale grey, crystalline, pale beige on fresh surfaces. A 20-40 cm thick breccia horizon at top. Top at 141.5 m.

22. Dolostone to limestone: light colored beige grey, massive, with mass tubular biomolds (*Amphipora*?). Sporadic biomolds after brachipods and unidentified macrofossils. Top at 143.0 m.

23. Limestone to dolostone: medium grey, with even to buckled lamination; no fossils. Top at 146.3 m.

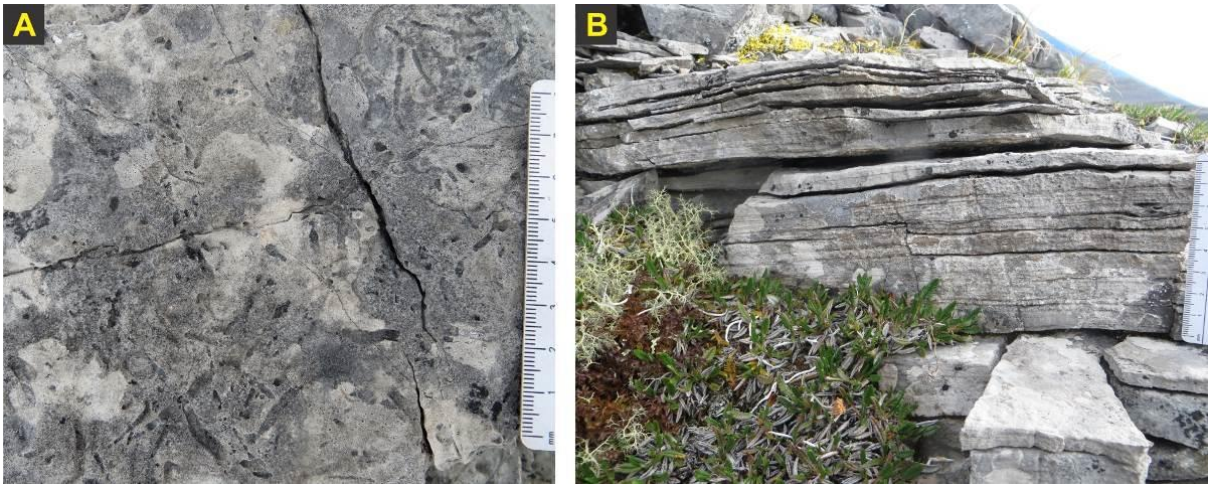

Figure 14. (A) Tubular biomolds (*Amphipora*?) in unit 22. (B) Lamination at top of unit 23.

24. Limestone: crystalline, grey to brownish grey, massive, thick-bedded, resistant and towering on the ridge, with rare poorly preserved bioclasts. Sedimentary texture is not preserved. Possible interpretation: dedolomite. The upper 1.5 m is more nodular, thin-bedded, and more dolomitic (Conodont samples 16KOA028/147.8, 16KOA028/150). Marly pebbles in upper 20 cm. Top at 151.0 m.

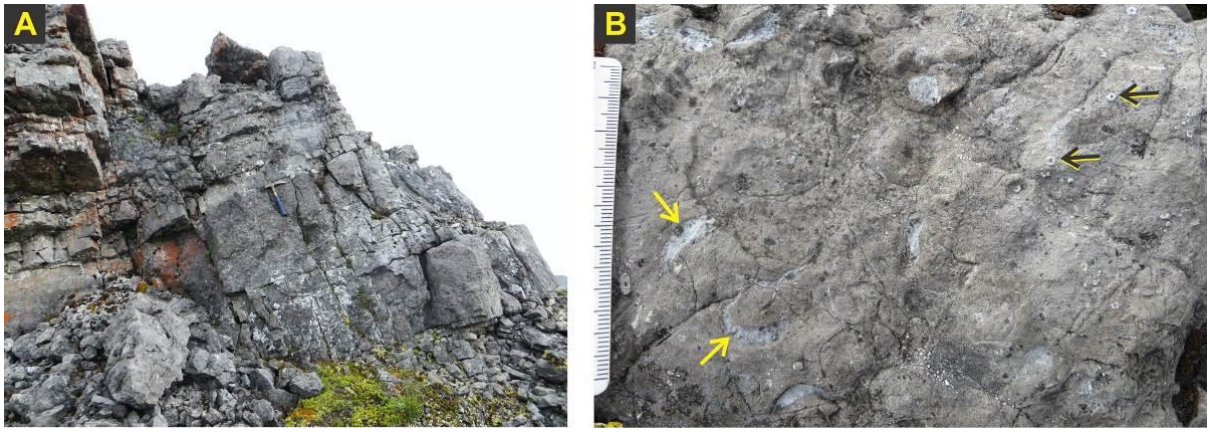

Figure 15. Recrystallized limestone of unit 24: (A) bedding in a resistant tower on the ridge; (B) slab with poorly preserved brachiopods (yellow arrows) and pelmatozoan ossicles (black arrows).

25. Dolostone: calcareous, with minor limestone; pale grey, weathers pale beige, thin-bedded, semi-recessive. Amphiporid biomolds in upper part, some show branching. Buckled microbial lamination near the top. A stromatolite horizon at 152.3 m. Dense network of calcite spar veins in uppermost part. Top at 155.0 m.

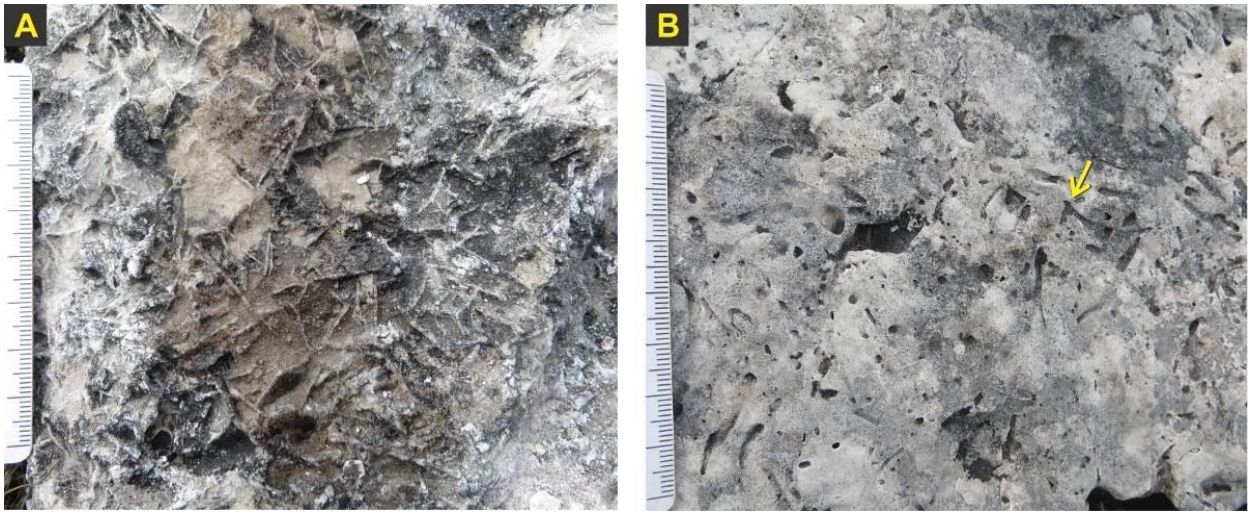

Figure 16. Upper part of unit 25: (A) "boxwork" of calcite spar veins; (B) tubular biomolds (*Amphipora*?); a branching biomold is arrowed.

26. Dolostone: meter-scale alternation of dark brownish grey and pale grey facies ("zebra unit"). The texture is massive in the lower 0.5 m and mostly retains buckled microbial lamination above. Three main dark-light couplets/cycles. Vuggy dolostone with birds-eye laminar fabric at top. Top at 163.3 m.

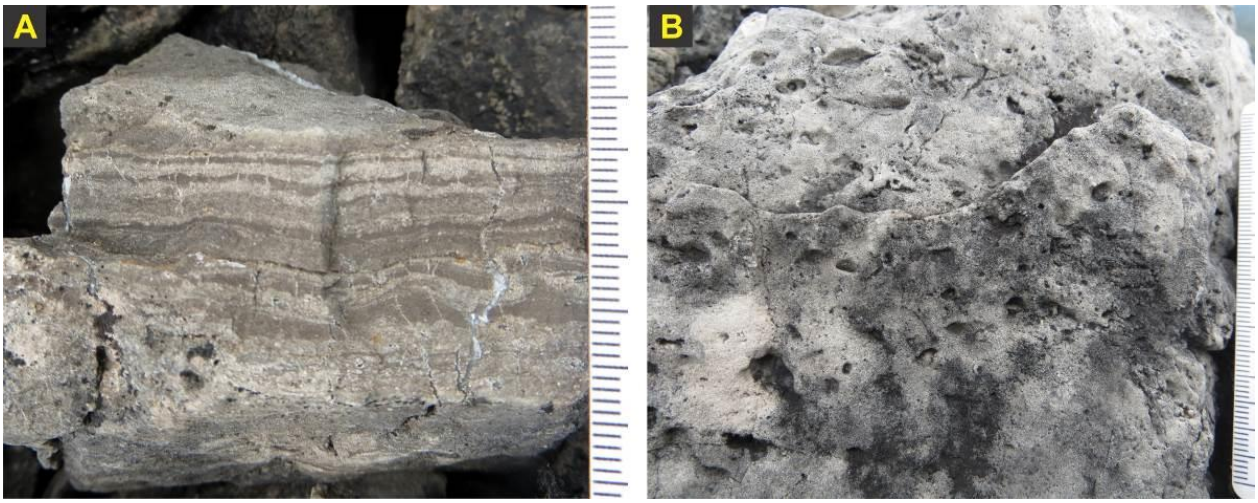

Figure 17. Unit 26: (A) Buckled and disrupted sedimentary lamination at 156.0m. (B) Vuggy dolostone at top (163.5 m) retaining fenestral and/or solution vugs.

27. Dolostone: dark brownish grey, partly calcareous. The unit looks acyclic (no meter-scale dark - light color alternation). Poorly preserved biomolds concentrated in thick laterally disappearing laminae. The upper half is slightly lighter colored and contains several horizons with gently buckled lamination. Top indicated by gradation to pale grey dolostone. Top at 174.0 m.

28. Dolostone: calcareous, finely to medium crystalline, brownish pale grey, retaining vague lamination. Top at 177.5 m.

29. Dolostone: “zebra” alternation of dark and light colored dolostones, six 2-3 m thick couplets in total. From base to top: (1) dark brownish grey, rubbly, with buckled lamination and low-relief stromatolites in basal part and massive with biomolds in the upper part – 2.5 m; (2) pale grey dolostone with lost sedimentary fabric – 1.5 m; (3) dark dolostone with vague microbial lamination. The pale-colored bed in the interval top does not show lamination. Top at 186.5 m.

30. Dolostone: dark brownish grey, with crude thick lamination accentuated by weathering, and the system of burrows (Figure 18B). A thin rubbly breccia horizon at top (Figure 18C). Top at 190.5 m.

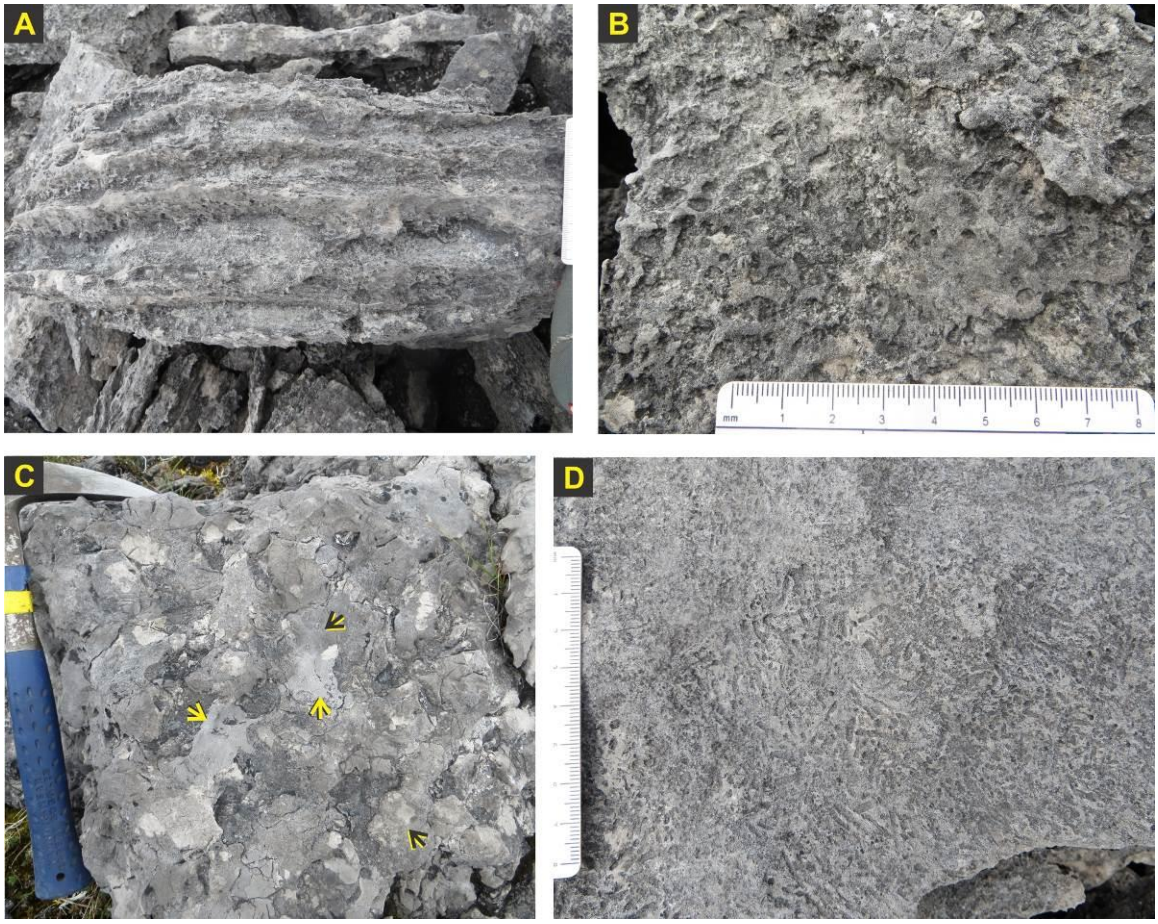

Figure 18. (A-C) Unit 30: (A) crude lamination; (B) burrow system; (C) brecciated top of unit 30, bedding plane; black arrows point at fragmented host rock, and yellow arrows at secondary (probably pedogenic) argillaceous stringers. (D) Mass *amphipora*(?) on a bedding plane, unit 31.

31. Dolostone: calcareous, brownish grey, thin-bedded, with horizons of mass tubular biomolds (*amphipora*; Figure 18D). Top at 193.3 m. Bed dip: 30/297

32. Limestone to dolostone: nodular, with light bluish grey limestone nodules (wackestones and amphiporan rudstones) embedded in a thick matrix of brownish grey dolostone. Some bedding planes are littered with *amphipora* (the latter preserve skeletal structure in limestone nodules). Small stromatoporates or *Stacheoides* in same limestone nodules. A 1 m thick massive pale grey limestone bed at 197.0 m. Dolostone/limestone ratio varies from 30:70 to 70:30 in different parts of the unit. Top at 200.6 m.

33. Limestone: thin-bedded, recessive, partly fissile and flaser, very dark grey on fresh surfaces, contains compacted thin-shelled brachiopods. Conical poorly preserved microfossils, ≤ 1 mm in size, can be tentaculitids. Conodont sample 16KOA029/201. Top at 201.2 m.

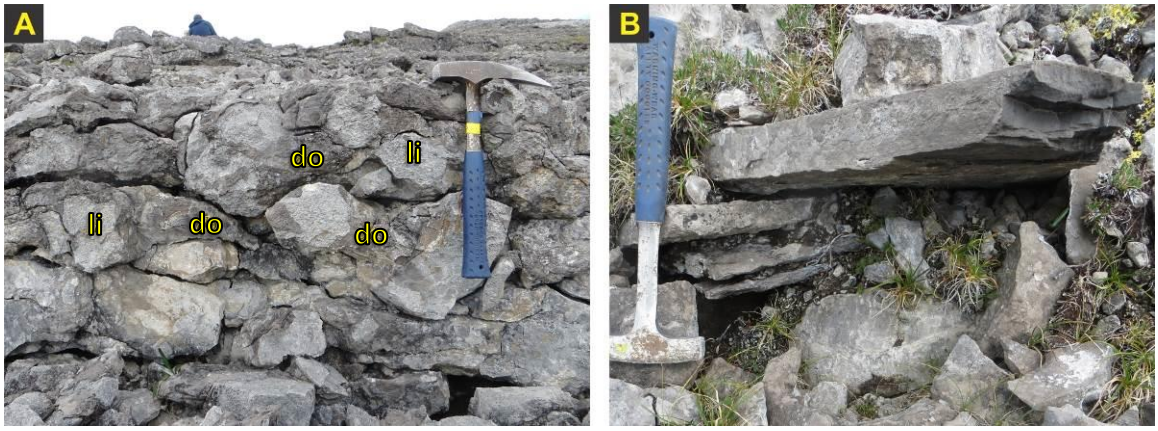

Figure 19. (A) Nodular limestone to dolostone, unit 32; (li) is limestone nodules, (do) is dolomite matrix; (B) thin-bedded, partly fissile limestone of unit 33.

34. Limestone to dolostone: nodular, thick to thin bedded, similar to bed 32. The middle part is recessive, forming a shallow saddle. The limestone is bioturbated and fossiliferous: diverse brachipods (*in situ*), crinoid stalks, and solitary rugose corals. Conodont sample 016KOA029/208. Top at 211.5 m.

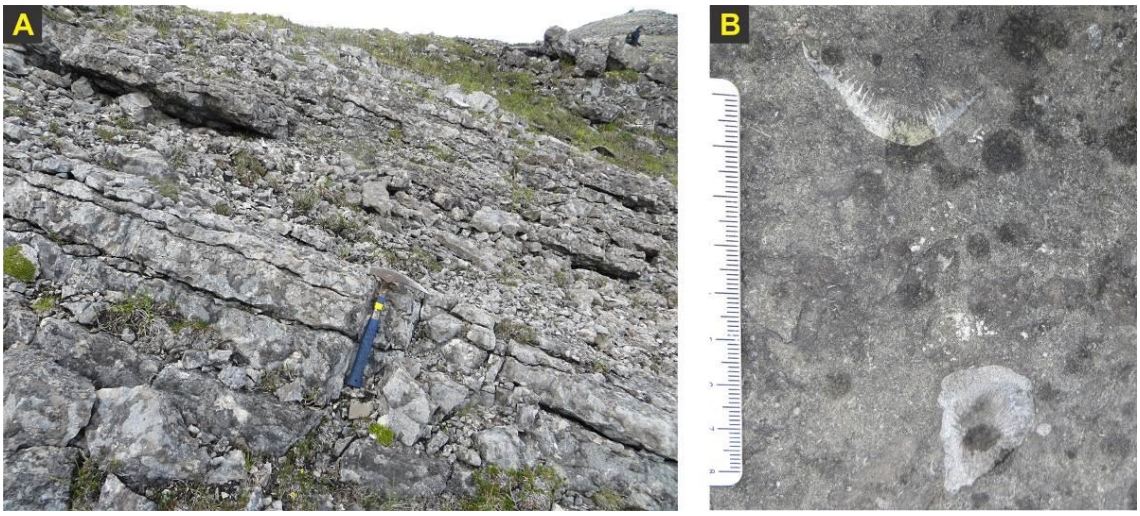

Figure 20. Unit 34: (A) bedding and nodularity, horizontal northerly view; (B) rugose corals.

35. Limestone to dolostone: brownish grey, partly mottled and with mass amphiporas in basal 2-3 m (amphiporas were not observed in beds 32-34). The upper part is mostly massive dolostone with no preserved fossils. Top at 216.5 m.

36. Dolostone: stands out by its very pale grey, almost white color; finely crystalline, with thin buckled lamination, contains oblique burrows (Figure 21B & C). Top at 219.0 m.

Figure 21. (A) Contact of massive unit 35 and laminated unit 36. (B and C) channels/burrows in the laminated dolostone of unit 36.

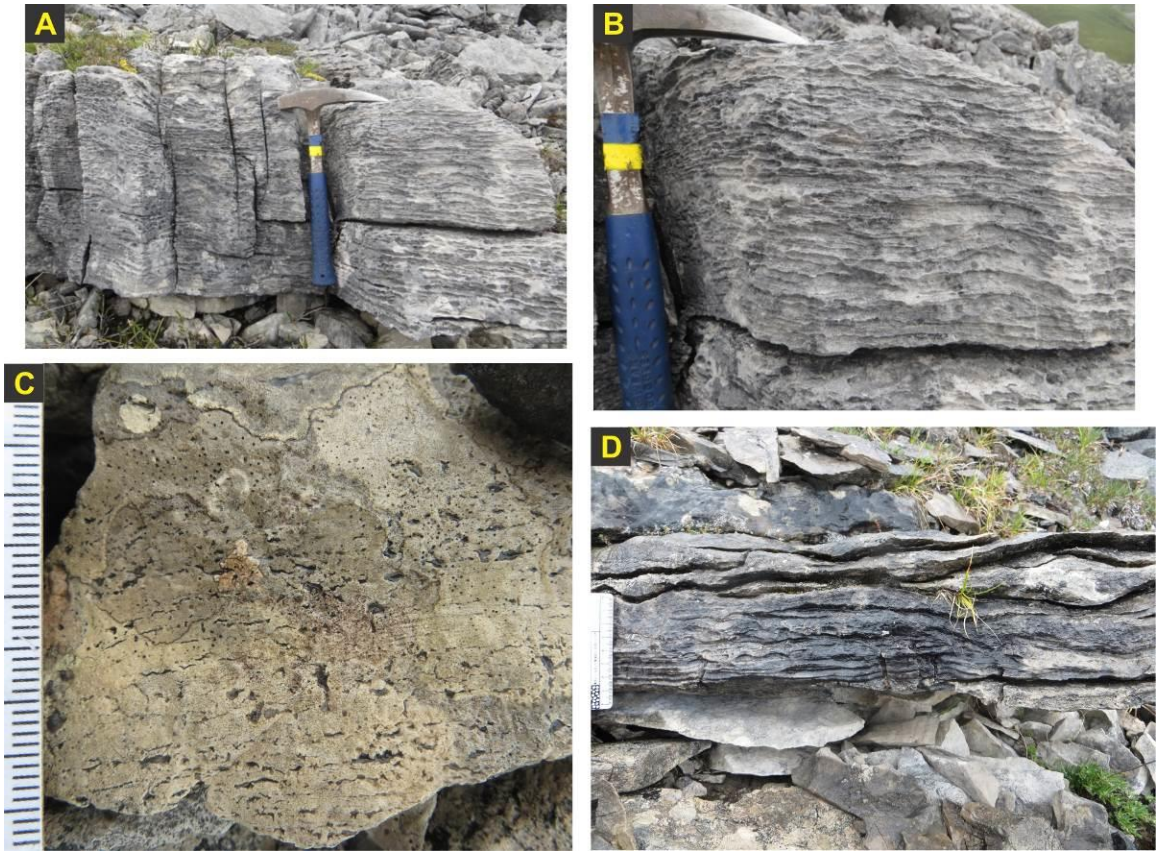

Figure 22. (A and B) Stromatolite horizon at 245.0 m. (C and D) Unit 39 at top of Arnica Formation: (C) fenestral dolostone; (D) stromatolitic bed in uppermost part.

37. Dolostone: finely to medium crystalline (0.1-0.2 mm); cyclic "zebra" unit composed of six dark – light colored couplets. Dark and pale grey units both contain laminated and massive facies. Some dark grey units contain meshes of *Amphipora* biomolds, which was not observed in the light grey dolostones. A brachiopod coquina at 236.8 m. The uppermost part is distinct by the thickest light colored interval (234.0-237.5 m). Top at 237.5 m.

38. Dolostone: alternation of dark mostly massive and light grey mostly laminated facies; seven main dark – light couplets; minor limestones preserved as residual nodules in dark grey dolostones; rare stromatolites. Dark brownish grey dolostone at top. Top at 266.0 m.

39. Dolostone: finely crystalline, recessive, weathers with distinct peach color; preserves fenestral laminar texture. More resistant stromatolitic bed in uppermost part. Top at 267.5 m.

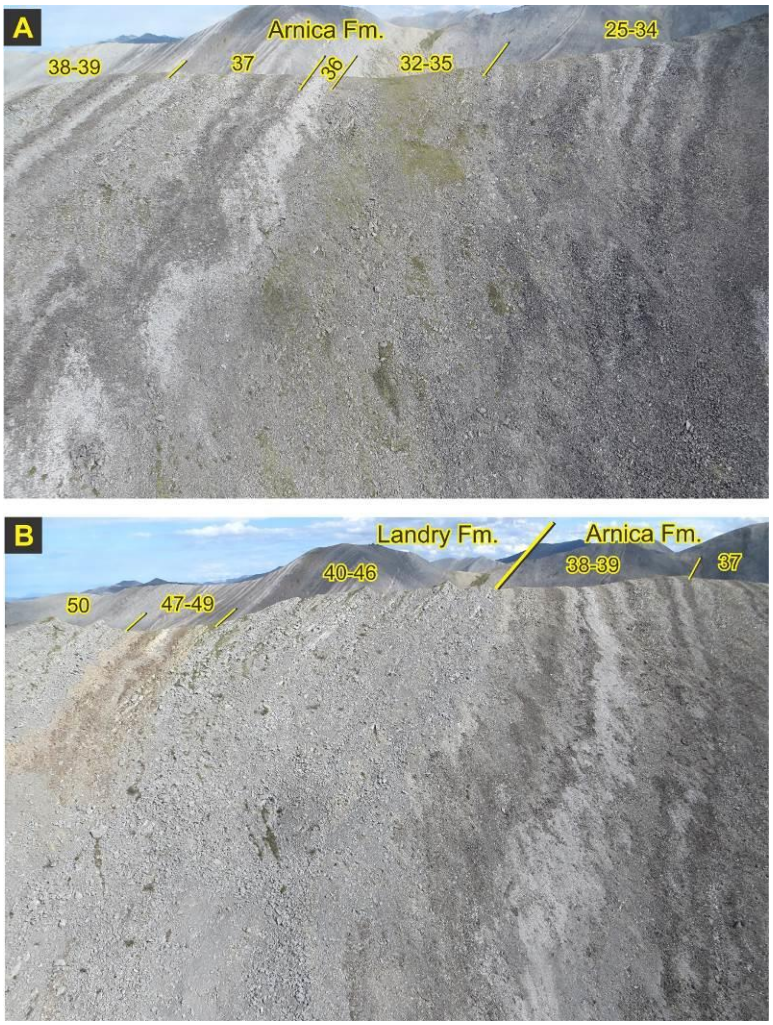

Figure 23. Overlapping airborne photos with Arnica-Landry contact and descriptive units; east ridge of Rumbly Creek in the background.

LANDRY FORMATION

40. Limestone: pale grey, thick-bedded (0.1-0.7 m), resistant, forming ribs and low towers on the ridge (Figure 23). Textures: clotted calcimudstones (micrites and dismicrites) with ostracods. A thin (0.2 m) dismicrite weathering with peach color, with microbial lamination at 271.5 m. Charophyte gyrogonites locally present. Top at 277.0 m. Bed dip: 26/284

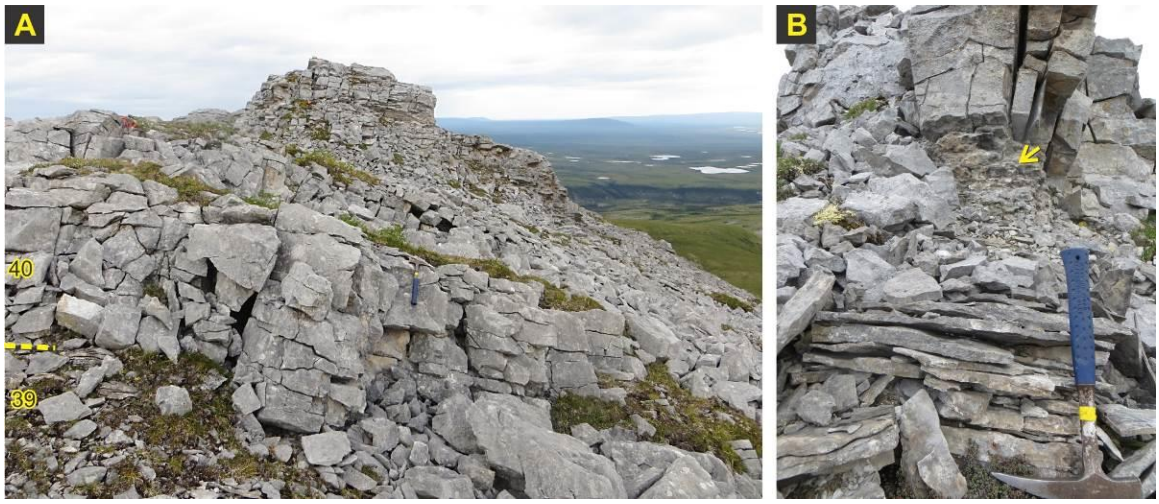

Figure 24. (A) Contact of Arnica and Landry formations (dash-traced from the left), northerly view from the ridge. (B) Unit 44: hammer-pick points to the base; nodular calcimudstone is arrowed.

41. Limestone: grey, darker and thinner bedded than unit 40, with more pressure solution features; more recessive in the lowermost part. Texture: bioturbated bioclastic wackestone. Fossils are more diverse than in unit 40: dominantly ostracods, some thin-shelled brachiopods. Top at 278.0 m.

42. Limestone: weathers pale grey; thick-bedded at base and thin-bedded at top. Texture: calcimudstones with microbial lamination at base, non-laminated and containing ostracods in the middle, and partly laminated at top. Top at 282.2 m.

43. Dolostone: unevenly calcareous, finely crystalline (crystals < 0.15 mm); weathering distinct peach color. Partly retains wavy lamination and collapsed thin shells. Top at 283.0 m.

44. Limestone: pale grey, in lower 1 m grading from laminated to nodular to massive. Dolomitized at base. Texture: calcimudstones, locally alternating mudstones and fine-grained rounded-grain grainstones; clotted mudstone to peloidal grainstone with calcispheres at 286.0-286.5 m. Interbeds of thin-bedded (1-2 cm) dark grey calcimudstones. Blocks with rubbly breccia fabric are found at 292-293 m but not located in bedrock – possible thin paleokarst horizon. Thinner bedded, extensively stylolitized dismicrite at top. Top at 297.3 m.

Overlying units 45-49 are overall recessive and forming saddle on the ridge (Figure 23B and Figure 25).

45. Dolostone: marly, weathering peach-colored to yellow, massive at base and laminated in upper half; darker brownish at top. The bed forms part of a recessive saddle. Top likely conformable. Top at 299.0 m.

46. Limestone: medium-bedded, grey. Texture: weakly laminated grainstone to calcimudstone (dismicrite) with mass calcispheres. Rare limestone clasts in the base. Minor admixture of quartz sand. Top even, conformable. Top at 299.5 m.

Figure 25. Units 45-49, downdip view; yellow arrow points at the pedogenized yellow-weathering "palustrine facies" in unit 48; red arrow points at the measuring pogo stick.

47. Dolostone: brown, marly, finely crystalline, with distinct thin lamination, low teepee structures, and desiccation cracks. The upper 1/3 is grey-weathering dolomitic to non-dolomitic limestone. Top by decline of lamination. Top at 301.7 m.

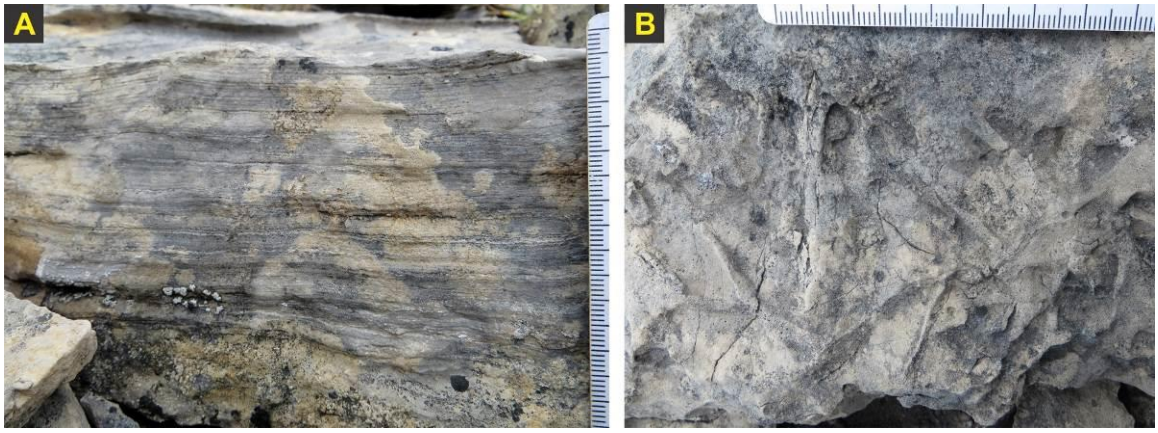

Figure 26. Dolostone of unit 47: (A) lamination; (B) sole marks of probably desiccation polygons.

48. Limestone: grey at base and top, yellow-weathering in the middle. Grey limestones are birds-eye calcimudstones. Yellowish facies in the middle is dolomitic limestone grading to crystalline dolostone; in less dolomitized patches it is micritic limestone with curved fenestrae, circum-granular shrinkage cracks, and overprints of dark grey argillaceous infiltrations ("rotten zones") and solution microbreccias (pack to floatbreccias with marly matrix). Some limestone patches/nodules contain small blackened lithoclasts expelling odor when crushed. This yellowish limestone is very similar to "palustrine facies" in the Landry Formation of Kugaluk N-02 (Kabanov, 2014). The upper grey limestone is nodular and represents a compacted (stylolitized) lithoclastic calcarenite, indicating a disconformity. Top at 303.5 m.

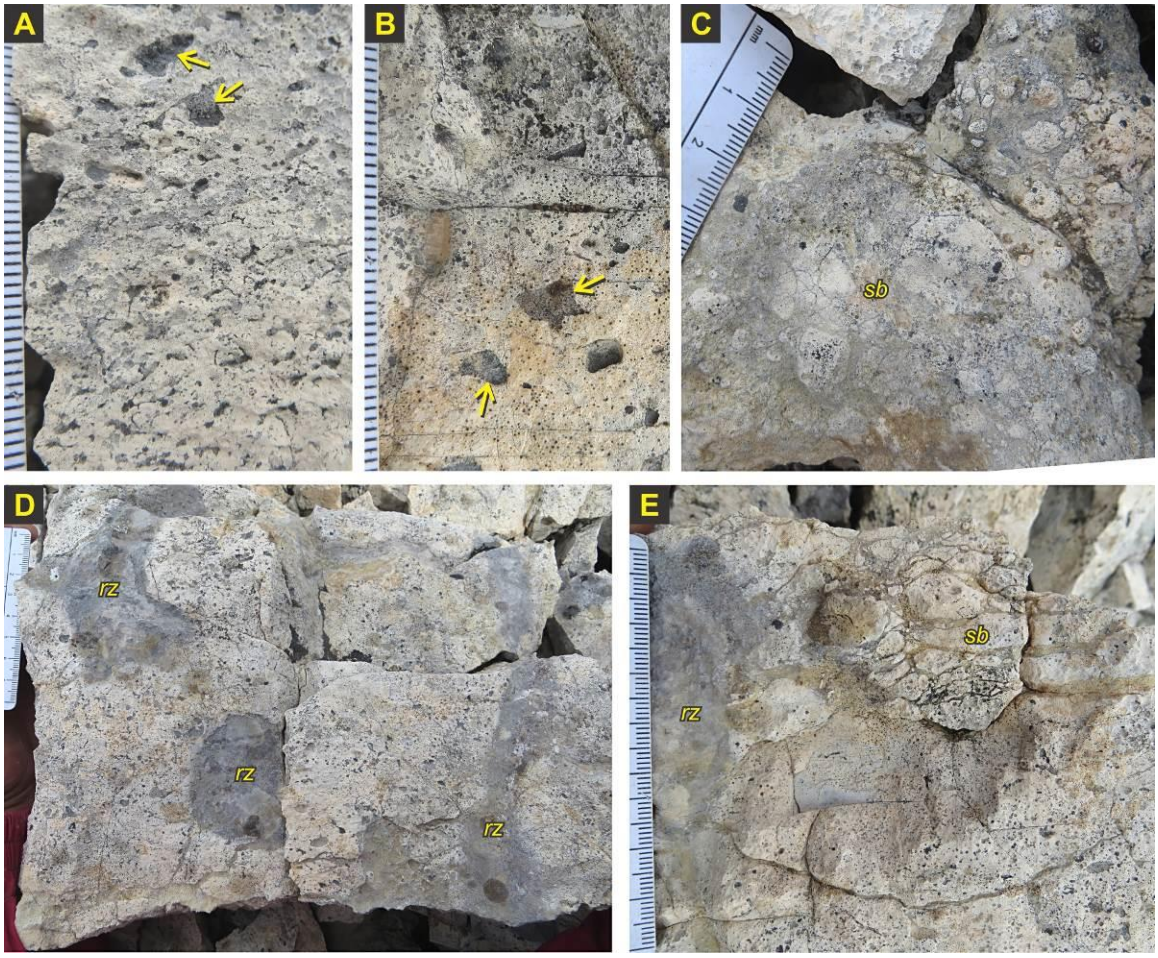

Figure 27. Macro-imaging of "palustrine facies" in unit 48: (A) fenestral fabric; (B) intraclasts of soft dark grey marl (arrowed in A and B); (C-E) complex solution-reprecipitation fabrics indicating pedogenesis, note "rotten zones" (*rz*) and solution breccias (*sb*); (C) is bedding-plane view, (D and E) are normal to bedding.

49. Dolostone: weathers dark brown in basal one-half and peach color in the upper half. Texture: stromatolitic in lower part, grading to finely buckled (crenulated) horizontal lamination with desiccation cracks in the upper part; brecciated under the top. Top at 307.3 m.

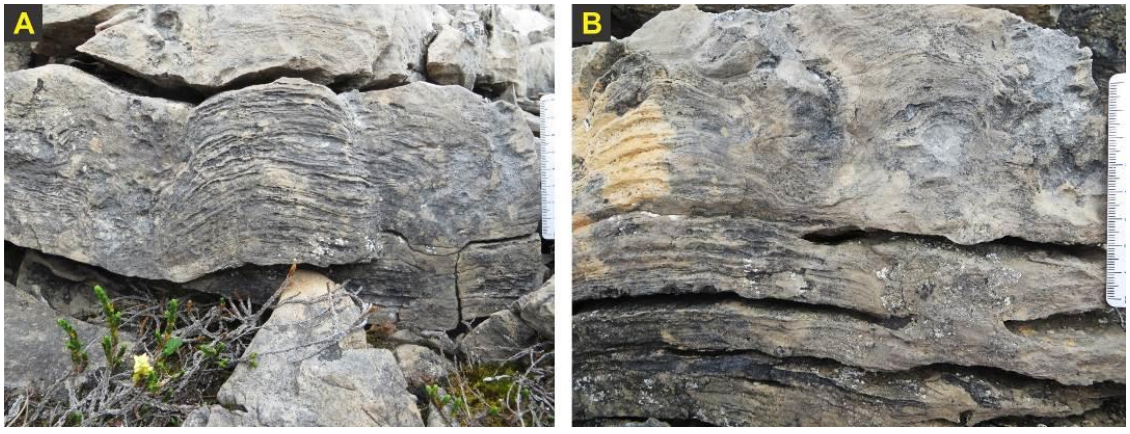

Figure 28. Stromatolites in lower part of unit 49.

50. Limestone: weathering pale grey, massive, resistant, tower forming; patchy dolomitization near the base. Textures: calcimudstones and minor grainstones; a 15 cm thick bed of medium-grained rounded grainstone at 309.0 m. Dwarf amphiporids in the uppermost part. Top at 322.5 m.

51. Dolostone to limestone: weathering bright peach color, retaining the fabric of "palustrine facies"; thin unit locally buried under the rubble of grey limestone. Top at 323.0 m.

52. Limestone: grey, alternation of thick-bedded, resistant and rib forming limestone and slightly recessive thin limestones; thin very recessive flaser-bedded limestones also occur. Textures: mostly calcimudstones, minor wackestones and packstones with thin graded bioclastic laminae composed of ostracods. Thin lenses of pinkish weathering dolostone at 328.0 m; interval with admixture of quartzose sand at 336.0 m. More fossiliferous limestone at 342.0-347 m with small brachiopods and *Amphipora*. Top at 360.0 m.

Figure 29. Weathered slabs from unit 53; note solution-collapse chambers filled with rounded clasts (*ch*); blackened lithoclasts are arrowed.

53. Calcareous dolostone to limestone: bright peach-colored weathering, fenestral brecciated facies ("palustrine limestone"). Top at 360.5 m.

54. Limestone: weathering light grey, thick-bedded at base and thin to nodular bedded in the upper half. Textures: peloidal-bioclastic wackestones, packstones, minor peloidal grainstones and dismicrites (fenestral calcimudstones and wackestones). The thin-bedded part is fossiliferous: mollusks, thin-shelled brachiopods, unidentified encrusting forms, large stromatoporoids. Conodont sample 16KOA034/362.0. Top at 363.0 m.

55. Dolostone: marly, recessive, weathering dark beige; texture massive, finely crystalline; conchoidal fracturing. Top at 363.6 m.

56. Limestone: grey, dolomitic in the upper part; ostracodal calcimudstone with tiny birds-eye fenestrae, faintly laminated. Top at 366.2 m.

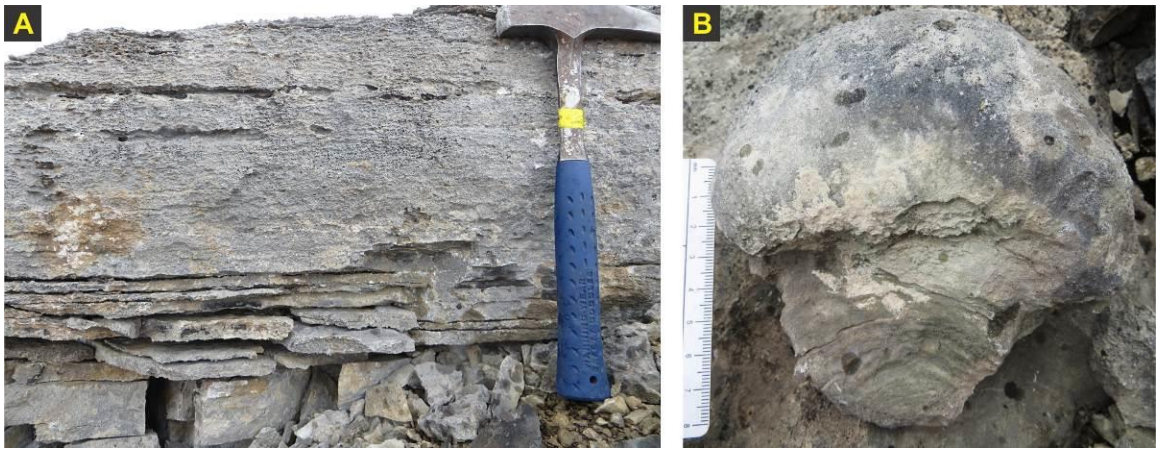

Figure 30. (A) Crude lamination in unit 58. (B) Large mushroom-shaped stromatoporoid from fossiliferous limestone of unit 54.

57. Dolostone: bright peach-colored weathering, variously calcareous, with texture of "palustrine limestone". Top at 366.8 m.

58. Limestone: medium bedded to very thin bedded, weathering pale grey, dark grey on fresh surfaces; crudely laminated. Texture: ostracodal packstones and calcimudstones. Top at 368.8 m.

Overlying units 59-60 are recessive and forming a small saddle on the ridge.

59. Dolostone: calcareous, grading to dolomitic limestone; weathers brown to beige and shows discontinuous lamination; grades upward to unit 60. Top at 370.2 m.

60. Limestone: dolomitic, weathering peach, with texture of "palustrine facies". In addition to fenestrae and solution features, this bed displays branching tubular structures, either root traces or burrows, which were not observed in the "palustrine facies" below. Top at 371.0 m.

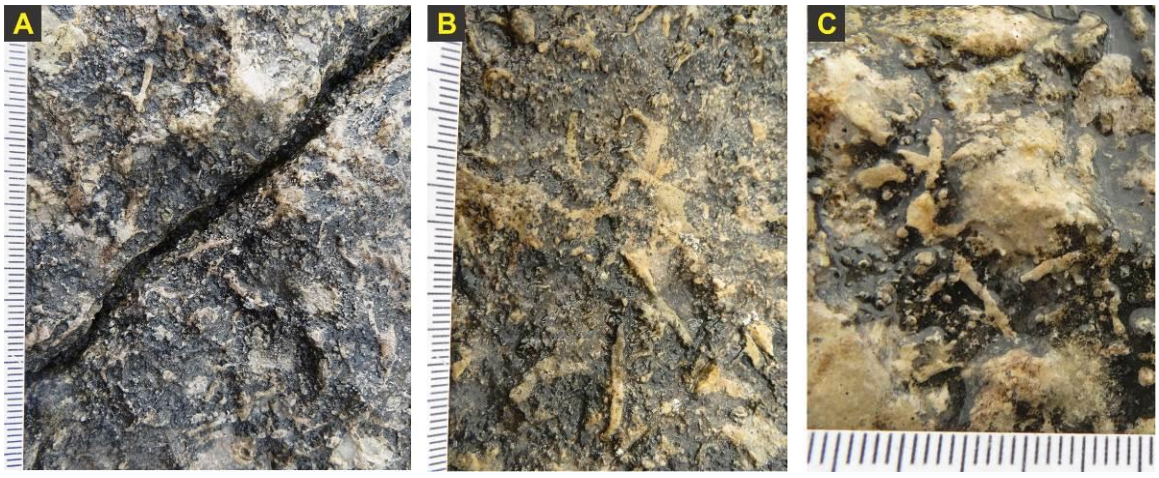

Figure 31. Unit 60: branching tubular structures in "palustrine facies".

61. Dolomitic limestone to dolostone: medium to thin bedded, weathers brown to grey, laminated, with residual non-dolomitized patches/nodules of limestone. Top at 371.5 m.

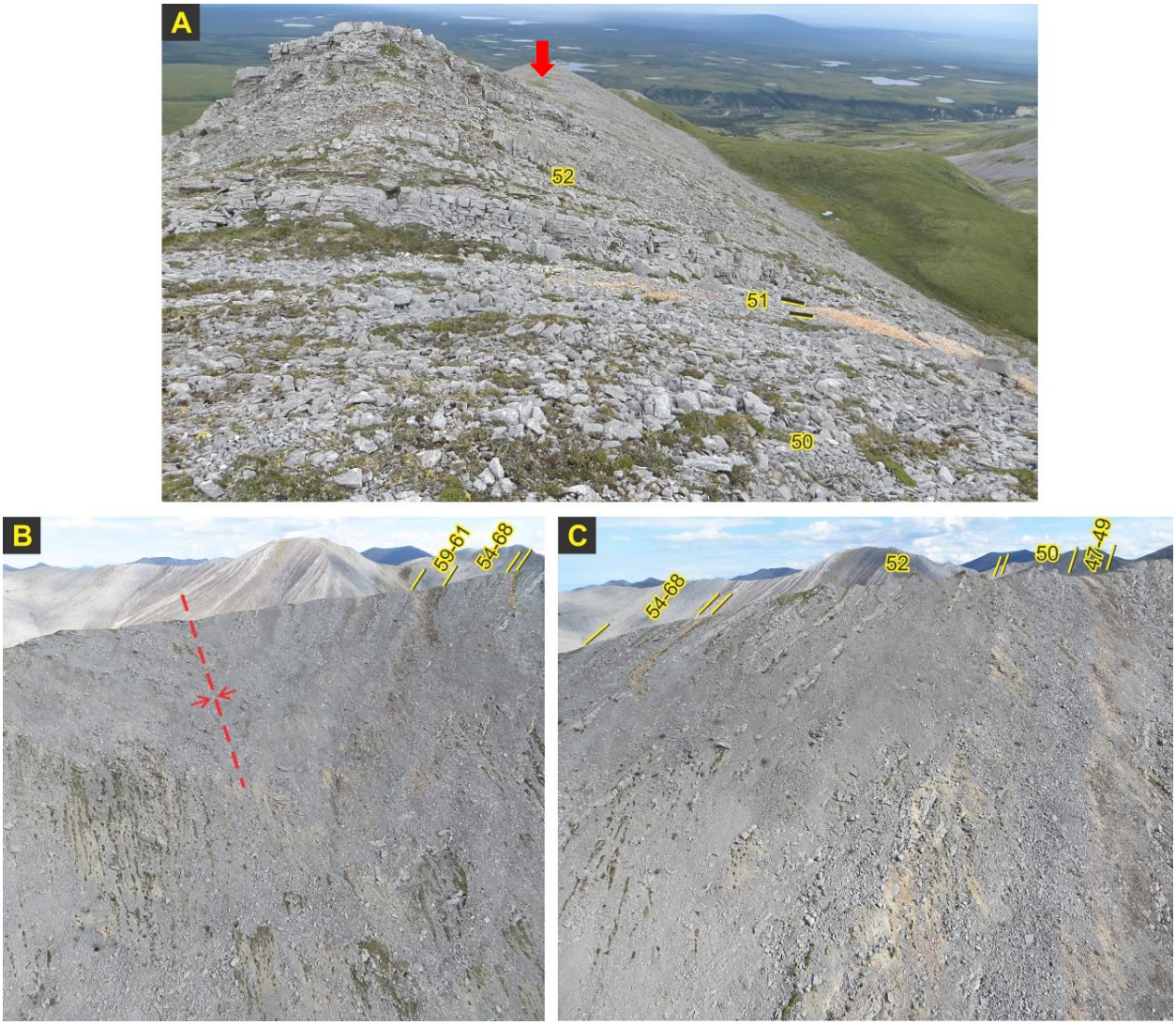

Figure 32. Upper portion of measured section: (A) units 50-52, downdip view; (B and C) overlapping airborne views; hinge of the syncline complicating Landry section is arrowed (A) and traced in red (B).

Unit 61 is conformably overlain by thick-bedded grey limestone that was not measured.

End of measured section.

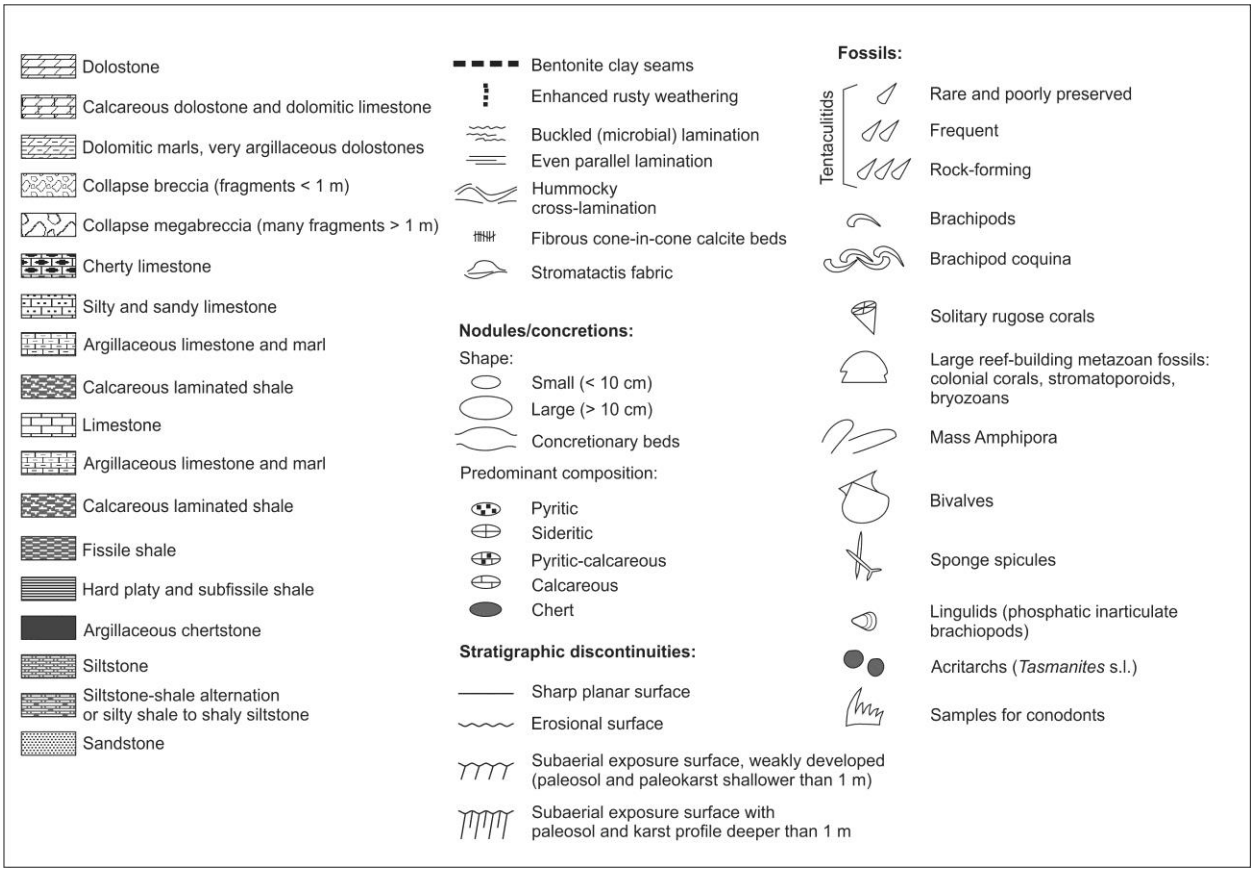

Figure 33. Litholog and SGR logs of the Rumbly Creek West Ridge and the legend for lithologs.

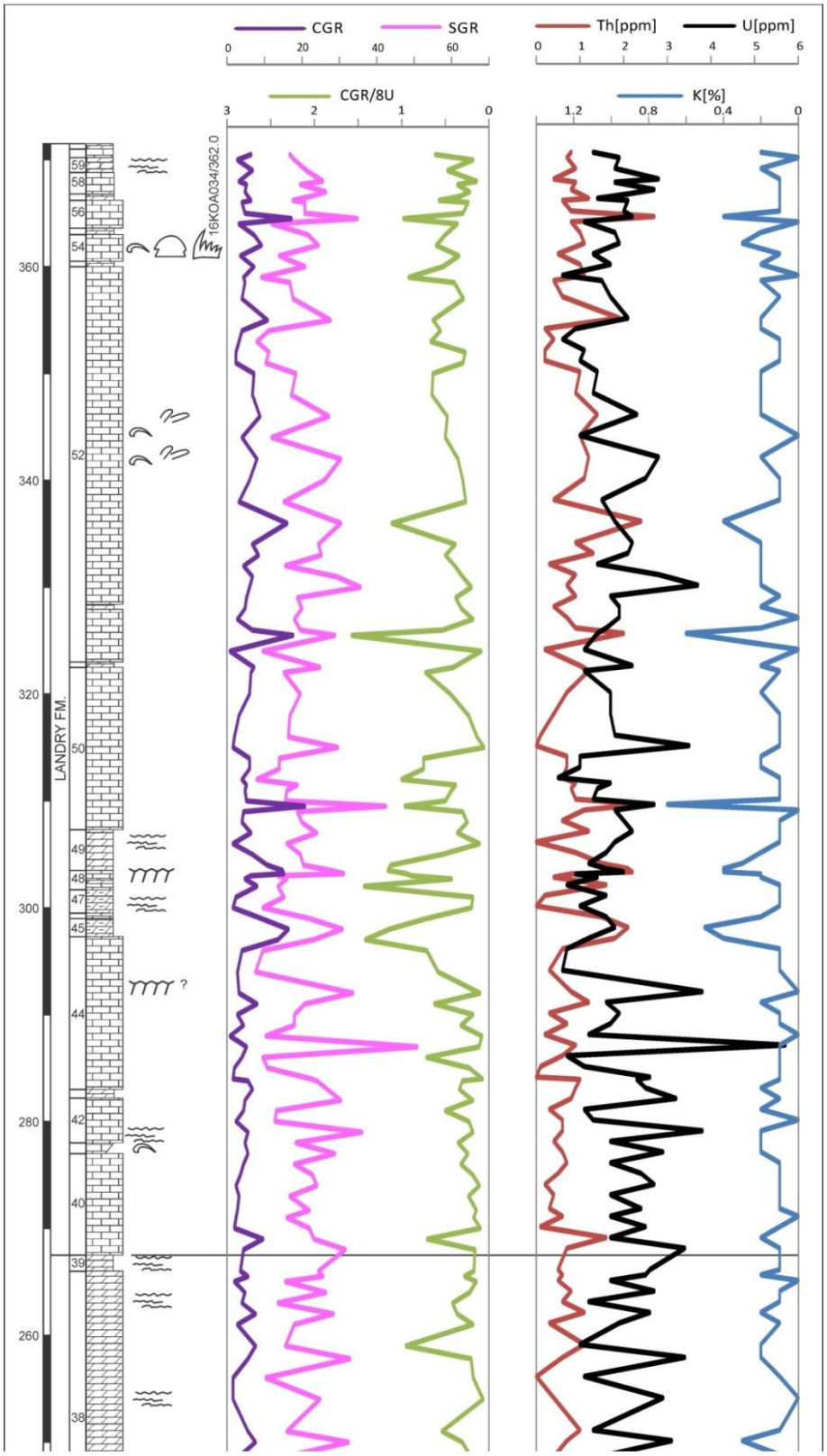

Figure 33 (continued). Litholog and SGR logs of the Rumbly Creek West Ridge and the legend for lithologs

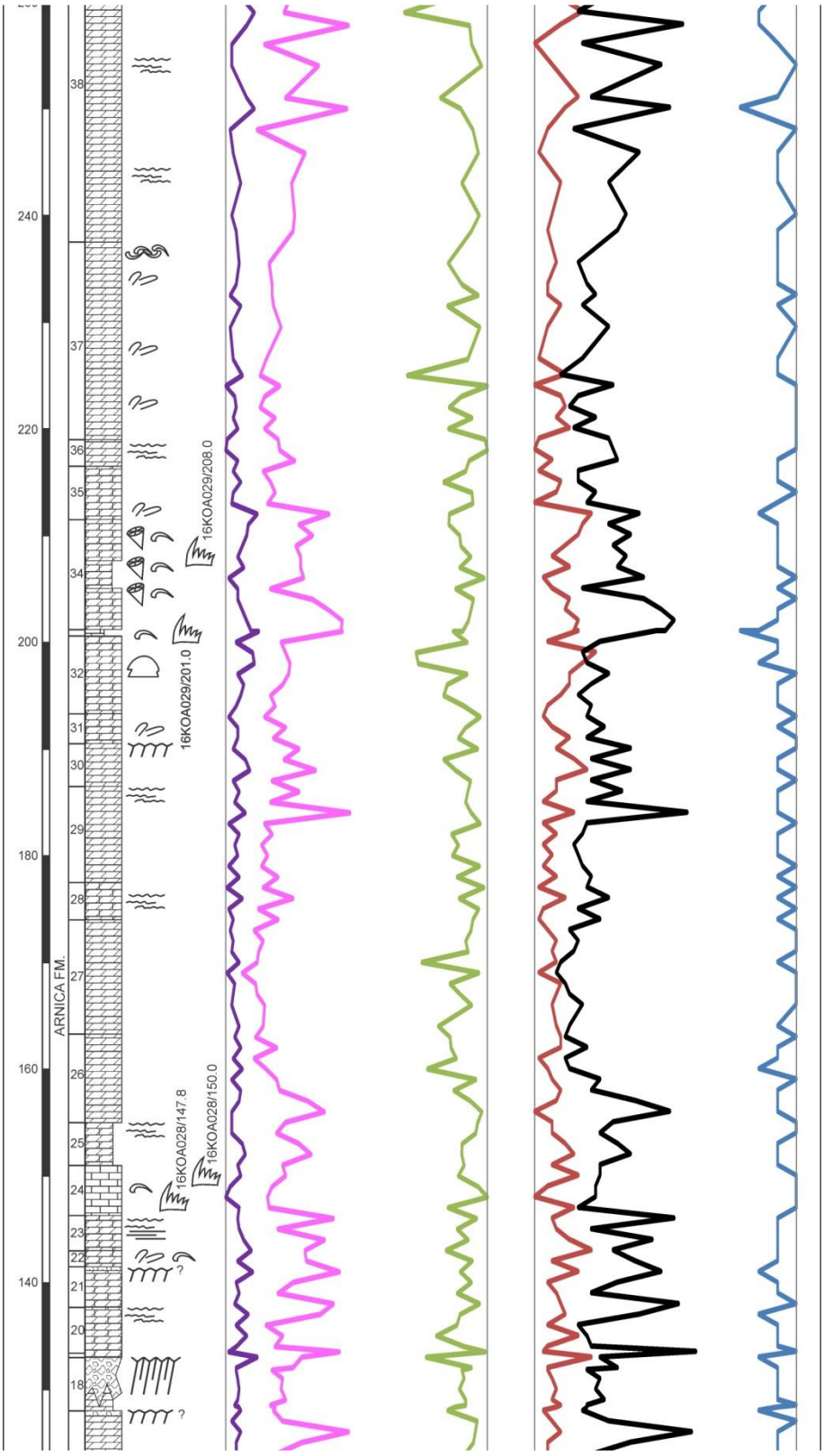

Figure 33 (continued). Litholog and SGR logs of the Rumbly Creek West Ridge and the legend for lithologs.

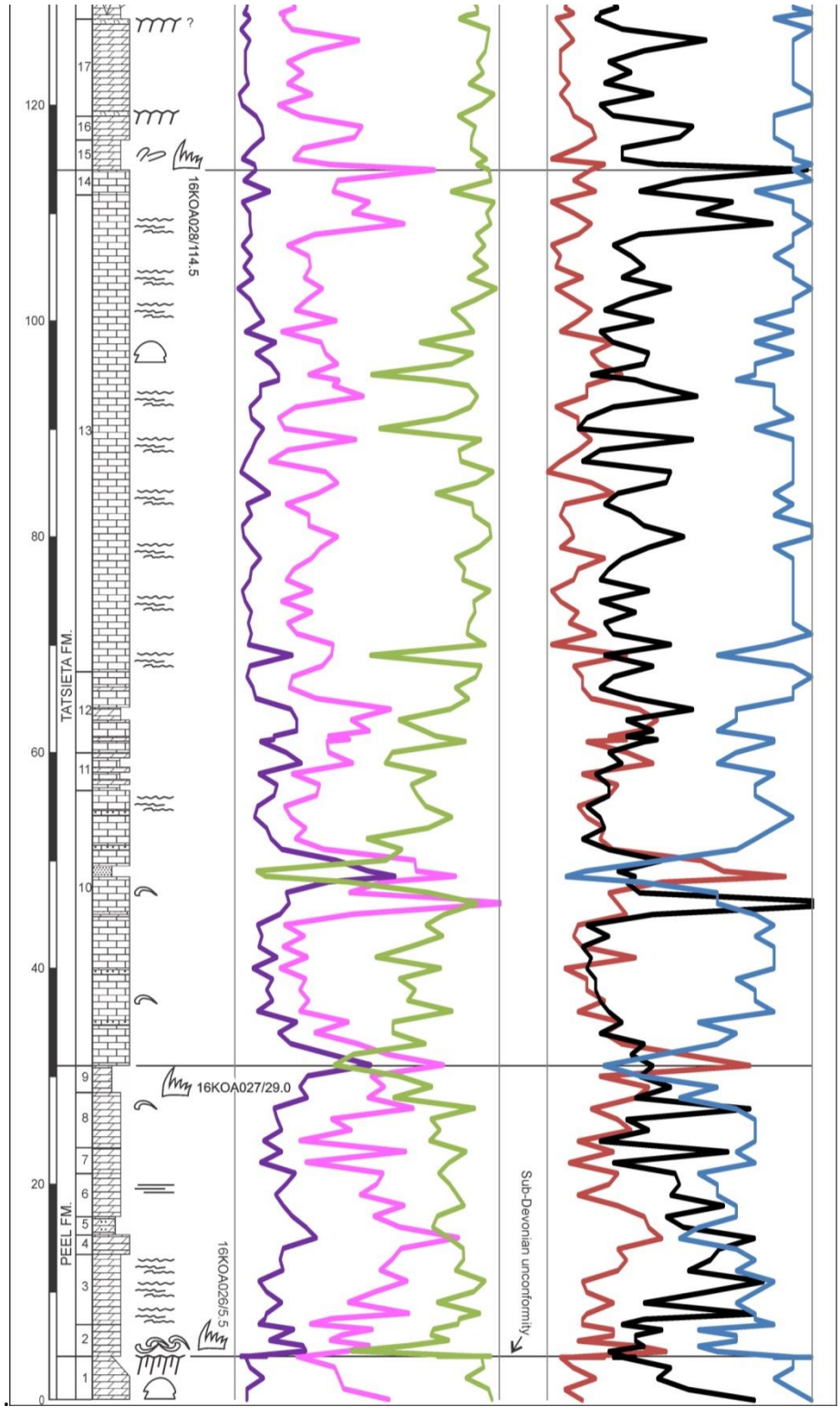

Figure 33 (continued). Litholog and SGR logs of the Rumbly Creek West Ridge and the legend for lithologs.

Powell Creek Lower Devonian

Base of section: 16KOA011	
DATUMZONE	NAD_1983_UTM_Zone_9N
ELEVATION	378.2
LATITUDE	65.270558
LONGITUDE	-128.779833
PDOP	7.7
SATS USED	4
VISITDATE	2016-07-19
Top of section: 16KOA016	
DATUMZONE	NAD_1983_UTM_Zone_9N
ELEVATION	350.6
LATITUDE	65.272985
LONGITUDE	-128.775398
PDOP	7.7
SATS USED	4
VISITDATE	2016-07-21

Zero datum at 1.6m below the top of unit 1.

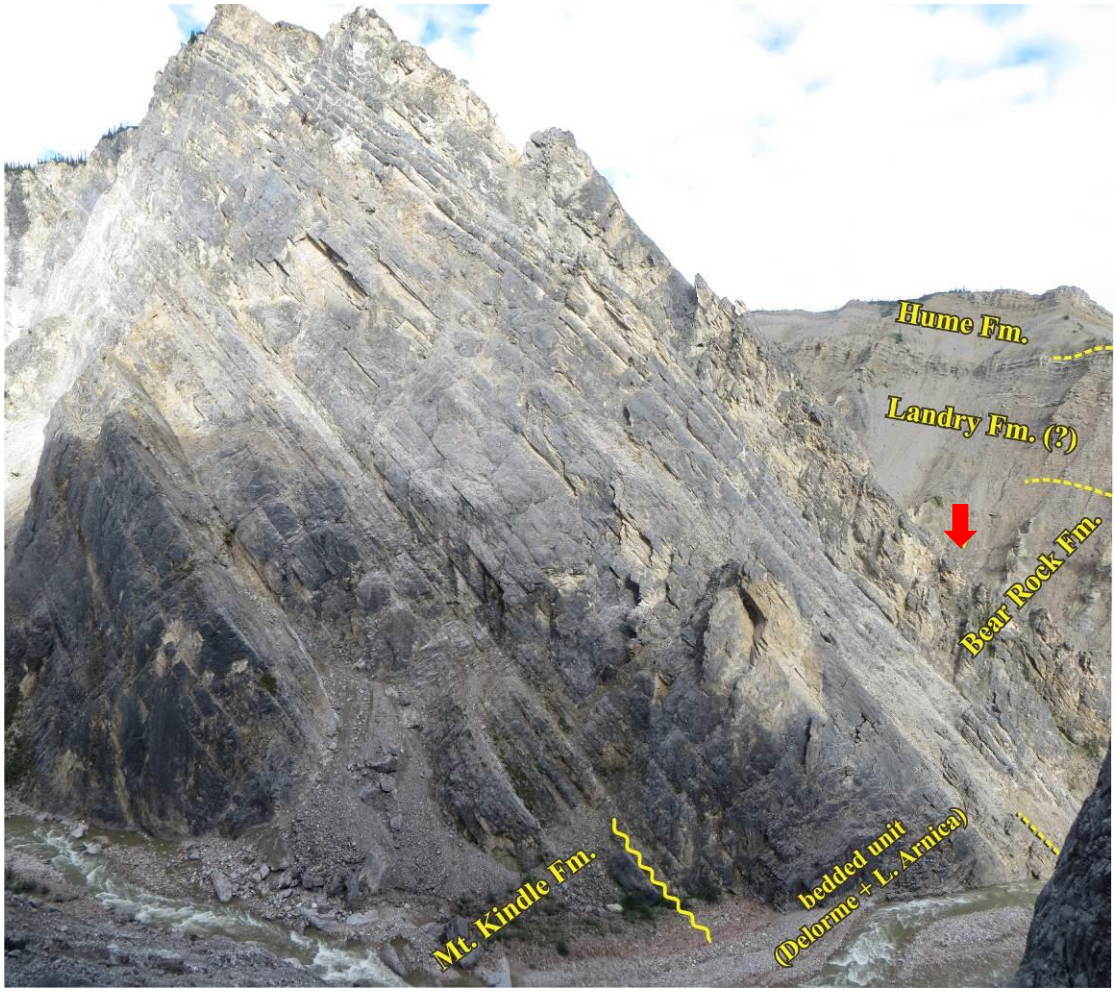

Figure 34. Stratigraphic units interpreted on the Western wall of the lower Powell Creek canyon opposite to the measured section. Sub-Devonian unconformity traced by wavy line. Arrow points at the gully formed by the recessive weathering of breccia of unit 29 (upper Bear Rock breccia).

MOUNT KINDLE FORMATION

The measured section starts high on the proluvial talus at Station 16KOA011 (Figure 35A) and is underlain by dolostones of Mt. Kindle Formation. Ten meters below the base of unit 1 are covered by the scree. The covered recessive interval (Figure 36A) may be composed of fragile (finely fractured) dolostone found in the scree rubble. Dolostone that is exposed stratigraphically below this covered interval is light brownish grey, non-calcareous, with curly or mottled fabric (Figure 35B).

Figure 35. (A) Up-scree view at the basal part of the measured section. Geologist in red circle for scale. (B) Curly fabric in Mt. Kindle dolostone in 10 m below the base of unit 1.

1. Dolostone: grey, thick to medium bedded, in basal part mottled and vuggy (vugs lined with white coarsely crystalline dolomite). The upper main part of the unit is massive, less mottled, and locally finely brecciated. Top is marked by a horizon of moderately recessive finely nodular dolostone (Figure 36B). Uncovered thickness 8 m. Top at 1.6 m.

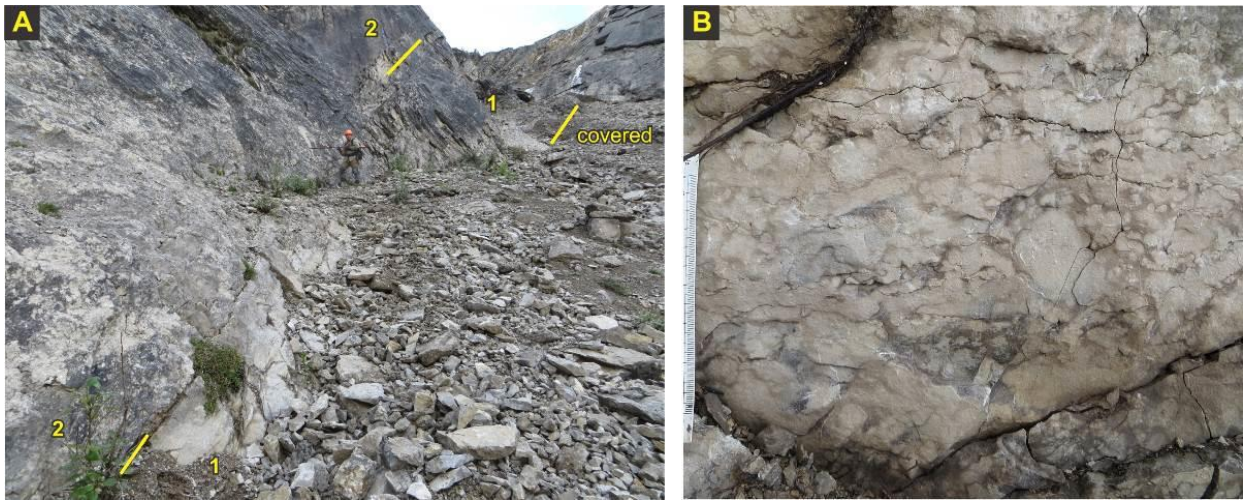

Figure 36. Mount Kindle Formation: (A) Up-scree view at units 1 and 2 with geologist (orange helmet) pointing at the contact; (B) Nodular dolostone at top of unit 1.

2. Dolostone: pale grey and tan grey, thick-bedded (0.2-1.0 m), massive and vaguely mottled, with stylolitized bedding planes, locally with poorly visible fine brecciation (Figure 37A). Top at 7.0 m.

3. Dolostone: thinner bedded than unit 2 (0.1-0.2 m) and slightly recessive, standing out by partly laminar mottling vaguely resembling stromatactis fabric (Figure 37B). Top at 7.8 m.

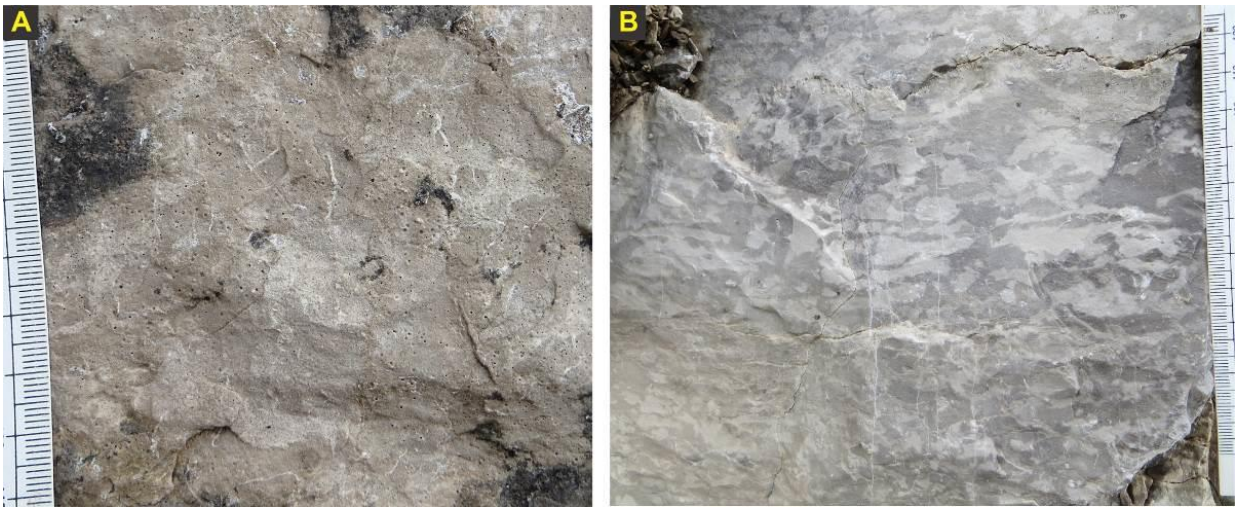

Figure 37. Mount Kindle Formation: (A) Fine brecciation in unit 2 at 6.5 m; (B) Mottling in unit 3; photos oriented stratigraphically upward.

4. Dolostone: grey, hard, massive, very thick-bedded, mottled (darker colored tight finer crystalline mottles and paler colored intermottles of coarser crystalline dolomite). Top is picked on gradation to non-bedded and non-mottled dolostone. Top at 13.0 m.

5. Dolostone: massive, non-bedded, hard and wall forming, with locally preserved domal stromatoporoids. Top at 17.8 m.

6. Dolostone: tan colored, very thick-bedded, vuggy, with rough vug walls. Some vugs are large (> 10 cm) and retain the domal shape of stromatoporoids. The rock is weakly brecciated, locally faintly mottled. A vuggy (karstified) shell bed with patchy black chertification at 23.0 m. This bed is traceable over the distance of at least 20 m. The upper 2.0 m is massive, with small vugs. Top at 25.0 m.

7. Dolostone: basal part is massive, grades upward into a medium-bedded dolostone with zebra fabric and buckled laminar features. In the upper half of the unit, it grades into fine pack- to floatbreccia with rounded clasts and pale yellow to greenish matrix, indicating development of a paleosol (also described as an upper part of vadose dissolution profile). The upper 5-8 cm of unit 7 are a hard resistant bed with finely brecciated fabric detected only with hand lens (floatbreccia with argillaceous patches). Top stylolitized, at 27.9 m.

The top of unit 7 is matched to the top of Mount Kindle Formation.

Figure 38. Mount Kindle Formation: (A-D) Vugs in dolostone of unit 6; note that vug on (B) retains the shape of a domal fossil; (D) is a karstified macrofossil bed; fossils (arrowed) are mostly pentamerid brachiopods. (E) Stromatoporoid preserved with skeletal structure in unit 5. (D and E) are oriented stratigraphically upward.

Figure 39. Lower part of unit 7 with zebra fabric; (B) close-up of (A) looks stratigraphically upward.

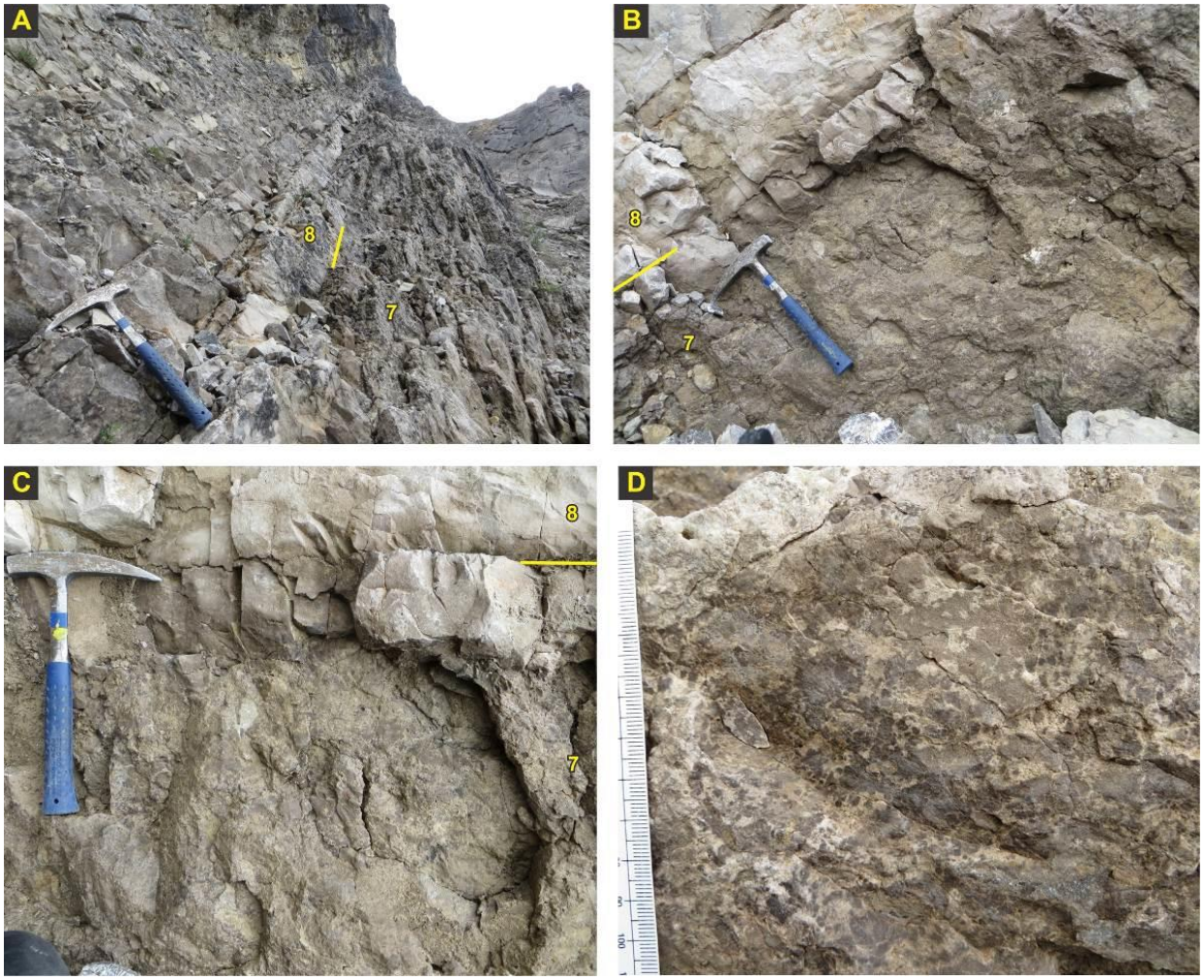

Figure 40. Successive close-ups at the Mount Kindle - Delorme contact. (C) Note a massive tight bed just under the stylolitized top of unit 7. (D) Detail of fine breccia in upper 30 cm of unit 7.

DELORME – LOWER ARNICA INTERVAL

8. Dolostone: thin bedded (2-20 cm), moderately recessive, weathering pinkish to yellowish grey. In lower 0.5 m preserves ripped-up lamination with small teepee structures. In the rest of the unit the dolostone is massive, very finely crystalline, non-fossiliferous, with conchoid fracturing on upright surfaces. Top at 31.0 m.

9. Dolostone: brownish grey, thick bedded, massive and fractured, tight, very finely crystalline. Top at 33.2 m.

10. Dolostone: dull tan color, medium to thick bedded, with stromatolites. Top at 33.8 m.

11. Dolostone: brownish grey, massive, resistant, thick-bedded, fractured, with rare shell biomolds. Disrupted lamination at top. Top at 40.6 m.

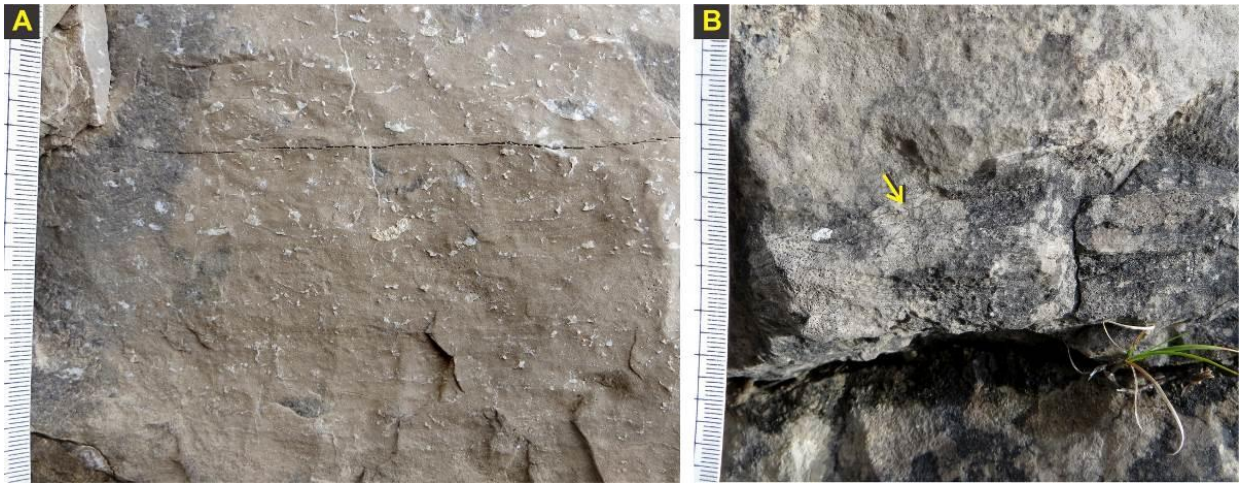

Figure 41. Delorme facies: (A) Unit 8 with white birds-eye fenestrae and poorly seen buckled lamination disrupted by desiccation cracks; (B) Stromatolite (arrowed) in unit 10.

12. Dolostone: brownish grey, massive, very thick-bedded (1.5-2.0 m), with traceable brachiopod coquinas and thin poorly laminated horizons. Conodont sample 16KOA011/42.0-43.0. The upper 2.0 m is massive. Top at 47.2 m.

Figure 42. Brachiopod coquinas in unit 12.

13. Dolostone: brownish grey, hard, finely crystalline, with fine laminar facies in about one half of the interval. Rare syndepositionally folded lamination that could result from slumping. Lenses of biogenic structures occur in less laminated to non-laminated intervals of this unit – possible banks of *in-situ* fenestellid bryozoans (hard to confirm since skeletal structure is obliterated by dolomitization). Top at 50.0 m.

14. Dolostone: tan colored, thick bedded (0.5-2.0 m) to non-bedded; in lower one-half massive, microcrystalline, with patches of vuggy dolostone; the upper one-half is one very thick bed of intensely jointed finely to medium crystalline dolostone; Top at 66.0 m.

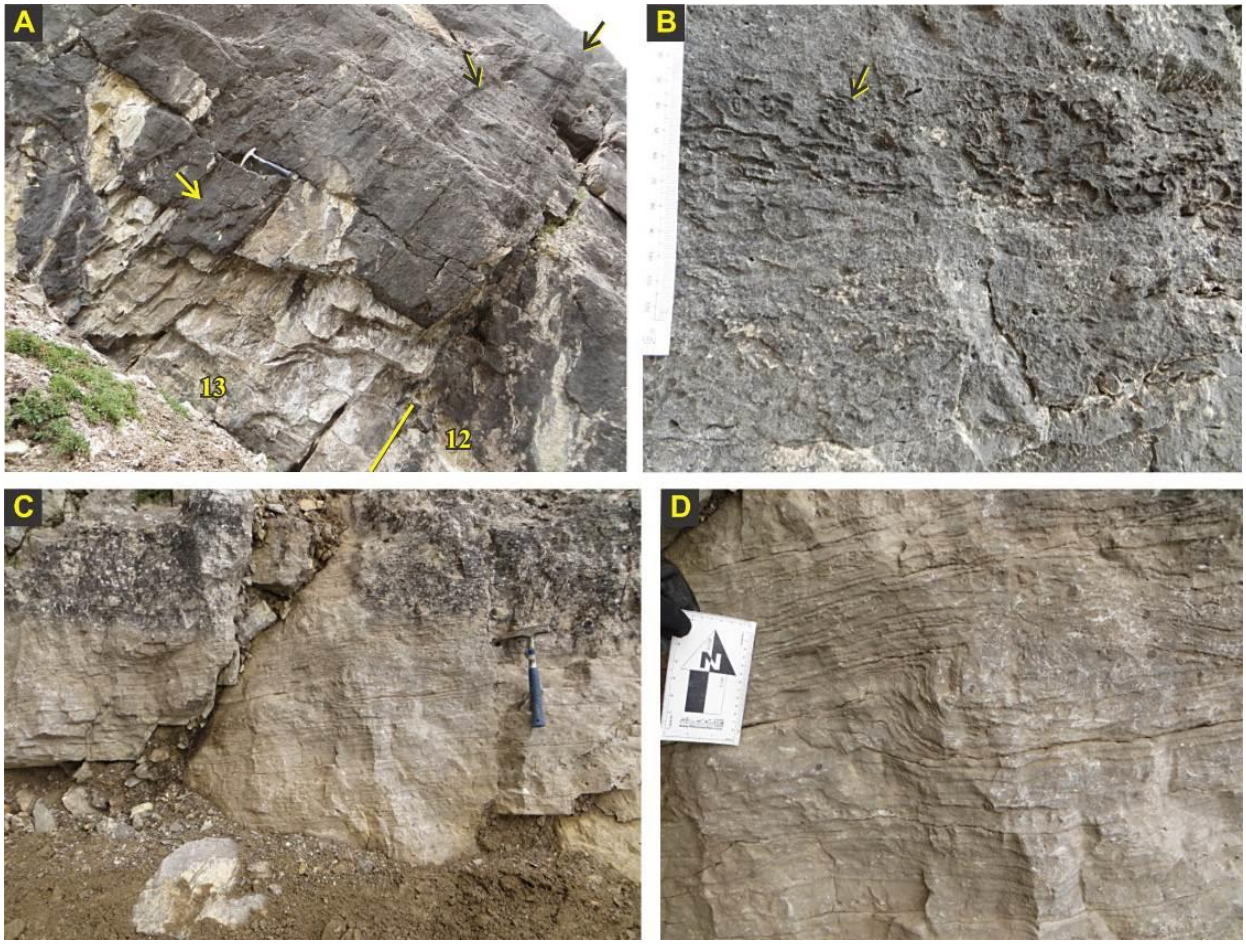

Figure 43. Unit 13: (A) outcrop view, laminar horizon at yellow arrow and fenestellid(?) lenses are black arrows; (B-D) close-ups: (B) at a fenestellid(?) lens; (C and D) at one of the laminar horizons with detail of a folded structure (D).

15. Dolostone: tan color, massive, thick-bedded (0.3-1.0 m), finely crystalline and homogeneous, distinct by large (1-10 cm) voids partially filled with white calcite spar. Walls and floors of these voids are lined with at least one layer of white isopachous sparry calcite. Intermixed floorings of isopachous calcite and brownish dolomite were observed, indicating syndepositional formation of isopachous cement. Interpretation: *Stromatactis* fabric (small forms with relatively simple structure). In the upper part many voids do not preserve linings of white calcite. Top at 69.9 m.

16. Dolostone: thick-bedded, mottled (bioturbation or polymud fabric like in Waulsortian facies), with a lacy network of chert and some elliptical nodules of chert. Top at 70.9 m.

17. Dolostone: thick-bedded, mottled (bioturbation?), with undulating and laterally fading bedding planes and vuggy horizons. Mottling fades out in the upper half. Common poorly preserved macrofossils, mostly as biomolds: coiled forms (cephalopods or gastropods), rare tabulate corals. Top at 78.0 m. Conodont samples 16KOA011/72.4 and 16KOA011/77.4.

18. Dolostone: brownish grey to neutral grey, medium bedded, partly mottled, with a nodular pressure-solution horizon at 80.5 m, with chains of vugs (probably solution-enlarged fenestrae) in the upper part. These vugs are floored with bluish siliceous and/or argillaceous dolostone. Top at 87.0 m.

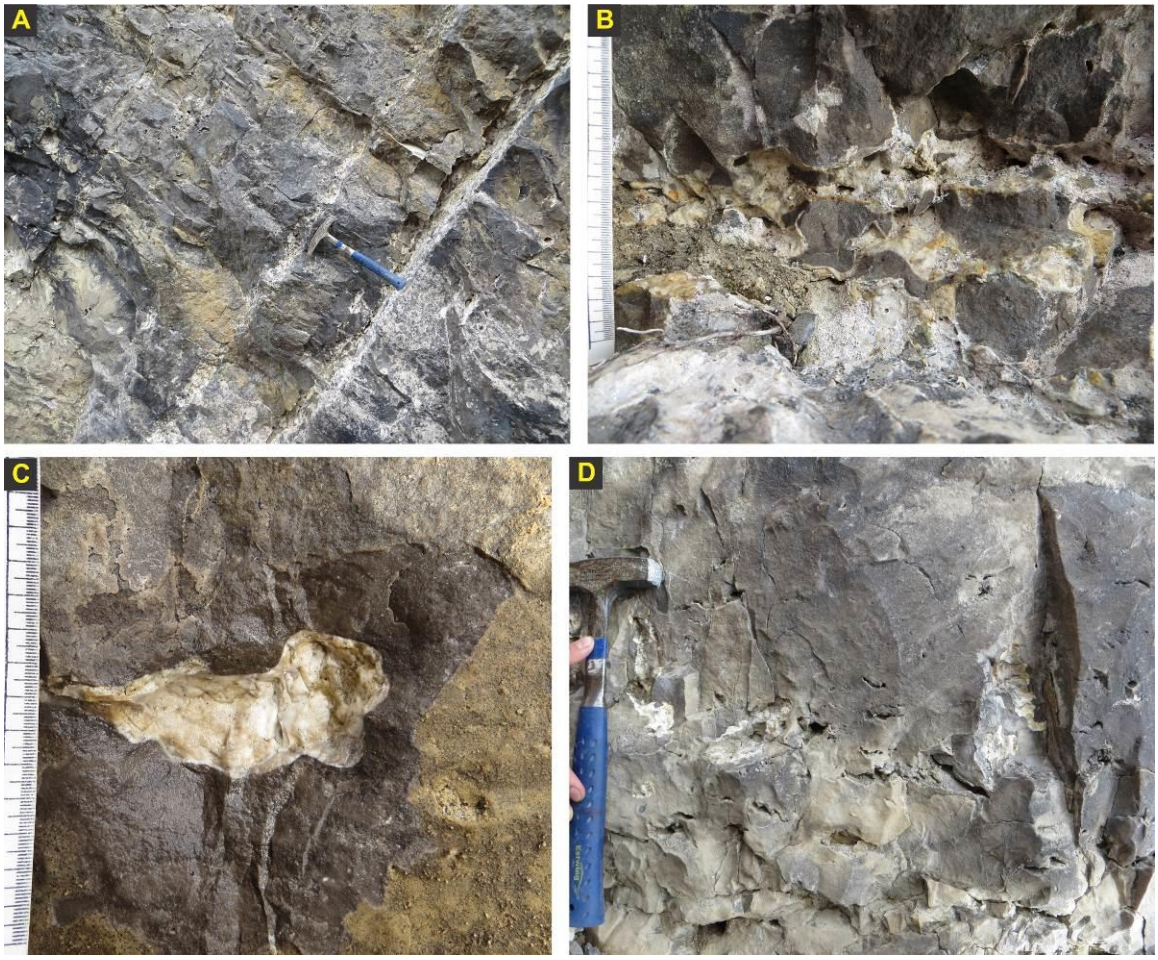

Figure 44. Unit 15: (A) Outcrop view with two main Stromatactis horizons at the upper and the lower end of the hammer; (B) Detail of the upper main horizon from (A); (C) A smaller Stromatactis filled with white calcite; (D) upper part of unit 15 with only few Stromatactis voids lined with white sparry calcite.

Figure 45. Unit 16: (A) Lacy chertification (arrowed); (B) mottling with its location indicated by red square and black arrow on (A).

Figure 46. Poorly preserved macrofossils in unit 17: (A) Unidentified biomolds; (B) Goniatite or bellerophontid gastropod; (C) Favositid coral.

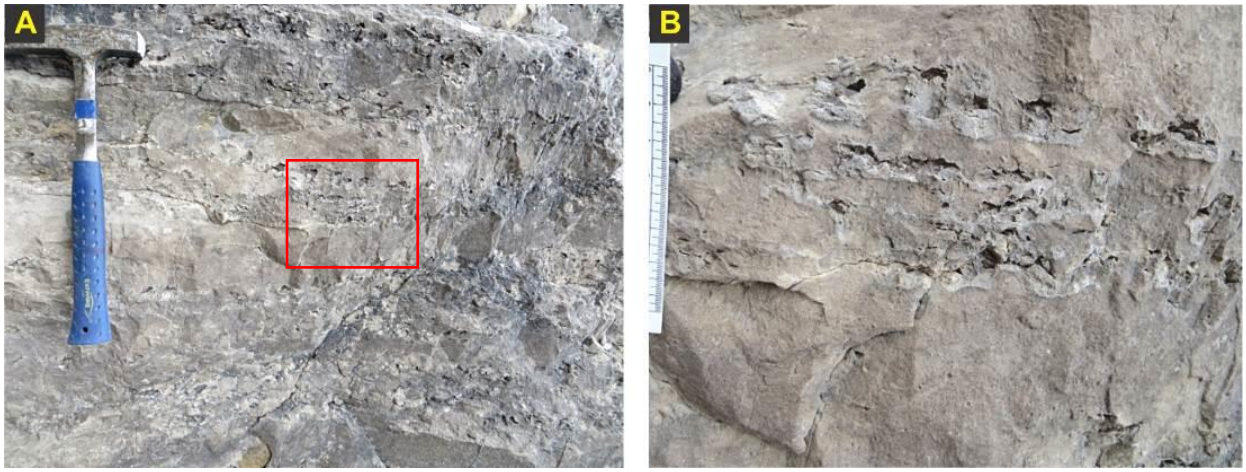

Figure 47. Vuggy upper part of unit 18; closer view on (B) shows geopetal deposits in vugs composed of bluish argillaceous dolomite.

19. Dolostone: light grey to tan color, hard, monolithic, massive, non-fossiliferous, pelitomorphic to medium crystalline. Top at 87.7 m.

The upper part of unit 20 and the unit 21 form a recessive interval traceable on both walls of the canyon.

20. Dolostone: very pale grey, medium-bedded (0.1-0.2 m), moderately recessive, medium crystalline sucrosic. Non-disturbed microlamination emerges locally on etched surfaces. The top is sharp, undulating, erosional, ferruginized and blanketed by thin green shale; rare small solution pockets are filled with similar dolomitic shale (claystone) containing crumbles of dissolved carbonate rock. Thin (5-7 cm) bluish vuggy dolostone is locally present right below the top of unit 20. Top at 89.0 m.

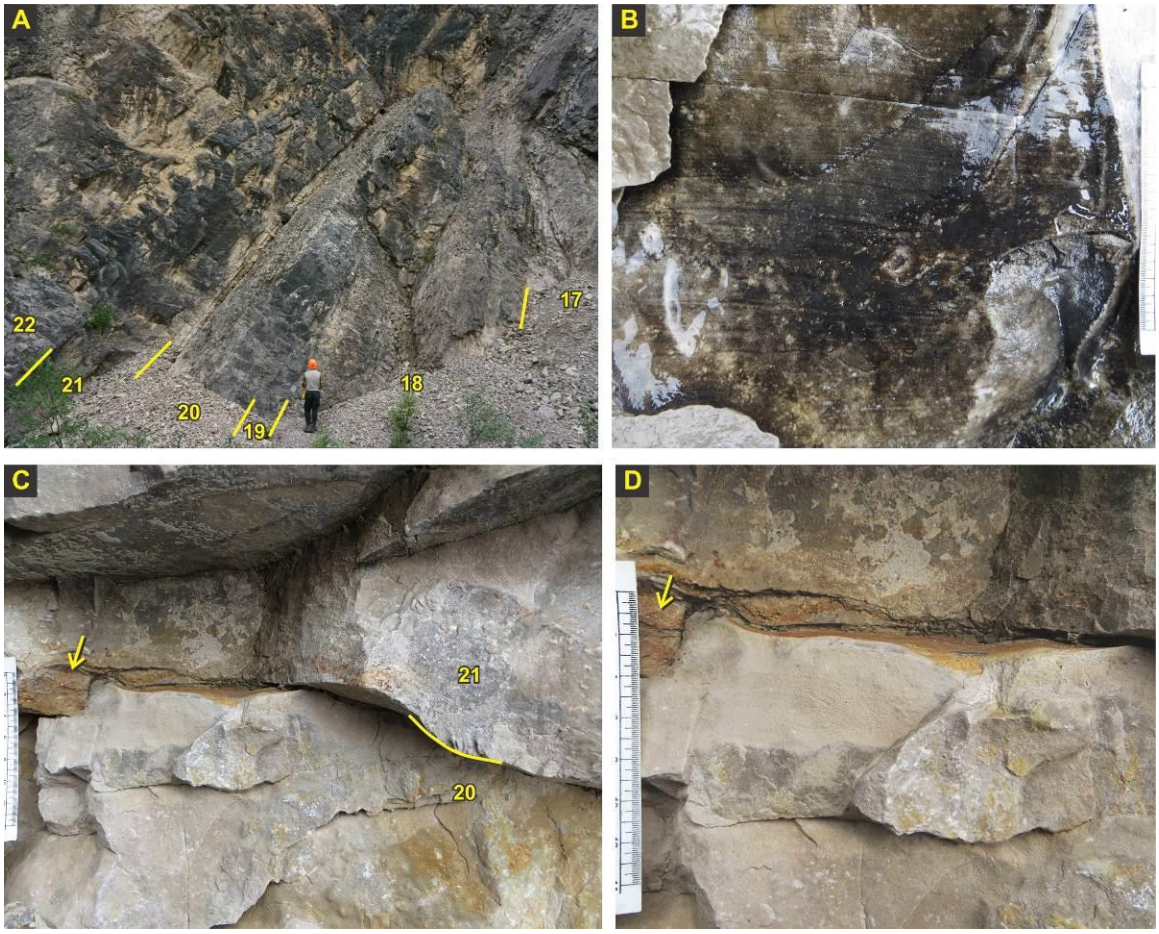

Figure 48. Units 17-21: (A) Interpreted units with one of authors for scale; (B) Lamination on the lichenized upright surface of unit 20; (C and D) Disconformable contact between units 20 and 21 at different distances from the camera; small claystone-filled solution pocket is arrowed.

BEAR ROCK FORMATION

21. Dolostone: thin-bedded in basal part (0.1-0.15 m) to medium bedded (0.2 m) in upper major part; retains fine lamination with meter-scale wavy undulations - probably stromatolites; horizons of small-scale rip-up breccias; Small-pebble (≤ 0.5 cm) conglomerate in basal 2-5 cm. Top sharp, stylolitic. Top at 90.6 m.

22. Dolostone: tan color, medium-bedded (0.1-0.3 m), 90% laminated; basal 1.2 m distinctly stromatolitic. Top at 98.0 m.

23. Dolostone: very pale grey, recessive, with rusty bedding planes, similar to bed 20; retains buckled microbial lamination. Top undulating, with thin (< 0.5 cm) coatings of greenish shale and shaly dolostone. Top at 99.2 m.

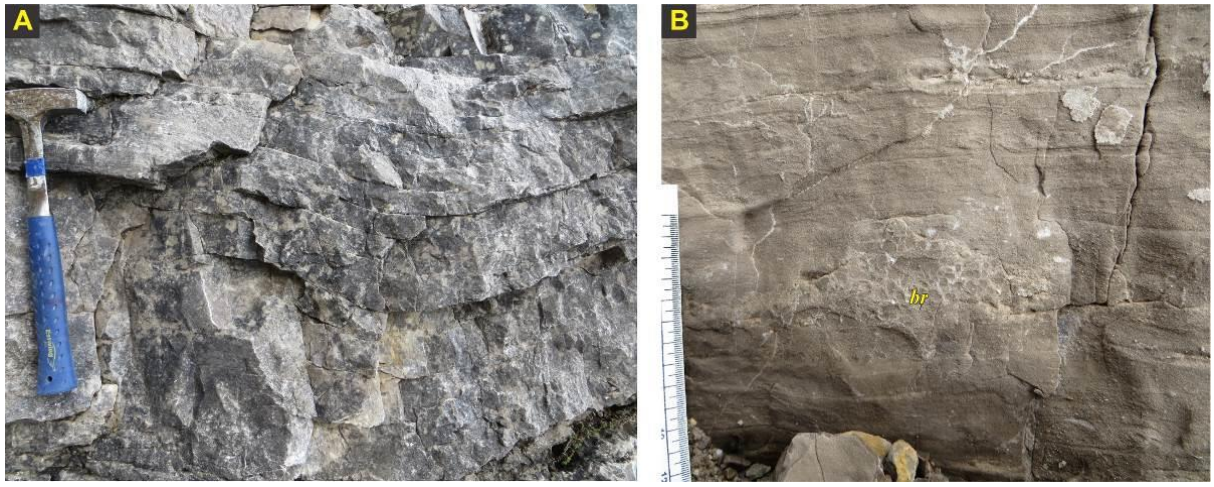

Figure 49. Unit 21: (A) meter-scale wavy undulations in sedimentary lamination; (B) Detail of lamination and the swelling and pinching brecciated horizon (*br*).

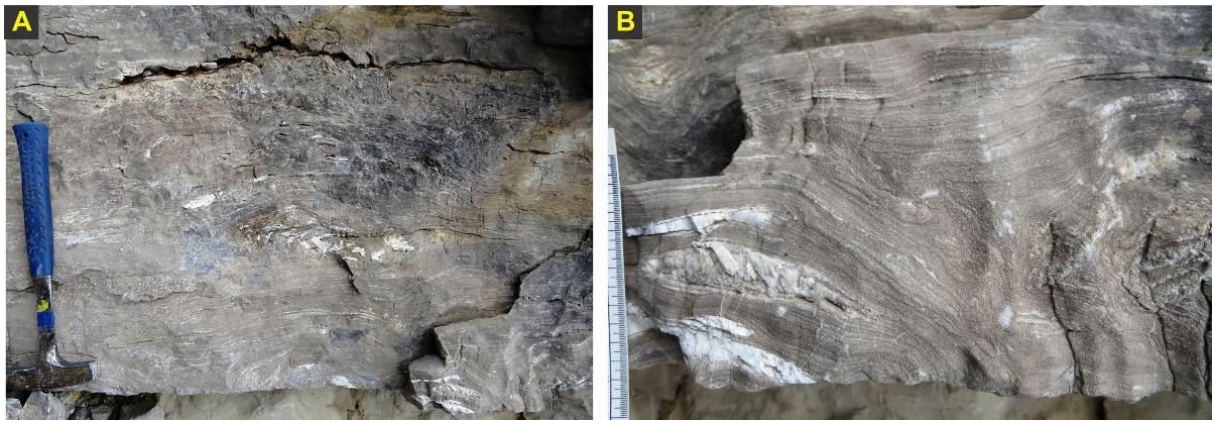

Figure 50. Stromatolitic basal part of unit 22.

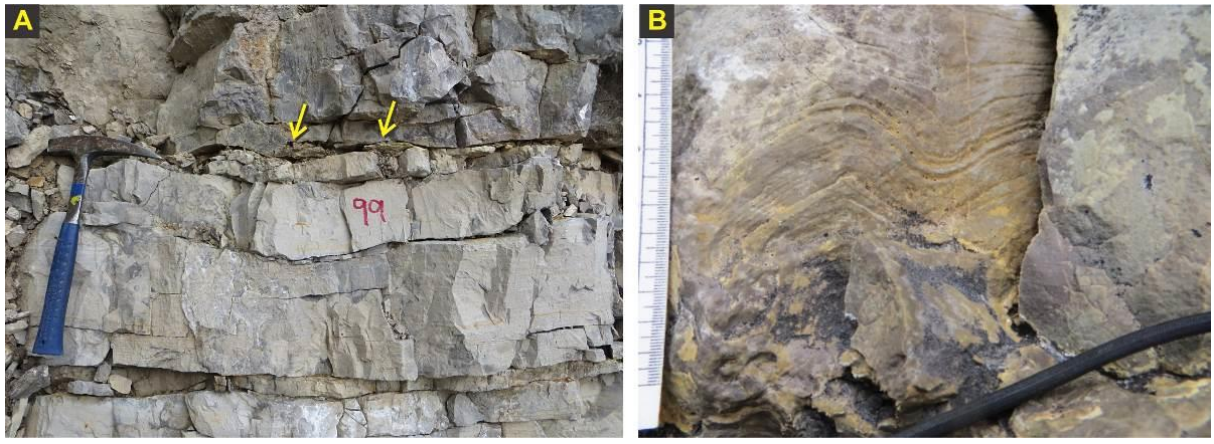

Figure 51. (A) Contact of units 23 and 24; note thin shale at the contact (arrowed). (B) Stromatolite texture in fractured dolostone of unit 24.

24. Dolostone: brown and brownish grey, well-bedded (beds 0.1-0.4 m thick), with gently buckled lamination; low stromatolitic domes are common. The unit shows minor decameter-scale brecciation (rudimentary megabreccia). Here megabreccia refers to coarse breccia fabrics with many clasts over 1 m in size. Top at 109.0 m.

25. Dolostone breccia: brown-colored well-cemented collapse breccia (packbreccia) with different-sized fragments; some fragments exceed 1 m in linear size (megabreccia); fractured, with black coatings on fracture planes (manganese staining?) and extensive rusty crusts on fragment surfaces; bedding is locally preserved in displaced position. Top at 121.0 m.

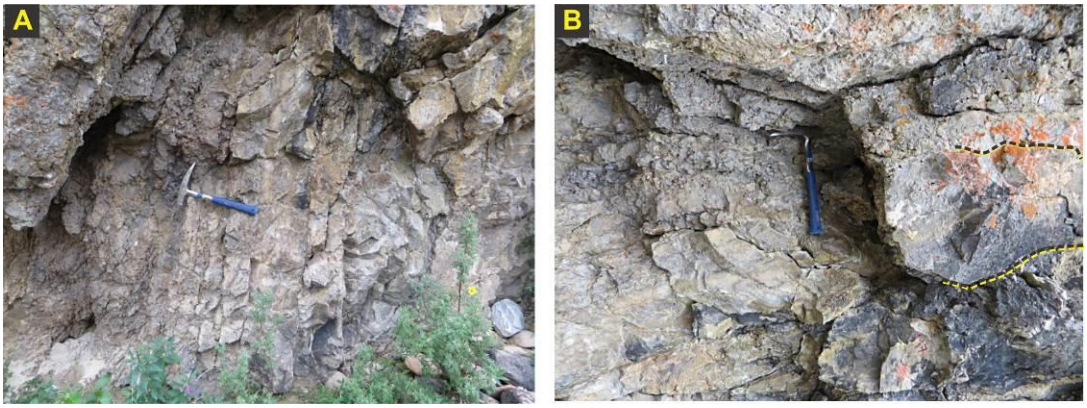

Figure 52. Breccia of unit 25: (A) outcrop view with partly preserved bedding; (B) Close-up with one cobble partly traced from the right edge.

26. Dolostone: light tan color, thin-bedded (5-15 cm), intensely jointed. Lamination is rarely present; sedimentary texture with crinoid ossicles and diverse bioclasts, probably bioturbated. Only lower 3.0 m of unit 26 is exposed on creek-facing canyon wall. Conodont samples 16KOA012/121.2 and 16KOA012/122.6. At 124.5 m (station 16KOA012), the canyon wall recedes in a gully with 26.5 m of bedrock section covered by a rubbly proluvial talus (Figure 53). The mirroring gully is developed on the other side of Powell Creek (arrowed on Figure 34). Units 26-28 and the base of unit 29 were traversed along the southern edge of the talus between stations 16KOA012 and 16KOA015. This traverse goes along bedding planes of units 27 and 28, which impedes accurate thickness measurements. Continuous stratigraphic section was accessed in the narrow head of the talus at the station 16KOA015 and immediately above it.

As seen along the talus edge, the upper portion of unit 26 shows gradation from non-laminated to vaguely laminated facies and contains breccia patches. Estimated top at 126.0 m. Conodont sample 16KOA013/126. Bed dip: 52/282

27. Dolostone: light grey at base and brown in main upper part, thin to medium bedded (0.05-0.4 m), probably sandy (sand admixture in some beds), with even parallel lamination. No buckled microbial or desiccation features. No fossils or bioclasts. Alternation of vuggy and tight laminated dolostones in the upper part. Estimated top at 128.0 m.

28. Dolostone: tan color, weathers yellow to pink, thin-bedded (0.03-0.1 m), recessive. Different from unit 27 by massive medium-crystalline texture and rusty coatings on bedding planes. A rippled bedding plane was observed at the stratigraphic level of unit 28. Contact with breccia of unit 29 is sharp; local breccia is developed deep into unit 28 and probably underlying beds. Estimated top at 129.0 m.

Figure 53. Contact between units 25 and 26, talus, the upper resistant cliff-forming part of unit 29 on the background. One of authors for scale.

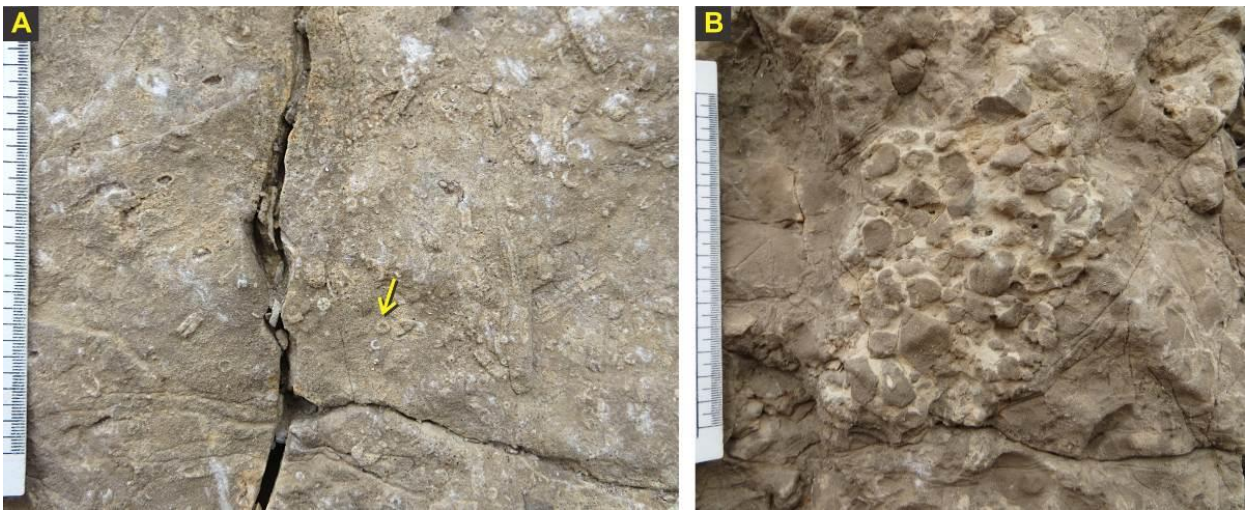

Figure 54. Bedding planes in unit 26: (A) diverse bioclasts, notably crinoid ossicles (one is arrowed); (B) Breccia patch.

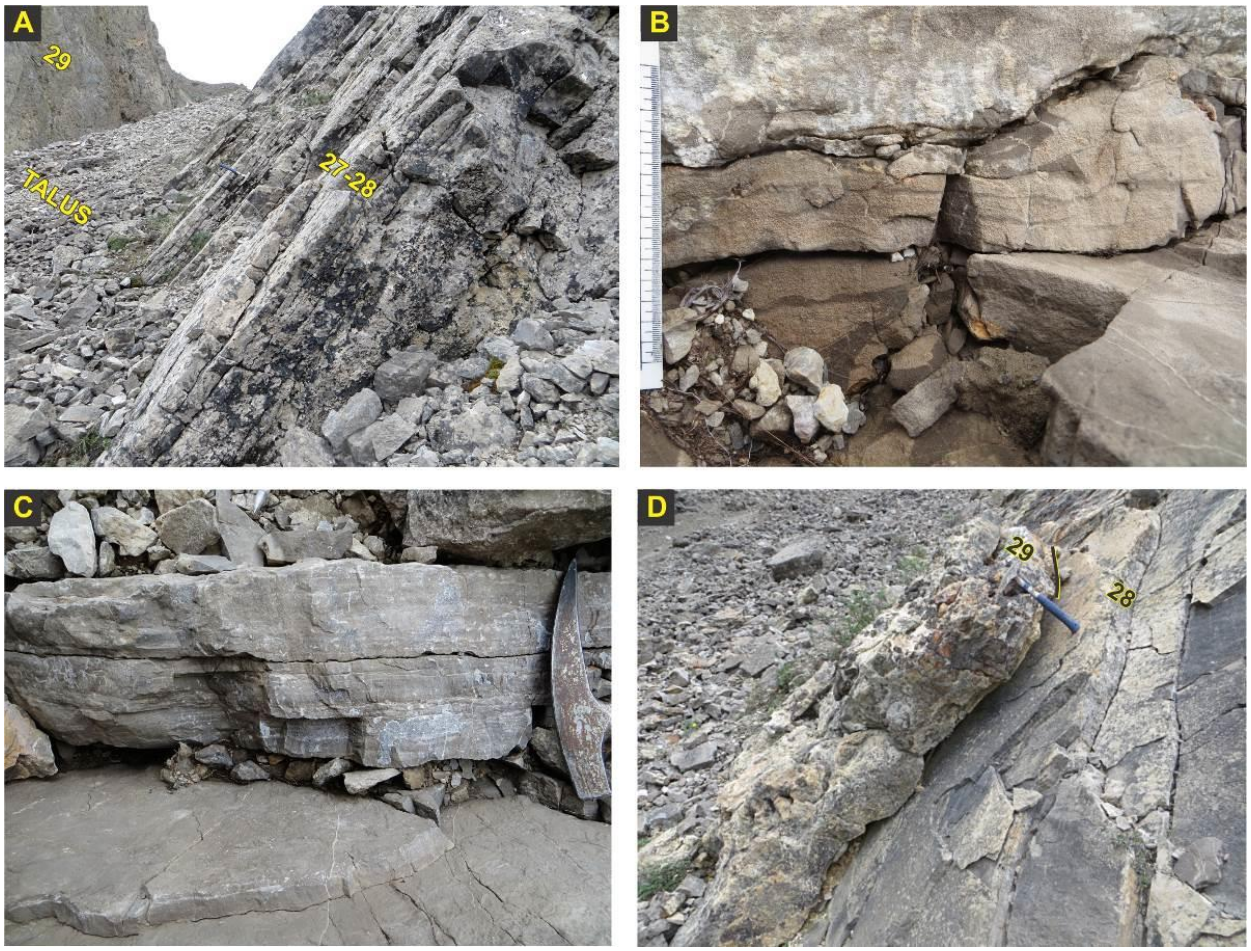

Figure 55. Units 27-28 between stations 16KOA014 and 16KOA015: (A) Thin bedding in 27-28; note the resistant upper part of unit 29 behind the talus; (B) lamination in a sandy dolostone bed of unit 27; (C) even lamination in unit 27; (B and C) are oriented stratigraphically upward. (D) A knob of breccia (unit 29) in contact with unit 28.

29. Collapse breccia: the basal 0.4-0.6 m is exposed as knobs (small outliers) on top of the thin-bedded unit 28 around station 16KOA015. There it is composed of variously dissolved and chertified rubbles (clasts) of microcrystalline dolomitic limestone and dolostone with thin buckled lamination. Clasts are chaotically lumped in a matrix of soft yellowish and light green argillaceous dolostone. The base is sharp, with only few local brecciation features penetrating into underlying units (Figures 55D and 23B).

The most receded interval above basal knobs is composed of very poorly cemented to non-cemented breccia that produced most of the rubble in the talus. Estimated thickness of this poorly cemented basal part of unit 29 is 10-12 m. Transition to the overlying wall-forming megabreccia is gradational.

The resistant upper part of unit 29 was measured on a creek-facing cliff. (Figure 57).

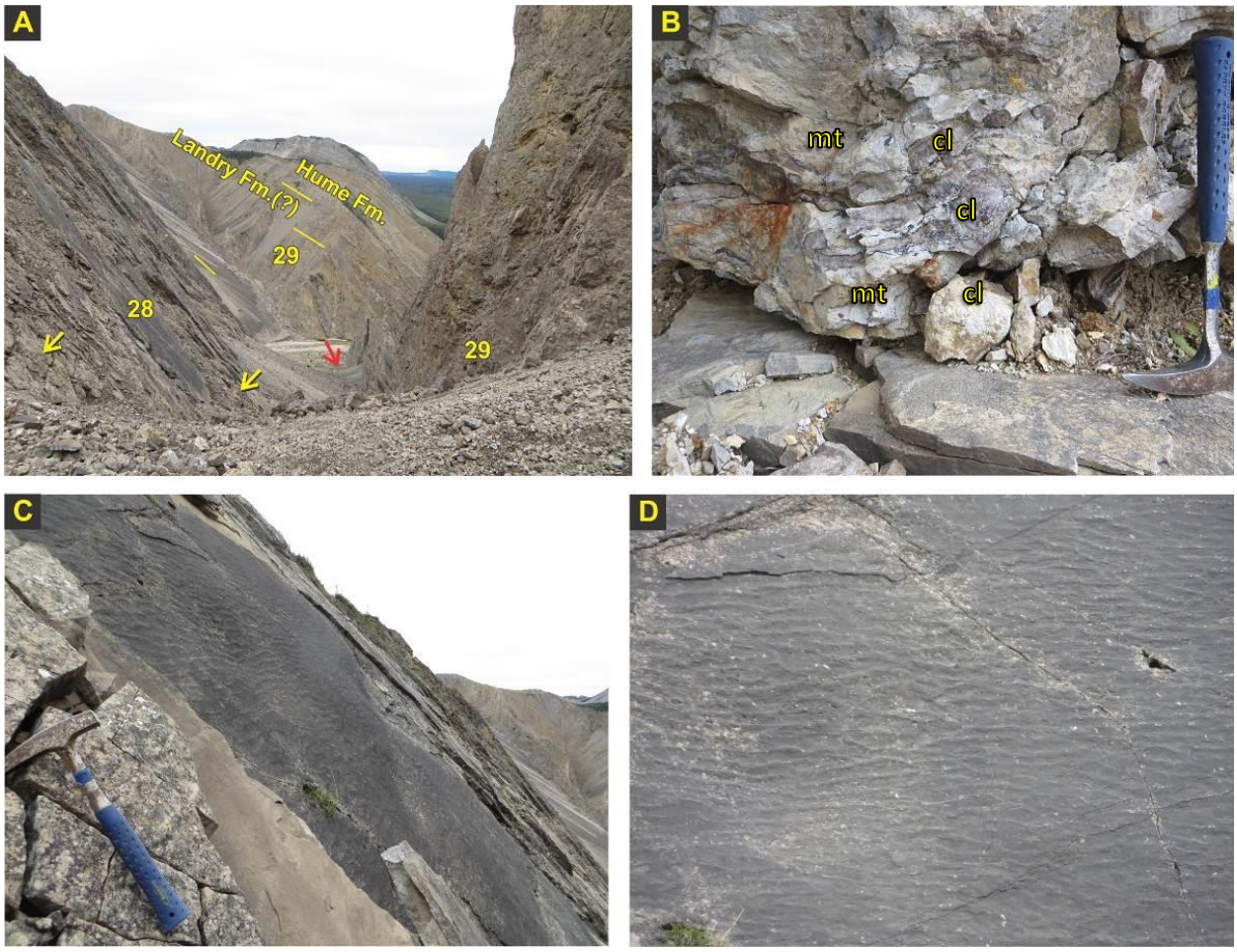

Figure 56. Contact of units 28 and 29 at 16KOA015: (A) Northwesterly view at the mirroring gully and the Landry-Hume section on the other side of the creek; knobs of breccia on top of unit 28 are yellow-arrowed; fly camp site is indicated with red arrow; (B) Detail of contact in one of arrowed knobs, oriented stratigraphically upward, *(cl)* are limestone and dolostone clasts, (mt) is greenish marly matrix; (C) Rippled bedding plane in the upper part of unit 28 zoomed-in on (D).

29 (upper resistant part of the unit) Collapse megabreccia: chaotic rubble with fragments far exceeding 1 m in size (Figures 57B and 57C), cemented by marly pelitomorphic limestone (marlstone) and dolomite. Clast composition ranges from clean limestone and dolostone to brown-colored dolomitic marl expelling odor when crushed. Fossils are absent. Limestone fragments are usually recrystallized with loss of sedimentary fabric. The cliff is extensively caved from the dissolution and crumbling of less cemented breccia patches. Near the left edge of the cliff, the upper 2 m are less brecciated and composed of densely fractured pale colored crystalline (sucrosic) limestone. Top at 221.0 m (end of outcrop).

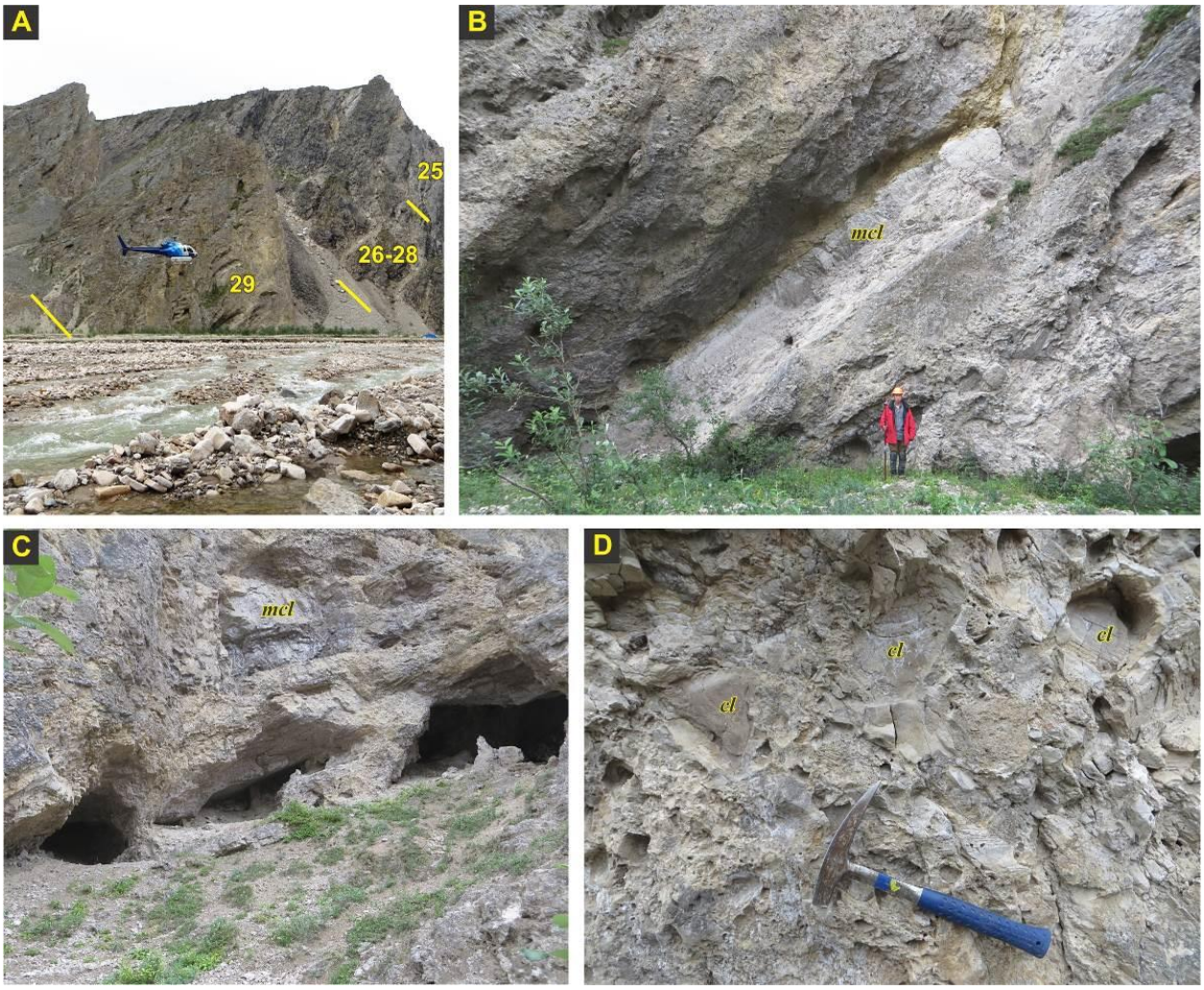

Figure 57. Upper Bear Rock megabreccia (unit 29): (A) Southeasterly view on a cliff of resistant megabreccia; note that base and top are covered; (B and C) Cliff face views with examples of megaclasts (*mcl*) and caves; (D) Close-up at chaotic breccia fabric with angular clasts (*cl*).

Measured section stops at the left (northern) end of the cliff (station 16KOA016).

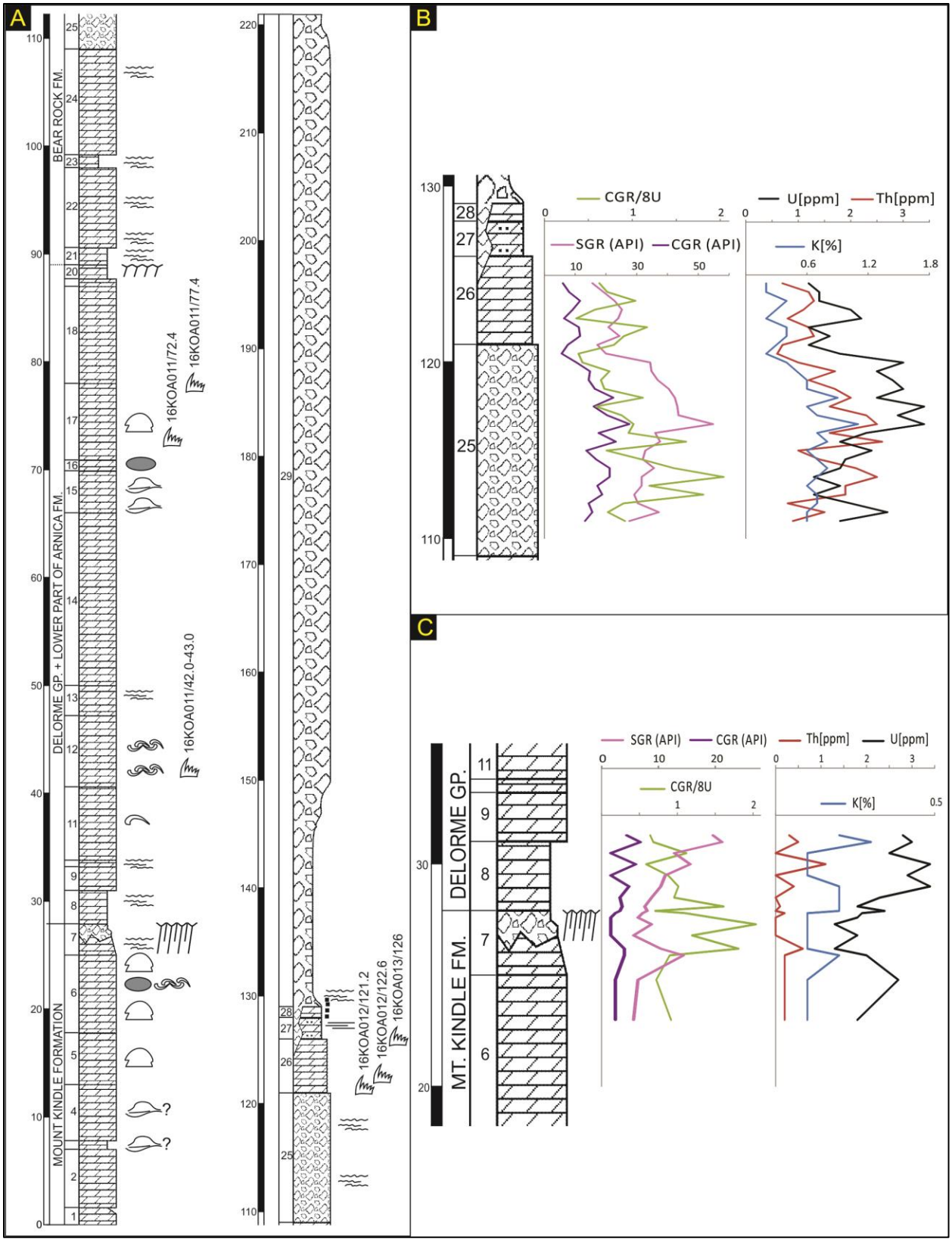

Figure 58. Powell Creek Lower Devonian section: (A) Litholog; (B) SGR logs in units 25-26; (C) SGR logs across the sub-Devonian unconformity. See Figure 33 for legend.

Powell Creek Landry-Hume

Left bank of Powell Creek across the creek from the fly camp

Base of section: 16KOA017	
DATUMZONE	NAD_1983_UTM_Zone_9N
ELEVATION	354.2
LATITUDE	65.273493
LONGITUDE	-128.778242
PDOP	3
SATS USED	7
VISITDATE	2016-07-21
Top of section: 16KOA018	
DATUMZONE	NAD_1983_UTM_Zone_9N
ELEVATION	352
LATITUDE	65.274623
LONGITUDE	-128.776855
PDOP	2.1
SATS USED	4
VISITDATE	2016-07-21

Numbering of measured units continues from Powell Creek Lower Devonian section. Zero datum at 10.0 m below the top of Bed 29 (upper breccia member of the Bear Rock Formation).

BEDDED UNIT (LANDRY FORMATION?)

30. Marl: calcareous, dull brown, laminated, soft, probably microporous and recessive; intercalations of dark grey, finely crystalline (microsparitic), intensely fractured limestone; marls and limestones release bitumen smell when crushed. The upper 0.5-0.6 m shows the succession of a monolithic pale grey (bleached) small-scale packbreccia with smooth undulating top overlain by a thin (5-10 cm) overcompacted and recrystallized limestone and a collapsed rubbly horizon. The latter is calcareous and dolomitic partly nodular claystone with blackened crystalline clasts – possible pebbles. Provisional interpretation of bed top: microkarst/paleosol. Top at 14.0 m.

31. Marls and breccia: alternation of dark brown marls and bleached brecciated horizons; the facies spectrum is similar to Bed 30. Marlstone in the lowermost part of the unit contains small (< 1 cm) lithoclasts from the gently reworked top of Bed 30. The interval contains at least 3 partly collapsed peritidal cycles. Top at 17.3 m.

32. Dolomitic limestone: brecciated at base, more integrated at top; yellowish grey, massive, fractured, thick-bedded, with clotted micritic fabric in upper part, recrystallized in lower part. Top overcompacted, rusty. Top at 18.5 m.

33. Marl: dolomitic to calcareous, brown, soft and recessive, with bitumen smell when crushed, with several horizons of slightly more resistant solution-collapsed breccia. The uppermost part is bleached, with a ferruginized collapsed horizon, very similar to the top of unit 30. Top at 20.7 m.

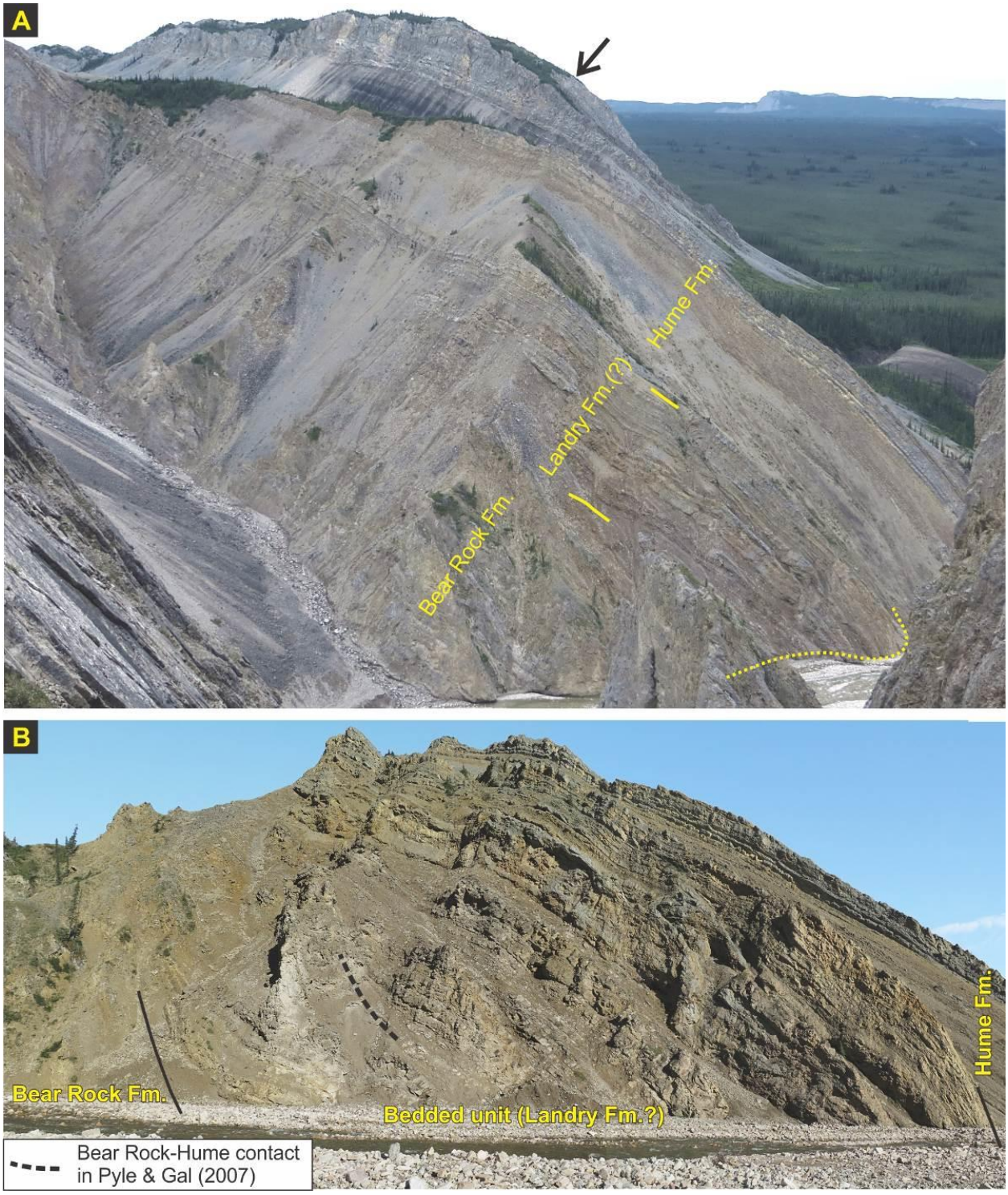

Figure 59. Powell Creek Landry-Hume section showing bedded unit (Landry equivalent) between the Bear Rock and Hume formations. (A) The measured section route is shown by dotted line; its lower part is occluded by the pinnacle rock in the foreground; the ridge formed by Hare Indian and Ramparts formations is arrowed; northwesterly view from station 16KOA015. (B) Closer view from fly camp site with Bear Rock – Hume contact as interpreted earlier by Pyle and Gal (2007) also shown.

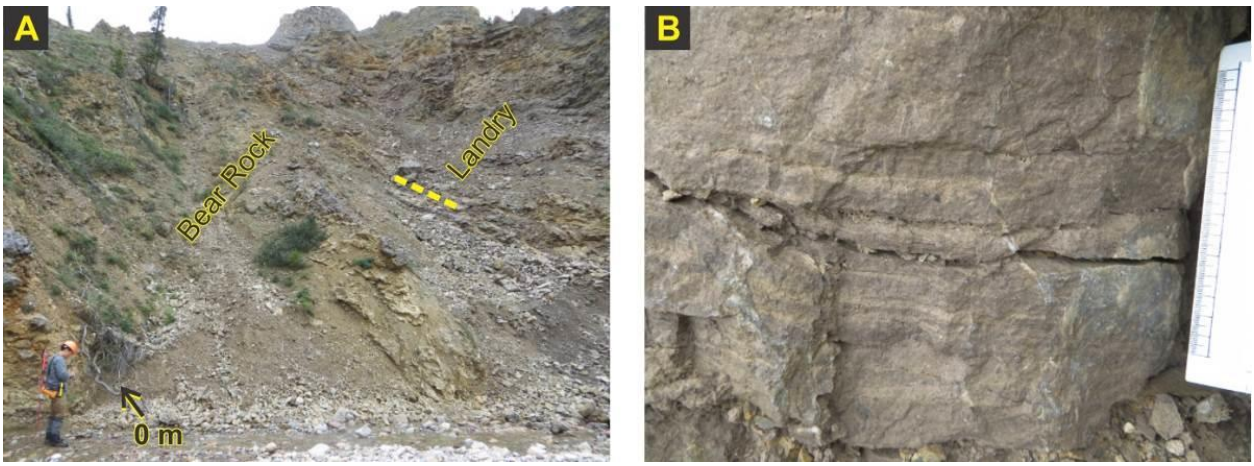

Figure 60. Station 16KOA017: (A) Contact of upper breccia member of Bear Rock Formation (bed 29) and the bedded unit (Landry Fm.); zero datum is arrowed; (B) laminated marl in the middle of unit 30. Scale bar in all figures graduated in cm and mm.

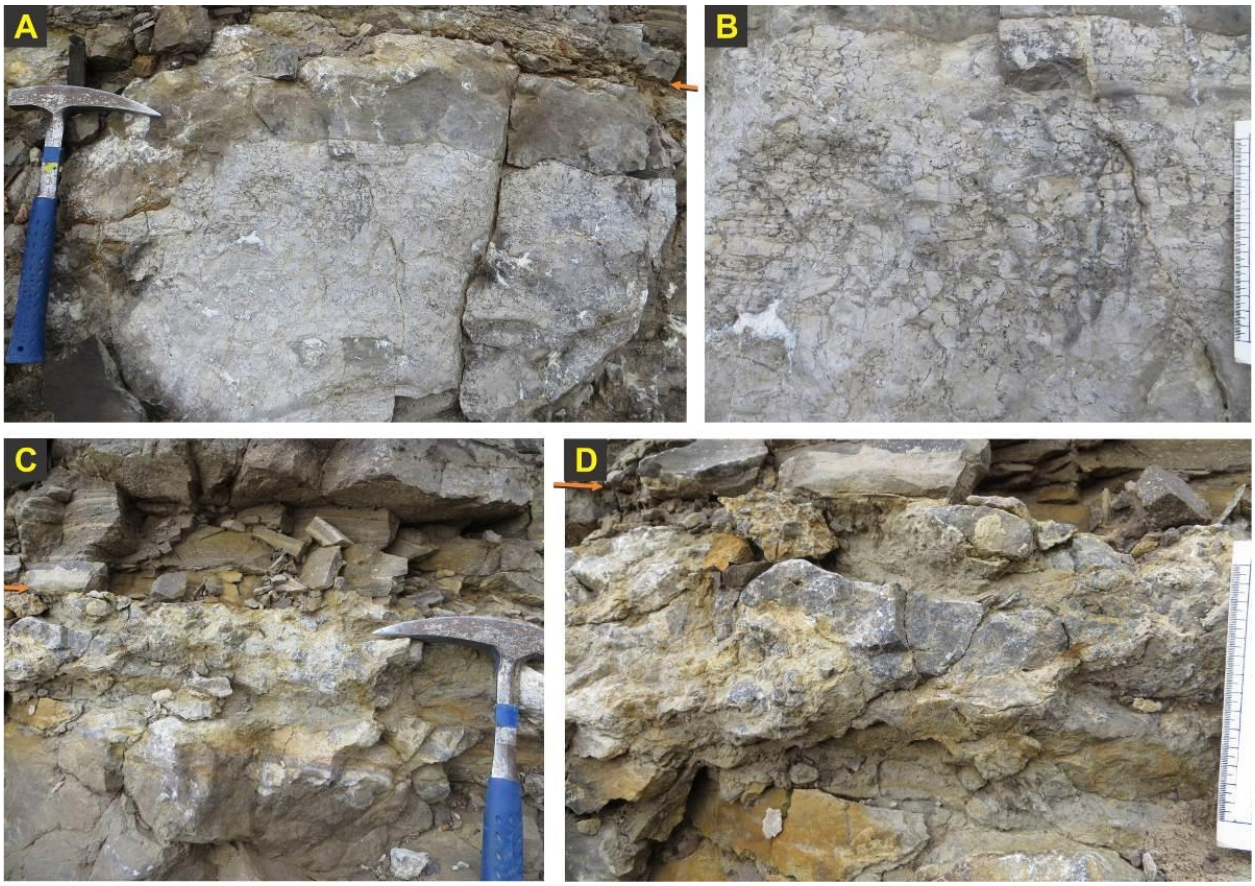

Figure 61. Disconformable contact of units 30 and 31 (orange arrows): (A, B) Packbreccia with rounded fragments and marly fills (microkarst?) overlain by darker grey recrystallized limestone and rubbly claystone; (C, D) Collapsed rubbly claystone with recrystallized carbonate fragments, probably a paleo-topsoil. (B and D) are respective close-ups of (A and C).

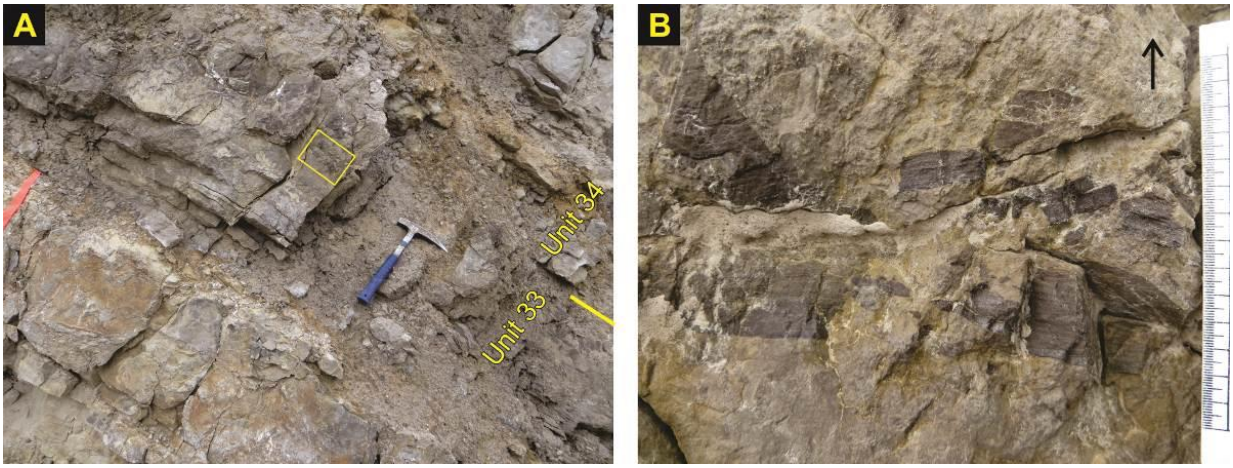

Figure 62.Breccia in top of unit 34. (B) is detail of (A) in a yellow box; arrow shows stratigraphic up.

34. Limestone: yellowish white, marly, finely brecciated, with displaced recemented fragments. Part of solution-collapsed package. Top at 21.7 m.

35. Breccia: brown marly dolomitic limestone and dolostone with chaotically oriented breccia clasts, with bitumen smell in freshly crushed matrix and clasts. The uppermost part is less brecciated, with spherical crystalline inclusions. The unit is moderately recessive at base and resistant at the less brecciated top. Top at 31.1 m.

Figure 63. Unit 35. (A) sharp erosional contact of laminated and microbrecciated units inside unit 35, reworked clast is arrowed; (B) breccia patch. Photos oriented stratigraphically up.

36. Marl: laminated (buckled microbial laminar features), recessive, with significant chaotic breccia. Lowermost part prominently recessive. Characteristic bitumen odor when crushed. Top at 37.5 m.

37. Dolomitic limestone: marly dolomitic limestones and minor dolostones; dominantly brownish grey and thin-bedded rocks with buckled lamination, some birds-eye horizons, minor breccia horizons and internal stratigraphic discontinuities. The unit is moderately resistant and somewhat lighter colored than unit 36. Top at 47.0 m.

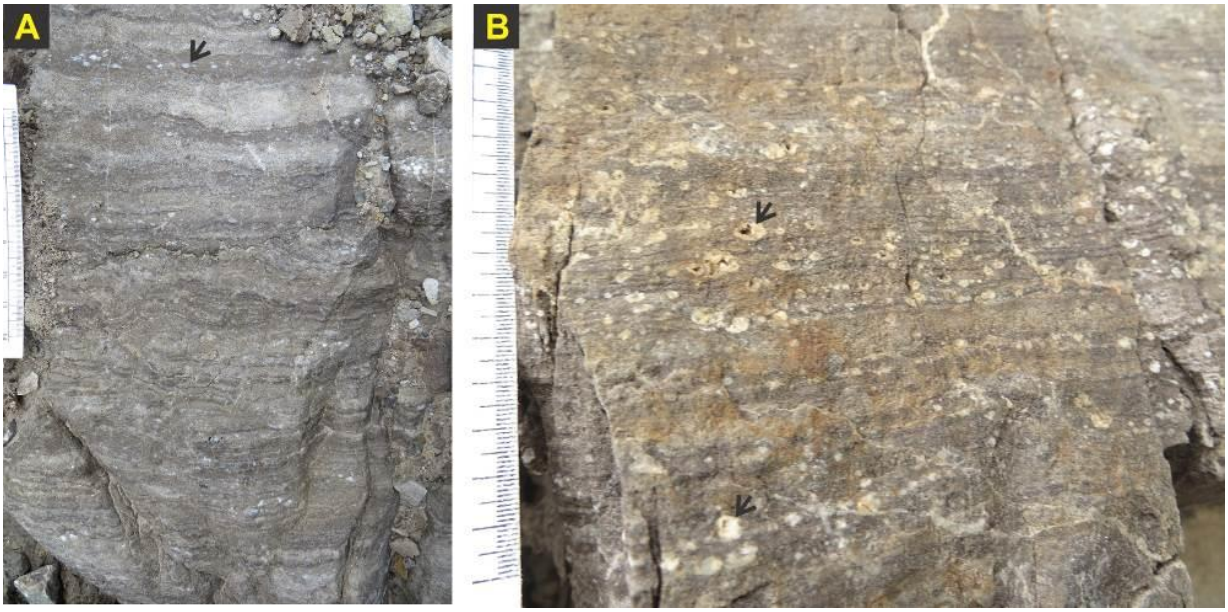

Figure 64. Unit 37: buckled microbial lamination and elliptical "birds-eyes" (arrowed) filled with sparry calcite.

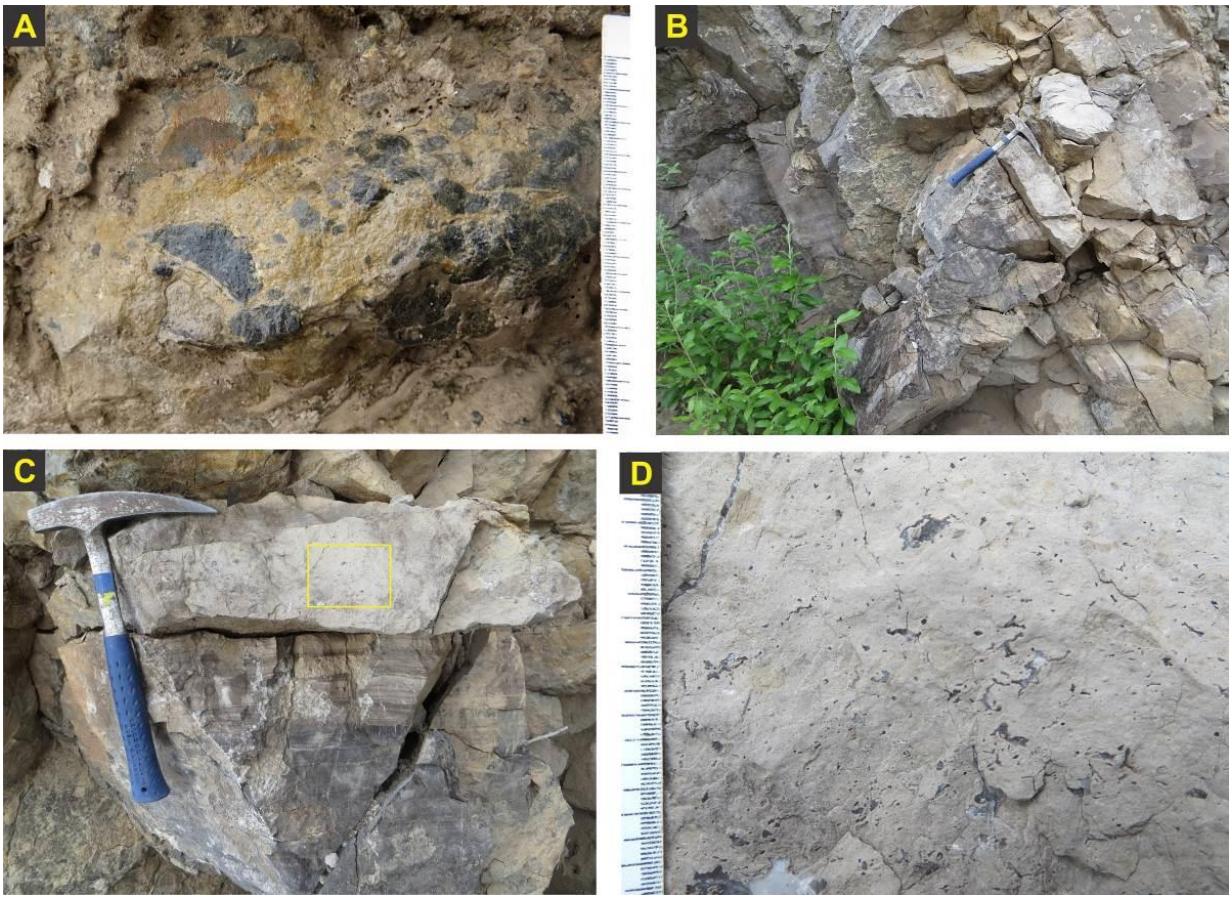

Figure 65. (A) Top of unit 38 with floatbreccia of black angular limestone clasts in marlstone matrix; (A-D) unit 39 with finely buckled lamination and lenses of fenestral dolomitized rock, probably a "palustrine facies". (C and D) are successive zoom-ins of (B) oriented stratigraphically up; area of (D) is outlined by yellow on (C).

38. Dolostone: brownish, moderately recessive, marly, laminated, expelling bitumen odor when crushed. Top at collapsed marly horizon with black angular limestone clasts. Top at 52.0 m.

39. Dolostones and limestones: moderately resistant, brownish grey, fractured. A dolomitized analog of a "palustrine facies" from Kugaluk N-02 (Kabanov, 2014) is encountered (Figure 67D). Small-scale breccia horizons, one at the unit top. Top at 58.6 m.

40. Dolostone and dolomitic limestone: marly, soft and recessive, brownish grey, laminated (buckled microbial lamination, especially distinct in the base); bitumen smell when crushed. Top at 65.0 m.

41. Limestone-dolostone alternation: limestones are grey, with blackish laminae (dendritic penetrations of probably Mn staining), with several rubbly breccia horizons. Blackish staining is strongest in basal 2.0 m. Top at 72.0 m.

42. Marl: brown, soft and recessive, with locally preserved microbial lamination, with bitumen smell when crushed. Top at 75.5 m.

43. Dolomitic limestone: thick-bedded, resistant, brecciated; basal part more recessive, fractured and caving. Top at 80.5 m.

44. Limestone: thin and evenly bedded (0.05-0.15 m), grey, intercalated with fissile shale; dominantly lime mudstones with infrequent fine-grained bioclastic graded laminae. Conodont sample 16KOA018-81.7 m, middle-lower part of the bed. Top at 83.5 m.

45. Limestone to breccia: strongly brecciated and slumped, thin to thick bedded lime mudstones; massive texture, bioclasts small and rare. Lower part with discontinuous lamination (Figure 66C**)**. Conodont sample 16KOA018-92.7 m, 1.5 m below the top. Top at 94.2 m.

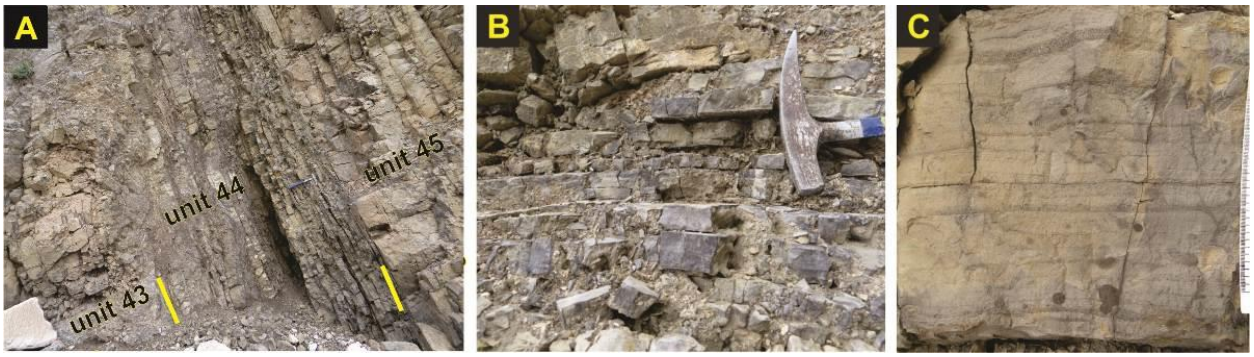

Figure 66. (A) Units 43-45; (B) is the detail of thin bedding in bed 44; (C) is fine-gained graded laminae in base of bed 45. (B) and (C) oriented stratigraphically up.

HUME FORMATION

46. Limestone: argillaceous, thin-bedded (0.03-0.15 m) and nodular, grey with rusty inclusions from weathered pyrite; weathers dull yellow; bioclastic lime mudstones and wackestones; lamination is disturbed and preserved as graded bioclastic beds; distinct bioturbation, strongly brecciated and slumped, thin to thick bedded lime mudstones; massive texture, bioclasts small and rare. Lower part with discontinuous lamination. The limestone beds are intercalated by soft shale. The base is picked at the base of very thin-bedded dark brown lime mudstone with black weathering. The bedding in this

basal part is very even (flaggy), unlike uneven and nodular bedding above. Brachiopods and other macrofossils rare to common. The shale interbeds increase to the top, indicating transition to unit 47. Conodont samples 16KOA018-102.2 m (2.0 m below the top), 16KOA018-96.7 m (7.5 m below top).Top at 104.2 m.

47. Limestone-shale alternation: thin interbedding of nodular to unevenly bedded argillaceous limestones and soft expandable shales. Tempestite textures common, graded shell coquinas. Diverse brachiopod-bryozoan fauna, rugose corals, etc. Limestones in the lower half are somewhat less fossiliferous and more micritic. Conodont samples 16KOA018-108.7 m, 16KOA018-104.7 m (4.5 m below top).Visible top at 109.2 m, visible thickness 5.0 m. The overlying part of Hume Formation is very recessive and covered under scree (Figure 66A).

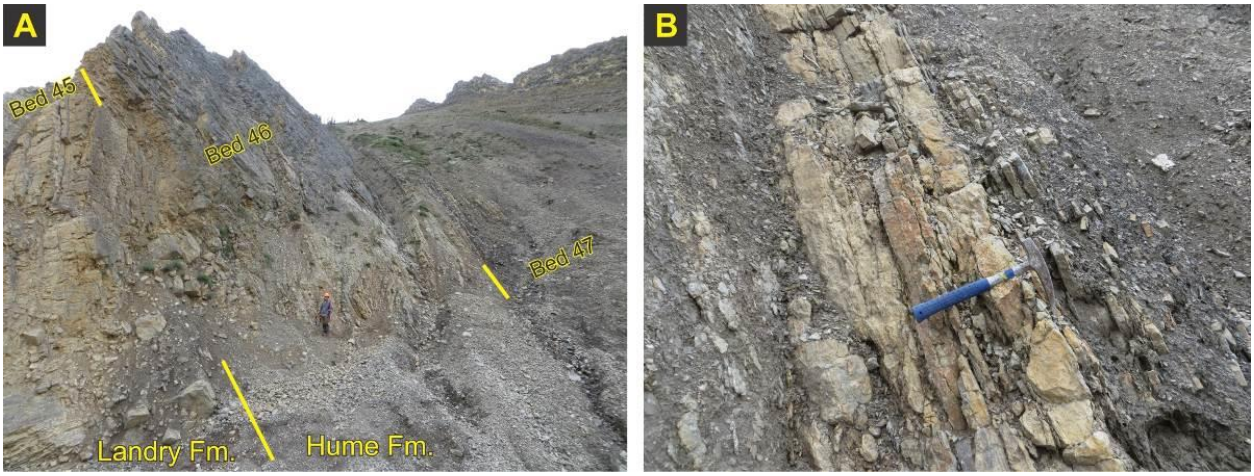

Figure 67. (A) Station 16KOA018 with Landry/Hume contact; (B) is the nodular uneven bedding of limestones and thick shale interbeds in the richly fossiliferous unit 47.

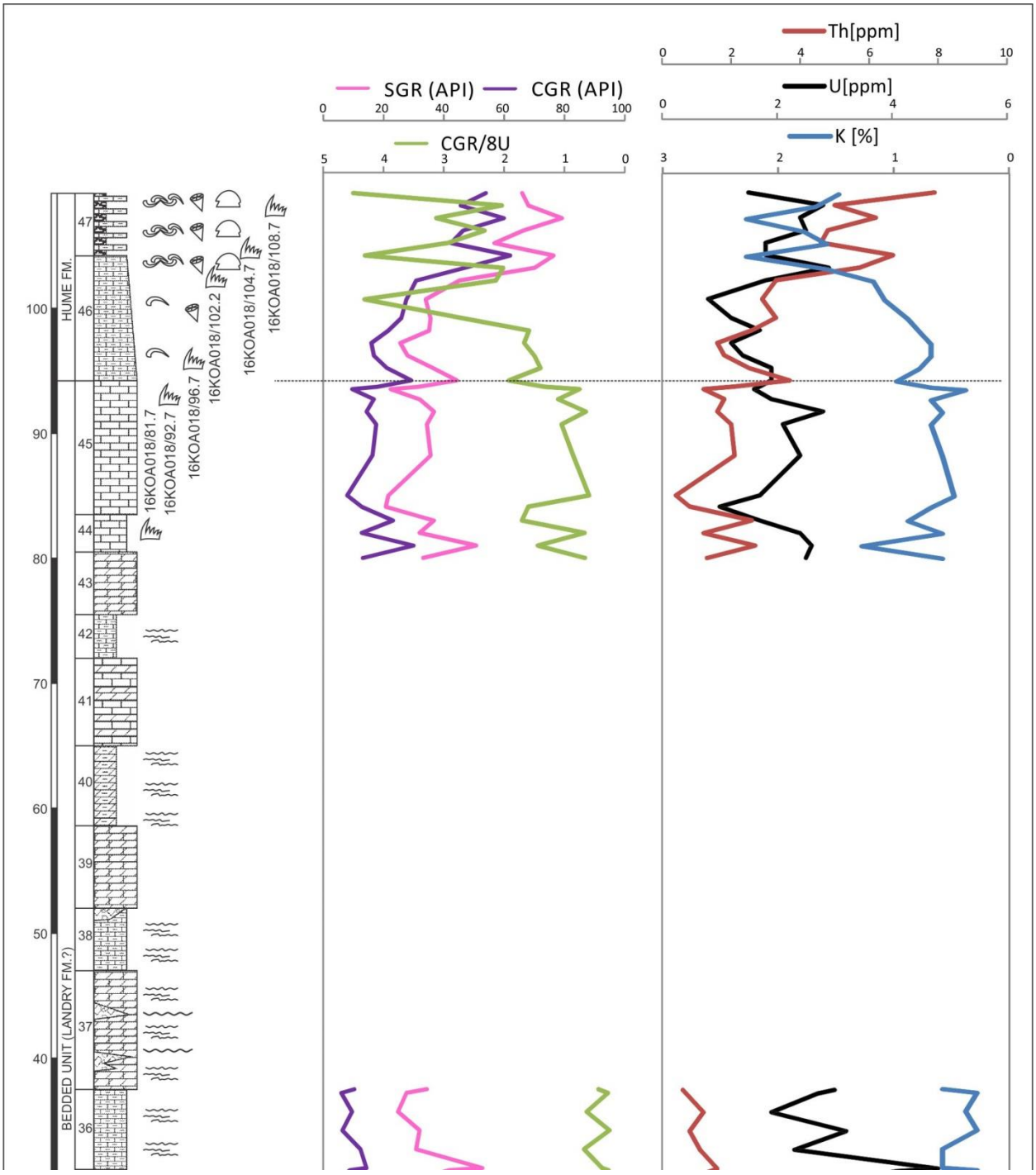

Figure 68. Litholog of Powell Creek Landry-Hume section. See Figure 33 for legend.

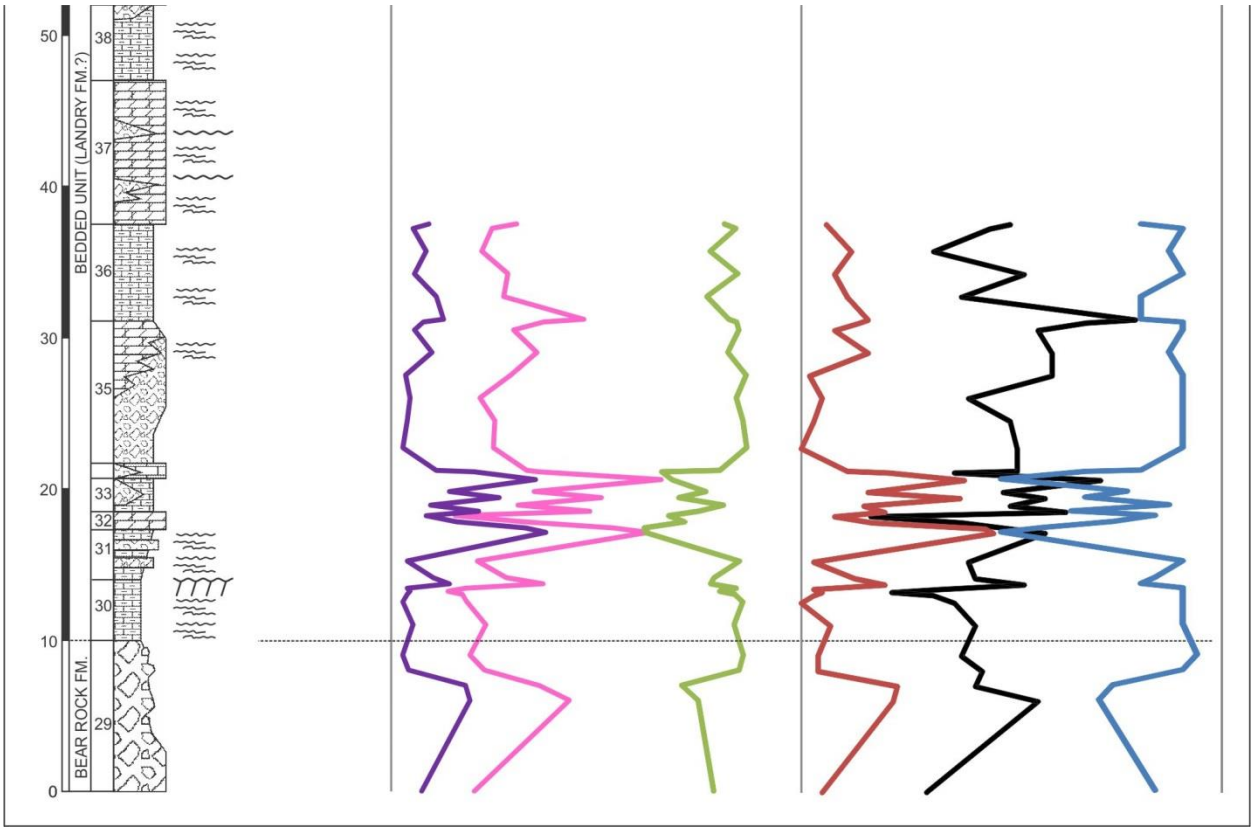

Figure 68 (continued). Litholog of Powell Creek Landry-Hume section. See Figure 33 for legend. See Figure 33 for legend.

Powell Creek West

Base of section: 16KOA023	
DATUMZONE	NAD_1983_UTM_Zone_9N
ELEVATION	415.2
LATITUDE	65.277085
LONGITUDE	-128.788305
PDOP	3.7
SATS USED	5
VISITDATE	2016-07-28
Top of section: 16KOA025	
DATUMZONE	NAD_1983_UTM_Zone_9N
ELEVATION	457.7
LATITUDE	65.277398
LONGITUDE	-128.788017
PDOP	2.8
SATS USED	7
VISITDATE	2016-07-28

Zero datum at the base of unit 2 (brownish grey marly limestone with brachiopods).

Section was sampled for conodonts (see the stratigraphic log)

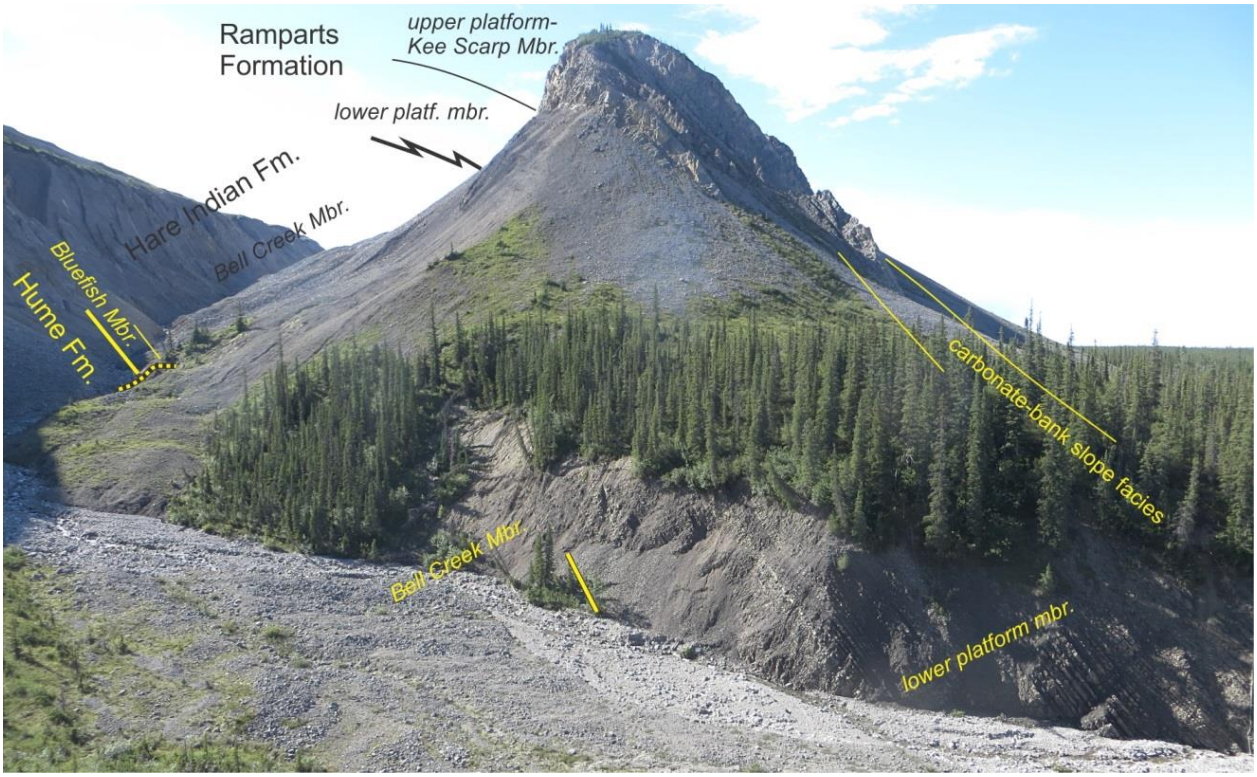

Figure 69. West tributary of Powell Creek with measured Hume-Bluefish section (dot-traced on the left), westerly view.

HUME FORMATION

1. Limestone: light grey, tight and massive, thick-bedded; micrite-rich bioclastic wackestone with rare brachiopods *in situ*; bedding defined by thin fissile (weakly argillaceous?) limestones. Visible thickness 1.3 m. Top at 0 m.

2. Limestone: brownish grey, argillaceous, compacted, with collapsed brachiopod valves; consists of two parts: basal brownish grey marl and upper brachiopod coquina with imbricated and disarticulated brachiopod valves. The lower marl is bioclastic wackestone to lime mudstone with tentaculitid cones detected. Top at 0.1 m.

3. Limestone: grey thick-bedded massive bioclastic wackestone; conchoid to plumose fracture surfaces; compacted argillaceous brachiopod coquina at 0.1 m above base. Top at 0.55 m. Bed dip: 53/279

Figure 70. Downdip view on outcrop (A) and basal part of section (B); fibrous calcite beds in Bluefish Member are arrowed. (C and D) Successive zoom-ins onto unit 2 (0 m in its base); (*bm*) is basal marl; (*ubc*) is upper brachiopod coquina.

4. Marl-limestone alternation. The limestone beds form resistant ribs. Recessive marl with brachiopod coquinas in basal 0.4 m; these coquinas contain lingulid debris. Marly interbeds are fissile, recessive, and slightly thicker than resistant limestone beds; these marls also contain several *in situ* brachiopods and rugose corals. Top at 2.2 m.

5. Limestone: massive resistant brownish grey monolithic bed with conchoid fracturing; this bed is similar to resistant limestone beds in unit 4 but significantly thicker (0.3-0.4 m). Top at 2.5 m.

6. Argillaceous limestone (marl): moderately fissile and flaser-bedded, soft, bioturbated; contains numerous *in situ* brachiopods (dominantly genus *Leiorhynchus*) and common *Lingula*. A horizon of hard grey resistant wackestone is present in the middle of the unit and is locally pinched into nodules. Top at 3.0 m.

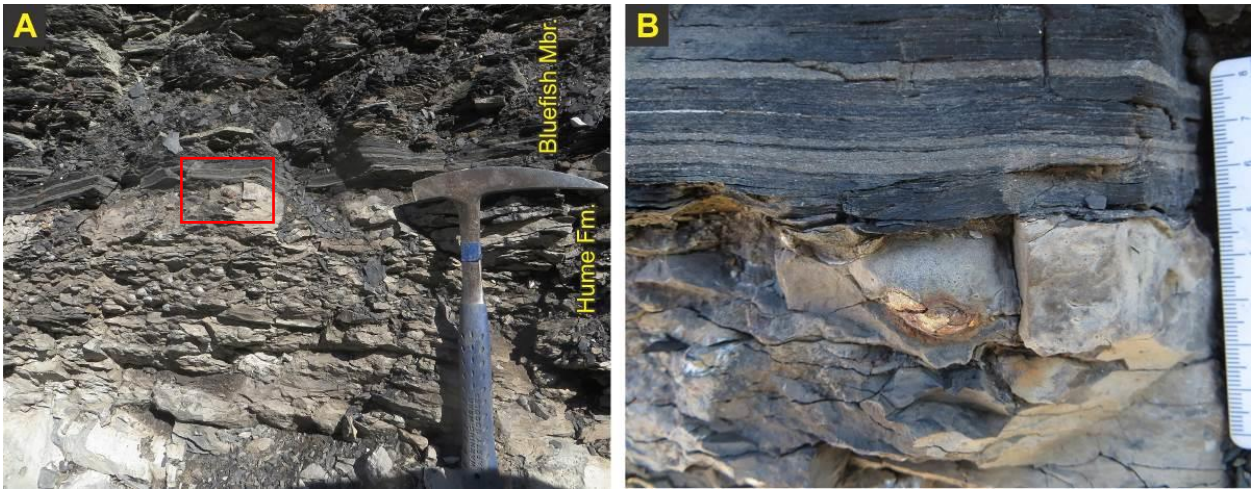

Figure 71. (A) Hume-Bluefish contact (pointed to by hammer); (B) close-up of area in red square on (A).

HARE INDIAN FORMATION

BLUEFISH MEMBER

7. Shale: black, fissile, laminated, partly calcareous, relatively hard; calcareous tentaculitid-rich laminae at the base; top of this unit is at the base of the first fibrous calcite bed. Top at 4.9 m.

8. Limestone-shale alternation: black, laminated, with upwards increasing proportion of shale. A 5 cm thick bed of cone-in-cone fibrous calcite at the base. The limestone in the middle part has a micritic/microsparitic texture (calcisiltite?) with slightly conchoidal bedding planes showing small pectinid bivalves and masses of tentaculitids. Thinner (1-2 cm) lenticular beds of fibrous calcite occur at 5.1 and 5.2 m. Pectinids are common, occur in limestones and shales. Top at 5.2 m.

9. Shale: black, fissile, calcareous, with large number of tentaculitids and tiny brachiopods (?) on bedding planes. Top at 6.1 m.

10. Shales: black, calcareous, laminated. Base and top defined by beds of cone-in-cone fibrous calcite; the upper bed of fibrous calcite is the thickest in the section (6-7 cm). A horizon of sandy and silty nodular limestone is found in the lower third. Top at 6.6 m.

11. Shale: black to very dark grey, very fissile, weathered in thin flakes; semi-recessive in outcrop. Laminar alternation of silty shales, pelitomorphic shales, and siltstones. A thin (2 cm) poorly formed horizon of cone-in-cone fibrous calcite is present at 7.5 m. Several fissility planes in shale contain black organic-walled acritarchs (*Tasmanites* sp. and other forms). Gradual transition to unit 12. Top at 7.9 m.

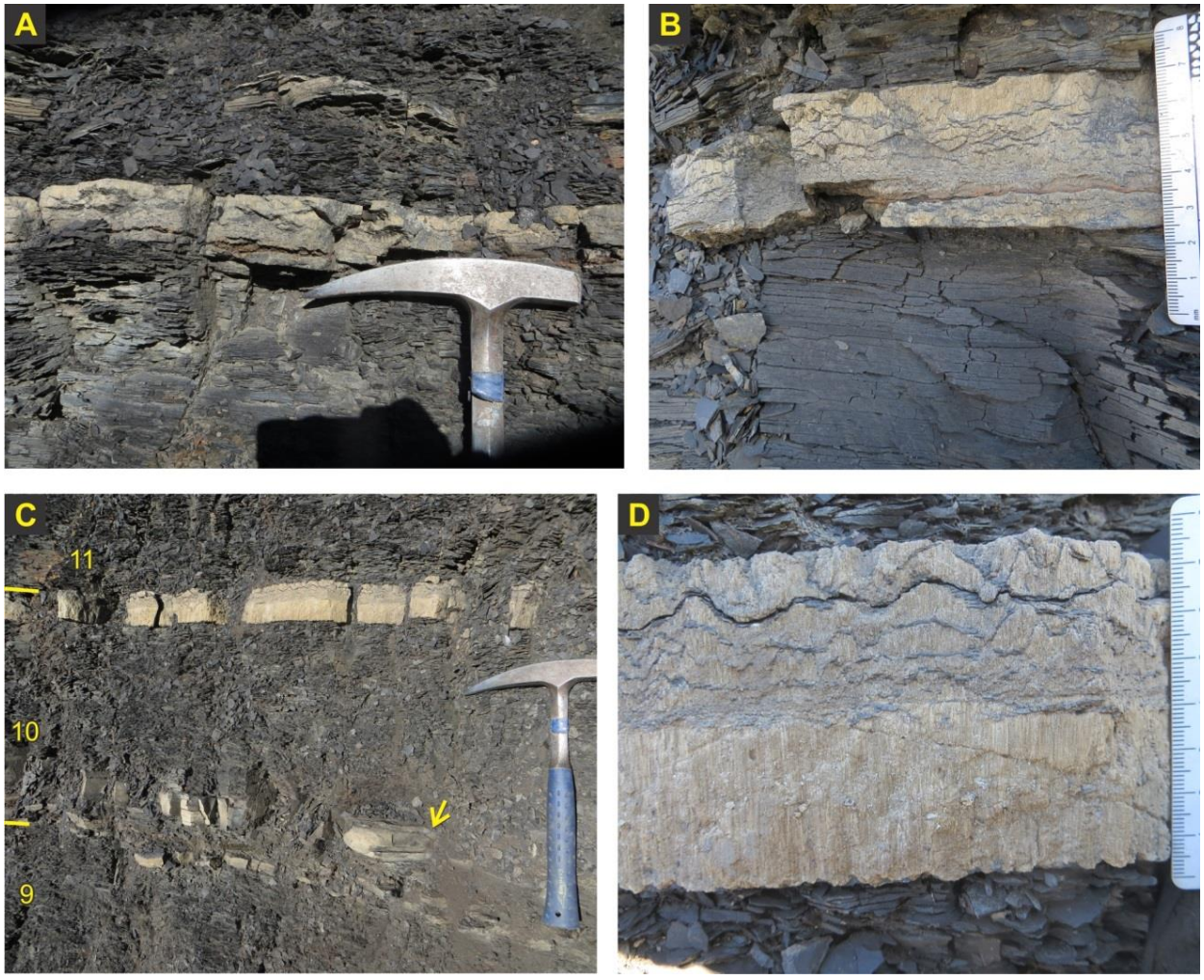

Figure 72. Black shales of Bluefish Member with cone-in-cone fibrous calcites: (A and B) contacts of units 7 and 8, (B) is the close-up of (A); (C and D) interval of units 9-11 with the thick fibrous calcite bed in top (textural details on D); nodular limestone is arrowed.

12. Shale: dark brownish grey and steel grey, very fissile, pelitomorphic, more recessive than unit 11. Rusty films on joints and fissility planes. Some shale flakes are spangled with organic-walled acritarchs; some contain poorly preserved collapsed tentaculitids. Top at 12.3 m.

Units 13-15 were accessed in a trench dug along the eastern side of the outcrop.

13. Limestone or calcareous dolostone: dark brownish grey, soft, weathered, earthy (very fine-grained), feels oily, shows vague lamination. A thin (1.0-1.5 cm) discontinuous horizon of fibrous calcite at the base. Top at 12.5 m.

14. Shale: moderately soft, dark grey, locally rusty, weathers into 1-5 cm wide plates; similar to unit 12. Numerous acritarchs and rare poorly preserved tentaculitids can be seen on fissility planes. Top at 13.3 m.

BELL CREEK MEMBER

15. Shale: silty, very recessive, soft, brownish grey, expanding in water, weathered into small soft crumbles; thin (1-2 cm) plates of harder calcareous siltstone occur in the slumped mass just above the trench end. These siltstone plates show rare collapsed tentaculitids. Top of unit is not exposed. Measurement stopped at 14.0 m.

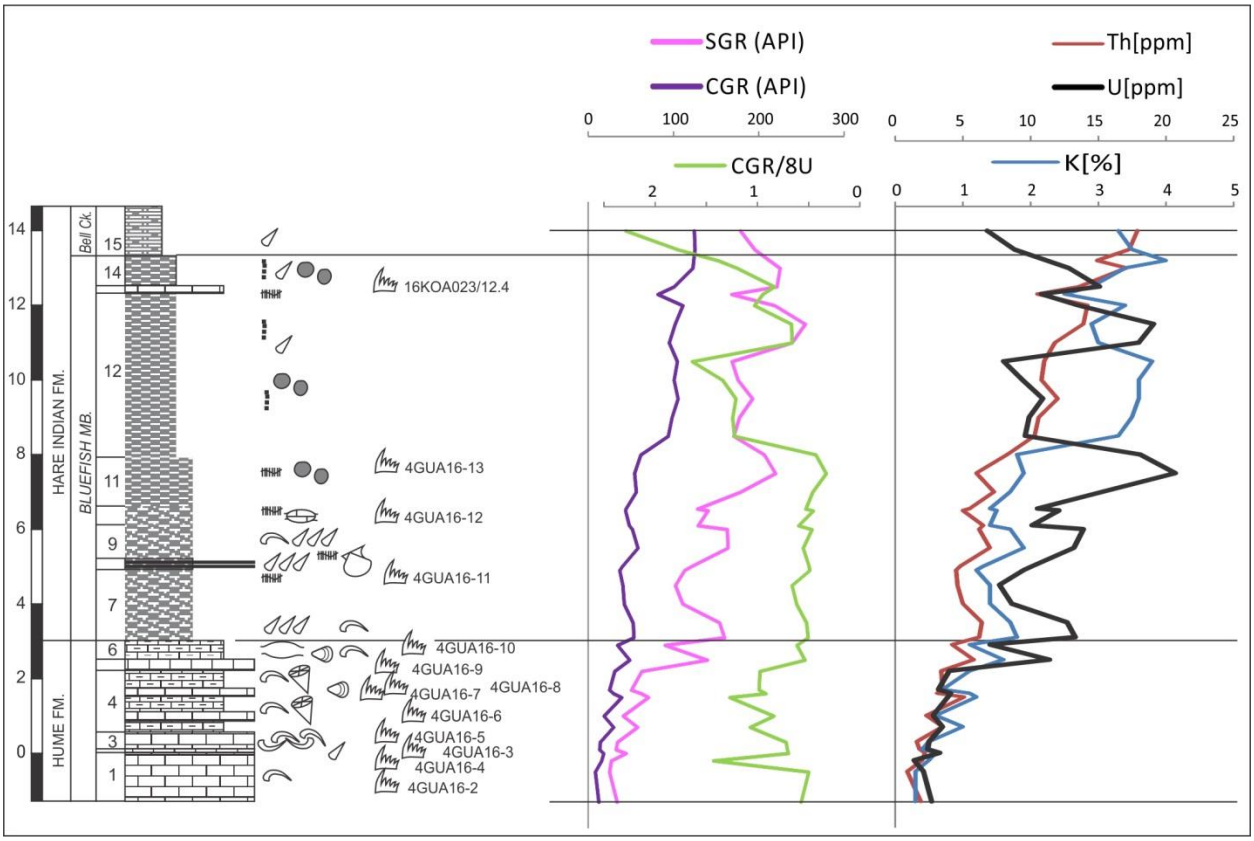

Figure 73. Litholog and SGR log of Powell Creek West. See Figure 33 for legend.

Rumbly Creek Tributary Waterfall

Base of section: 16KOA020	
DATUMZONE	NAD_1983_UTM_Zone_9N
ELEVATION	660.3
LATITUDE	65.403405
LONGITUDE	-131.359667
PDOP	3.2
SATS USED	3
VISITDATE	2016-07-23

Zero datum at the top of Hume Formation (contact of units 1 and 2). The section was sampled for conodonts (see litholog).

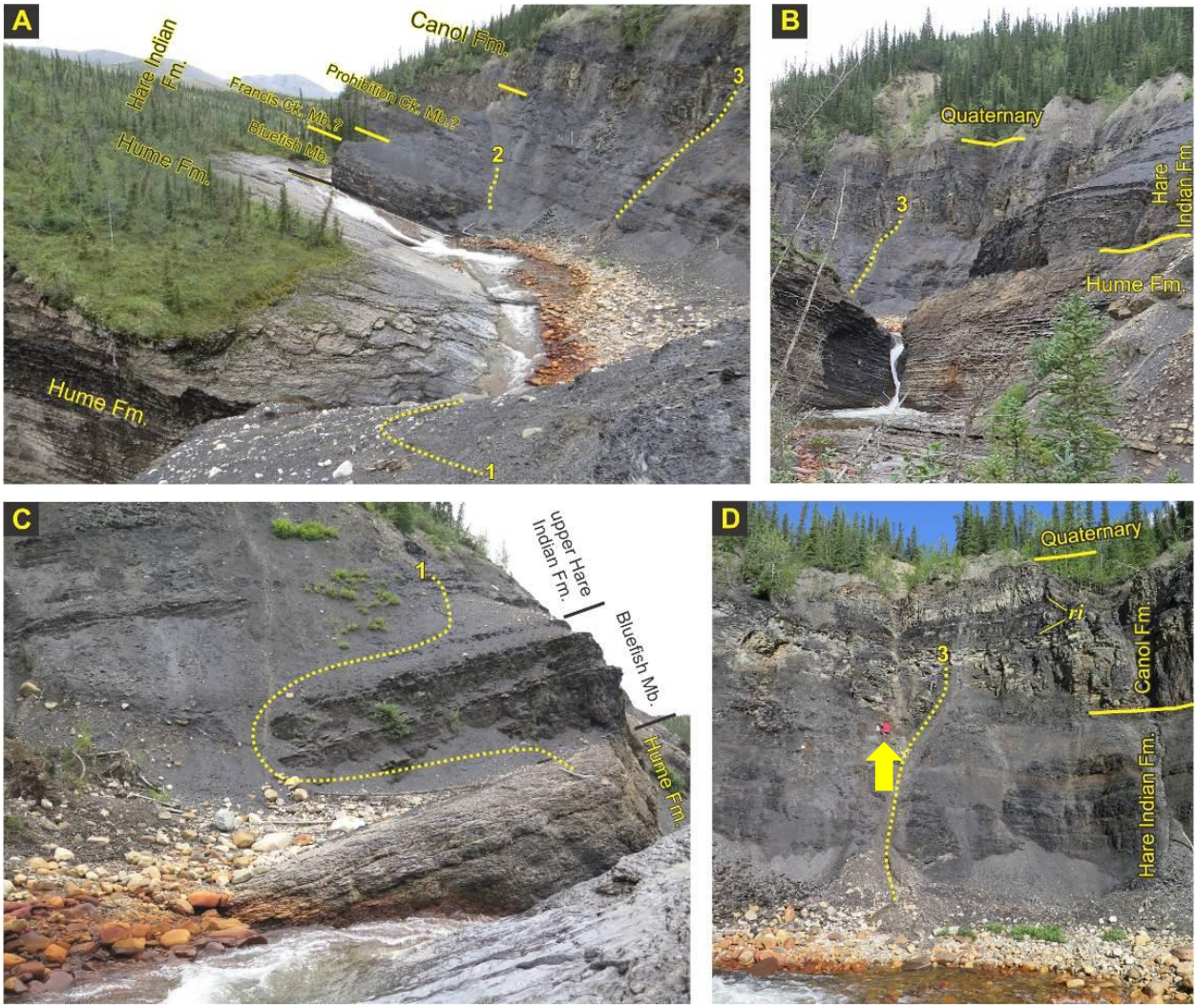

Figure 74. Different views of the section; three measured traverses are traced with dotted lines; (*ri*) on (D) indicates recessive interval correlated with units 2-5 of Rumbly Creek Canol section, geologist (arrow on D) for scale.

HUME FORMATION

1. Limestone: massive, with thick nodular bedding, fractured and cut through by veins of calcite spar; bioclastic packstones and wackestones; fossils: brachiopods, rare large colonial corals. The top is planar at outcrop scale but rugged and chemically corroded on decimeter scale; the top is ferruginized (decomposed pyrite?), and it is solution sculptured and covered by very thin (< 1 mm) black argillaceous film. Only upper 1.0 m was measured. Top at 0.0 m. Bed dip: 32/270

Figure 75. Hume-Bluefish contact at traverse no. 1: (A) in a cliff above the waterfall; (B) unit 2 dug from under the talus, sampled for conodonts; (C) close-up at unit 2 on (A) showing lamination; (D) bedding plane with rugged undulating top of Hume limestone blanketed by a basal bed of unit 2.

HARE INDIAN FORMATION

BLUEFISH MEMBER

2. Limestone: dark grey, thin-bedded (1-2 cm), partly silty, blanketing the undulating top of Hume limestone. Texture: tentaculitid packstone with rare brachiopod valves; mostly microlaminar, with minor patches of randomly oriented particles (bioturbation?). Bioturbation index (BI) approximately 2. Top at 0.3 m.

Figure 76. Macro-features of Hume-Bluefish contact: (A) corroded top of Hume limestone with colonial rugose corals; (B) bedding plane in unit 2 with mass tentaculitids (black arrows) and rare brachiopods (yellow arrow).

3. Shale: black, very fissile, weathers into small (1-3 mm) flakes, calcareous to non-calcareous; lenticular pre-compactional nodules of micritic calcite at 1.55 m. Top at 2.9 m.

4. Limestone-shale alternation: black fissile shale as in unit 3 alternates with muddy limestones containing textures of tentaculitid packstones. These limestones are dark grey to black on fresh surfaces; they weather yellowish and contain rock-forming small tentaculitids and minor micrite. Weak fetid odor when crushed. The uppermost limestone bed is more concretionary and micritic than the underlying limestone beds of this unit. Top at 3.4 m.

5. Shale: black, fissile, non-calcareous, weathers into small flakes; different from shales below by the more prolific powdery rusty weathering of surfaces. Uppermost part is relatively resistant. Top at 5.5 m.

6. Siltstone: dark grey, argillaceous, recessive, weathered and rusty; disintegrates into small (< 1 cm) flakes and crumbles. Top at 6.1 m.

7. Shale: very dark grey, pelitomorphic, slightly more resistant than unit 6, weathers into small (1-3 cm) flakes; organic-walled acritarchs on fissility planes. Uppermost part is gradational. Top at 7.0 m.

HARE INDIAN FORMATION, UPPER PART

8. Shale: dark grey, recessive (most recessive unit in the outcrop), flakey, non-calcareous, pelitomorphic in lower part and silty in upper part; the top is rusty colored. Top at 9.5 m.

9. Shale: dark grey to black, non-calcareous, more resistant than unit 8, with rare thin (1-2 cm) horizons of brownish grey and black authigenic dolostones. Shale flakes are often littered with acritarchs. Rare poorly preserved impressions of tentaculitids. The uppermost part weathers into conchoidal shards and is densely penetrated by rusty joint surfaces. Top at 13.6 m.

10. Dolostone: soft (locally powdery), brownish black, finely crystalline (≤ 0.1 mm), with nodules and stringers of decomposed pyrite. Top at 14.1 m.

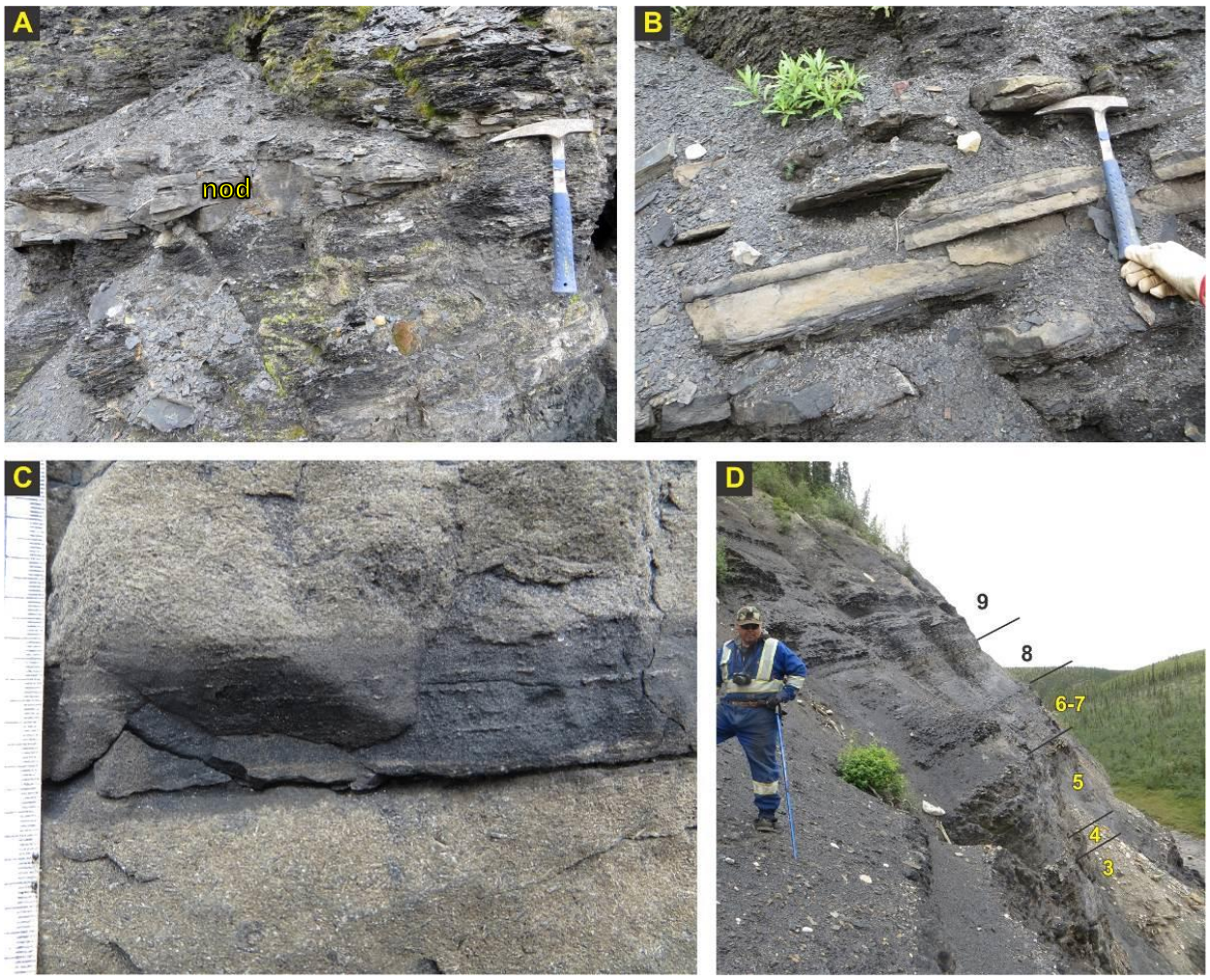

Figure 77. Hare Indian Formation: (A) fissile shale of unit 3 with large poorly formed calcareous nodule (*nod*); (B and C) limestone-shale alternation of unit 4; the close-up view on (C) shows massive tentaculitid packstones interbedded with laminar black-colored marly limestone and shale; (D) easterly view from traverse no. 1; note recessive grey shale of unit 8.

11. Shale: very dark grey, soft, weathers into small flakes and crumbles; abundant tiny loose-lying crystals of swallowtail gypsum (apparently product of weathering). Top at 18.0 m.

12. Dolostone: soft, weathered, with residual nodules of very hard dolostone; the latter are very dark grey, pyritic, and often retail microlamination on fresh surfaces. Conodont sample 16KOA020/18.1. Top at 18.3 m.

13. Shale: dark steel grey, soft, crumbly, with small nodules and stringers of brownish dolomite. Top at 21.4 m.

14. Dolostone to dolomitic shale: the lower 0.3 m is a dull brown soft weathered dolostone with residual nodules of very hard (non-weathered) dolostone. This lower dolostone grades upward into extensively rusty dolomitic shale. Top at 22.5 m.

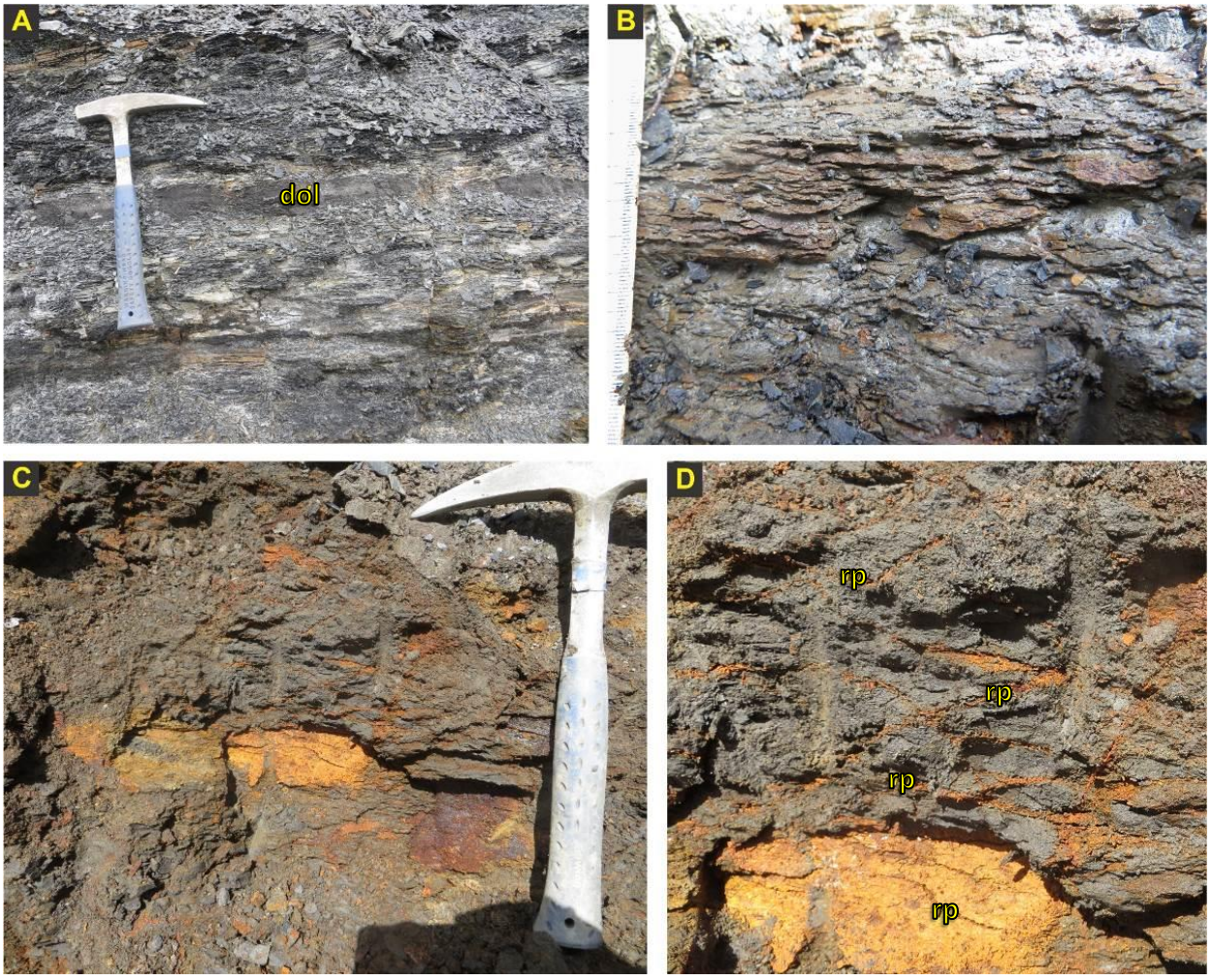

Figure 78. Macro-features of shales and dolomitic beds in upper Hare Indian Formation: (A) fissile shale with thin dolomitic seams (dol) in unit 9; (B) dolomitic shale, upper part of unit 14; (C and D) soft weathered dolostone, lower part of unit 14; note extensive rusty partings (rp on D).

15. Shale: dark steel grey, soft, crumbly, pelitomorphic, with yellow partitions; fissility planes show sub-mm scale flaky fabric and ghost dark angular fragments (probably coaly detritus). Top at 23.3 m.

16. Dolostone: brown, weathered, soft, with thick rusty crusts (decomposed pyrites) cutting the bed in different directions. No hard dolostone nodules, in contrast to units 12 and 14. Top at 23.9 m.

CANOL FORMATION

17. Shale: very similar to unit 15; grades to unit 18 through very rusty and crumbly dark-grey shale. Top at 25.5 m.

18. Siliceous shale: hard, platy, silty, wall-forming in an outcrop; black to dark steel grey on fresh surfaces, weathers crimson and minor yellow; Correlated to unit 1 of Rumbly Creek Canol section. Top at 34.5 m.

The inaccessible recessive interval above unit 18 (*ri* on Figure 74D) is correlated to units 2-5 of Rumbly Creek Canol section.

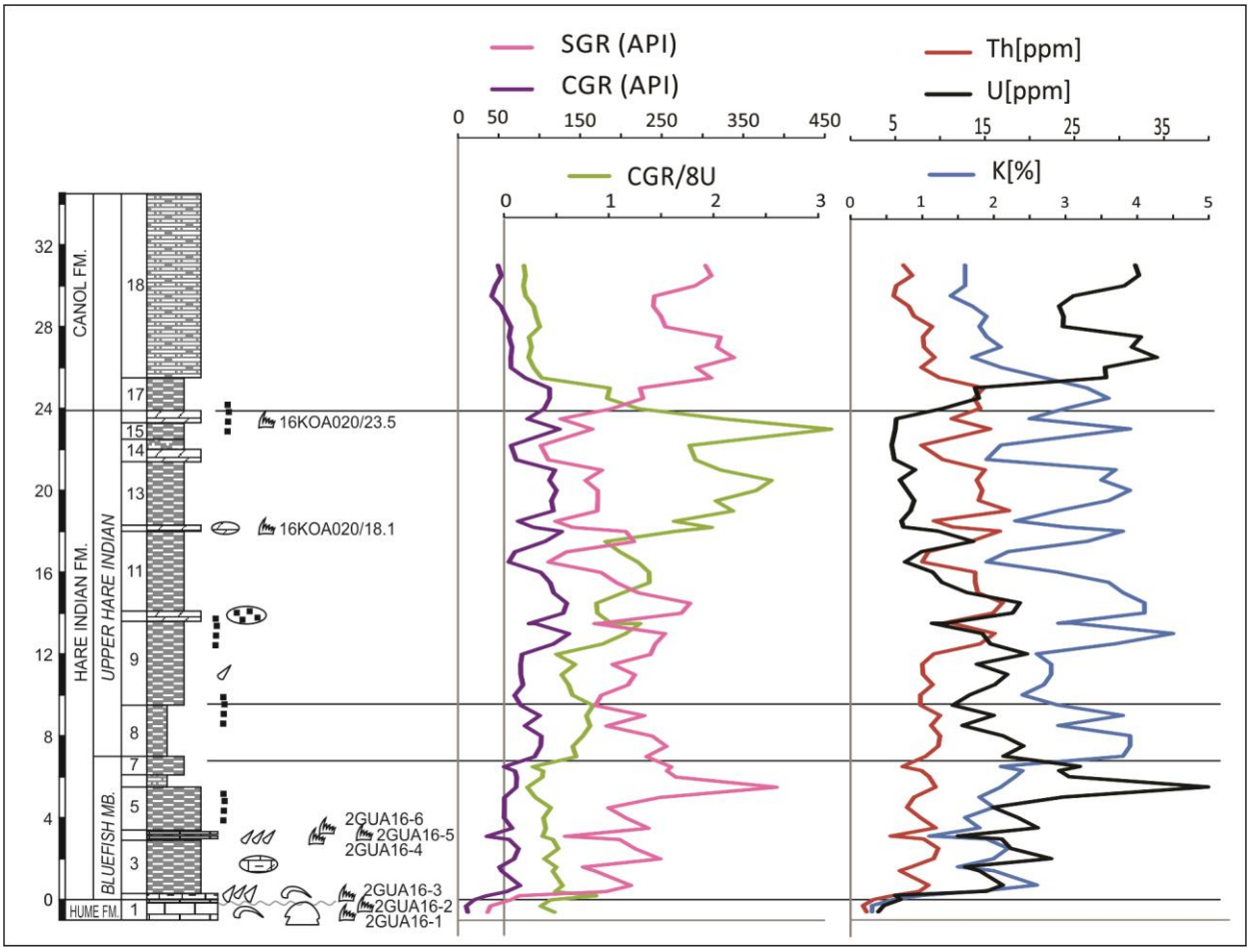

Figure 79. Litholog and SGR logs of Rumbly Creek tributary waterfall section. See Figure 33 for legend.

Rumbly Creek Canol

Base of section: 16KOA021	
DATUMZONE	NAD_1983_UTM_Zone_9N
ELEVATION	570
LATITUDE	65.407646
LONGITUDE	-131.309137
PDOP	N/A
SATS USED	0 (manual entry)
VISITDATE	2016-07-23

Zero datum in the middle of unit 3 (resistant dolostone 0.1-0.3 m in thickness).

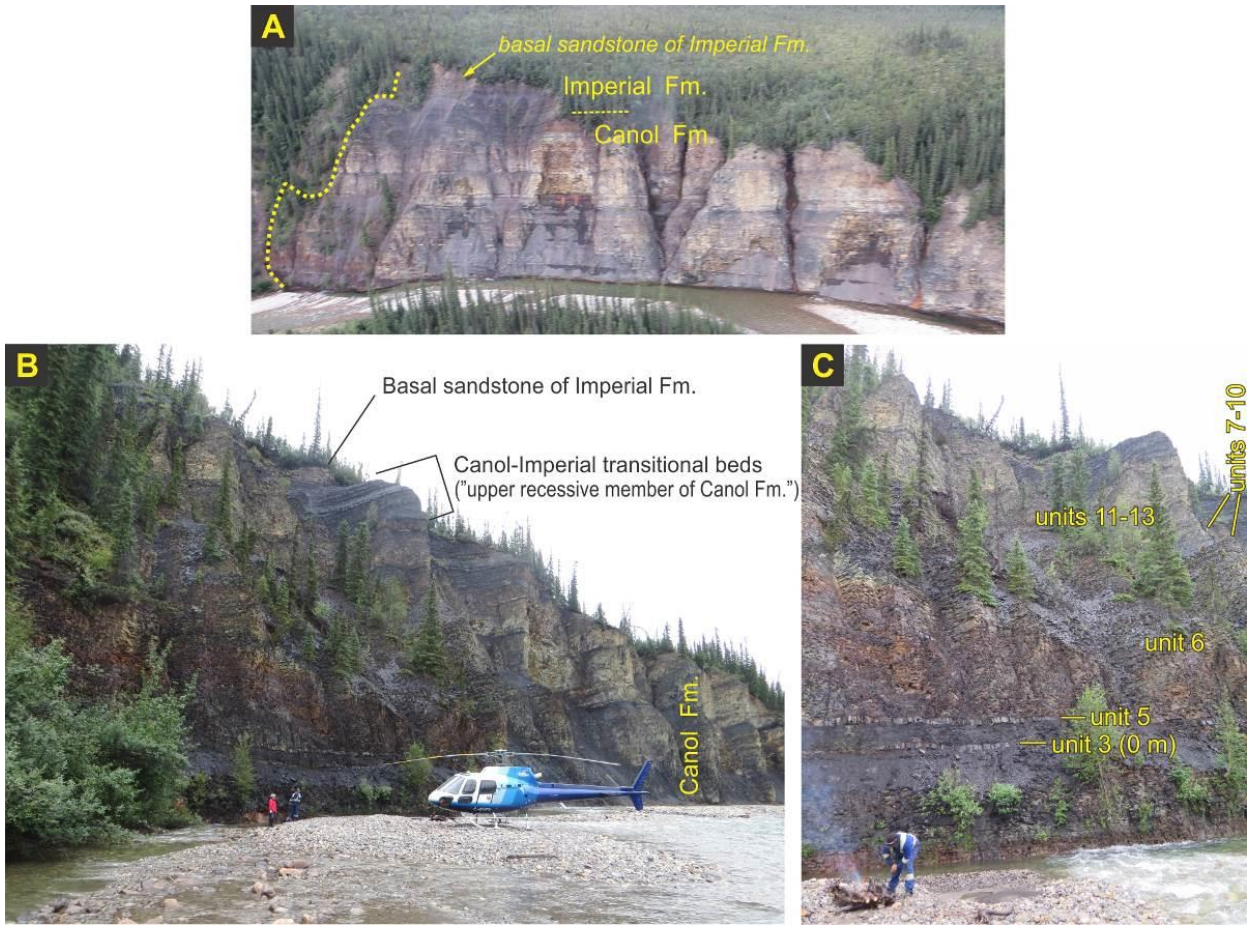

Figure 80. Rumbly Creek Canol section: (A) downdip airborne view, dotted line indicates the measured section; (B-C) Ground views: (C) closer view of the cliff at the left of helicopter on (B). The "upper recessive member" on (B) refers to transitional beds placed either in the Canol Formation (Pyle et al., 2014) or in the Imperial Formation (Pyle and Gal, 2016).

CANOL FORMATION

1. Siliceous shale: flaggy, black on fresh surfaces, hard, laminated, disintegrates into 1-7 cm thick plates. A slightly more recessive 0.4 m thick interval at -4.0 m. The resistant typical Canol shale is recurring just above this interval and grades upward into the more recessive Unit 2. Top at -2.0 m.

2. Shale: silty, slightly more recessive, fissile (1-10 cm wide plates). The upper 1.0 m is the most recessive, dark grey shales, weathering intensively rusty red. Contains at least two levels of elliptical carbonate (dolomite-calcite) nodules reaching 0.5 m in diameter. Both levels were sampled for conodonts 3GUA16-1 and 3GUA16-2. Top at -0.1 m.

3. Dolostone: unevenly calcareous, finely crystalline (pelitomorphic), black, hard, laterally constricted; vertical fracture surfaces are plumose and conchoidal, showing lamination (Figure 81); dolostone forms a resistant rib and grades into mudrocks in lowermost and uppermost part; 0 m datum in the middle of the unit.

4. Shale to siltstone: dark greenish grey to black, semi-recessive, weathers rusty (red to ochre). Minor sulphate foams from decomposed pyrites. Top at 1.1 m.

5. Dolostone: similar to unit 3, thickness 0.4-0.45 m. Top at 1.5 m.

6. Shale to chertstone: shale is siliceous and partly silty, laminar, dark steel grey, weathers rusty, hard, platy, locally disintegrating into paper-thin sharp plates; alternating with minor chertstones and siltstones (low-contrast lithological alternation); a calcareous nodule in decomposed (rusty) pyrite rind is encountered at 11.3 m. Conodont samples 16KOA021/6.3, 16KOA021/13.6 and 16KOA021/19.3. Top at 21.3 m.

7. Shale: siliceous, pelitomorphic to silty, slightly more recessive than unit 6, weathers yellow. Top at 24.0 m.

8. Shale: moderately recessive, probably dolomitic, dark grey to black; crumbles into small (0.5-3.0 cm) shards. Top at 25.8 m.

9. Dolostone: dark grey, finely crystalline, moderately hard to soft, black on fresh surfaces, with conchoid fracturing; swellings of lamination on contact with mudrock indicate pre-compactional (early diagenetic) origin. Conodont sample 16KOA021/26.0. Top at 26.2 m.

10. Shale: siliceous and dolomitic, crumbly, recessive, with very gradual transition from underlying dolostone. Top at 26.6 m.

11. Siliceous shale: intercalated with chertstones, flaggy to fissile, weathering yellow; low-contrast shale-chertstone alternation locally defines 3-5 cm thick rhythms; poorly segregated dolomitic lenticles (and dolostone-limestone nodules occur at 29.2-29.4 m (Figure 82). Conodont sample 16KOA021/29.3. Top at 37.4 m.

12. Shale: black, relatively recessive, fissile, pelitomorphic and minor silty, weathered into smaller (0.5-2.0 cm) flakes. Poorly preserved sponge spicules were encountered. Calcareous nodules with decomposed pyritic rinds in uppermost part. Conodont sample 16KOA021/39.0. Top at 39.0 m.

13. Shale-chertstone alternation: very similar to unit 11; low-contrast alternation of more fissile siliceous shales and brittle chertstones with fine conchoid fracturing (jointing); texture pelitomorphic to vaguely silty; weathers ochre rusty; common weathered pyrite nodules. Top at 44.3 m.

14. Siliceous shale: thick (0.4-0.5 m) alternation of very fissile shales and harder subfissile cherty intervals. Uppermost part very gradational. Top at 48.5 m.

Figure 81. Rumbly Creek Canol section. (A) Lower part of section with elliptical carbonate nodules in unit 2 (arrowed, partly slumped) and marker dolostones (units 3 and 5). (B and C) Wet surface of unit 11 showing alternated cherts (thin flaggy beds) and shales (fissile interbeds); (C) is close-up of interbedded cherts (cht) and shales (shl); note fine conchoid fracturing and lamination in chert beds; rugged upright surfaces are stylolites. (D) Dolostone of unit 3 with lamination arrowed.

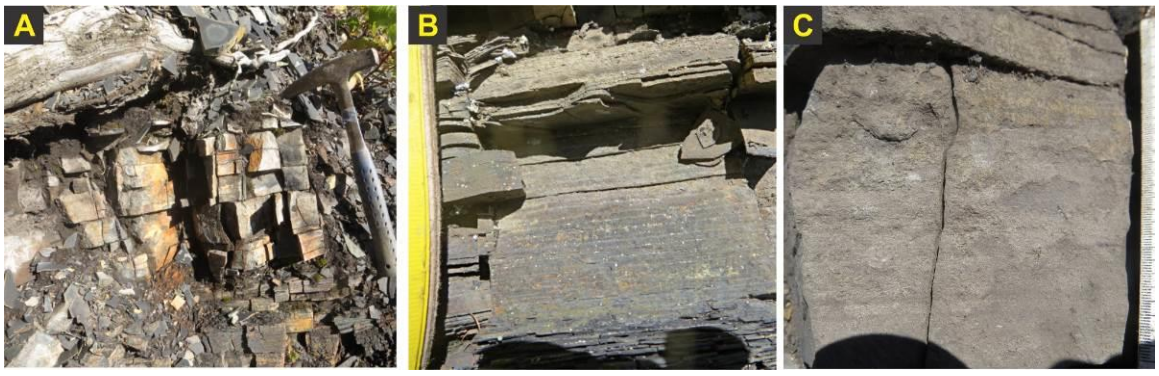

Figure 82. Dolomitic lenticles in unit 11 at 29.2-29.4 m: (A) appearance in a weathered outcrop; (B and C) finely crystalline texture and variously preserved sedimentary lamination.

Figure 83. (A) calcareous-pyritic nodule (pyrite decomposed into rust) in top of unit 12. (B) rib-forming cherty beds in the fissile shale of unit 15.

Units 15-17 comprise the Canol-Imperial transitional interval; contact of formations is provisional, picked by SGR.

15. Shale: black, hard, fissile, weathers into thin and sharp 0.5-3.0 cm wide plates; with intercalations of thin (0.5-5.0 cm) flaggy chertstones that are more resistant (rib-forming) and weather rusty yellow on vertical surfaces; rare small rusty pyritic nodules; top right above the last chertstone bed. Top at 54.3 m.

IMPERIAL FORMATION

16. Shale: black, hard (not swelling upon wetting), fissile, recessive, pelitomorphic, weathers into small (< 2 cm) shards and crumbles; very little yellow residue on weathered surfaces; no pyrite nodules. Top at 60.9 m.

17. Shale: fissile, slightly harder (more siliceous) than below, forming a low semi-resistant bench in a generally recessive interval; yellow powdery residue on weathered surfaces; becomes more recessive to the top where weathering produces smaller shards and flakes; small spicules of siliceous sponges are common; uppermost part grading into grey shale (64.0-64.4 m). Top at 64.4 m.

18. Shale: soft, recessive, swells upon wetting, variably silty; alternating dark grey and bluish grey shales; grades to muddy siltstone in the uppermost part. Top at 67.5 m.

19. Siltstone: dark greenish grey on fresh surfaces, weathers crimson, muddy and sandy, finely fractured; minor laminae of muddy very fine-grained sandstone; unit hosts flattened elliptical dolomitic nodules with rusty coatings. Top at 70.5 m.

20. Alternation of sandstones and siltstones: rhythmic coarsening-upward unit; sandstones are hard, massive, very fine-grained (≥ 0.1 mm), with rusty speckles left after oxidation of pyrite; dark grey on fresh surfaces, weather beige; upper parts of normally graded rhythms are formed by siltstones and locally capped by shales; the shale interbeds are very thin and prominently recessive (many of them caved into fissures); shales and siltstones contain an abundance of coaly detritus. Hummocky cross-stratification is common and especially distinct in siltstone parts of rhythms. Top at around 80.5 m.

Figure 84. Basal Imperial sandstone: (A) three-member rhythms in unit 20, at 72.0 m; (B) two-member rhythms in unit 21 at 87.0 m; (*ms*) is massive basal sandstone, (*hcs*) is sandstone with hummocky cross-lamination, and (*md*) is recessive mudrock (siltstone and shale).

21. Sandstone: very fine-grained to fine-grained, weathering pale yellow and brown (lighter colored than unit 20), thick-bedded (0.1-0.4 m), with thin shale and siltstone interbeds; the interval shows a rhythmic repetition of these beds, different from unit 20 by predominantly sandstone composition and thinner upper parts of rhythms. No channel facies was observed. End of observation at 90.0 m. The bedrock above is reworked into soil.

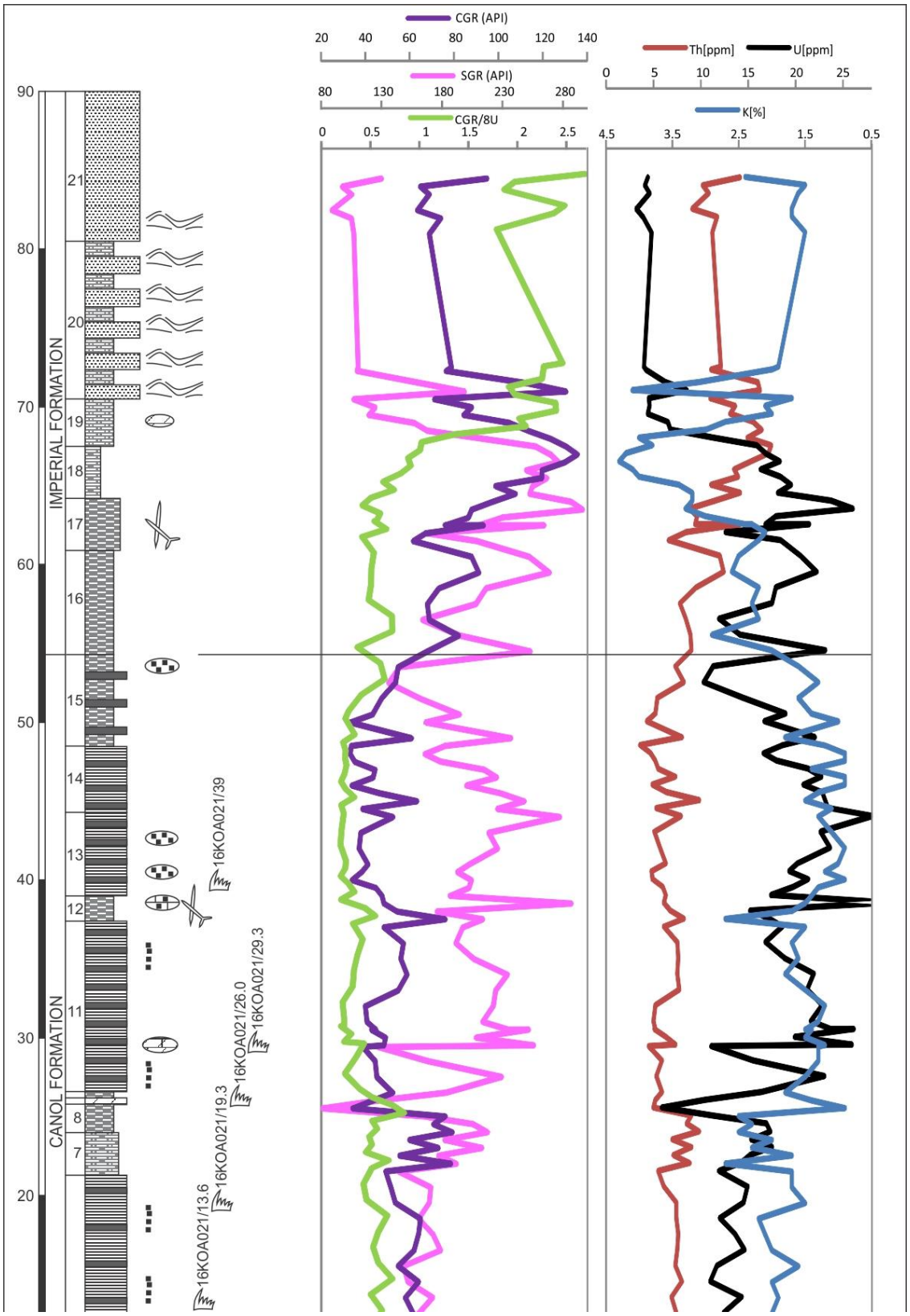

Figure 85. Litholog and SGR logs of Rumbly Creek Canol section. See Figure 33 for legend.

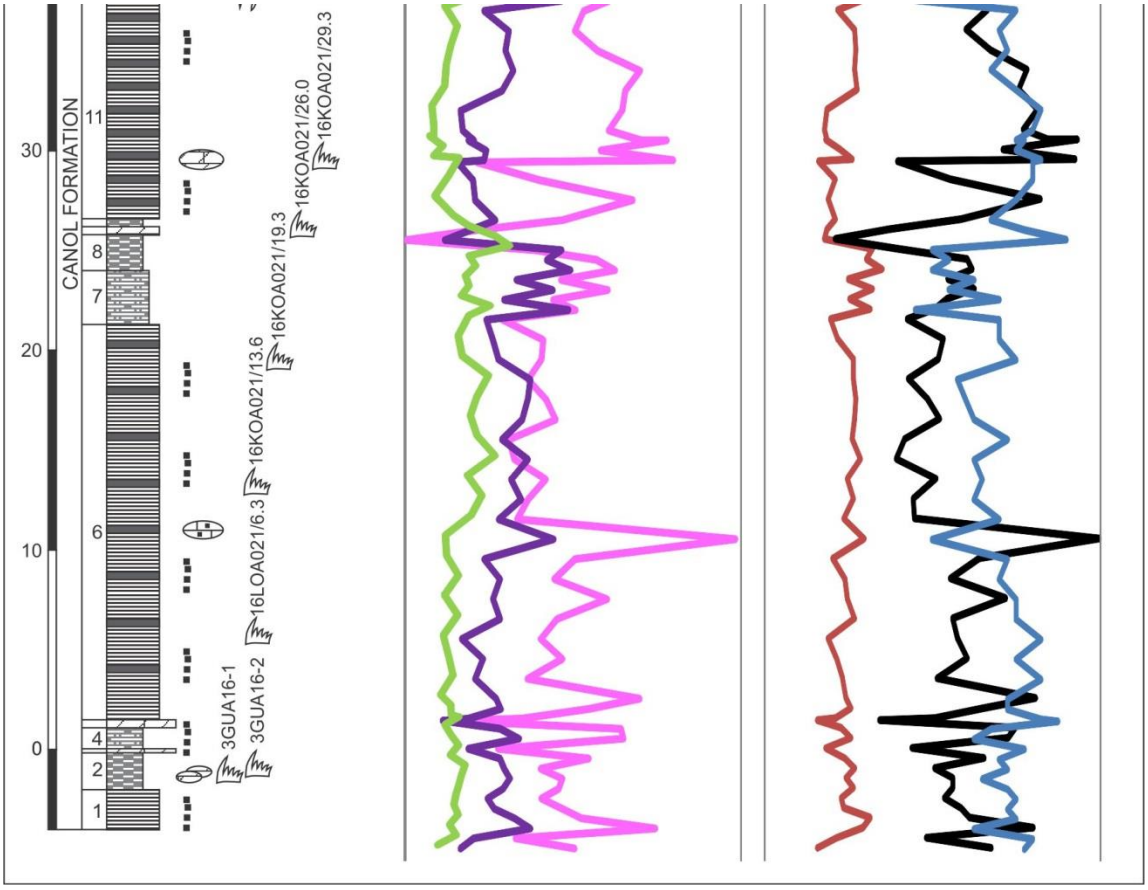

Figure 85 (continued). Litholog and SGR logs of Rumbly Creek Canol section. See Figure 33 for legend.

Powell Creek Canol

Base of section: 16KOA005	
DATUMZONE	NAD_1983_UTM_Zone_9N
ELEVATION	350.5
LATITUDE	65.277455
LONGITUDE	-128.773645
PDOP	2.5
SATS USED	7
VISITDATE	2016-07-17

Zero datum at base of unit 3.

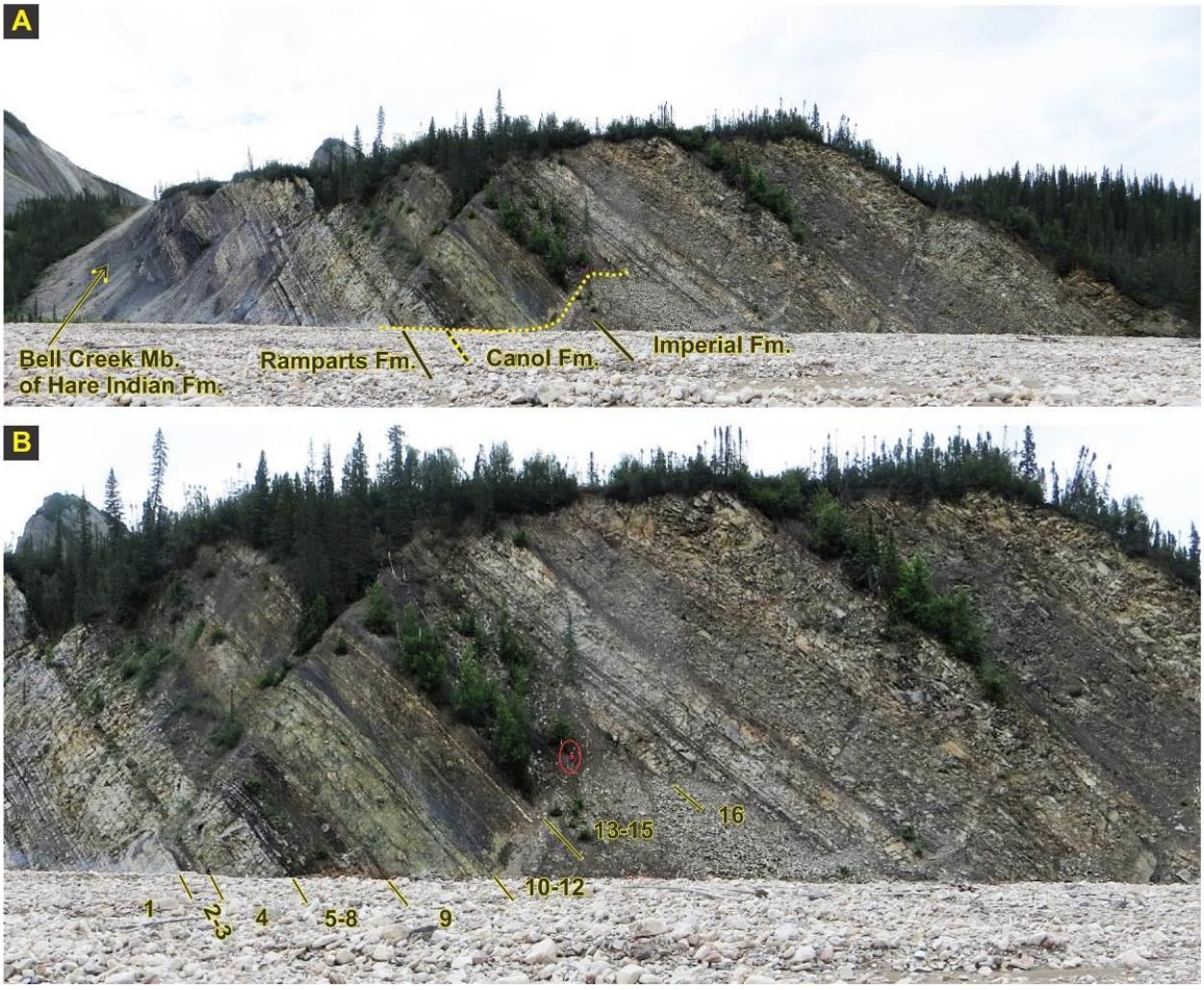

Figure 86. Type section for Canol Formation with interpreted descriptive units: (A) traverse of the measured section indicated by dotted line; (B) zoom-in with interpreted descriptive units; geologist in circle for scale.

RAMPARTS FORMATION

LOWER PLATFORM MEMBER

1. Limestone: pale grey, resistant, with distinct medium to thick bedding, with thin-bedded (< 0.3 m) and nodular interbeds of more argillaceous limestones and shales. The upper 1.5 m show patches of mass in-situ pachyporid corals (genus *Thamnopora*) and probably other reef-forming encrusting fossils. Texture: bioclastic packstone to bafflestone. The top is gently undulating with an amplitude not exceeding 20 cm (Figure 87). Estimated thickness is 9-11 m. The unit is underlain by a limestone-shale alternation. Top at -1.5 m.

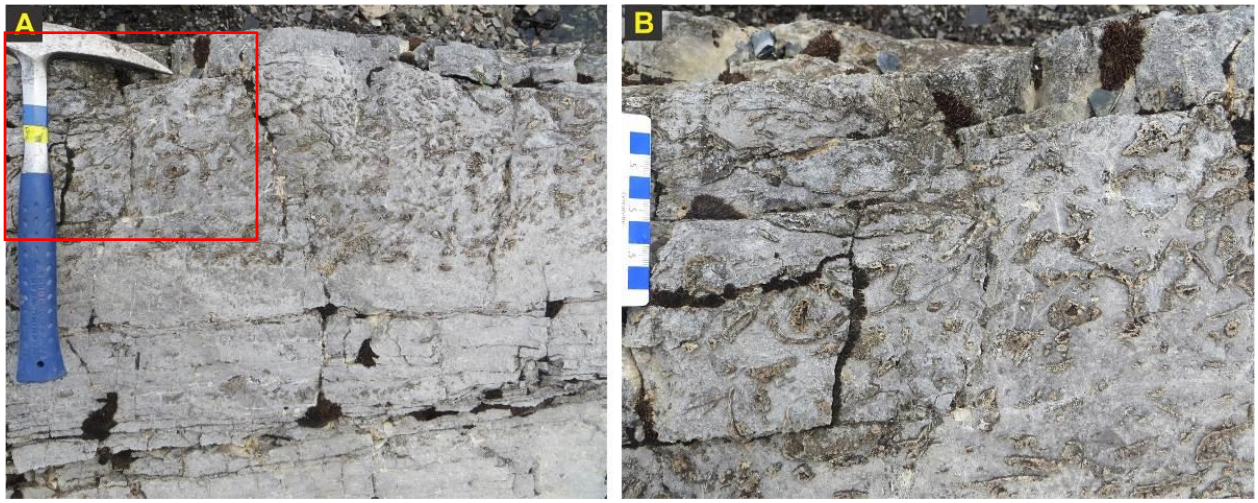

Figure 87. Top of unit 1 with encrusting fossils forming boundstone; (B) zoom-in to the red box in (A).

CARCAJOU MEMBER

2. Limestone: Thin-bedded (0.5-20 cm), argillaceous, dark colored (black on fresh surfaces), intercalated with 1-5 cm thick calcareous shales, with fine-grained, micritic-bioclastic partly laminated and partly bioturbated texture. The lamination is thin (1-2 mm), wavy and discontinuous, mostly developed in upper parts of bed (Figure 89A). Fossils: scattered brachiopod valves. Top at 0.0 m.

3. Shale: brownish black, very recessive, calcareous, fissile, weathers into thin plates, with chains of micritic limestone nodules. Limestone nodules show faint lamination and expel fetid odor when crushed. Top at 0.3 m.

3A. Limestone: lenticles or possibly slumped blocks of hard massive limestone with texture of *Thamnopora* boundstone; the measured lenticle is 0.55 m thick and 2.5 m wide along strike (Figure 89A). The shale of unit 3 is pinched under this lenticle to less than 5 cm in thickness.

Figure 88. Ramparts and Canol formations with measured units; bedding downlap in unit 4 is partly traced; yellow arrow locates unit 8; white arrow points at a large pyritic-calcareous nodule.

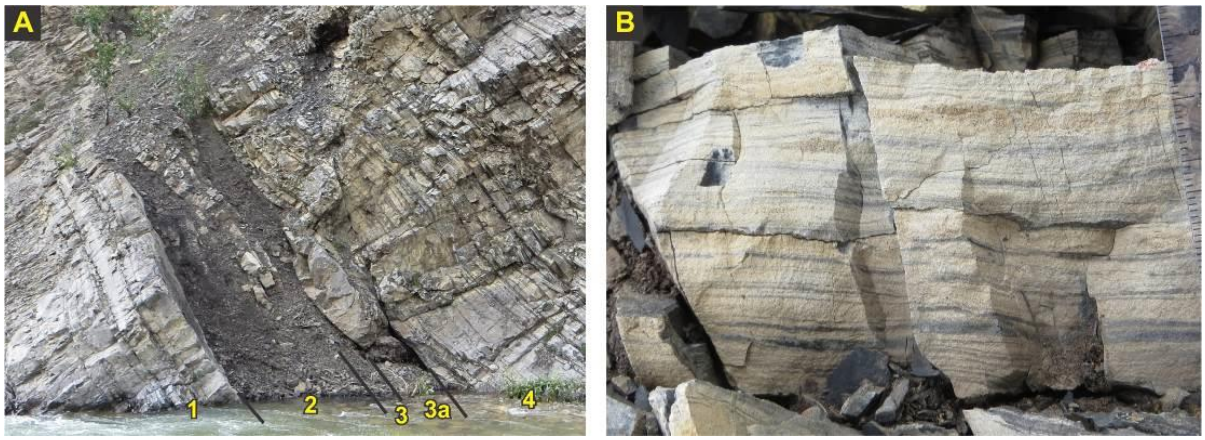

Figure 89. (A) Close-up at units 1-4. (B) Unit 2, lamination in upper part of limestone bed.

RAMPARTS OR CANOL FORMATION

ALLOCHTHONOUS LIMESTONE MEMBER

4. Limestone: resistant, cherty, thin to medium bedded and finely laminated with no observed bioturbation. Extensive development of black stratiform chert nodules. Top conformable through gradation to papery black shale with less calcareous material. The unit is distinct by synsedimentary slumping structures with pinching, swelling, contorted (wrinkled) bedsets (Figures 90B and 90C) and downlapping terminations of bedsets at larger scale (Figure 88). Fossils: graded bioclastic crinoid-rich beds, pavements of disarticulated brachiopods (Figure 91A). Conodont sample 1GUA16-1. Top at 4.5 m.

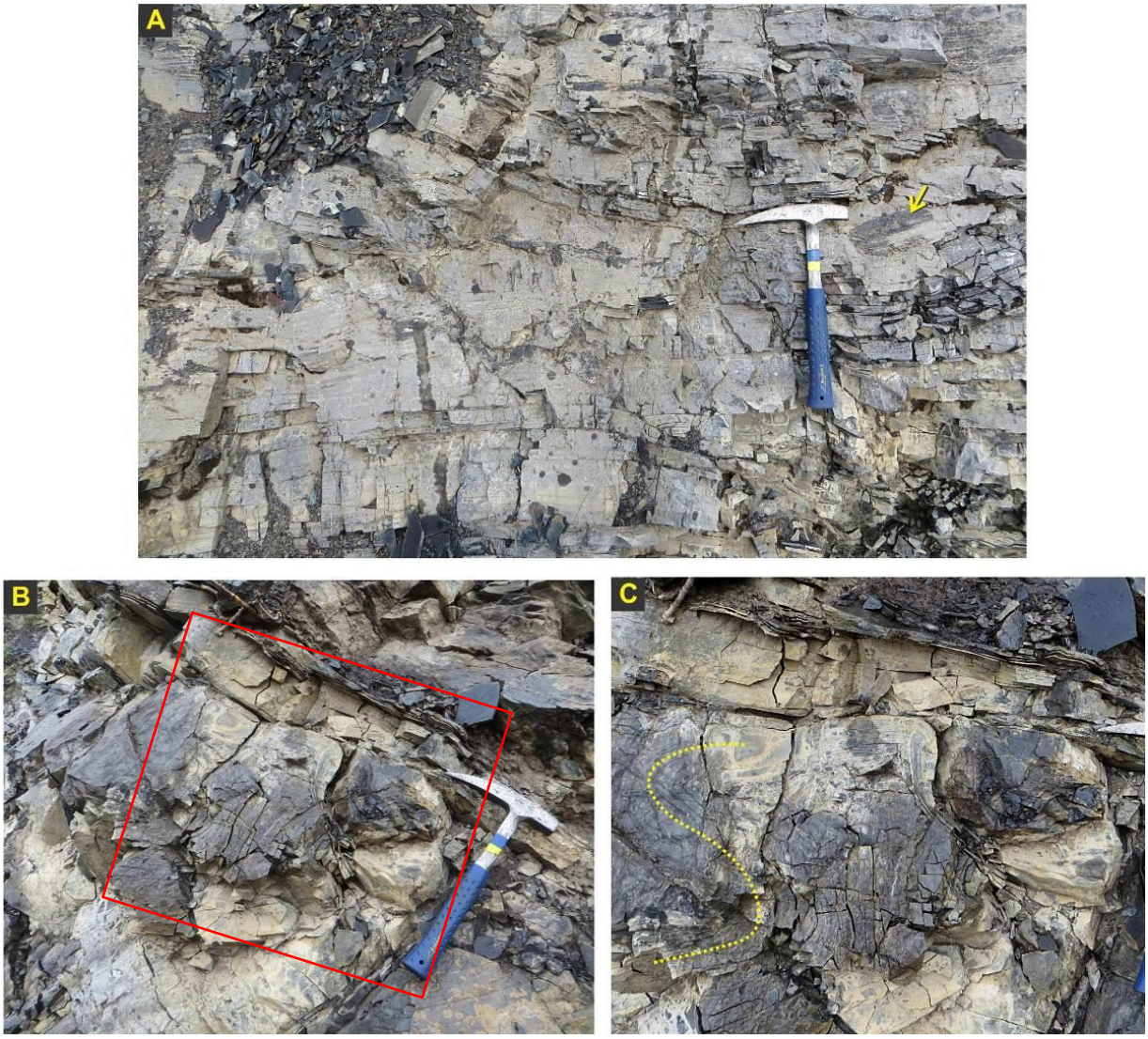

Figure 90. Allochthonous limestone member (unit 4): (A) Wavy bedding of finely laminated limestone, black chert is arrowed; (B and C) slumping structure; (B) is sinistrally rotated central part of (C) showing strongly contorted laminae (partly traced from left edge).

CANOL FORMATION

5. Shale: black, fissile, papery, calcareous, with several 3-10 cm thick beds of limestone; low-amplitude slumping textures. Limestone beds: graded bioclastic packstones (Figures 91B and 91D). Top at 7.6 m.

6. Limestone: 15 cm thick normally graded bed of bioclastic crinoid-rich packstone; the upper half contains rolls of laminated marl and flakes of black shale; the latter concentrate in top. Somewhat thicker and more traceable than graded beds in unit 5. Conodont sample 1GUA16-2. Top at 7.75 m.

7. Shale: hard, black, siliceous, laminated, calcareous to non-calcareous, thin-bedded or platy (0.1-2.0 cm), weathers rusty red (Figure 91B); upper 0.5 m weathers partly yellow. Calcareous material mostly as calcisiltite laminae (< 5 mm thick) and rare crinoid-rich calcarenite; two thickest calcarenite beds at 9.3 m and 9.65 m (both sampled for conodonts 1GUA16-3 and 1GUA16-4). Top at 10.75 m.

Figure 91. Limestone beds in units 4-7. (A) Bedding-plane view near the top of unit 4 with arrowed brachiopod valves. (B) Unit 7 with two arrowed limestone beds at 9.3 m and 9.65 m; (C) is close-up of the limestone bed at 9.3 m; note erosional base and fining-upward texture. (D) Graded bed of unit 6 with rolls of laminated marl (yellow arrow) and flakes of black shale (black arrow).

Figure 92. Clay seam of unit 8 (sampled for juvenile zircons).

8. Clay: bluish grey, very soft, weathered – possibly bentonite; contains partly decomposed nodules and coarsely crystalline aggregates of pyrite. Top at 10.7-10.8 m.

9. Siliceous shale to chertstone: hard, resistant to semi-resistant, laminated, thin-flaggy (platy), dark steel grey on fresh surfaces, weathers yellow with minor crimson; the basal 0.5-0.8 m is rustier weathered, which makes it similar to unit 7. Cm-scale rhythmic alternation of shales and chertstones: shales are more fissile, whereas chertstones are relatively monolithic and finely jointed with conchoidal fracture surfaces (Figures 93A and 93B). The interval is generally non-calcareous; a calcareous tentaculitid seam (0.5 cm thick) is observed at 13.2 m. Authigenic carbonate nodules of two types: (1) elliptical calcareous-dolomitic-pyritic nodules, some of them reaching 0.7 m in diameter; (2) dolostone lenticles in the upper one-half (Figure 88). The latter are finely crystalline, expelling fetid odor when crushed. Conodont samples 1GUA16-5 to 1GUA16-8. The upper 0.6 m is less resistant and contains a thin (2-5 cm) horizon of recessive fissile shale with poorly formed dolostone lenses; the latter preserve ghosts of tentaculitid cones. Top at 22.1 m.

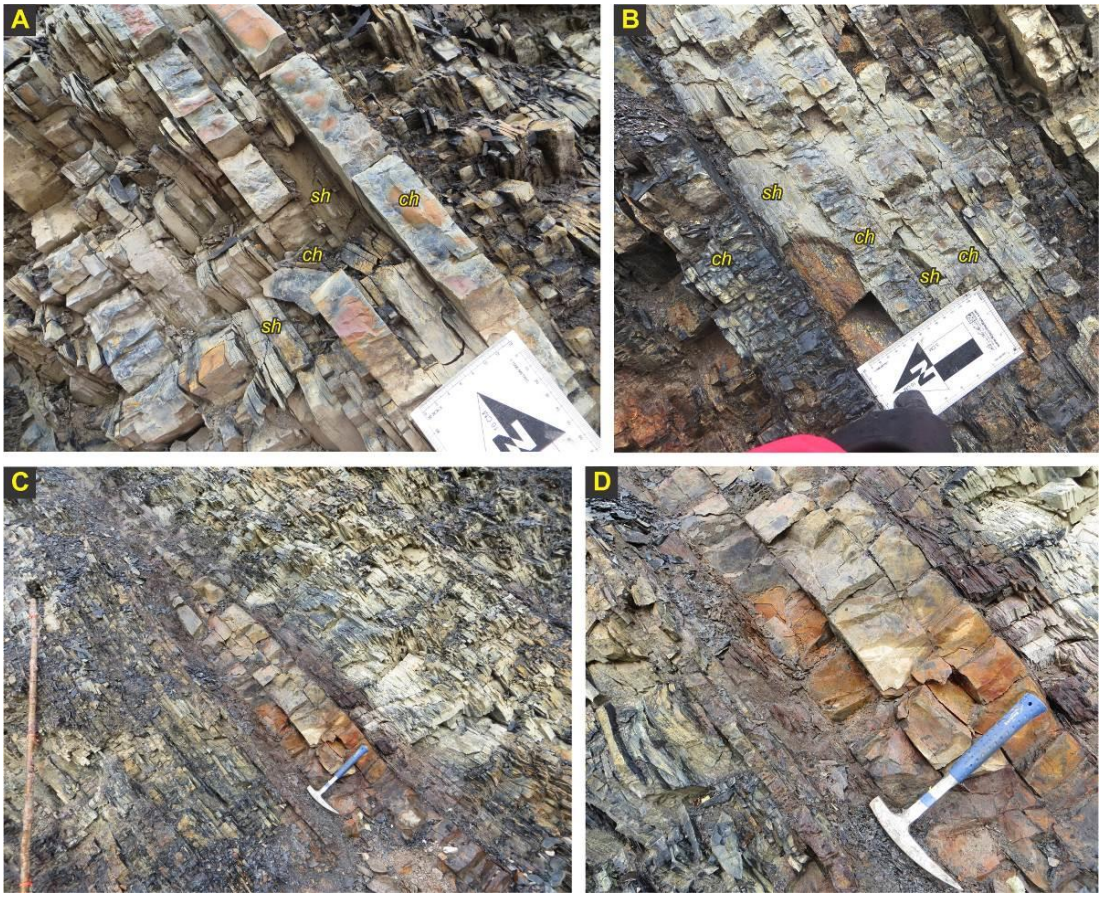

Figure 93. Unit 9: (A and B) typical rhythmicity with alternating shales (*sh*) and chertstones (*ch*); (C and D) dolostone lenticle at 20.0 m, (D) is close-up of (C).

10. Shale: siliceous, hard, slightly more recessive than unit 9; black and steel grey on fresh surfaces; weathers in small shards and sharp plates with less rusty surface material than in units 7-9. Lowermost 1.0 m transitional from unit 9; contains rare chertstone beds and weathers yellowish. At least three lenticular horizons of authigenic dolostone; the middle horizon is the thickest (0.15 m) and most traceable. Conodont sample 1GUA16-9. Top at 29.1 m.

11. Shale-dolostone alternation: low-contrast interbedding of fissile black shale and authigenic dolostones; the latter are black on fresh surfaces and grade into shales. The unit weathers rusty to yellow. Top defined by the base of the first limestone bed (conodont sample 1GUA16-10). Top at 30.2 m.

12. Shale-limestone alternation: in lower 2/3 dominated by shales with nodular limestones (also described as calcareous nodules); some calcareous nodules are wrapped in rusty rinds of decomposed pyrite. The main calcareous bed in the upper 1/3 is a mixture of finely to coarsely crystalline calcite, dolomite, and rusty material with complex diagenetic structures (Figure 94): chambers, cloudy irregular fabric, and fan-shaped calcite aggregates (or pseudomorphs after other mineral). Conodont samples 1GUA16-11 and 1GUA16-12. Top at 31.2 m.

IMPERIAL FORMATION

13. Shale: fissile, dark steel grey, pelitomorphic, moderately hard at base and progressively softer and more recessive to the top; weathers into small flakes and shards with crimson and minor yellow surface staining. Top at 33.6 m.

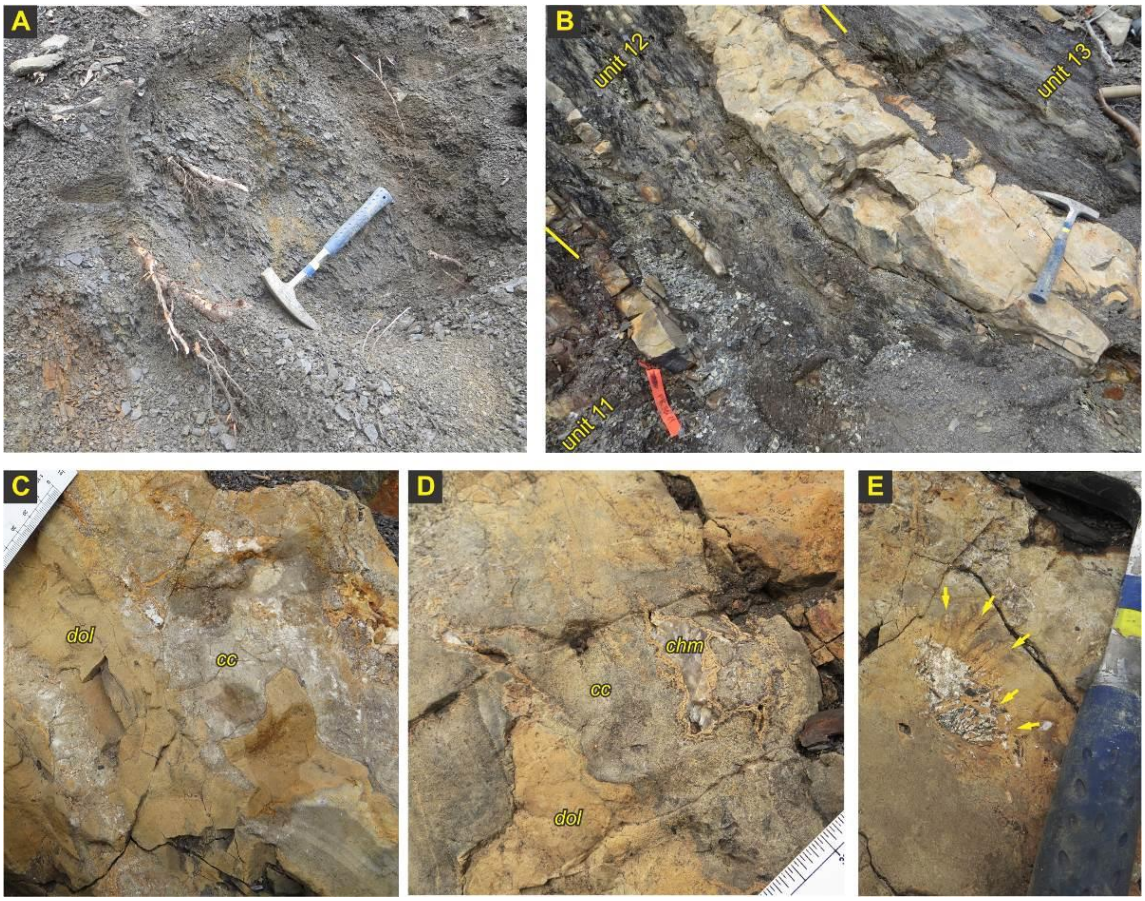

Figure 94. Top of Canol Formation and basal Imperial shale: (A) Uncovered soft shale of unit 14; (B) unit 12 with thin nodular calcareous beds in lower part and a thick bed in upper part; (C-E) fabrics of upper carbonate bed: (*dol*) is dolomite, (*cc*) is calcite, (*chm*) is chamber filled with drusy calcite spar; (E) fan-shaped calcite aggregate with arrowed terminations of radiating crystals.

14. Shale: recessive, soft, homogeneous, pelitomorphic, light grey colored, crumbling out in small (about 1 cm) plates. Smells of brick indicating high content of clay minerals. The interval was trenched from the vegetated talus. Top at 38.3 m.

15. Shale: dark grey, partly silty, with siltstone laminae, locally slickensided. Together with units 13-14 recedes in a vegetated gully (Figure 86B) but is slightly harder and better exposed than unit 14; weathers brown and crimson. The upper one-half is silty shale to siltstone with very fine coaly detritus. Top is sharp, erosional, at 48.3 m.

16. Sandstone: in basal 1.5 m light grey, thick-bedded, fine-grained (0.1-0.25 mm), massive to laminated, hard, resistant and wall-forming. Thickness not measured.

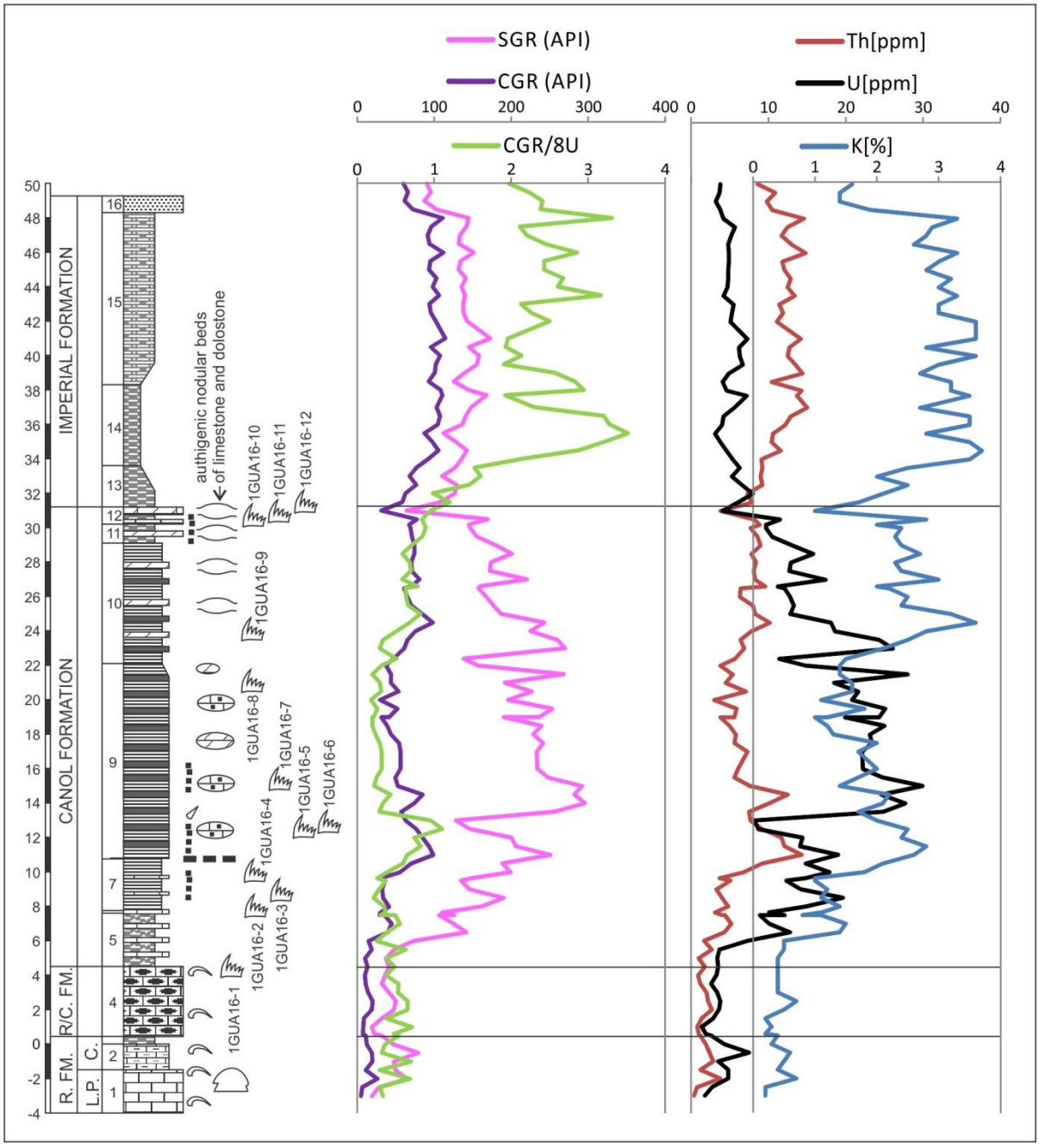

Figure 95. Litholog and SGR log of Powell Creek Canol section. See Figure 33 for legend. Abbreviations: R.FM. – Ramparts Formation, L.P. – Lower Platform Member, C. – Carcajou Member, R/C FM. – Ramparts or Canol Formations.

Turnabout Creek Ramparts-Canol

Base of section: 16KOA030	
ELEVATION	511.6
LATITUDE	65.324645
LONGITUDE	-129.645705
PDOP	2.3
SATS USED	7
VISITDATE	2016-08-01
Top of section: 16KOA031	
ELEVATION	508.4
LATITUDE	65.323685
LONGITUDE	-129.644313
PDOP	2.9
SATS USED	6
VISITDATE	2016-08-01

Zero datum at water level in the upstream corner of outcrop.

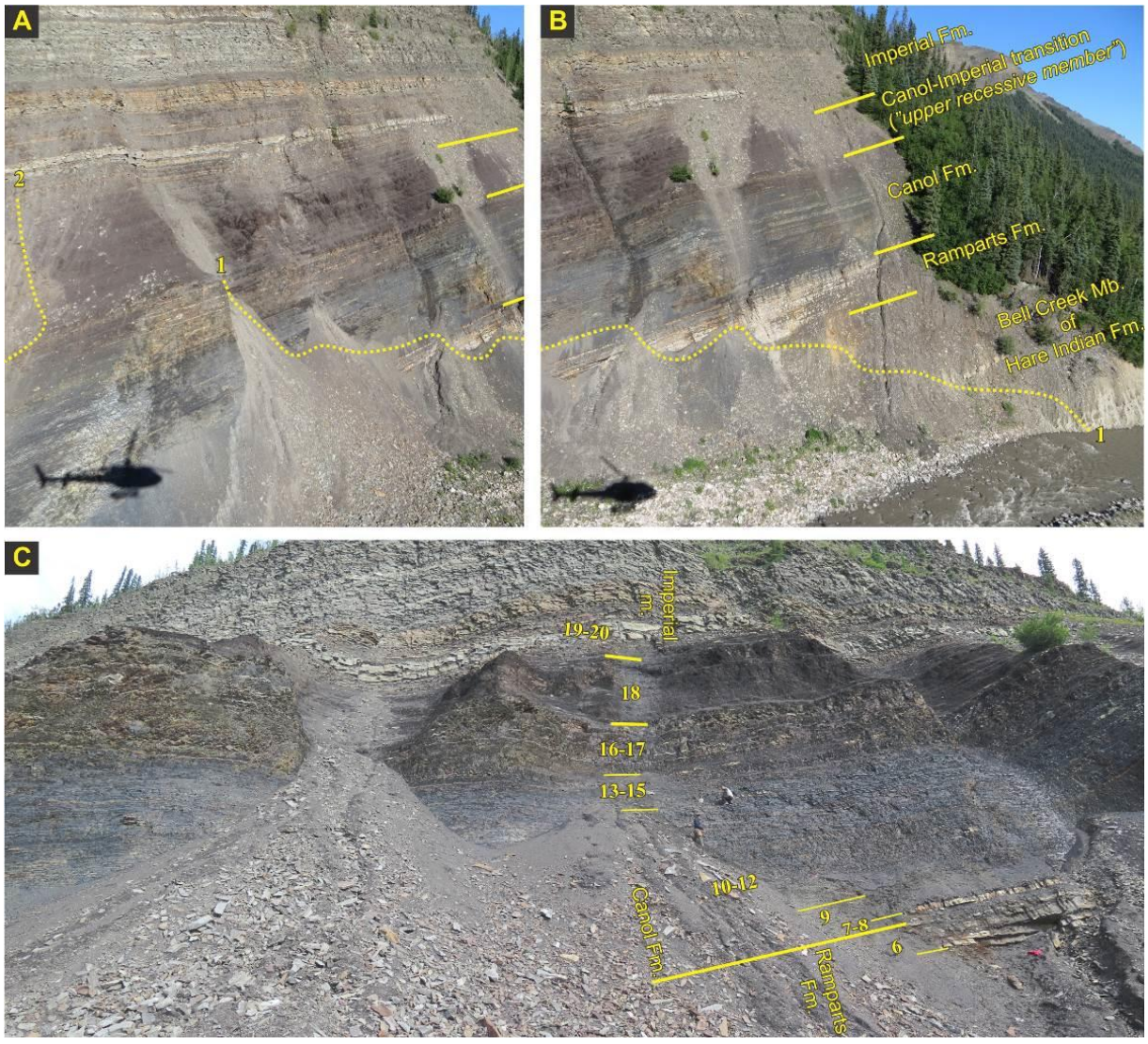

Figure 96. Horn River Group – Imperial section at Turnabout Creek: (A and B) Dot-traverses of measured sections, overlapping airborne views, helicopter shadow for scale; (C) ground view with traced descriptive units.

HARE INDIAN FORMATION

BELL CREEK MEMBER

1A. Siltstone: greenish light grey, muddy, recessive, with nodular resistant beds of calcareous siltstone. Top at 4.3 m. The unit continues under water (stratigraphically downward) and apparently under the scree (stratigraphically upward).

Covered: 4.3-8.5 m.

1B. Siltstone and shale: greenish grey soft shales and siltstones with calcareous nodules and nodular beds. A chain of flattened calcareous nodules with disarticulated brachiopods right under the top. Top at 10.2 m.

2. Limestone: pale yellowish grey, silty, finely crystalline (microsparitic) with nodular bedding and shale interbeds in lowermost and uppermost part and massive in the middle; bioclastic wackestone with rare macrofossils. Top at 11.5 m. Bed dip: 28/281

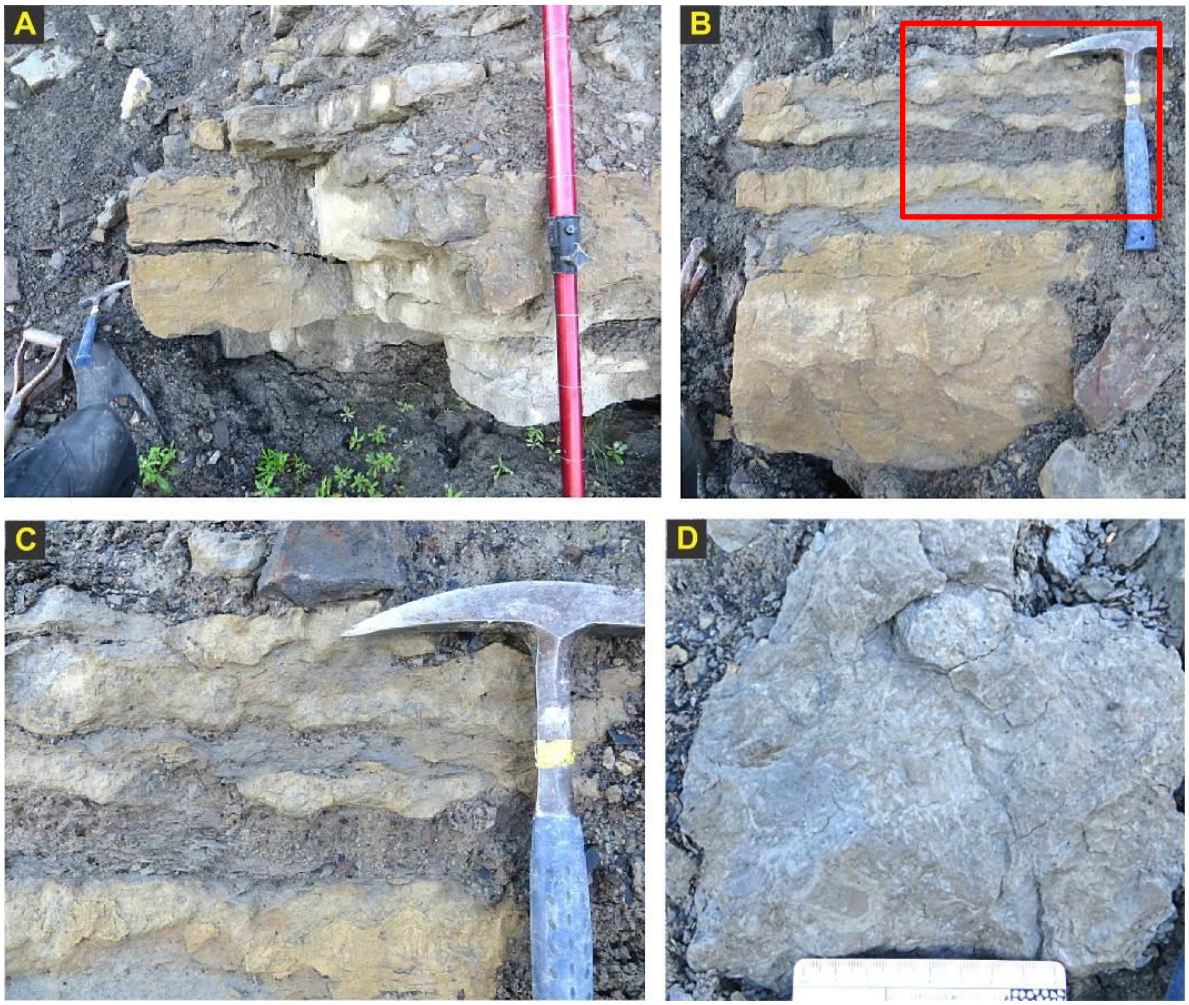

Figure 97. Bell Creek Member of Hare Indian Formation: (A-C) limestone of unit 2; rectangle on (B) frames close-up on (C). (D) Intensely bioturbated siltstone, unit 1.

3. Siltstone: greenish grey, variously calcareous and argillaceous, bioturbated, intercalated with nodular limestones. Uncovered top at 13.0 m; this unit apparently continues upward under the scree.

Covered: 13.0-21.0 m.

4A. Siltstone and shale: interbedding of pale grey soft shales, slightly harder calcareous siltstones, and minor silty nodular microsparitic limestones, dissected by rusty partings/joints. Uncovered with shovel up to 24.0 m.

Covered: 24.0-25.4 m.

4B. Siltstone: soft, bluish grey, with nodular horizons of silty limestone. Top at 26.5 m.

The interval of units 1-4 is overall recessive.

RAMPARTS FORMATION

"LOWER PLATFORM MEMBER"

5. Limestone: brownish grey on fresh surfaces, weathering pale yellow, very silty and argillaceous, with poorly formed elliptical chert nodules; low-contrast alternation of 0.1-0.3 m thick limestone beds and more recessive interbeds of silty shale and nodular limestone. Wavy undisturbed lamination is mostly preserved in silty and shaly interbeds; bioturbation is overall weaker than in units 1-4 where no laminated facies were observed. Graded bioclastic beds with erosional soles and brachiopod coquinas (Figure 99). A thick nodular siltstone-limestone interval with lamination and minor slumping wrinkling at 29.0-30.3 m. Very argillaceous nodular limestone in upper 0.8-0.9 m. Top at 32.5 m.

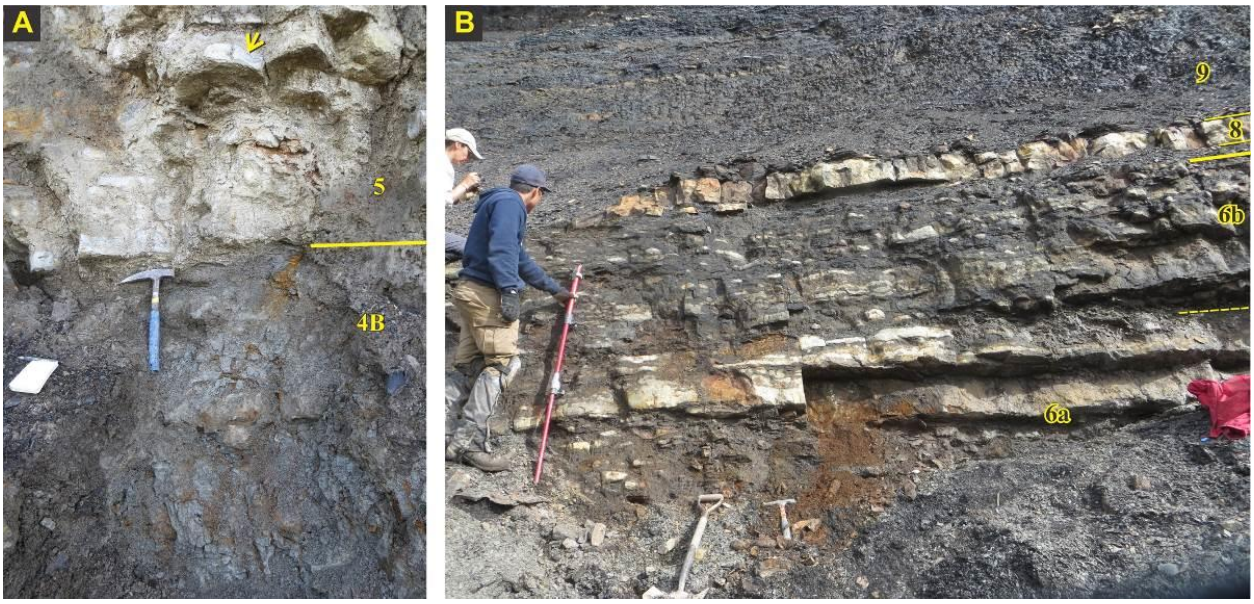

Figure 98. Top and base of Ramparts Formation: (A) base at contact of units 4B and 5, a chert nodule is arrowed; (B) Carcajou Member (6a and 6b) and basal part of Canol Formation.

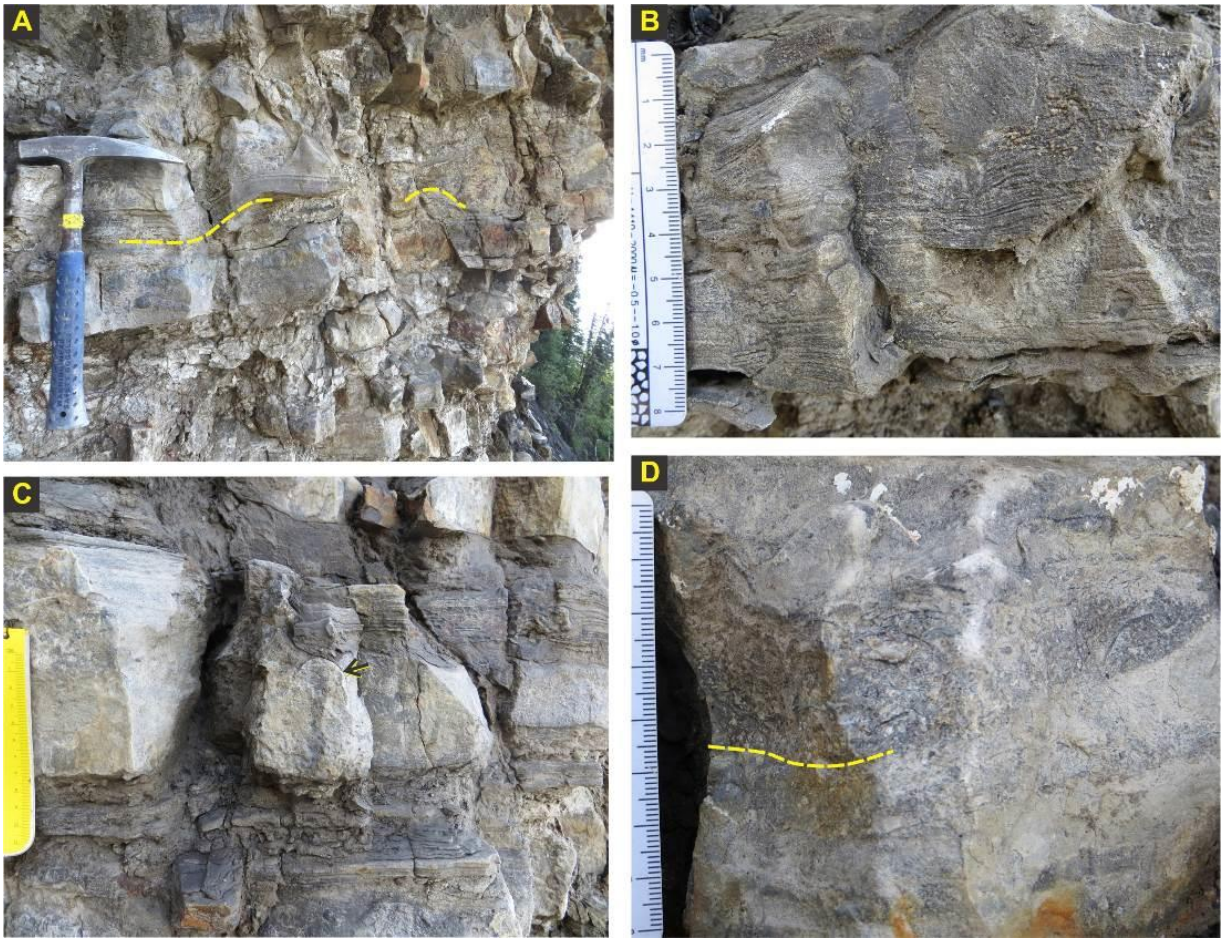

Figure 99. Unit 5: (A) rhythmic bedding; lamination buckled from slumping is partly traced; (B) lamination in a silty limestone; (A and B) 29.0-30.3 m; (C) limestone-siltstone alternation; (B) graded bioclastic bed with partly traced scouring sole; (A and B) from 28.0-29.0 m.

CARCAJOU MEMBER

6. Limestone: darker colored, more monolithic and recessive than unit 5; pale grey limestone nodules are floating in black silty and calcareous matrix. Fossils: diverse, mostly disarticulated, brachiopods. Ichnofossils: *Phycosyphon*(?), *Diplocraterion*. The unit is divided in two subunits (6a and 6b) of nearly equal thickness by very dark grey fine-grained calcareous sandstone to siltstone. The lower subunit (6a) has slightly lighter colored matrix and contains more diverse macrofossils (solitary rugose corals, small stromatoporoids, bryozoans, and brachiopods). Top at 34.4 m.

CANOL FORMATION

7. Shale: black, very fissile, laminated, siliceous, very rusty, silty and sandy, weathers into sharp flakes. Top at 34.6 m.

8. Limestone: hard and monolithic, silty, with conchoid fracturing, with planar top and base; black on fresh surfaces, weathers intensely rusty. Graded bioclastic bed with shale flakes in the upper finer-grained part. Lamination is not obvious; Horizontal preferred orientation of bioclasts indicates lack of bioturbation. Top at 34.9-35.0 m.

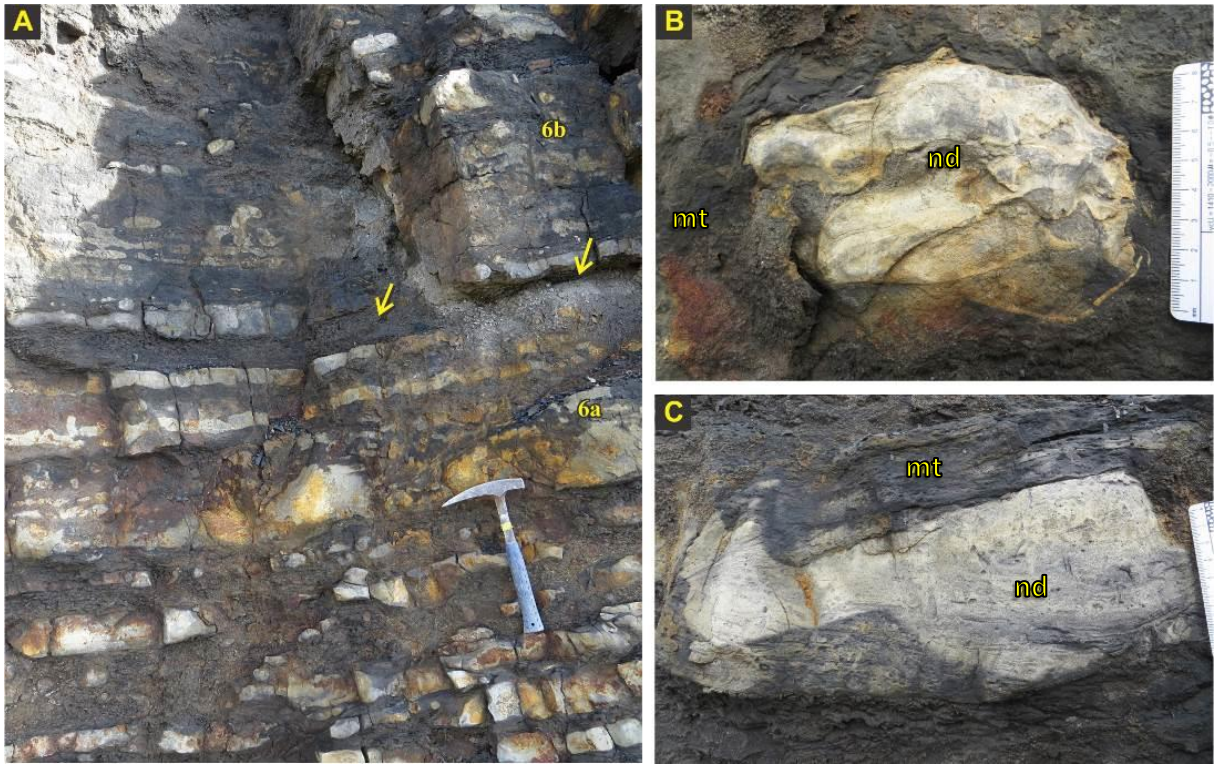

Figure 100. Carcajou Member: (A) rhythmic bedding; arrows at the sandstone seam between 6a and 6b; (B and C) close-ups at subunit 6b with pale colored nodules (*nd*) in thick dark matrix (*mt*).

Figure 101. Unit 8; graded bioclastic composition of this limestone is emphasized by natural etching on (B); the sharp sole is partly traced from the left.

9. Shale: black, very recessive, pelitomorphic at base, progressively harder and siltier upward. Weathers yellow in basal part and rusty to yellow in the upper main part. Top at 36.1 m.

10. Siltstone: argillaceous and sandy, intensely fractured, with thick rusty crusts and zeolites on joints and fissility planes. Top at 36.7 m.

11. Shale: semi-recessive, silty at base and more pelitomorphic above, very fissile, weathering rusty. Top at 38.0 m.

12. Shale-chertstone alternation: moderately resistant, dark steel grey black, evenly laminated, thin bedded, weathering rusty with minor yellow. Rusty weathering is more intense in the upper one-half. Chertstones are massive and extensively jointed with conchoid surfaces. Shales are fissile. Common dolostone lenticles. Top at 45.0 m.

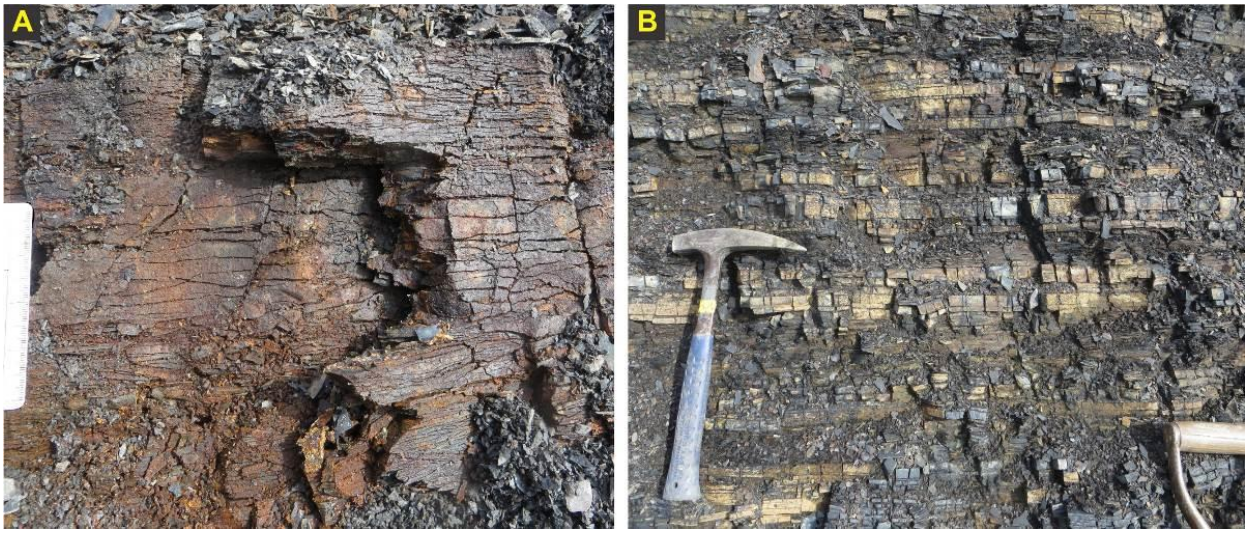

Figure 102. Canol Formation: (A) Siltstone of unit 10; (B) Alternation of siliceous shales and chertstones in unit 12.

Units 13-15 form a moderately recessive interval between two hard siliceous shales.

13. Shale: siliceous, slightly recessive, weathers rusty, with minor chert interbeds. A horizon of carbonate nodules at base. Top at 47.5 m.

14. Dolostone: muddy and silty, unevenly constricted, thin (≤ 20 cm), finely crystalline, weathering intensely rusty, retains fine parallel lamination. Top at 47.7 m.

15. Shale: siliceous, black, weathers yellow to rusty, relatively recessive, very fissile, pelitomorphic to silty. Top at 48.2 m.

16. Shale: siliceous, hard, moderately resistant, very homogeneous, black to dark steel grey, mostly pelitomorphic, weathers dull brown to intensely rusty, fissile with only minor conchoid fracturing characteristic of Canol chertstones. Large carbonate nodules at the base. Pinching dolostone horizon similar to unit 14 is traced at 50.8 m; smaller dolomitic lenses occur above and below. A horizon of rusty dolomitic shale with distinct calcareous nodules at 52.2 m. These nodules have coarsely crystalline texture and locally preserve poor remains of tentaculitid cones. The upper 1 m is slightly more recessive, with two thin horizons of soft rusty lighter-colored very fine-grained sandstone. Top at 53.4 m.

17. Shale: hard, fissile, pelitomorphic to silty, forming a low semi-resistant rib in outcrop. Top at 53.9 m.

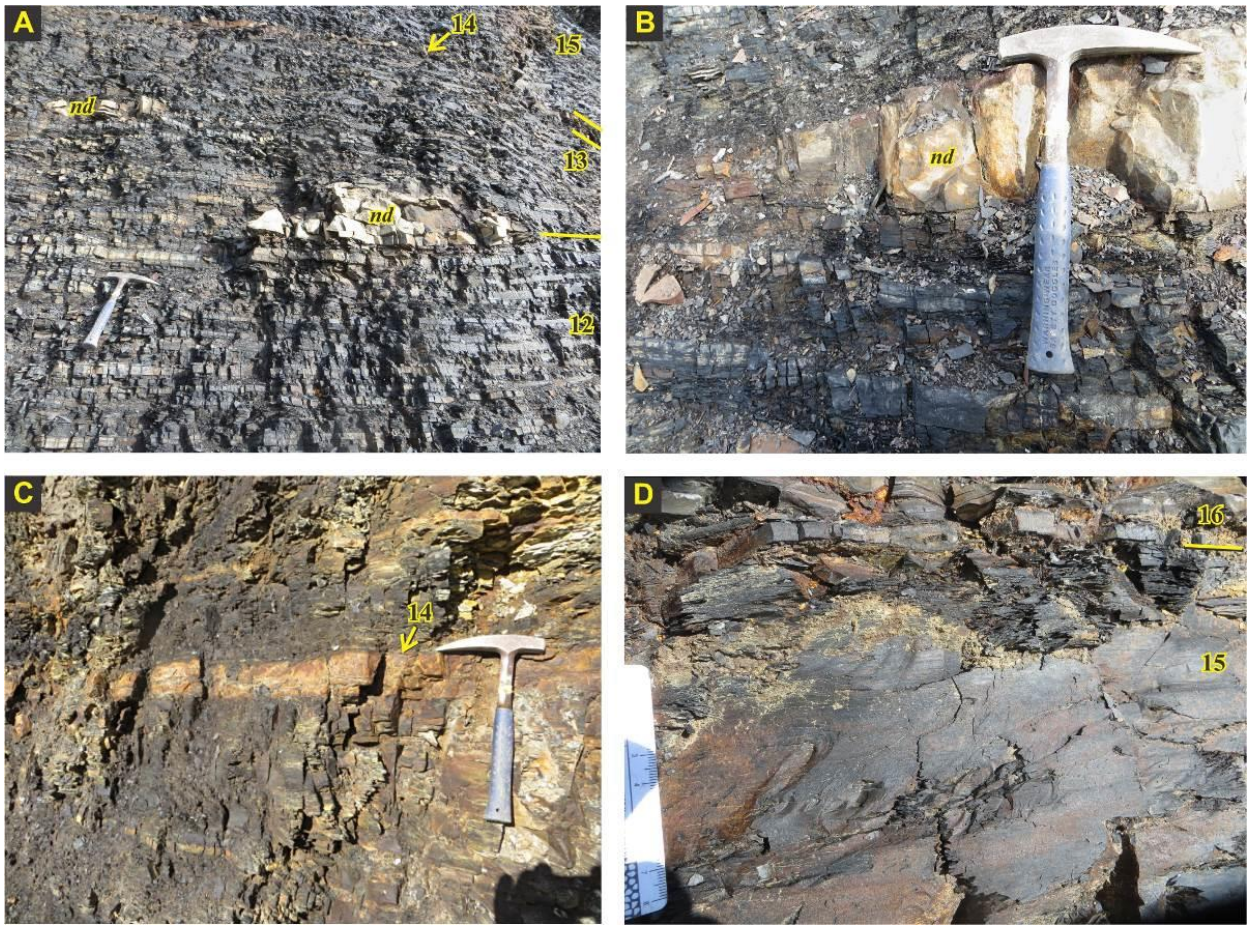

Figure 103. Canol Formation: (A) units 12-15; note carbonate lenticular nodules (*nd*) in unit 13; (B) close-up at one of nodules in unit 13; (C) rusty dolostone bed of unit 14 (arrowed on B and C); (D) fissile shale of unit 15.

Figure 104. Canol Formation, unit 16: Nodules of crystalline calcite at 52.2 m; yellow arrowed on (A); black arrow points at the host horizon of dolomitic shale and dolostone.

IMPERIAL FORMATION

18. Shale: fissile, dark brownish grey, moderately recessive, pelitomorphic to silty, hard, weathering into small (0.1-3.0 cm) shards with dull brown surface stain. Fine-grained coaly detritus on fissility planes. Small poorly formed nodules of dolomitic shale and argillaceous dolostone. Around 61.5 m the unit becomes silty, slightly more resistant, and at 63.0 m. grades into siltstones (alternation of silty shales and siltstones) with minor very fine-grained muddy sandstones. The siltstones in this upper part are dark bluish grey on fresh surfaces, weather crimson and are frost-shattered into small conchoidal chips. Top at 70.7 m.

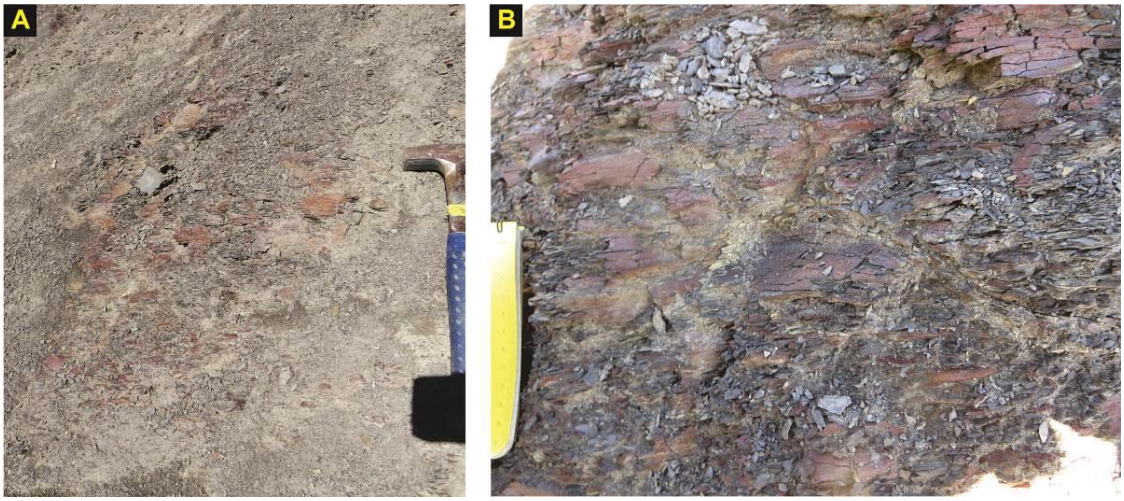

Figure 105. Crimson-weathering shales and siltstones of unit 18.

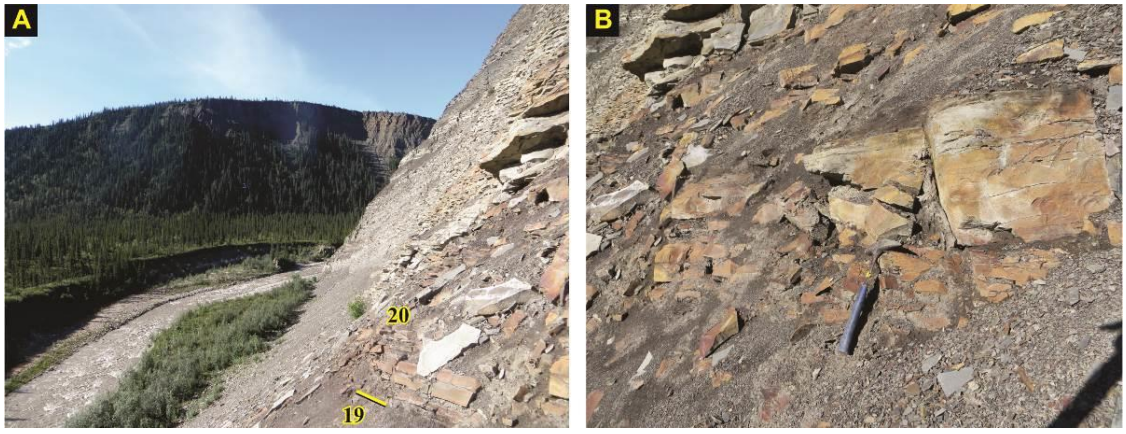

Figure 106. Basal sandstone of Imperial Formation: (A) view north (downstream) from the end of observation at traverse 2; (B) closer view of outcropping sandstone beds.

19. Shale: very soft and recessive, greenish grey, very silty; weathers dull yellow. The base is sharp. Top at 71.1 m.

20. Sandstones: coarsening-upward rhythmic succession of fine-grained sandstones and siltstones. Measurement stopped at the second main sandstone bed at 74.0 m.

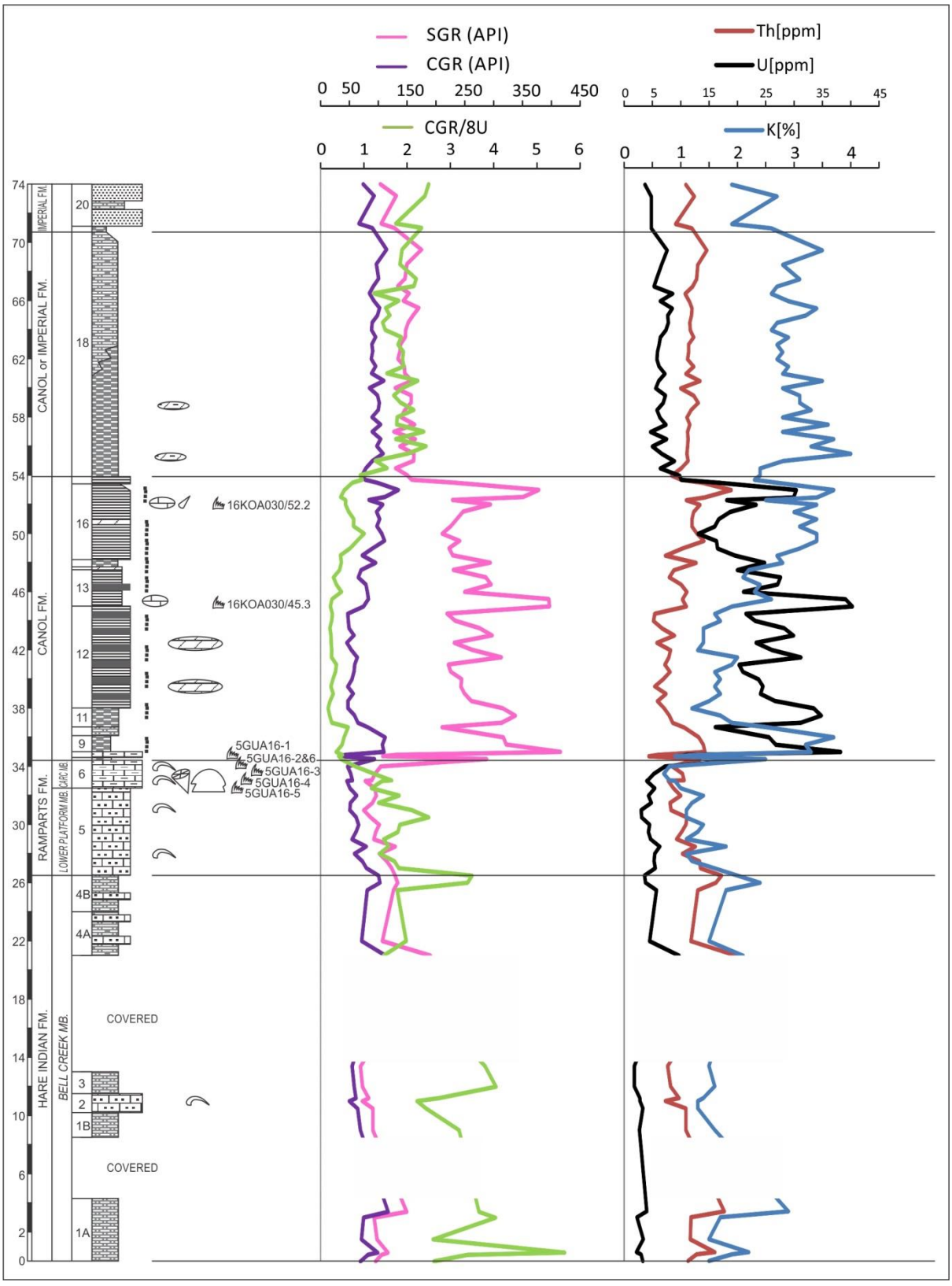

Figure 107. Litholog and SGR log of Turnabout Creek. See Figure 33 for legend. Abbreviations: CARC. MB. – Carcajou Member.

Station 16KOA033

(upper Rumbly Creek)

ELEVATION	697.4
LATITUDE	65.38127
LONGITUDE	-131.342613
PDOP	2.4
SATS USED	4
VISITDATE	2016-08-02

Ground reconnaissance of the canyon-forming lower reach of the right tributary of Rumbly Creek (Fig. 1) confirmed that the hinge zone of the anticline exposes Peel dolostones and the top of the Mount Kindle Formation is not exposed. Pinkish grey finely crystalline thin to thick bedded dolostones of the Peel Formation are mostly barren, but at station 16KOA033 a bank of *in-situ* brachiopods has been encountered and sampled for conodonts (Figures 109A and 109B).

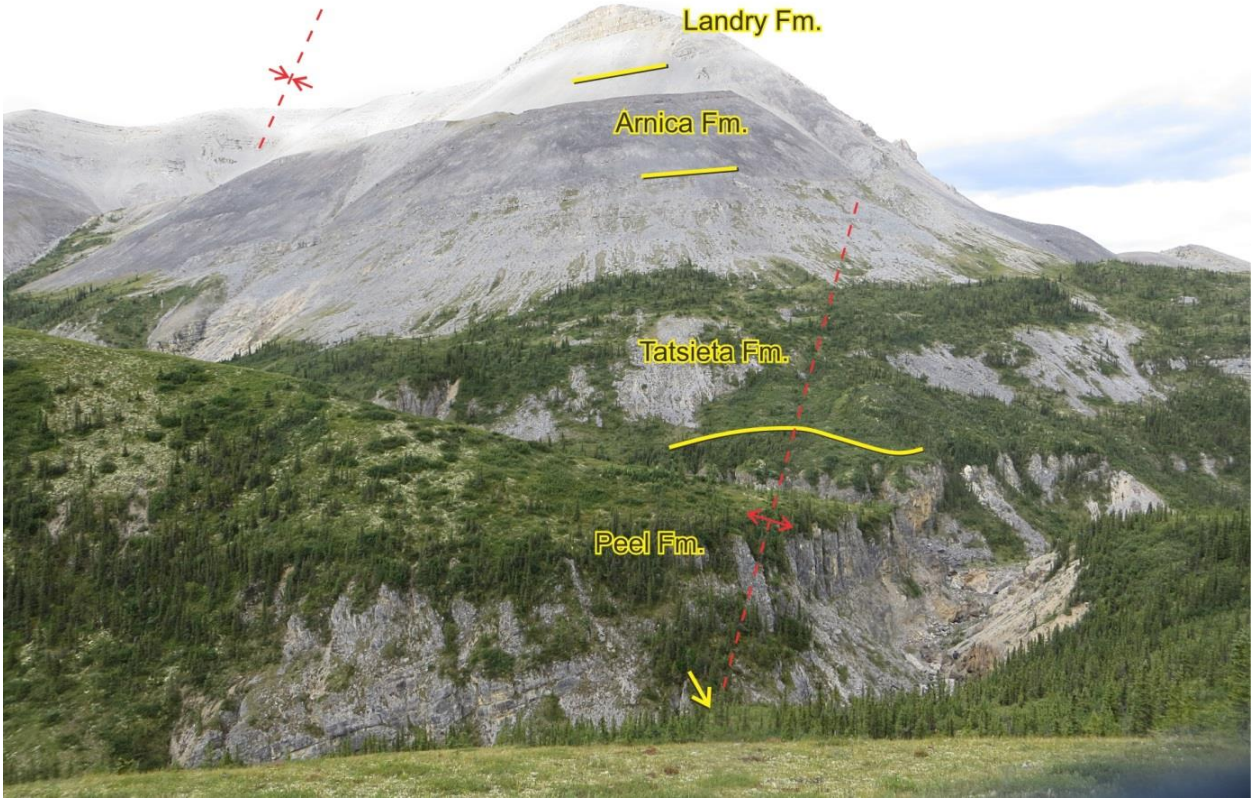

Figure 108. Northwesterly view at the east ridge of Rumbly Creek with interpreted formations; syncline and anticline hinges are indicated by dash lines; station 16KOA033 is yellow-arrowed.

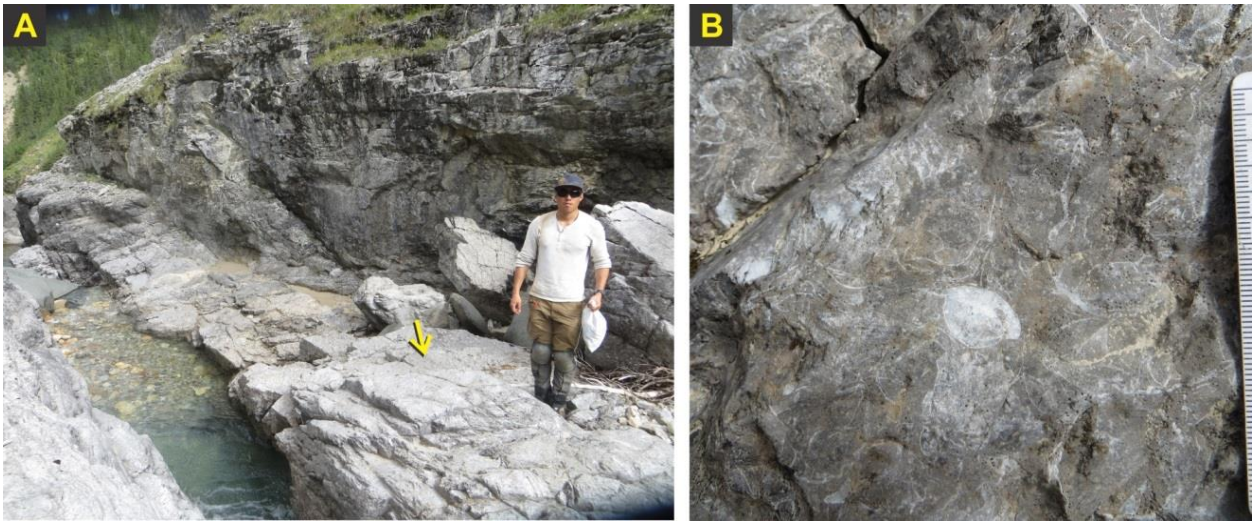

Figure 109. (A) Station 16KOA033 in the hinge zone of an anticline; arrow points at a brachiopod bank; one of the authors holds a sample for conodonts; (B) close-up at bank-forming brachiopods, some of them in life position.

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