Upper Fifteenmile Group in the Ogilvie Mountains and correlations of early Neoproterozoic strata in the northern Cordillera

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ABSTRACT

An ~2-km-thick stratigraphic section measured through three consecutive shale-carbonate sequences documents the previously undescribed upper Fifteenmile Group in the Coal Creek inlier. These descriptions provide the basis for correlation with Proterozoic strata of adjacent inliers in eastern Alaska, as well as in the eastern Ogilvie Mountains.

The lowest unit contains interbedded limestone and mudstone with distinctive maroon-weathering layers. Similar strata are present in unit D of the Pinguicula Group exposed in the Hart River inlier. In that area however, the middle sequence containing massive dolostone, that is the most prominent unit of the upper Fifteenmile Group, is missing beneath an angular unconformity. The Callison Lake dolostone is above this surface and is lithologically indistinguishable from the uppermost, stromatolitic carbonate of the upper Fifteenmile Group. Both the middle and upper dolostone units are preceded by black shale, indicating abrupt transgressions. In contrast, the carbonate units contain abundant evidence of shallow water and periodic emergence. We interpret the upper Fifteenmile Group to comprise three shallowing-upward cycles in this area.

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INTRODUCTION

The Proterozoic record in northwestern Cordillera is gleaned from the study of erosional windows through the covering Phanerozoic platform strata (herein called inliers), augmented by sparse geophysical information and rare drillhole information. Fortunately, three inliers in western Yukon and eastern Alaska provide considerable exposure of Proterozoic strata, although structural complexity and depositional hiatuses pose formidable challenges in deciphering the record. Since early recognition of analogous sequences in the inliers (*e.g.*, Gabrielse, 1972; Eisbacher, 1978; Young *et al.*, 1979), correlation of units, particularly those with stratabound mineral potential, has been a principal goal in mapping and stratigraphic analysis. Improved understanding of sequence relationships, isotopic dates from volcanic zircons, and minimum ages determined from detrital zircons, have refined these correlations.

The Coal Creek inlier, located north of Dawson, Yukon, is under-studied by comparison to other Proterozoic sequences in northwestern Canada (Rainbird *et al.*, 1996; Long *et al.*, 2008; Fig. 1). Although regional-scale maps portray their distribution (Thompson *et al.*, 1994), the Fifteenmile Group strata overlying the Wernecke Supergroup lack a detailed description. This report contains information on the lithologic sequence of the 'upper' Fifteenmile Group in the western part of the Coal Creek inlier (Fig.1). It complements recent papers on the geochronology and chemostratigraphy of the 'upper' Fifteenmile Group (Macdonald *et al.*, 2010). An outline of some units of the 'lower' Fifteenmile Group, and their correlation, is found in Medig *et al.* (this volume).

REGIONAL SETTING

The Coal Creek inlier, a mountainous 35 km x 70 km area, consists of dominantly sedimentary strata (Wernecke Supergroup, Fifteenmile Group and Mount Harper Group; Fig. 1) that are unconformably overlain to the east, north and west by Cambrian and younger platformal carbonate rocks (Slats Creek, Bouvette and overlying formations),

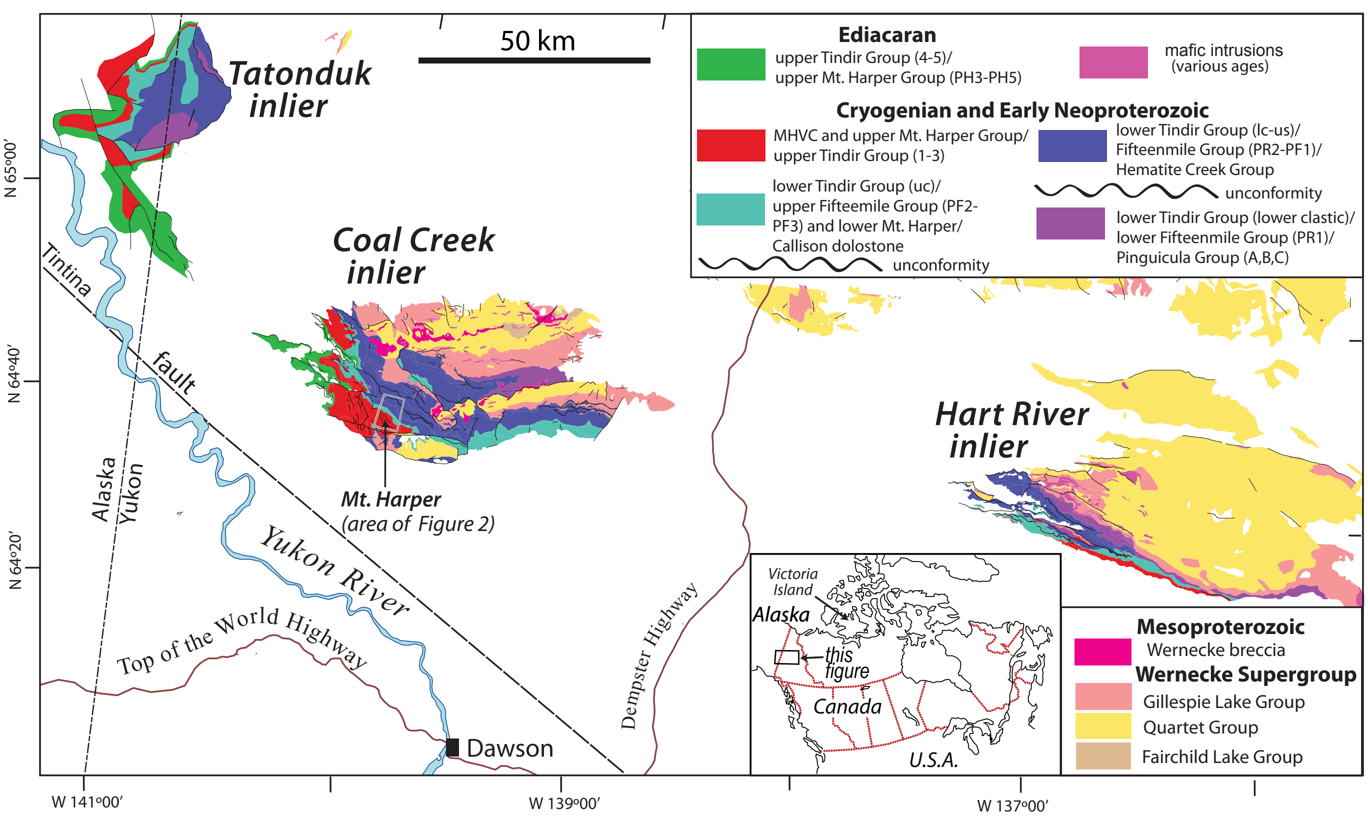

Figure 1. *Distribution of Proterozoic rocks in west-central Yukon and adjacent Alaska. Modified from Gordey and Makepeace, 2003. Text in brackets represents unit designators by previous authors (see references listed on Figure 12; MHVC = Mount Harper volcanic complex).*

and are truncated to the south by the Dawson fault. The older strata comprising the Fairchild Lake, Quartet and Gillespie Lake groups of the Wernecke Supergroup (*e.g.,* Delaney, 1981; Thorkelson *et al.*, 2005) are exposed in variably tilted, fault-bounded blocks in the northern half of the outlier. Fifteenmile Group strata unconformably overlie these older units, and flank them mostly to the south and west. Overlying the Fifteenmile Group are conglomerate, bimodal volcanic rocks, diamictite and shale of the Mount Harper Group (Mustard and Roots, 1997).

FIFTEENMILE GROUP

Previous work on the Neoproterozoic strata of the Ogilvie Mountains was carried out during the course of regional mapping (Thompson *et al.*, 1987; Thompson *et al.*, 1994). The Fifteenmile Group (Roots and Thompson, 1992), named after Fifteenmile River, which drains the southern slope of the Ogilvie Mountains, was designated to distinguish these strata from those of the Tindir Group (Young, 1982), Pinguicula Group (Eisbacher, 1981; Thorkelson, 2000) and Mackenzie Mountains Supergroup (Gabrielse *et al.*, 1973). Recent geochronologic and chemostratigraphic studies on the Neoproterozoic rocks in the Coal Creek inlier have strengthened these correlations (Macdonald *et al.*, 2010; in press).

The Fifteenmile Group unconformably overlies rocks of the Wernecke Supergroup. It was separated into upper and lower subdivisions, and unit designations of the regional map by Thompson *et al.* (1994) are retained here, with the exception of the lowest unit, which we reassigned to PF1a (Fig. 2). The 'lower' Fifteenmile Group includes six map units (PR1a, PR1-PR5)[3] which form alternating shale-dominated and dolostone-dominated successions (Thompson *et al.*, 1994). Direct age constraints on the lower Fifteenmile Group are lacking. Some units may be compared with strata in the Wernecke Mountains (*e.g.*, Thorkelson *et al.*, 2005; Medig *et al.*, this volume). The 'upper' Fifteenmile Group consists of three thick packages of carbonate rocks separated by thinner siliciclastic units, with an interbedded argillite-dolostone sequence at the base (PF1a, PF1, PF2 and PF3; Thompson *et al.*, 1994). A tuff unit within the lower-most map unit of the upper Fifteenmile Group constrains the depositional age to a maximum of 811.51 ± 0.25 Ma (Macdonald *et al.*, 2010; in press). A maximum age constraint on the upper Fifteenmile Group comes from a 717.43 ± 0.14 Ma quartz-phyric rhyolite flow in the overlying Mount Harper volcanic complex (Macdonald *et al.*, 2010; in press).

[3]All Coal Creek inlier units discussed in this paper are prefixed with a 'P' for Proterozoic following the convention of Thompson et al. (1994).

LOWER CONTACT OF THE UPPER FIFTEENMILE GROUP

Stratigraphic relationships between the upper and lower Fifteenmile Group have been revised from the original interpretation of Thompson *et al.* (1994). The legend accompanying the open file maps by Thompson *et al.* (1994) indicates, below the upper Fifteenmile Group, a "disconformity, local angular unconformity over PR1". In contradiction, the maps show PF1a in stratigraphic contact with PR5 (dominantly shale) and less commonly PR4 (dolostone breccia and dolostone). Thompson *et al.* (1994) interpreted the mafic sills, dykes, and the Wernecke Breccias, to have intruded the lower Fifteenmile Group, and that this intrusive event had ceased before deposition of the upper sediments. The presence of intrusive breccias in the lower Fifteenmile Group was subsequently disproved (Abbott, 1997; Thorkelson, 2000; Medig *et al.*, this volume). As in the Wernecke Mountains, only strata of the Wernecke Supergroup are intruded by these breccias, which formed at 1.6 Ga (Thorkelson *et al.*, 2005).

Our field observations suggest that the contact between PR5 and PF1a is conformable. Although an intrusive event has been disproved between the lower Fifteenmile and upper Fifteenmile strata, the separation between the shale-dominated (lower) and the carbonate-dominated (upper) parts is retained. Although gradational, the base of the upper Fifteenmile Group can be defined by the onset of widespread limestone deposition above PR5, in general accordance with Thompson *et al.* (1994; Fig. 2). However, this separation may be locally complicated by the presence of dolomite patch reefs within unit PR5.

MEASURED SECTION OF THE UPPER FIFTEENMILE GROUP

A composite section of the upper Fifteenmile Group was measured over three ridge-forming carbonate units separated by recessive shale units (Fig. 3; Table 1). The strata have a combined thickness of ~2 km and dip to the southwest (20° to 40°). The units are exposed with little change in thickness from Mount Harper eastward for 20 km along the southern edge of the Coal Creek inlier (Figs. 2, 3).

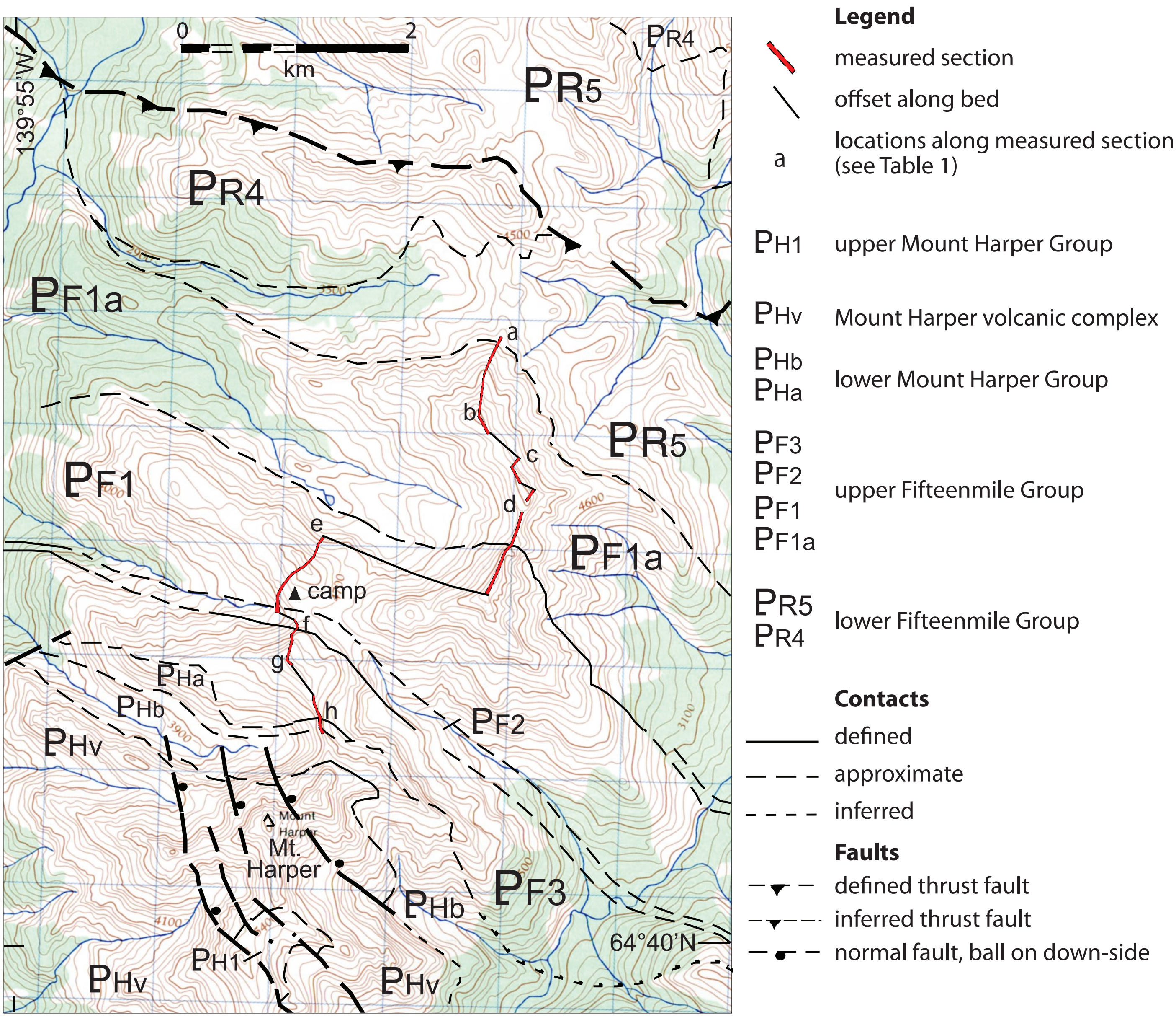

Figure 2. *Distribution of geological units near Mount Harper with location of the measured section (line a-h), modified from Thompson et al. (1994). Letters correspond to endpoints along the composite stratigraphic section (see descriptions in Table 1 and Fig. 4).*

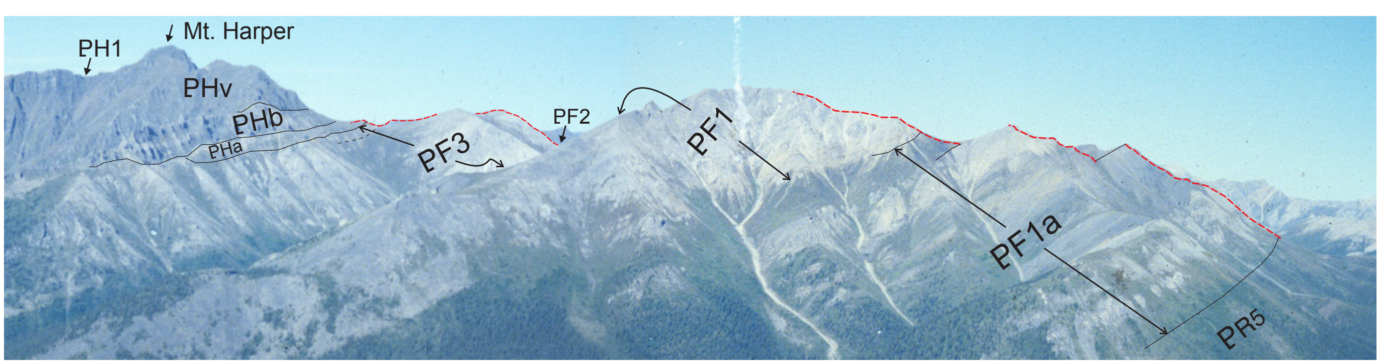

Figure 3. *View northwestward of upper Fifteenmile Group strata. Field of view is 5 km.*

Table 1. *Locations of points along the measured composite stratigraphic section (Fig. 2) of the upper Fifteenmile Group (currently available topographic map 116B/12 (1971) is NAD 27, Zone 7W; contour intervals are 100 ft).*

Site location	UTM_E	UTM_N	Description
a	555910	7176920	base of section on north-most spur; lowest limestone bed on south side of broad shale/siltstone saddle; elevation 4400'
b	555650	7176170	top of ridge; local highpoint; section continues south along crest
c	555985	7176030	section measurement offset to east-facing gully; elevation 5225'
d	556090	7175655	north end of saddle; black shale; elevation 5360'
e	554400	7175060	section measurement offset; start in north-facing gully; elevation 4360'
f	554180	7174350	top of weathered brown shale; base of carbonate in gully; elevation 4900'
g	554050	7174000	top of ridge; section continues along crest; elevation 5500'
h	554420	7173340	top of upper Fifteenmile/base of Lower Harper Group (see Mustard and Roots, 1997); saddle elevation 5100'

The lowest unit (PF1a) is 689 m thick. The second carbonate succession (PF1) is 611 m thick and is succeeded by the black shale interval (PF2) that is 111 m thick. The uppermost carbonate (PF3) is 338 m thick and overlain by polymictic conglomerate of the Lower Mount Harper Group (PHa; Mustard and Roots, 1997). The section is diagrammatically drawn in Figure 4.

In the stratigraphic measurement presented here we recognize five distinct facies that are associated with particular sedimentary environments. They include: 1) *rhythmite* - parallel-laminated carbonate mudstone, turbidite and debris flows deposited below storm wave-base in slope and basinal settings; 2) *ribbonite* - thin, wavy-bedded carbonate wackestone, siltstone and mudstone deposited deep in the sublittoral zone, above storm wave-base; 3) *stromatolites* - discrete columnar to rounded microbialites with >1 cm of synoptic relief that are commonly associated with edgewise conglomerates; 4) *grainstone* - a well-sorted, medium to thick-bedded carbonate sand with common crossbeds, deposited in the shallow sublittoral zone; and 5) *microbialaminite* - undulose and crinkly to fenestral lamination, with common intra-clast conglomerate and tepee structures, that formed subaerially in the littoral to super-littoral zone. In Figure 4, the terms *breccia* and *conglomerate* include the genetic terms of *debris flow, intra-clast breccia* and *edge-wise conglomerate*.

The base of the section was measured along a north-facing slope at the lowest carbonate bed above a broad saddle dominated by hackly dark brown-weathering mudstone (unit PR5; Fig.2). Evidence for an unconformity or thrust was not observed at the base of this unit.

Unit PF1a overlies PR5 and is dominantly limestone with ~15% dolostone, four sandstone beds 1-2 m thick, and several mudstone and breccia/conglomerate layers that are interpreted as debris flows, overlain by 65 m of black shale. The lowest 100 m of unit PF1a includes rhythmically bedded lime mudstone with local preservation of asymmetric ripples, and grades upward to ribbonite. Several units of metre-thick conglomerates, interpreted as debris flows, occur about 80 m above the base of the measured section. A 10-m covered interval obscures the stratigraphy immediately above the conglomerate units. The covered interval is believed to be black shale based on an overlying unit of limestone beds containing black chert nodules and lenses (Fig. 5). From 100 m to 190 m above the base of the measured section, light and medium grey-weathering zebra-textured dolostone (Vandeginste *et al.*, 2005) is exposed in several cliff bands. A medium-grained gabbro sill (2 m thick) occurs 190 m above the base of the measured section. Above the sill, dark grey-weathering limestone predominates, and beds increase in thickness with several rhythmite beds grading upward to ribbonite in metre-scale parasequences. A 20-m-thick, medium grey-weathering, platy limestone at 360 m in the section is succeeded by grainstone interbedded with rippled, nodular, organic-rich limestone. Molar tooth structures (James *et al.*, 1998) are a characteristic feature of the organic-rich limestone horizon at this location in the section and throughout the region (Fig. 6).

Between 409 m and 489 m above the base of the section, PF1a is characterized by alternating beige, green, grey and maroon-weathering marl, limestone and sandstone cycles that are 3 m to 5 m thick (Fig. 7). The colour and nodular

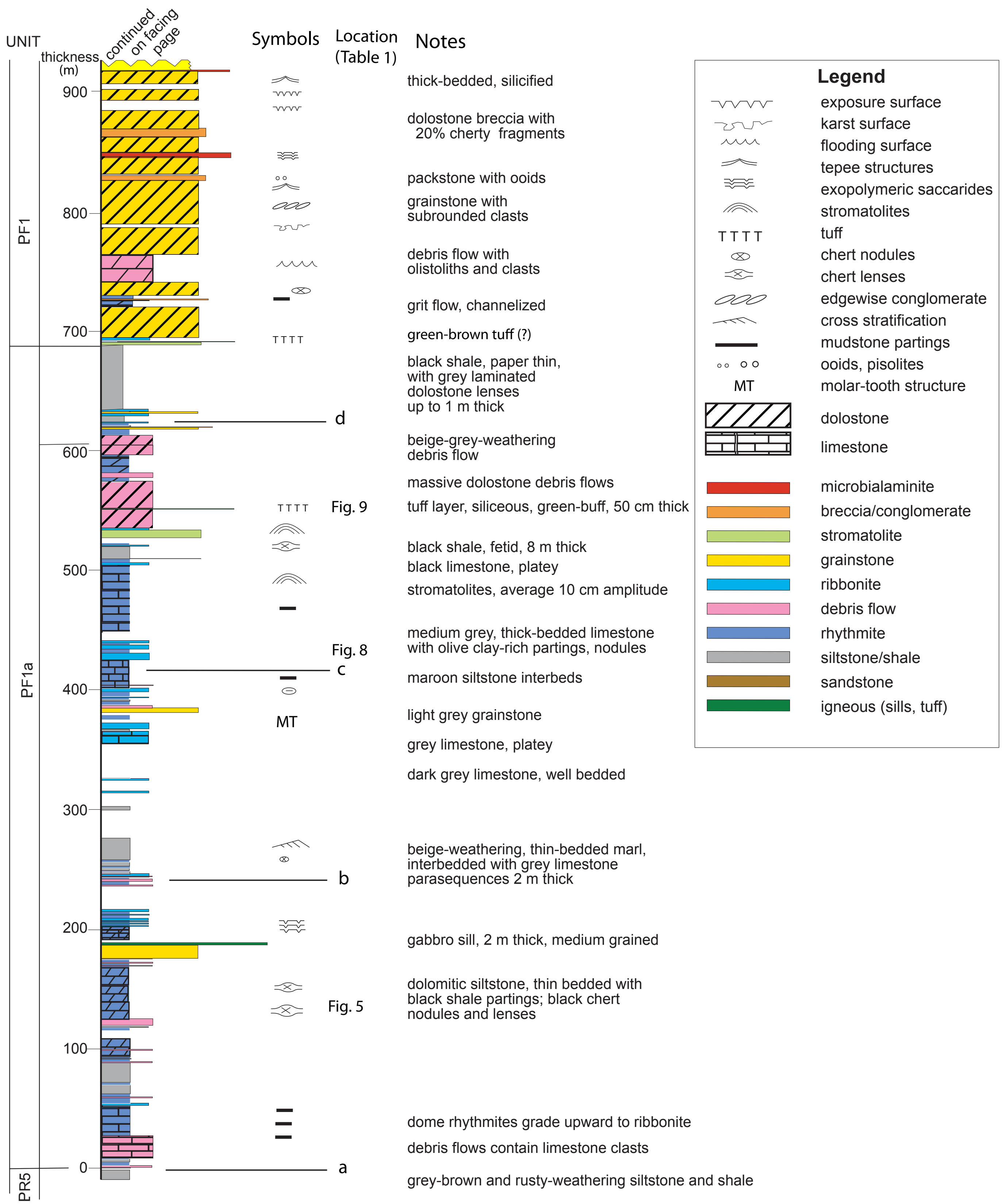

Figure 4. *Diagrammatic stratigraphic section of upper Fifteenmile Group strata. Location column is keyed to Table 1 and figures.*

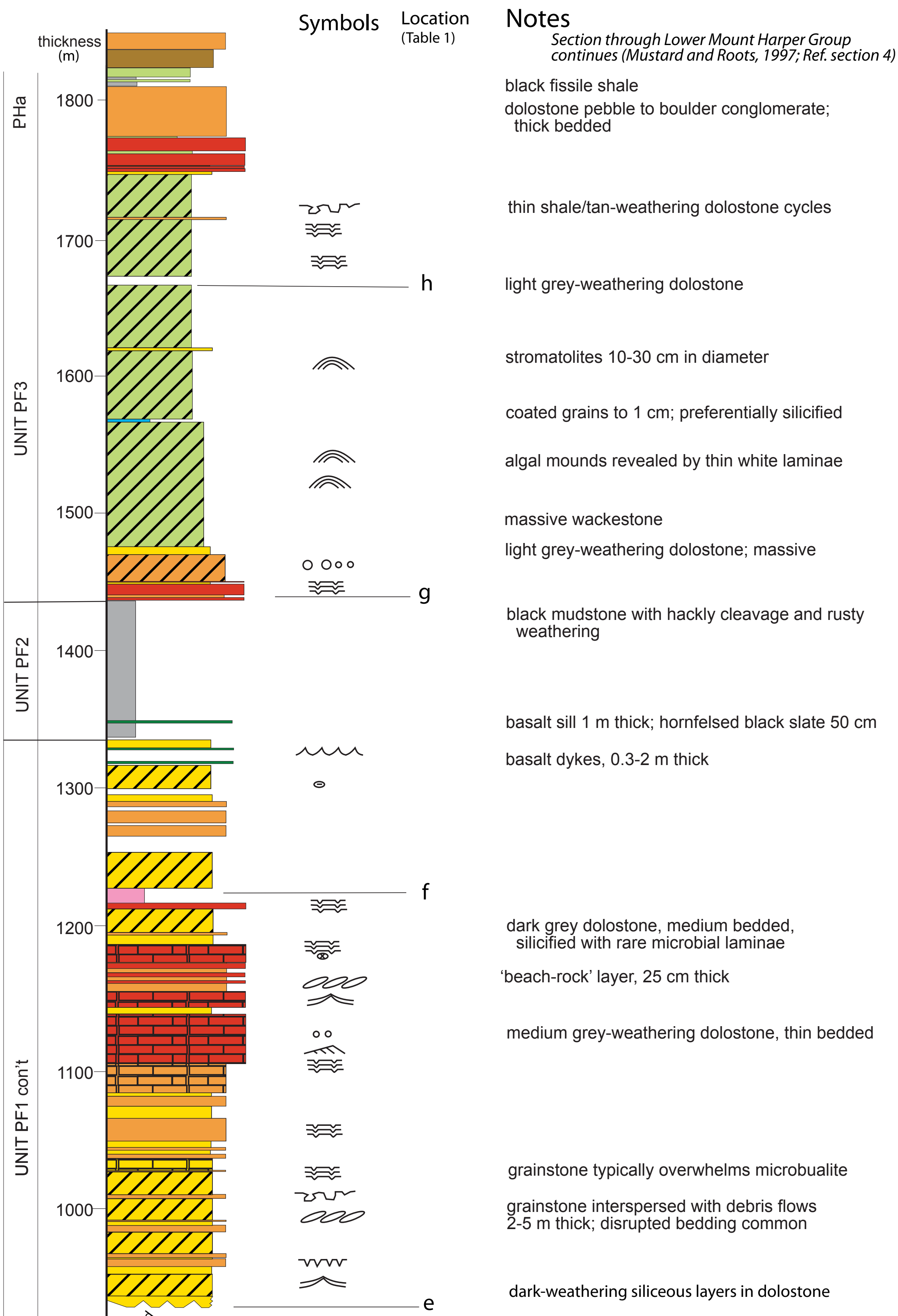

Figure 4. *continued.*

nature of these beds is distinctive and useful for regional correlation. Rhythmites are couplets of olive-coloured mudstone, intercalated with chert-nodular limestone (Fig. 8). The uppermost carbonate unit contains small branching stromatolites (2-5 cm in diameter) and has a humped upper surface overlain by pyritiferous black shale.

Figure 5. *Chert nodules and swales in lime mudstone overlain by grey limestone; 132 m above the base of measured section.*

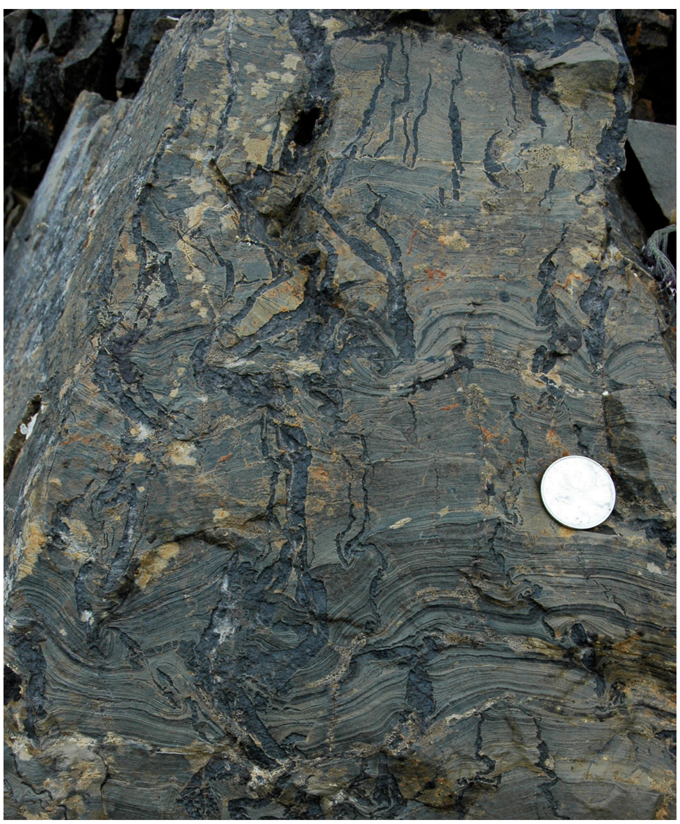

Figure 6. *Molar tooth structures in grey limestone of unit PF1a, 14 km north-northeast of Mount Harper (UTM 558000E 7186000N, elevation 4900').*

From 489 m to 560 m above the base of the section, exposure of PF1a is restricted to a ridge crest and includes grey-weathering limestone debris flows with minor carbonate beds containing black chert nodules. A light brown-weathering tuff horizon, situated 541.5 m above the base of the section, is 50 cm thick and occurs in a recessive gap between dolostone debris flows (Fig. 9a). It is cherty with faint brown streaks parallel to bedding. In thin section, the streaks define variations in the dust-sized particulate groundmass, and broken quartz grains (0.2 mm) are aligned with stratification (Fig 9b). Zircon crystals were extracted from the tuff unit (Fig. 9c) and yielded a crystallization age of 811.51 ± 0.25 Ma (Macdonald *et al.*, in press).

Overlying the tuff unit is a thick interval of chaotically oriented blocks of centimetre-bedded rhythmite that are interpreted as debris flows. Above this, is a tan-weathering dolostone which is thinly interbedded with black shale. The top of unit PF1a consists of 65 m of black shale. Although monotonous, the shale exposed on the narrow ridge saddle, reveals at least three, beige-weathering lenses of dolostone with fenestral textures interpreted to be bioherms. The uppermost bioherm is draped by an unusual green-brown unit, ~25 cm thick. Although we interpreted this to be a volcanic tuff, it did not yield zircons.

Figure 7. *View to the southeast of 80 m of well-layered upper part of unit PF1a (409-489 m above base of section). The brown-weathered intervals contain thin beds of maroon siltstone. Person circled for scale.*

Figure 8. *Rhythmites of limestone and lime mudstone, 461 m above base of section.*

The surface expression of Unit PF1 (611 m thick) forms a dark grey, craggy-weathering mountain. The lower contact is sharp, with dolo-rhythmite beds conformably overlying the black shale of PF1a. The base of PF1 begins with three ~15-m-thick parasequences consisting of thin-bedded, flat-laminated dolo-rhythmite, succeeded by crossbedded grainstone. These parasequences are overlain by ~70 m of tabular clast breccia and graded grainstone beds, interpreted as mass flow deposits. The upper ~600 m of unit PF1 is dominated by dolomitized grainstone and microbialaminite and contains common crossbedding, cements and porous 'tufa' structures. Evidence for sub-aerial exposure is extensive in the form of tepee structures, intra-clast breccia, and silica encrustations. Mafic dykes are common near the top of the unit, and have pilotaxitic and intersertal textures characteristic of lavas of the overlying Mount Harper volcanic complex (Mustard and Roots, 1997), less than 1 km to the south.

The contact between PF1 and PF2 is covered by colluvium and an alpine meadow; outcrops of PF2 are scant. The estimated 111 m thickness of PF2 is exaggerated by mafic sills which are resistant to erosion. Rusty-weathering shale and quartz sandstone are exposed at the contacts with the sills. On a ridge ~10 km northwest of the measured section, PF2 is well exposed, measuring 77 m in thickness. PF2 overlies a brecciated surface of PF1, and begins with up to 2 m of channelized, subrounded quartz gravel conglomerate in a sandy matrix. Overlying these beds is 17 m of green and red shale with dolomite lenses containing microbialite textures that are interpreted as bioherms. The bioherms are draped by an iron formation that is ~10 cm thick (Fig. 10). Above the multicoloured shale unit is an additional 60 m of black shale containing laterally discontinuous bioherms that can be distinguished by their peculiar waxy luster. Preliminary x-ray diffraction analyses indicate that this luster results from the presence of talc. In the absence of metamorphic alteration or mineral precursors, the talc appears to be detrital in origin.

Unit PF3 comprises a light grey to white-weathering limestone-dominated succession (311 m thick) overlain by dolostone and breccia (27 m thick). North of Mount Harper, the base of PF3 is indicated by an abrupt change from dark-coloured shale to microbial laminated dolostone, succeeded by massive, structureless breccia. Elsewhere in the study area this contact is gradational,

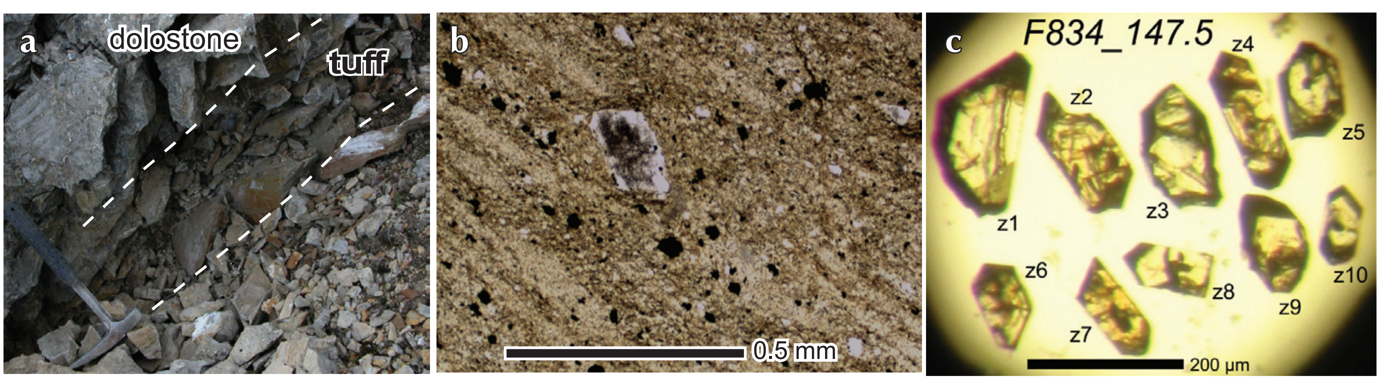

Figure 9. (a) *Cherty tuff and overlying dolostone units, 562 m above base of section.* ***(b)*** *Photomicrograph (plane light) of tuff unit containing aligned quartz grains and opaque minerals (secondary pyrite?).* ***(c)*** *Zircon crystals separated from tuff unit (sample F837_147.5) for single-crystal ID-TIMS dating (Boise State University; data in Macdonald et al., in press).*

Figure 10. *Hematite and chert draped on laminated dolostone (tan and rust weathered) within unit PF2. This site is ~12 km north-northeast of Mount Harper. Rock hammer for scale. (UTM 0555753E 7185050N, elevation 5500').*

Figure 11. *Stromatolite characteristic of Unit PF3 (Callison Lake dolostone) located at 1616 m above base of section.*

with black talc beds draping *Jacutophyton* stromatolites. Continuing upwards in the section, the overlying 222-m-thick distinctive succession contains abundant domal stromatolites of two forms: 1) 2 to 3-mm-thick algal laminae forming hemispheres 15-25 cm across; and 2) branching forms characteristic of *Tungussia* (Fig. 11). The stromatolitic beds are typically 2-4 m thick and are intercalated with beds consisting of cm-sized, preferentially silicified, coated grains; these features have also been observed in the Callison Lake dolostone at the Hart River inlier (Abbott, 1997; 145 km east of Mount Harper).

The upper part of unit PF3 was measured along a ridge crest that has intermittent bedrock exposure. Many layers are clast-supported dolostone breccia containing algal-laminated limestone blocks, separated by silica-encrusted cavities that may represent a paleokarst surface (Mustard and Donaldson, 1990).

UPPER CONTACT OF THE UPPER FIFTEENMILE GROUP

The paleokarst at the top of unit PF3 is overlain by 19.5 m of black fissile shale, interbedded with tan-weathering, thin-bedded dolostone. We include these beds with the ~270-m-thick Lower Mount Harper Group on the northern flank of Mount Harper (see Mustard and Roots, 1997). These shale beds are overlain by a pebble to boulder conglomerate with rare dolomitic mudstone and wackestone horizons (unit PHb). Unit PHb is interpreted as subaerial alluvial fans that were likely sourced at a fault scarp 4 km south of the measured section. The proportion of carbonate lithologies in the conglomerate is inverse to the upper Fifteenmile Group stratigraphy, suggesting progressive downward denudation of the uplifted fault scarp (Mustard and Roots, 1997).

DISCUSSION

DEPOSITIONAL ENVIRONMENT

Three transgressive-regressive cycles constitute the upper Fifteenmile Group, however, they do not correlate with the existing map units to date. In the context of a sequence stratigraphic framework, if the top of the PR5 shale is included with PF1a in the first cycle, then the shaly top of unit PF1a forms the second cycle with PF1, and finally, PF2 and PF3 constitute the third cycle. Furthermore, it is nearly impossible to differentiate between transgressions resulting from subsidence of the shelf (block faulting, regional extension), global eustatic sea level rise, or geodynamic perturbations (e.g., Maloof *et al.*, 2006).

In the first cycle, the lowest carbonates of unit PF1a are characterized by rhythmite and ribbonite sequences that were deposited below, or near, storm wave-base. Sporadic preservation of wavy bedding and asymmetric ripples confirm the presence of bottom currents. These beds are succeeded by thin-bedded dolostone and grainstone, and contain occasional breccias that include imbricated tabular clasts, which are interpreted as debris flows. Stromatolites first appear 500 m above the base of the section. A high-stand tract is consistent with the successive thick-bedded limestone, marl and red-weathering siltstone layers. At least five debris flows near the top of this cycle exhibit large blocks of reef and algal-laminated carbonate, implying destruction of barrier or lagoonal deposits upslope. The tuff layer was deposited between two of these debris flow events.

The second cycle, the shale-carbonate cycle, begins with an ~70-m-thick black shale deposited below storm wave base. In the succeeding parasequences, rhythmites give way to crossbedded grainstone to packstone containing ooids and edgewise conglomerate, locally followed by emergence, causing breakdown and transport of carbonate crusts. Tepee structures, microbialites and porous tufa textures are indicative of a supra-littoral environment that periodically emerged. Silica encrustation further attests to the emergent, and possibly karstic, conditions in the upper part of the unit.

In the third cycle, shale is directly overlain by stromatolites. Stromatolite emergence is consistent with a marginal reef environment that extended as far as the Hart River inlier. With shelf subsidence, the reef continued to build to a thickness of more than 250 m. Subsequent sea level drop produced an emergent shelf that was exposed to karst dissolution and collapse. Burial beneath the Lower Mount Harper Group fanglomerates resulted in preservation of the unit.

CORRELATION WITH ADJACENT INLIERS

The paucity of absolute time markers, an incomplete stratigraphic record, and the reality of lateral facies changes, has hindered attempts to correlate strata between the Proterozoic inliers of the northwestern Cordillera. Further complicating the issue is the stratigraphic nomenclature that is unique to each inlier, thereby limiting the inferences that can be made about the regional depositional and tectonic history. In Figure 12, we present a new correlation chart based on our litho and chemostratigraphic studies for each of the inliers. Below, we discuss these correlations with respect to the upper Fifteenmile Group.

Tatonduk inlier

Proterozoic strata exposed near the Yukon-Alaska border (85 km northwest of Mount Harper; Fig. 1) are broadly divided into an upper and lower Tindir Group (Young, 1982). The purple mudstone and diamictite (unit 2; Fig. 12) at the base of the upper Tindir Group, which constitutes the Windermere Supergroup in this region, is likely correlative to unit PH1 of the upper Mount Harper Group (Fig. 12).

Lower Tindir strata underlie ridges separated by major faults, such that correlation of units across valleys is often uncertain. In recent mapping, four units have been recognized in the lower Tindir Group (Macdonald *et al.*, 2010) and include: i) a 'lower shale' unit; ii) a 350-m-thick 'lower carbonate' unit characterized by light grey quartzite with discontinuous stromatolitic bioherms (pCtq; Fig. 12); iii) an 'upper shale' unit (pCtsl, pCts; Fig. 12) that includes minor sandstone and debris flows; and iv) an 'upper dolostone' unit (pCtds; Fig. 12) that is dominated by grainstone and breccia. The full thickness of these units is 1130 m. The 'upper shale' unit was previously mis-mapped and contains two shale-to-limestone sequences. The upper of these two sequences (pCtds; Fig. 12), consists of fissile shale with dolostone olistostromes (48 m thick) succeeded by dark grey limestone rhythmite with interbedded debris flows and black chert lenses. The lower carbonate unit (pCtsl; Fig. 12) is lithologically similar to our unit PF1a. However, the exact correlations between the upper two units of the lower Tindir Group and units PF1 and PF3 of the upper Fifteenmile Group are unclear. Van Kooten *et al.* (1997) suggested the presence of an unconformity beneath the upper carbonate (PCtds). Although we have not observed this unconformity during our mapping, carbon isotope chemostratigraphy shows an abrupt change within the upper shale unit (Macdonald *et al.*, 2010). If the upper carbonate correlates with PF3 and the Callison Lake dolostone, the unconformity may truncate units PF1 and PF2 of the upper Fifteenmile Group.

Hart River inlier

In the Hart River inlier, Abbott (1997) defined six Pinguicula-correlative units unconformably overlain by the Callison Lake dolostone, a light grey-weathering, nearly massive unit (Fig. 12). From the base of the Pinguicula Group, the units include: PPA, PPB and PPC, and three

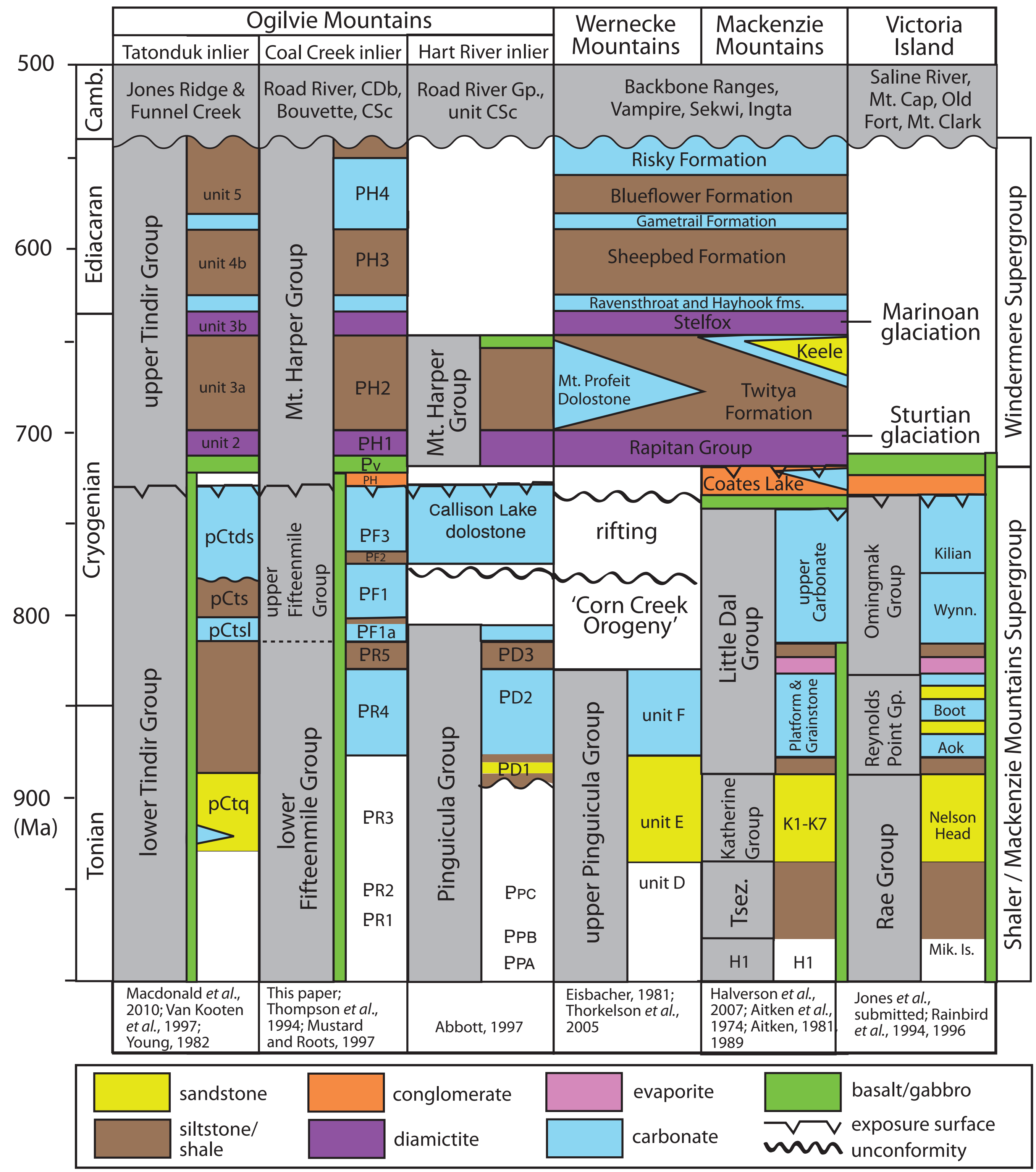

Figure 12. *Strata correlative with Neoproterozoic upper Fifteenmile units in the Ogilvie Mountains (Tatonduk, Coal Creek and Hart River inliers), Wernecke Mountains, Mackenzie Mountains and Victoria Island.*

discontinuous members of unit D (PD1 - brown shale; PD2 - thin-bedded brown limestone overlain by grey dolostone; and PD3 - brown sandstone and minor orange dolostone [Fig. 12]). A low-angle unconformity beneath the Callison Lake dolostone truncates unit PD3 progressively eastward across the Hart River inlier (see Fig. 13). The Callison Lake dolostone was correlated with Fifteenmile unit PF1 (Abbott, 1997; Thorkelson *et al.*, 2005).

We have examined the units above and below this unconformity. The Callison Lake dolostone is ~340 m thick, with delicate algal-laminated, stromatolitic and pisolitic texures preserved. The lowermost ~30 m of the Callison Lake dolostone consists of a black shale unit with a waxy luster. Together, these distinct facies of the Callison Lake dolostone display striking lithological similarities to units PF2 and PF3 of the upper Fifteenmile Group. The sedimentary rocks preserved beneath the unconformity include maroon shale and thin-bedded, orange-weathering dolostone, which resemble the middle interval of unit PF1a in the section north of Mount Harper.

We believe that the correlation of Callison Lake dolostone with PF1 is incorrect because the two units are lithologically and geochemically dissimilar (Macdonald *et al.*, 2010; in press). Instead, we recognize that strata absent beneath the unconformity would correlate with unit PF1. If the Callison Lake dolostone – Fifteenmile PF3 correlation is correct, then the unconformity cuts out strata equivalent to PF1. This is consistent with the basal PF2 contact observed ~10 km north of the measured section north of Mount Harper, where gravel lags are above an exposure surface at the top of PF1. An unconformity at this level matches the unconformity suggested by Van Kooten *et al.* (1997) in the Tatonduk inlier and provides a possible explanation for the absence of any obvious equivalent of PF1 in that region. Moreover, the unconformity beneath the Callison Lake dolostone may also explain the absence of Pinguicula units E and F (Eisbacher, 1981; later correlated with upper units of the Mackenzie Mountains Supergroup by Thorkelson *et al.*, 2005) in the Hart River inlier. Incursion of quartz-rich sediment from a continental-scale river system (Rainbird *et al.*, 1997) appears thickest in the Mackenzie Mountains (Katherine Group), with tongues thinning into the

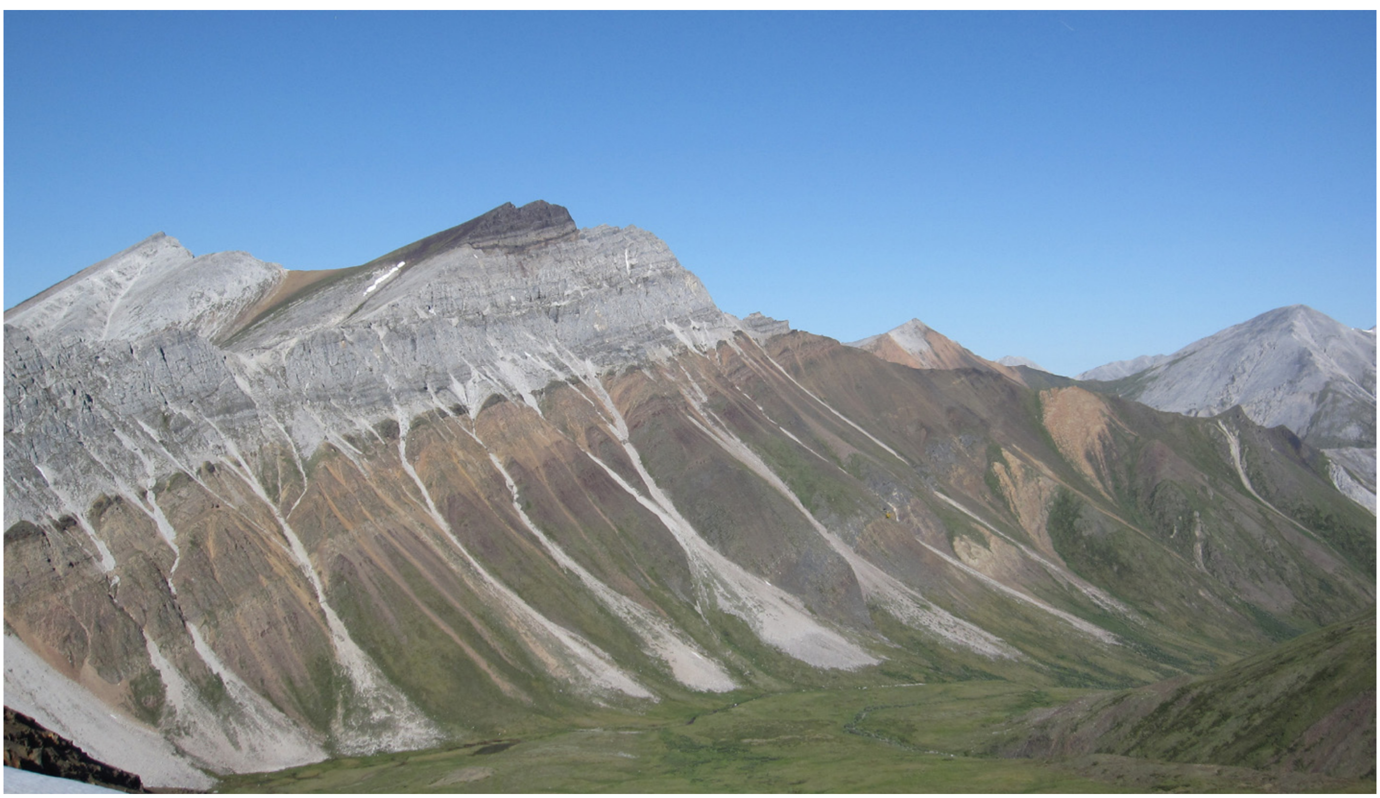

Figure 13. *Photo of the unconformity beneath the thick, grey Callison Lake dolostone, truncating orange- and brown-weathering beds of member PD3 (Abbott, 1997). Photo is looking southwest across the head of Marc Creek, Hart River inlier (64°34' 22.53"N 136°48'05.20"W, elevation 5500').*

Wernecke Mountains (Pinguicula D and E, or Corn Creek lithofacies; Fig. 12). Alternatively, rather than being removed beneath the unconformity, the sandstone may not have extended to the western Ogilvie Mountains, with the possible exception of channelized bodies in the lower Fifteenmile Group and the lowermost unit of the lower Tindir Group (pCtq).

FUTURE WORK

Our stratigraphic studies to date within the inliers of the Yukon have led to more questions than answers. First-order questions include: What is the tectonic significance of the unconformity beneath the Callison Lake dolostone, and, to what extent has it confounded correlations? By better understanding the regional extent and nature of this surface, we will be able to establish correlations through the Proterozoic inliers of the Yukon with more confidence. Future mapping and stratigraphic studies aim to define formations within upper Fifteenmile Group, and extend these formation names to the other inliers in the Ogilvie Mountains, thereby replacing the informal and local map units. The resulting correlations will allow us to infer regional-scale lateral facies changes and learn more about the depositional environments and accommodation mechanisms recorded by Neoproterozoic strata in Yukon.

Reconnaissance work suggests that Pinguicula Group units A-D are equivalent to the lower Fifteenmile Group (Medig *et al*., this volume) and a part of PF1a. These strata contain isolated stromatalite reefs similar to patch reefs in the basinal assemblage of the Little Dal Group (Turner *et al*., 1997). Facies patterns in the lower Little Dal Group indicate a shallow-water area to the southeast (platform assemblage), and deep water with patch reefs to northwest (basinal assemblage) (Aitken, 1981). Further work is necessary to test these possible correlations and refine the geometries that evolved on the Proterozoic margin of northwest Laurentia.

CONCLUSIONS

Except for stratigraphic omissions beneath low-angle unconformities, time-correlative strata are exposed in the Tatonduk, Coal Creek and Hart River inliers, and eventually their nomenclatures should merge. The PF3 unit of the upper Fifteenmile Group should henceforth be called the Callison Lake dolostone.

The unconformity beneath Callison Lake dolostone in the Hart River inlier represents considerable erosion, or non-deposition of units, equivalent to the Fifteenmile Group.

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