ERCB/AGS Open File Report 2012-17

Grosmont Formation (Mikkwa Formation Outcrop T106-R2W5-01) on Harper Creek, North-Central Alberta (NTS 84J/01)

Energy Resources Conservation Board

Alberta Geological Survey

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Energy Resources Conservation Board
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February 2013

ISBN 978-1-4601-0086-8

If you use information from this publication in other publications or presentations, please acknowledge the ERCB/AGS. We recommend the following reference format:

Schneider, C.L., Fenton, M.M. and Weiss, J.A. (2013): Grosmont Formation (Mikkwa Formation outcrop T106-R2W5-01) on Harper Creek, north-central Alberta (NTS 84J/01); Energy Resources Conservation Board, ERCB/AGS Open File Report 2012-17, 21 p.

Published February 2013 by:
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Acknowledgements

We thank H. Vigneault of Highland Helicopters for transportation to the sulphur-rich junction of Harper and Lambert creeks and for his knowledgeable discussion of the region. We also thank P. Glombick and M. Grobe for helpful comments in their review of the manuscript.

Abstract

This report describes an outcrop of the Mikkwa Formation, located at the junction of Harper and Lambert creeks, and is considered an equivalent to the Grosmont Formation based on (1) the similar lithology and paleontology to the Grosmont Formation in outcrop and observed in core, (2) the lack of a mappable Mikkwa Formation lithostratigraphic unit in the subsurface (e.g., Switzer et al., 1994), and (3) prior correlation of the Mikkwa Formation with the Grosmont Formation by Cutler (1983). The outcrop is dolomitic and contains abundant stromatoporoids, representing shallow-water patch reef and reef-proximal paleoenvironments within the Grosmont Formation carbonate platform.

1 Introduction

In the summer of 2011, AGS geologists visited outcrops of the Mikkwa Formation along Peace River and at the conjunction of Harper and Lambert creeks to investigate surficial and bedrock stratigraphy in support of new geological maps of the province of Alberta. This report describes the outcrop at the junction of Harper and Lambert creeks, which is placed within the Grosmont Formation.

Norris (1963) first used the term "Mikkwa Formation" for the limestone outcrops along the Peace River east of Vermilion Chutes. Green et al. (1970) extended the mappable extent of the Mikkwa Formation to include outcrops exposed along Harper and Lambert creeks to the southeast.

According to Norris (1963) and Green et al. (1970), the Mikkwa Formation occurs in the Peace River area, overlying the Ireton Formation and underlying the Grosmont Formation (Figure 1). Norris (1963) described the Mikkwa Formation from a single core (Hudson's Bay Fort Vermilion No. 1, L.S. 15, Sec. 32, Twp. 104, Rge. 8, W 5th Mer. [abbreviated 15-32-104-8W5]; Figure 1), of which the critical interval has been lost. The Mikkwa Formation is otherwise unknown from the subsurface. In other cores and well logs in the region, shale of the Ireton Formation conformably terminates against carbonate of the overlying Grosmont Formation without an intervening Mikkwa Formation unit. Cutler (1983) described an outcrop from the Vermilion Chutes area using the Mikkwa Formation name, but he correlated the Mikkwa Formation outcrop with the Grosmont Formation in subsurface.

The Mikkwa Formation outcrop of limestone occurring at the conjunction of Harper and Lambert creeks is herein treated as equivalent to the Grosmont Formation based on the following: (1) the lithology of the Mikkwa Formation is more similar to that of the Grosmont Formation than of the argillaceous Ireton Formation, (2) the Mikkwa Formation is not identifiable in regional cross-sections or core (e.g., Switzer et al., 1994), and (3) Cutler's (1983) correlation between the Vermilion Chutes outcrop of the Mikkwa Formation and the Grosmont Formation in subsurface.

2 Background

Norris (1963) described the "Mikkwa Formation" from an outcrop located near Vermilion Chutes along the Peace River. He divided the Mikkwa Formation into two informal units: a lower limestone member, which outcrops near the mouth of the Mikkwa River and which unconformably underlies the upper mottled limestone member, which is exposed at Vermilion Chutes.

From the surrounding area, Norris (1963) described the composite section of the "lower limestone" member, from base to top, as follows:

1) 1.1 m of dark grey, thin- to medium-bedded (up to 0.5 m thick) limestone containing sparse stromatoporoids and interbedded with 15 cm thick beds of dark grey, argillaceous limestone separated by partings of dark grey shale.
2) 5.4 m of dark brownish-grey, irregularly thin-bedded (3 to 10 cm thick), slightly dolomitized stromatoporoid limestone. Stromatoporoids are up to 30 cm in diameter. Occasional thin, discontinuous argillaceous layers contain abundant *Cladopora* stromatoporoids and sparse solitary rugose corals.
3) 2.1 m of light brownish-grey, 3 to 15 cm bedded, sparsely fossiliferous limestone.
4) 0.5 m of light brownish-grey, thinly and irregularly bedded, argillaceous limestone containing scattered stromatoporoids. A bed with abundant *Cladopora* stromatoporoids occurs 15 cm from the top of the unit.
5) 0.3 m covered interval.
6) 0.3 m of a brownish-grey, bedded, unfossiliferous dolomitic limestone.

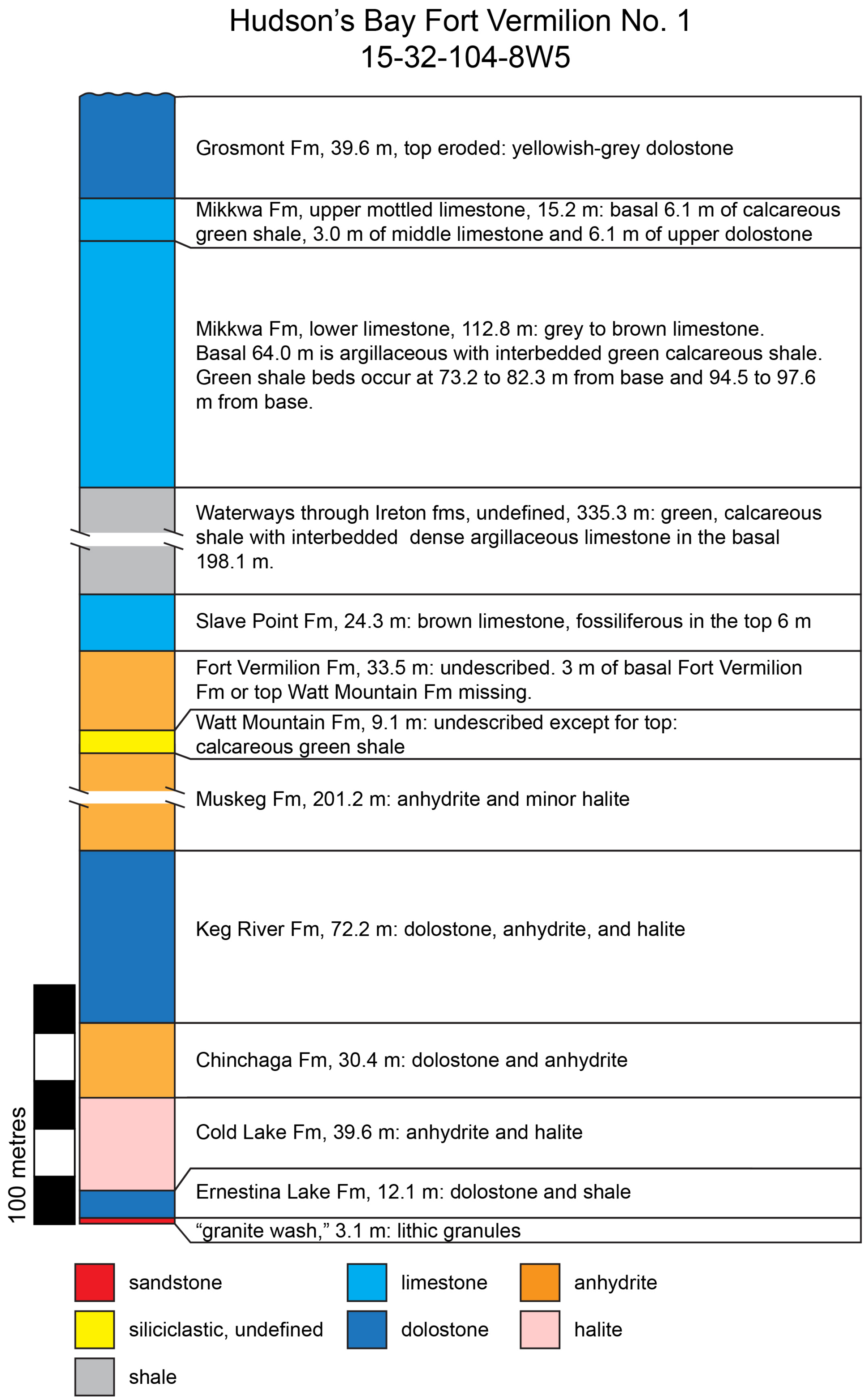

Figure 1. Core from Hudson's Bay Fort Vermilion no. 1 well (15-32-104-8W5). Measurements are based on those of Crockford in Norris (1963) and updated to Table of Formations (ERCB, 2009) nomenclature, except for the Mikkwa and Grosmont formations, which were taken from Norris (1963). The core was unavailable during the writing of this report.

Norris's (1963) description of the composite section for the upper "mottled limestone" member of the Mikkwa Formation, exposed below the lower Vermilion Chutes on Peace River, from base to top, is as follows:

1) 1.8 m of medium brownish-grey, thin to medium-bedded, brachiopod and coral-rich limestone containing red argillaceous partings near the top.
2) 1.5 m covered interval.
3) 1.4 m of medium brown and purplish-red mottled, irregularly thin and nodular-bedded, sparsely fossiliferous limestone.
4) 1.0 m of medium brown and purplish-red mottled, irregularly thin-bedded (5 to 30 cm thick), richly fossiliferous limestone.
5) 1.2 m of medium brownish-grey and purplish-red mottled, rubbly thin-bedded, slightly argillaceous, fossiliferous limestone.
6) 1.8 m of medium brownish-grey and purplish-red mottled, massive, brachiopod and *Thamnopora*-bearing limestone.
7) 1.6 m of recessive, medium brownish-grey and dark purplish-red mottled, rubbly thin-bedded limestone.
8) 3.8 m of medium brownish-grey, massive, fossiliferous limestone becoming dolomitic and coral-rich towards the top.
9) 1.2 m of medium brownish-grey to light olive-grey with red to purple mottling, irregularly thin-bedded, argillaceous limestone containing abundant corals and brachiopods.

Norris (1963) estimated 1.5 m of covered section between the top of the composite section at the mouth of the Mikkwa River and the base of the composite section from Vermilion Chutes on Peace River.

Green et al. (1970) briefly described the Mikkwa Formation as a 122 m thick succession of limestone and dolomitic limestone with minor shale, underlying 15.2 m of Grosmont Formation outcrop.

Cutler (1983) correlated the Mikkwa Formation exposed at the lower Vermilion Chutes with the Grosmont Formation in the subsurface. In the outcrop of the Mikkwa Formation, Cutler (1983) recognized 1 to 4 m thick, shallowing-upwards cycles, each containing hardgrounds at the top.

Cutler's (1983) section of the Mikkwa Formation at the lower Vermilion Chutes, from base to top, includes the following:

Unit A: brachiopod and crinoid wackestone.

Unit B: nodular, argillaceous, brachiopod and crinoid wackestone with a green, calcareous shale at the base.

Unit C: brachiopod wackestone.

Unit D: nodular, crinoid- and brachiopod-bearing, calcareous shale.

Unit E: nodular, argillaceous brachiopod and coral wackestone with pyritized hardground surfaces.

Unit F: coral-stromatoporoid floatstone.

More recently, Buschkuehle (2003) investigated the same outcrop of the Mikkwa Formation exposed at the lower Vermilion Chutes along the Peace River. From base to top, Buschkuehle (2003) described it as follows:

1) A basal light grey to reddish dolomitic limestone containing fossil debris.
2) 1.0 m of red and red-grey, fossiliferous limestone containing abundant brachiopods.
3) 0.4 m of red-grey, nodular limestone.
4) 1.1 m of variegated red and grey, nodular, mudstone to wackestone.
5) 1.0 m of a yellowish-grey "brachiopod bank."
6) 2.0 m of yellow, massive, coral-rich dolostone, which is highly porous from coral dissolution and contains bitumen staining, calcite, and dolomite in the coral molds.

Although they did not describe the outcrop, Rice and Lonnee (2006) reported geochemical and petrological data from samples taken from Mikkwa Formation dolostone exposed along Harper Creek. They found two major stages of dolomitization: an earlier, pervasive recrystallization and a later stage of pore and fracture-filling saddle dolomite.

3 Geology

3.1 Access

Locations: UTM Zone 11, 657329E, 6451967N, NAD83 (Figure 2)

Access: By helicopter; land on the weedy bank east of the confluence of Harper and Lambert creeks (Figure 3). Wade the sulphur-rich stream to the outcrop along Harper Creek and walk upstream along Lambert Creek to a smaller outcrop. The area may also be accessed by quad trails from the north.

Note: Both streams are sulphur rich and milky brownish green from numerous upstream sulphur springs. Two springs at this locality, one at the base of the Harper Creek outcrop (Figure 4) and one east of the mouth of Lambert Creek (Figure 5), contribute to the sulphur content of the creeks.

3.2 Stratigraphy

The Grosmont Formation, described herein from an outcrop located at the confluence of Harper and Lambert creeks, forms a small (up to 10 m high) cliff along the north bank of Harper Creek (Figures 3 and 6). The lowermost bed of the outcrop disappears beneath the basal talus bordering the stream, whereas the top of the outcrop is eroded and overlain by a thin layer of soil and, upstream, Pleistocene fluvial alluvium.

The stratigraphy of this outcrop is illustrated in Figures 6 and 7. From base to top, this outcrop contains the following:

1) 76 cm (exposed), dolostone: resistant, beige-grey weathering, dark grey, fine to medium crystalline sub-bedded in lensoidal and discontinuous 10 cm thick beds, bulbous and branching stromatoporoid-bearing rudstone to bafflestone to bindstone. Massive stromatoporoids are mouldic but contain remnants of organic structures on the inner surfaces of their moulds. Branching stromatoporoids are mouldic or preserved as body fossils, are 1 to 5 mm in diameter, and include *Stachyodes* and *Amphipora*. This unit has a sharp contact with unit 2, most easily seen in freshly spalled areas of the cliff (Figures 6–9).
2) 50 cm, dolostone: resistant, beige-weathering, dark to medium grey, fine- to medium-crystalline, massive and branching stromatoporoid rudstone to bindstone. Massive stromatoporoids are mouldic, with relict organic structure on the interiors of most moulds, are up to 25 cm in diameter, occur every 10 to 30 cm in the matrix, and are randomly oriented. Some massive stromatoporoids are broken or fragmented. Branching stromatoporoids are mouldic or preserved as body fossils, are 1 to 5 mm in

diameter, and include *Stachyodes* and *Amphipora*. This unit varies in thickness by 20 cm along the outcrop, thinning where unit 3 thickens. The top of this unit is gradational into unit 3 over a 10 cm interval (Figures 5–11).

3) 80 cm, dolostone: resistant, mottled dark blue grey and beige weathering, dark grey and beige, fine crystalline, lensoidal and discontinuous-bedded (2 to 5 cm thick), branching and bulbous stromatoporoid rudstone to bafflestone. The mottled coloration results from a dark grey matrix and beige stromatoporoid fossils. The lower half of the unit contains fossils of branching stromatoporoids; the upper half contains both fossils and moulds of branching stromatoporoids. Branching stromatoporoids are 1 to 5 mm in diameter and include *Stachyodes* and *Amphipora*. Beds (1 to 2 cm) of exclusively *Amphipora* appear in the middle of the unit and increase in frequency and thickness (up to 5 cm) upwards. Small bulbous stromatoporoids constitute up to 10–15% of the fossil content. This unit varies in thickness along the outcrop, thickening at the expense of unit 2. The top of this unit is gradational with unit 4 (Figures 6, 7, 8, and 12).

4) 80 cm, dolostone: resistant, beige weathering, dark grey, fine to medium-crystalline, 10 to 15 cm bedded, branching stromatoporoid rudstone. Branching stromatoporoids are mouldic, are 1 to 5 mm in diameter, and include *Stachyodes* and abundant *Amphipora*. The top surface of the unit is wavy and has a sharp contact with unit 5 (Figures 6 and 7).

At this site, the remainder of the outcrop is inaccessible. The upper beds of the section were measured 50 m downstream from the first site, where a small, grassy slump allowed access to the upper cliff.

5) 3 cm, shale: recessive, brown shale interlaminated with discontinuous dolostone. Laminations are <1 mm in thickness (Figure 7).

6) 25 cm, dolostone: recessive, beige weathering, beige, fine crystalline, 1 to 20 cm nodular mudstone with anastomosing, dark brown, laminated shale partings up to 1 cm thick. This unit is variable in thickness; at the first site, this unit was approximately 80 cm thick and the maximum nodule size was approximately 4 cm in diameter (Figures 6, 7, 8, and 13).

7) 75 cm, dolostone: resistant, beige weathering, beige, finely crystalline, 1 to 5 cm bedded, branching and bulbous stromatoporoid bafflestone to rudstone. Most stromatoporoids are body fossils; only a few are mouldic. Branching stromatoporoids are 1 to 5 mm in diameter and include *Stachyodes* and *Amphipora*. Bulbous stromatoporoids make up less than 10% of the fossil content in most of the unit but increase to about 20% of the fossil content in the top 20 cm. This unit grades into unit 8 (Figures 6, 7, and 8).

8) 145 cm, dolostone: resistant, beige weathering, grey, finely crystalline, variably massive to 5 to 10 cm discontinuous wavy bedded, bulbous, massive and branching stromatoporoid and brachiopod rudstone. Fossils are fragmentary. Branching stromatoporoids are mouldic or are preserved as body fossils, are 1 to 5 mm in diameter, and include *Stachyodes* and *Amphipora*. This unit contains some discontinuous shale partings. The top of this unit is eroded and covered by a thin soil or by up to 1 m of fluvial alluvium (Figures 6 and 7).

Within this outcrop, units 2, 3, 4, 6, and 7 vary in thickness laterally. Where unit 2 (massive stromatoporoid unit) thins, units 3 and 4 (branching stromatoporoid units) thicken. Unit 6 (nodular mudstone unit) appears to thin where units 3 and 4 thin. Unit 3 creates a 40 cm benched rapid near the mouth of Lambert Creek (Figures 14 and 15).

The outcrop is jointed with near-vertical joints. Some fractures only affect the upper beds.

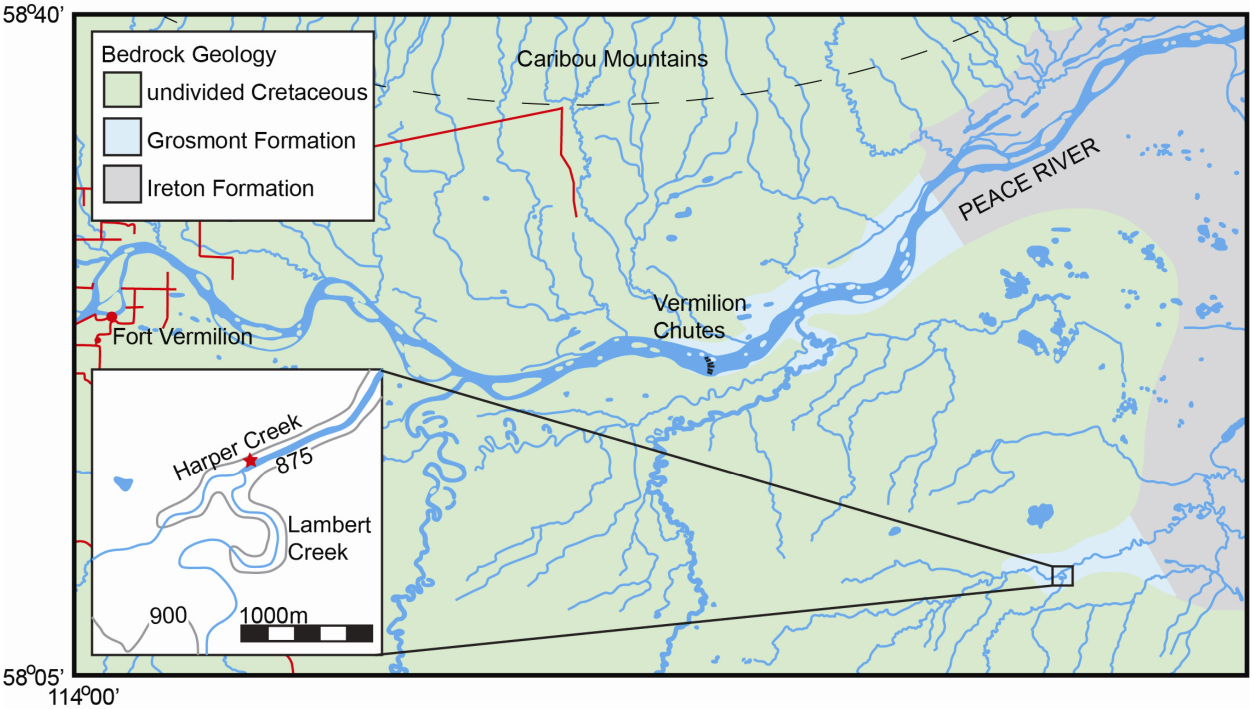

Figure 2. Generalized geological map showing the location of the confluence of Harper and Lambert creeks. The red star highlights the location of the outcrop described in this report. Formation boundaries were taken from the Geological Map of Alberta (Hamilton et al., 1999).

Figure 3. Outcrop of the Grosmont Formation located at the confluence of Harper (top left) and Lambert (bottom left) creeks. The greenish-brown colouration of the stream is caused by sulphur springs upstream (to the left in the photo) and near the confluence. Measured section is slightly downstream (to the right) of this photograph. Outcrop is approximately 4 m high.

Figure 4. Sulphur spring at the base of the Harper Creek outcrop. Black shape in the upper left of the photo is a boot, for scale.

Figure 5. Sulphur spring to the southeast of the confluence of Harper and Lambert creeks. Discharge is slow and is located at the head of small rill in a small pile of dolostone float. Spring water in this rill is turbid grey-brown and red with a microbial film on its surface. The water flows into Harper Creek a short way downstream.

Figure 6. Measured section of the Grosmont Formation on Harper Creek, located just east of its confluence with Lambert Creek. Note the lateral variability in the thickness of units 2 through 7. Water in Harper creek is greenish-brown and turbid from dissolved sulphur and associated microbial activity.

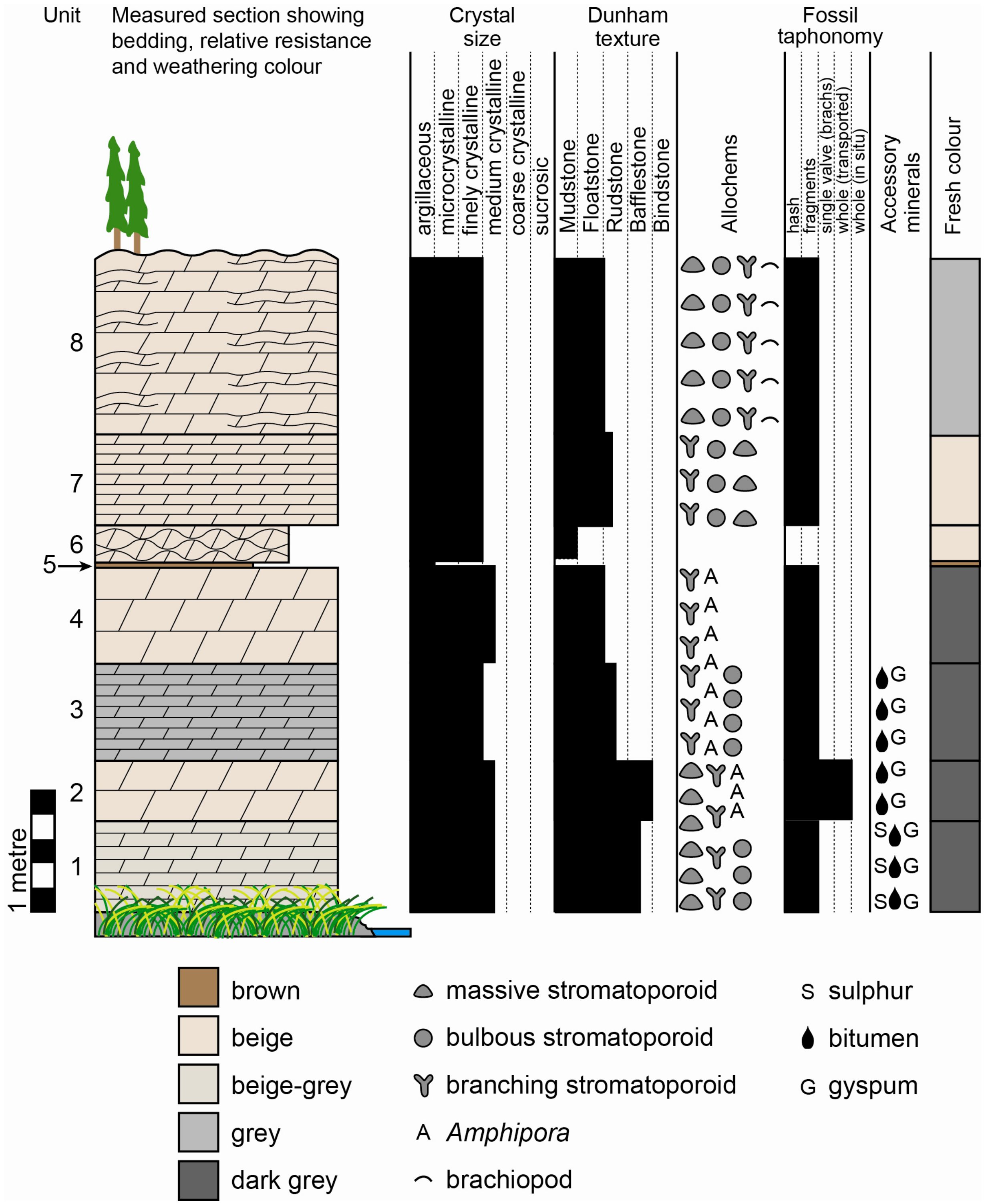

Figure 7. Stratigraphic section of the outcrop at the confluence of Harper and Lambert creeks.

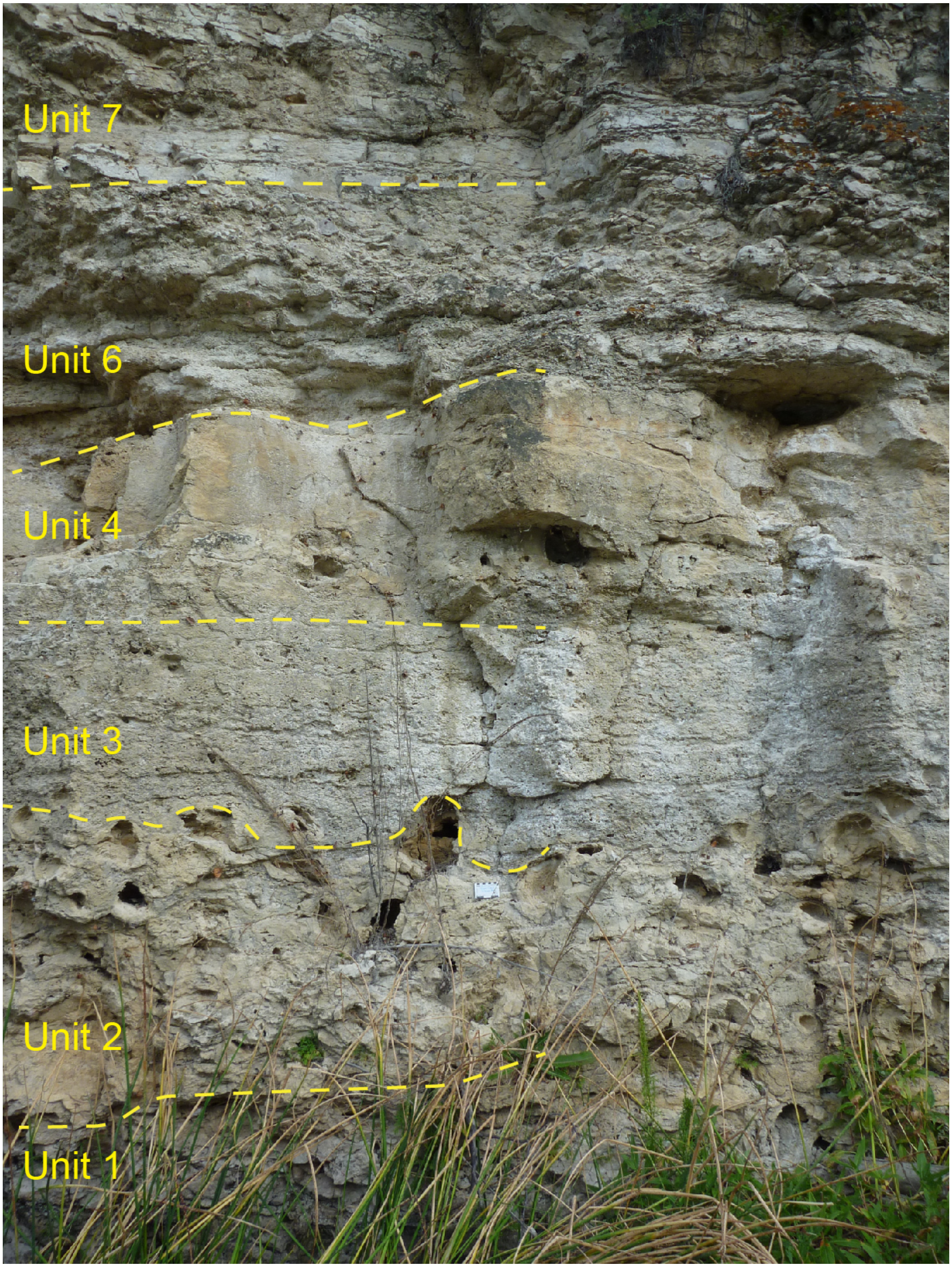

Figure 8. Outcrop at the confluence of Harper and Lambert creeks. Unit 5 is too thin to label on this photograph and occurs on the line between units 4 and 6. The 8 cm wide scale card is located in upper unit 2 near the centre of the photo.

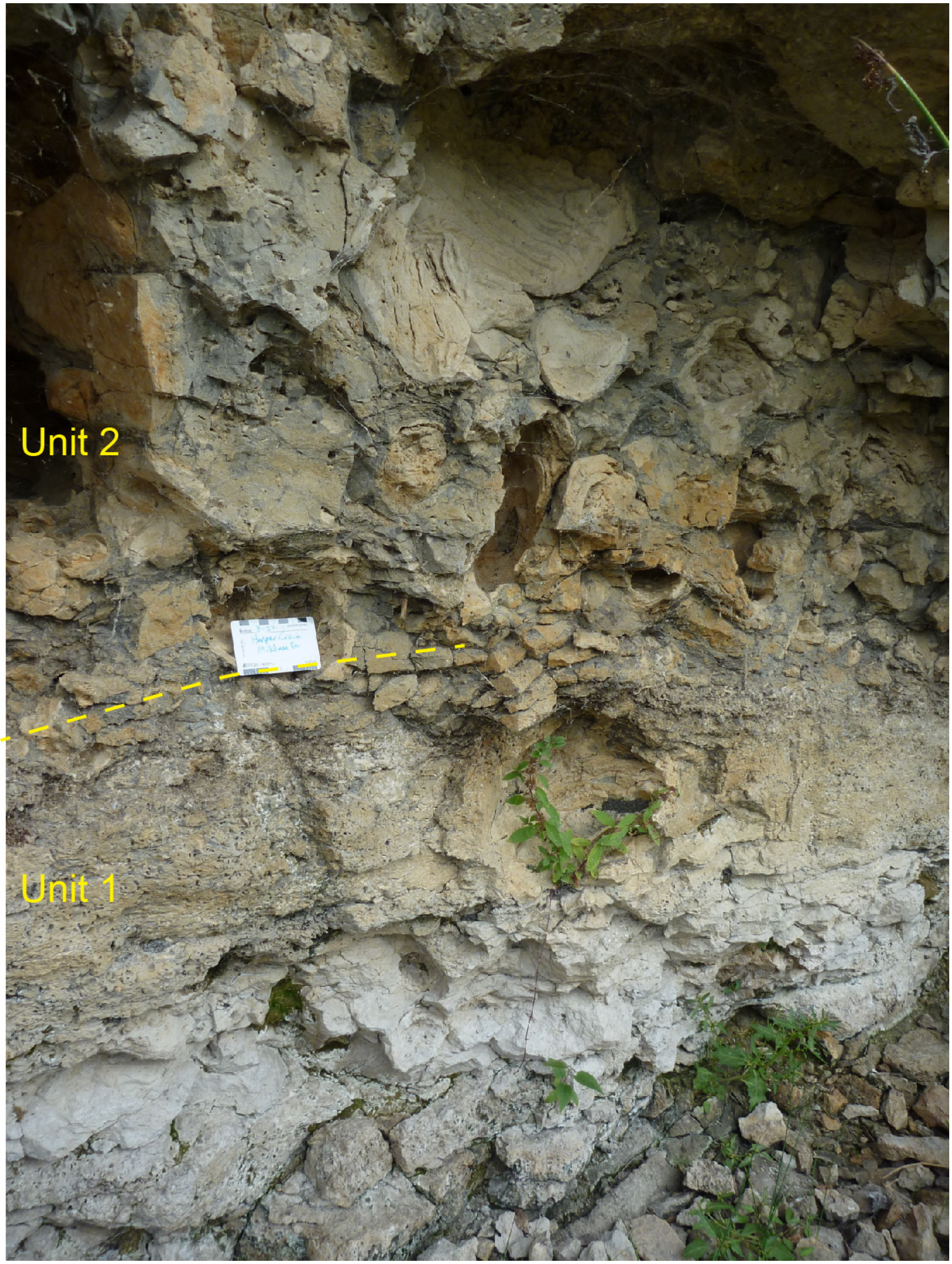

Figure 9. Unit 1 with vuggy porosity formed from mouldic branching and massive stromatoporoids and overlain by unit 2 with mouldic massive stromatoporoids. The upper portion of the scale card is in centimetres.

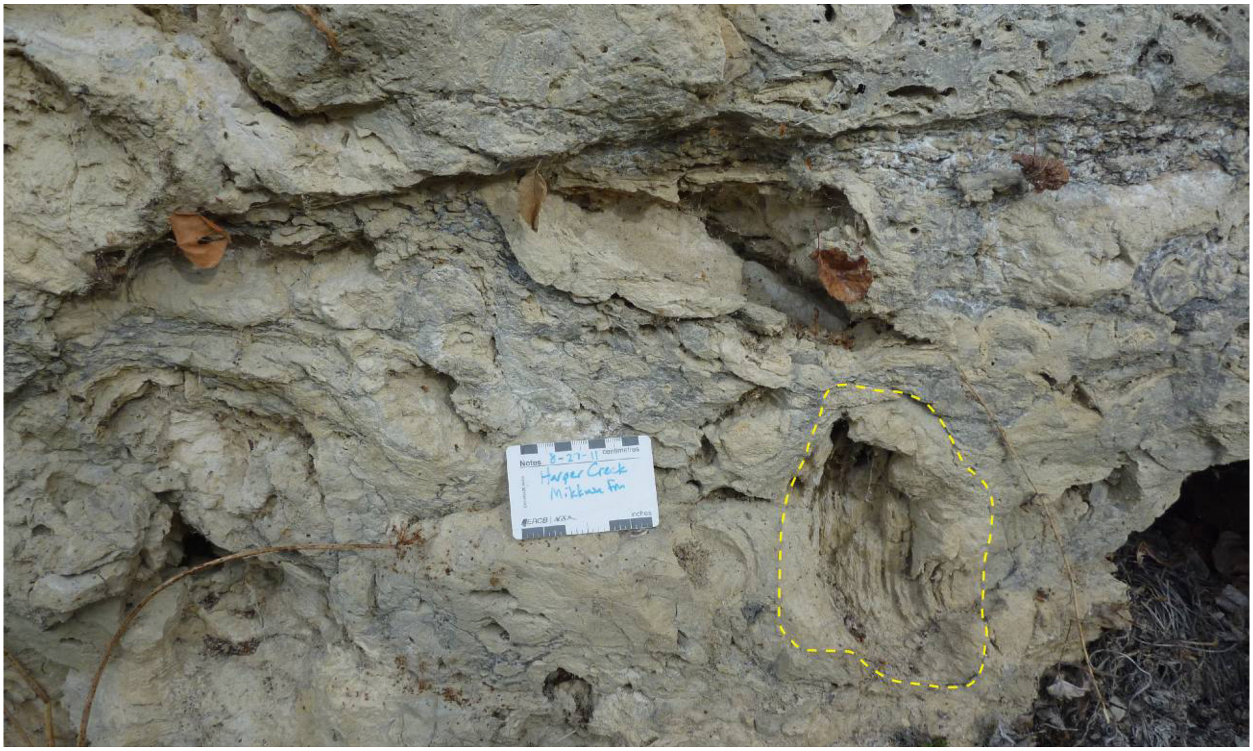

Figure 10. Close-up of unit 2 showing relict organic structure in mouldic stromatoporoids. Upper portion of the scale card is in centimetres.

Figure 11. Relict organic structure in a stromatoporoid mould from unit 2. This specimen is unusually well preserved.

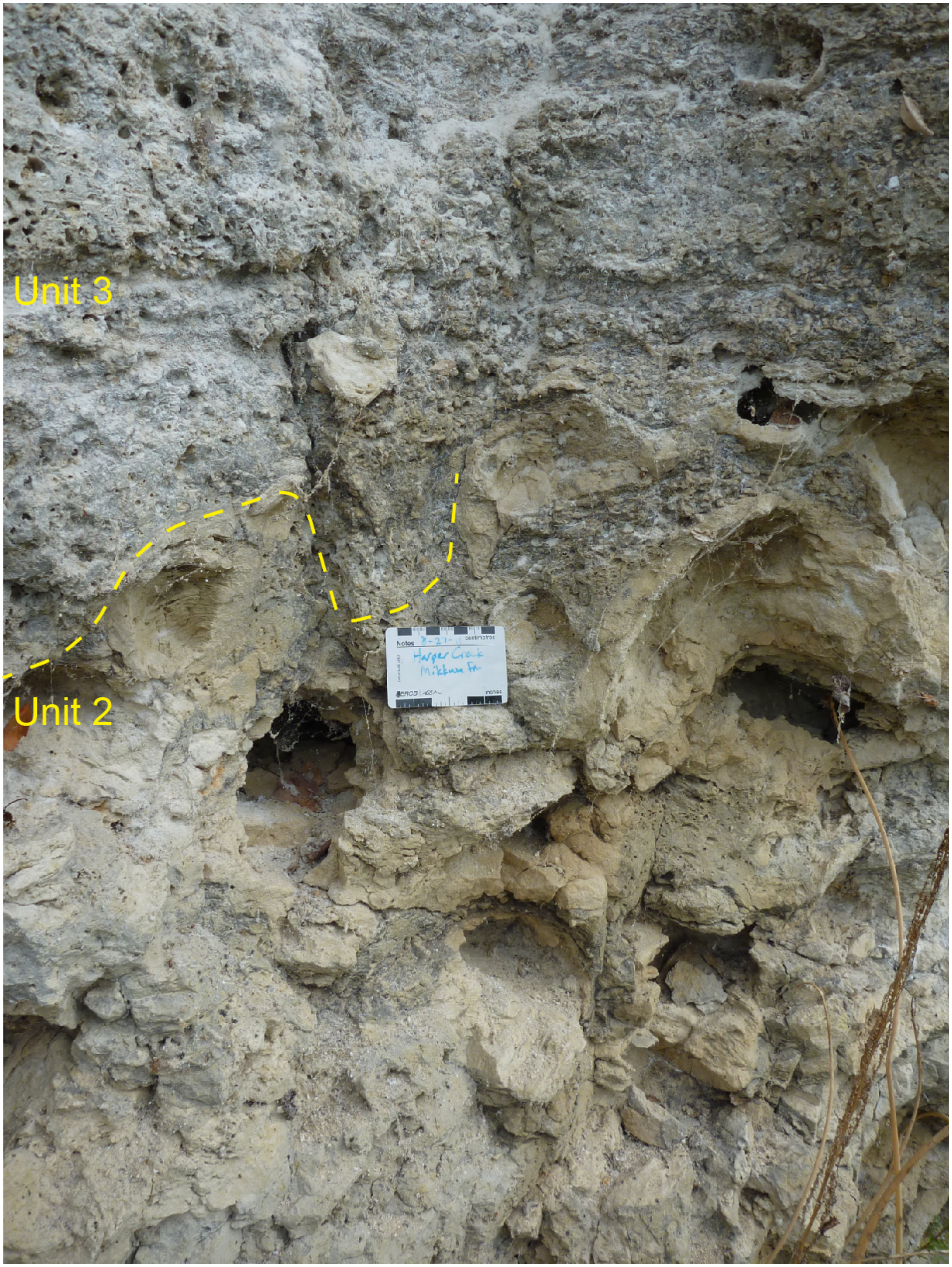

Figure 12. Mouldic massive stromatoporoid bioherm of unit 2 underlies the mouldic branching stromatoporoid bafflestone to rudstone of unit 3. Upper portion of scale card is in centimetres.

Figure 13. Close-up of the stromatoporoids in the upper portion of unit 6.

Figure 14. A dolostone bench forms a small rapid just upstream of the mouth of Lambert Creek.

Figure 15. Close-up of the dolostone forming the rapids in Lambert Creek: the stromatoporoid bafflestone to rudstone of unit 3. All of the stromatoporoids are mouldic; shadows darken the moulds in the rock.

3.3 Biofacies

The units at this outcrop fall within one of five biofacies:

1) *Stachyodes*-dominated biostrome (lower unit 3, unit 7)
   In this biofacies, branching stromatoporoids formed dense patches of water and sediment-bafflers. Secondary organisms include bulbous stromatoporoids and brachiopods. This fauna thrived in moderate- to high-energy conditions on the shallow, open shelf beneath the fair-weather wave base.

2) Massive stromatoporoid bioherm (unit 2)
   Massive stromatoporoids formed a patch reef. At this locality, many stromatoporoids are fragmentary and/or toppled, especially where the unit thins, suggesting that this unit formed within, or proximal to, the patch-reef environment. Fragments of branching stromatoporoids are common allochems in the inter-stromatoporoid matrix. The bioherm may have built sufficient positive topography to enter the high-energy fair-weather wave zone on the open shelf.

3) Mixed *Stachyodes* and massive stromatoporoid biostrome (units 1 and 8)
   This biofacies is a mixture of the *Stachyodes*-dominated biostrome and the massive stromatoporoid bioherm. Massive stromatoporoids in this biostrome represent the initial establishment of a bioherm in the *Stachyodes*-dominated biostrome. This successional stage in the ecosystem likely existed under moderate- to high-energy conditions on the open shelf, but below the fair-weather wave base.

4) *Amphipora* biofacies (upper unit 3, unit 4)
   In this biofacies, *Amphipora* is the dominant or exclusive organism. Diversity is low; other branching stromatoporoids and other fossils are rare. Because of abundant *Amphipora* at the expense of stenohaline organisms, this fauna likely existed in the back-reef lagoon under restricted circulation and low- to moderate-energy conditions, below the fair-weather wave base.

5) Abiotic argillaceous facies (units 5 and 6)
   During the formation of this facies, the environment precluded organisms. Thus, this facies contains no apparent fossils or traces. The paleoenvironment was one of low energy and restricted ocean circulation, which would promote dysoxia to anoxia near the sediment-water interface.

3.4 Paleoenvironmental Interpretation

According to Machel and Hunter (1994), bulbous and massive stromatoporoids occurred in the reef core but were most common behind the wave-washed reef crest. Similar facies occurred on the crests of patch reefs. Branching stromatoporoids lived proximal to the reef core, both in the back- and fore-reef environments.

Kershaw's (1998) interpretation of paleoenvironmental parameters controlling the distribution of stromatoporoid growth forms is similar to that of Machel and Hunter (1994). Bulbous and massive stromatoporoids built the reef core but became secondary to tabular stromatoporoids in the high-energy reef-crest environment. Branching stromatoporoids such as *Stachyodes* and *Amphipora* lived in the back-reef environment. *Stachyodes* had a reef-proximal distribution, whereas *Amphipora* was distributed throughout the lagoon.

This outcrop likely formed from sediments that accumulated in the shallow-water, moderate- to high-energy shelf behind the platform edge that favoured the growth of branching stromatoporoids. The abundant branching stromatoporoids in some beds, such as the *Stachyodes*-dominant biostromes of units 3 and 7, suggest a paleocommunity dominated by erect, sediment- and water-baffling organisms. These stromatoporoids did not form a cemented, organically-bound reef with significant positive topography, but rather created a dense, three-dimensional thicket that slowed water currents and trapped sediment particles. In this manner, the *Stachyodes*-dominated biostrome likely had a slight positive topography built on trapped sediment particles and abundant skeletal debris of the branching stromatoporoids.

The massive stromatoporoids within the branching stromatoporoid-rich unit 1 represent the successional phase between the branching stromatoporoid biostrome and the fully developed patch reef of unit 2. The abundance and size of stromatoporoids in unit 2 suggests the formation of a bioherm.

In unit 3, beds comprised exclusively of *Amphipora* are common and increase upsection into unit 4, which contains abundant *Amphipora* and fewer *Stachyodes*. In addition to *Amphipora* having a wide distribution in the back-reef, lagoonal environment (e.g., Kershaw, 1998), *Amphipora* is widely accepted as a euryhaline organism tolerant of restrictive marine conditions, such as those that could occur in back-reef lagoons isolated from the open ocean. The increasing abundance of *Amphipora* in units 3 and 4 suggests (a) intermittent (unit 3) and eventually continuous (unit 4) water circulation restriction and environmental stress and/or (b) regression during the deposition of units 3 and 4.

The thin shale horizon of unit 5 and the nodular mudstone of unit 6 indicate a brief departure from normal marine environmental parameters at this locality. It is possible that an exposure or omission surface occurs at the wavy top surface of unit 4 (branching and bulbous stromatoporoid unit) but was not observed. The increase of *Amphiopora* during the deposition of unit 4 may indicate shallowing in the lagoonal environment, potentially leading to exposure at the termination of unit 4 sedimentation. Although the surface of unit 4 is irregularly wavy in cross section, the surface itself could not be examined further for evidence of subaerial exposure, such as karst features or green clay.

A preliminary interpretation of the paleoenvironmental history of the facies in the outcrop follows, from oldest events to youngest, with a general interpretation of relative sea level/paleoenvironment illustrated in Figure 16:

Unit 1: The base of the outcrop starts in the lagoonal, mixed *Stachyodes* and massive stromatoporoid biostrome. Massive stromatoporoids formed the foundation for a bioherm.

Unit 2: Massive stromatoporoids abruptly increased in abundance to form a patch reef (the massive stromatoporoid biostrome).

Unit 3: With possible regression and the termination of the patch reef, the local ecosystem returned to the shallow-water *Stachyodes*-dominant biostrome.

Upper unit 3 and unit 4: Regression continued and *Amphipora* increased in abundance at the expense of the more stenohaline *Stachyodes*. Eventually, only *Amphipora* was able to thrive in the restricted and very shallow lagoon (*Amphipora* biofacies).

Top of unit 4: Continued shallowing resulted in subaerial exposure.

Units 5 and 6: Marine transgression returned the local paleoenvironment to a deep lagoonal setting with initially, laminated, clay-rich muds and later, argillaceous lime mud. Alternatively, laminated mud may have originated in the littoral zone, where wave swash in the distal back reef was minimal, allowing terrigenous clay and organic material to accumulate (the deep water interpretation is portrayed in Figure 12).

Unit 7: Sea level dropped, allowing a return to the *Stachyodes*-dominated biostrome. With the accumulation of skeletal debris for encrustation, the fauna soon included bulbous stromatoporoids.

Unit 8: Massive stromatoporoids of the mixed *Stachyodes* and massive stromatoporoid biostrome indicate the possible beginnings of another patch reef interval, similar to that in unit 1.

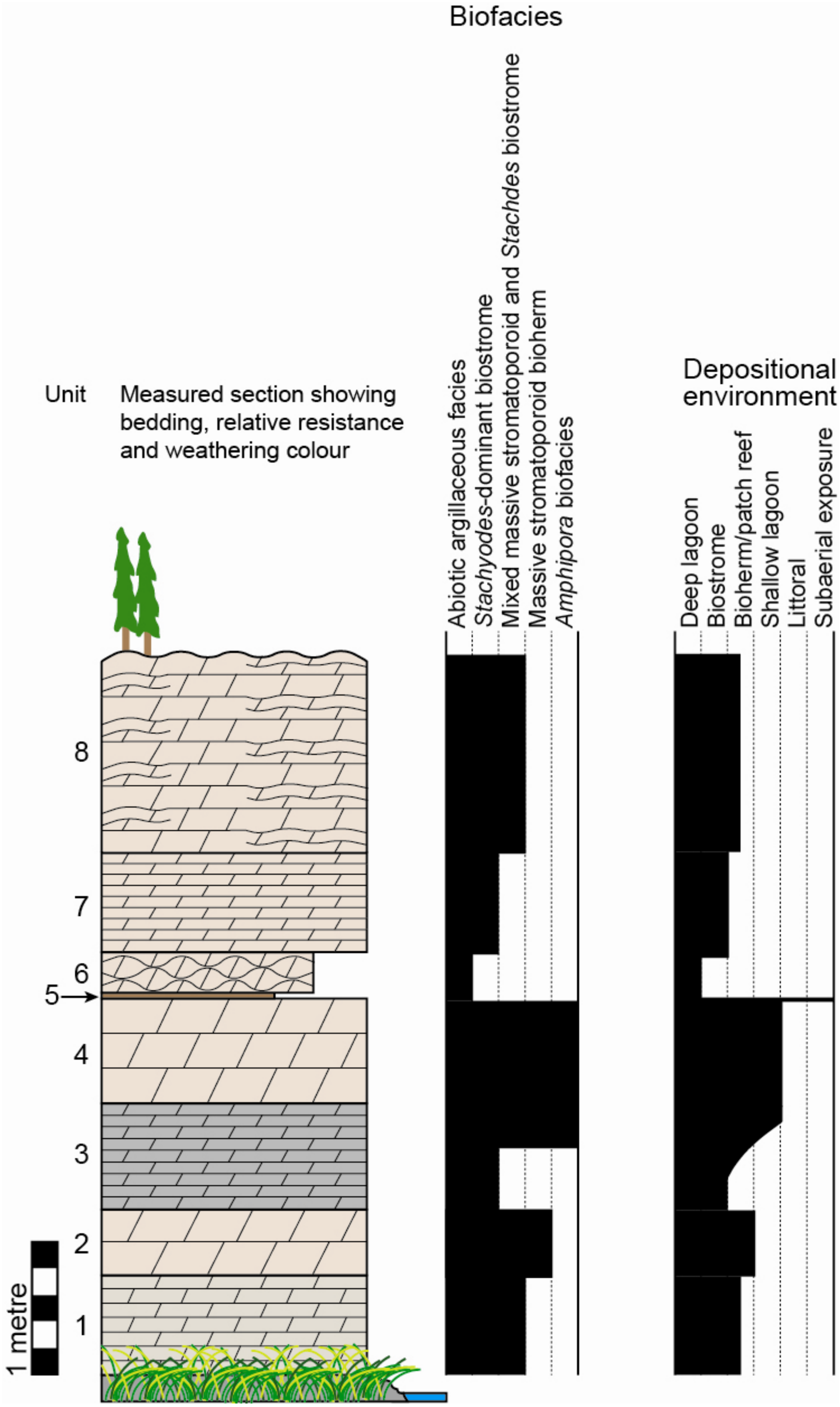

Figure 16. Biofacies and depositional environment interpreted for the units of the Grosmont Formation in the outcrop at the confluence of Harper and Lambert creeks.

4 Comparison to Grosmont and Mikkwa Formation Outcrops

The outcrops along Harper and Lambert creeks only partially resemble the Mikkwa Formation outcrops described by Norris (1963), Cutler (1983), and Buschkuehle (2003) from Vermilion Chutes along the Peace River. At Vermilion Chutes, most of the strata described as the Mikkwa Formation contains abundant, red-stained *Thalassinoides* burrow networks and an increase in fossil abundance (especially corals and stromatoporoids) near the top of the beds. Outcrops at the confluence of Harper and Lambert creeks contain abundant stromatoporoids, with very few other fossils and no evidence of *Thalassinoides* burrows. Furthermore, the lithology of the outcrop along the confluence of the creeks is dolomitic; the outcrop previously described as the Mikkwa Formation at the lower Vermilion Chutes is dominantly limestone.

Although significantly different lithology and biodiversity, the outcrop from the confluence of Harper and Lambert creeks most resembles Norris's mottled limestone member of the Mikkwa Formation that outcrops along the confluence of the Mikkwa and Peace rivers. Branching stromatoporoids are common to both localities.

An outcrop assigned to the Grosmont Formation at the upper Vermilion Chutes is dolomitic, like those from Harper and Lambert creeks, but is pervasively recrystallized. Most coral and stromatoporoid fossils in the Grosmont Formation dolostone are lost to dissolution and/or dolomitization; only vague remnants of stromatoporoids, corals, and bivalves are preserved. Conversely, the outcrop at the confluence of Harper and Lambert creeks contains good, if often mouldic, preservation of fossils in the dolostone beds.

The Grosmont Formation contains diverse facies within a regionally extensive platform, spanning supralittoral through platform margin paleoenvironments. The biofacies found in the outcrops at the confluence of Harper and Lambert creeks falls within those previously described from the Grosmont Formation. Thus, the outcrop described herein is considered to be part of the Grosmont Formation.

5 Summary

Outcrops at the conjunction of Harper and Lambert creeks that were placed within the Mikkwa Formation have been redescribed under the Grosmont Formation. Most of the outcrop at the junction of Harper and Lambert creeks originated from dolomitized stromatoporoid patch reefs and biostromes; a very small portion of the outcrop is unfossiliferous. The outcrop records a regression in its basal portion and most of a transgressive-regressive cycle in its upper units.

6 References

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