GS2019-7

First discovery of a Cretaceous fossil leaf in Manitoba (NTS 62N15)

by K. Lapenskie

Summary

During re-examination of Manitoba Geological Survey's stratigraphic drillcore M-08-78, a pyritized leaf was found within a nodule in the siliciclastic Cretaceous Swan River Formation. This leaf represents the first known occurrence of a Cretaceous fossil leaf in Manitoba. The fossil has been identified as belonging to a fern, most likely from the family Osmundaceae. Terrestrial lithofacies of the Swan River Formation may host other terrestrial faunal assemblages, which has important implications for geotourism and paleontological research in Manitoba, as well as providing new paleoenvironmental information important to understanding the depositional setting of this formation.

In Brief:

- First known example of a Cretaceous leaf discovered in Manitoba
- May indicate that there is Cretaceous terrestrial fossil fauna in the Swan River Formation

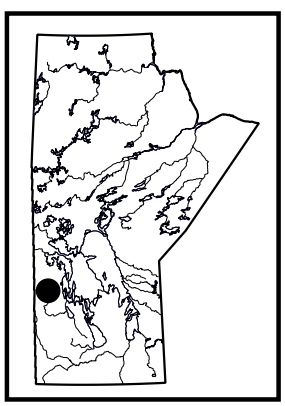
Citation:
Lapenskie, K. 2019: First discovery of a Cretaceous fossil leaf in Manitoba (NTS 62N15); *in* Report of Activities 2019, Manitoba Agriculture and Resource Development, Manitoba Geological Survey, p. 72–76.

Introduction

Drillcore M-08-78 was drilled by the Manitoba Geological Survey (MGS) in 1978 (Bannatyne, 1978), within the community of Pine River, situated on the eastern flank of Duck Mountain (Figure GS2019-7-1). In 2019, a pyritized fossilized leaf was discovered in a pyritized nodule within the Swan River Formation during a standard review of the drillcore for stratigraphic learning purposes. This discovery represents the first reported fossilized leaf from Cretaceous strata in Manitoba.

The siliciclastic Cretaceous Swan River Formation was deposited throughout southwestern Manitoba. Coeval siliciclastic strata were deposited in parts of Saskatchewan and North Dakota and likely correlate to the Cantuar Formation of the Mannville Group. The Swan River Formation is relatively understudied in Manitoba, with few core transecting the formation. There are limited exposures of the Swan River Formation in southwestern Manitoba; these exposures are located along rivers on the flanks of the Manitoba escarpment north of Riding Mountain (to the south of drillhole M-08-78).

The Swan River Formation is mainly composed of fine-grained sand to sandstone, interbedded with silt and clay intervals (McNeil and Caldwell, 1981; Glass, 1990; Nicolas, 2009; Natural Resources Canada, 2019). Minor investigations into the microfauna and macrofauna of the Swan River Formation have been conducted in the past (e.g., Guliov, 1967; Paterson, 1968); these studies have yielded carbonized plant fragments, palynomorphs and biogenic structures, but have not reported discernible terrestrial animal or plant fossils. Palynological studies and relative age dating indicate a mid-Cretaceous Albian age for the formation (Playford, 1971).



Drillcore M-08-78

The location of drillcore M-08-78 was originally chosen to test for a subsurface lignite bed that had been reported during previous drilling (Bannatyne, 1978). The hole was abandoned at a depth of 75.11 m, after encountering lenses of unconsolidated sand and silt; the lignite bed was not transected. The lithostratigraphic and lithological description of M-08-78 is provided in Table GS2019-7-1. Unconsolidated sand and silt was encountered between 45.00 and 75.11 m, with only 4.00 m of core recovered from this interval. Drillcore M-08-78 transected 3.98 m of Quaternary clays and shales, which unconformably overlie the Cretaceous carbonaceous and silty shale of the Ashville Formation (3.98 to 34.03 m) and the interbedded kaolinitic, carbonaceous shale and glauconitic, pyritic and calcareous sandstones of the Swan River Formation (34.03 to 75.11 m). However, only approximately 15 m of core was recovered from the Swan River Formation interval (Figure GS2019-7-2).

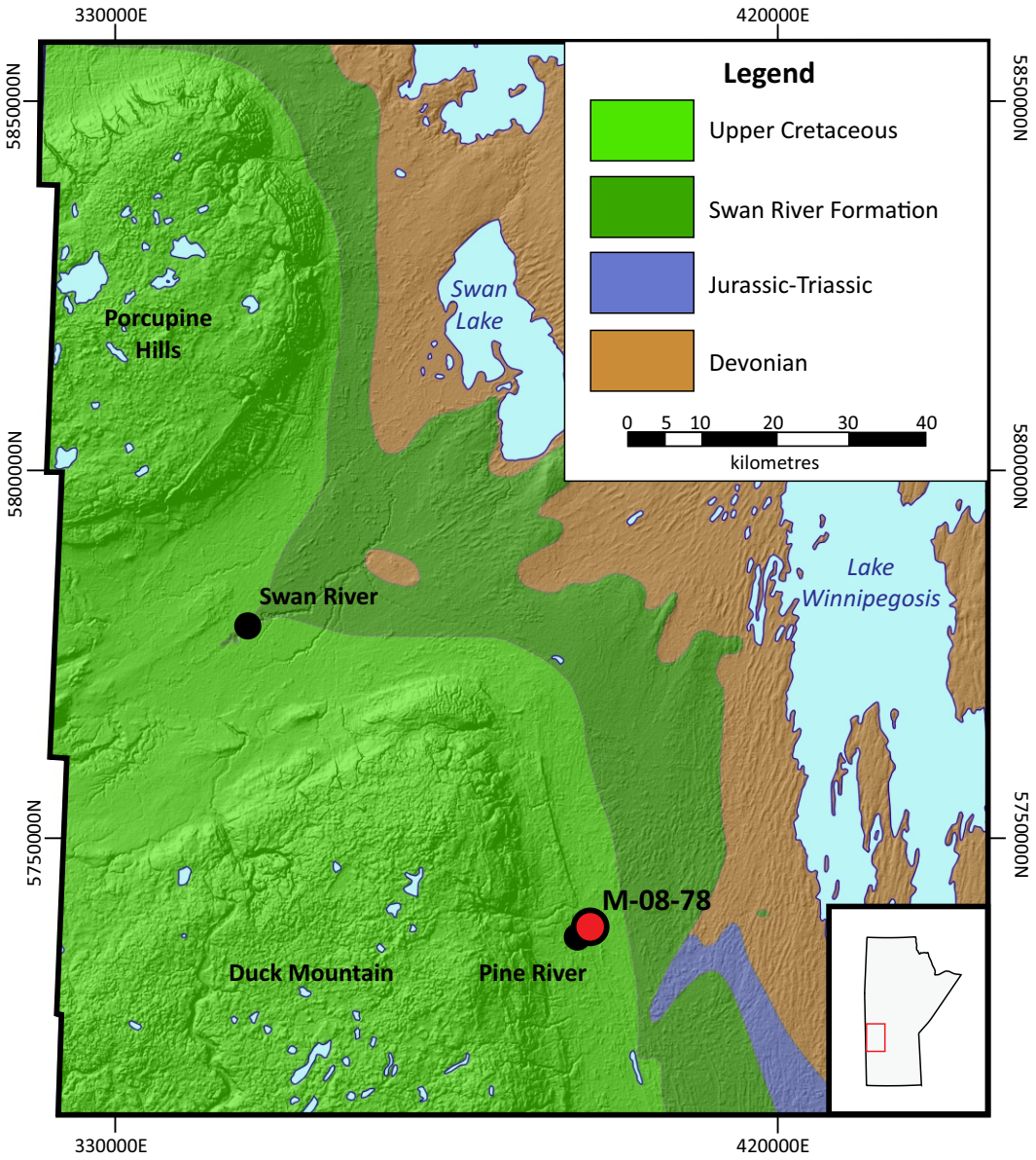


Figure GS2019-7-1: *Regional bedrock geology of east-central Manitoba (after Nicolas et al., 2010). Location of drillcore M-08-78 (Bannatyne, 1978) is shown. The background image was generated using the radar-derived Canadian digital surface model (United States Geological Survey, 2002). A hillshaded model has been added with transparency effect to enhance relief.*

Table GS2019-7-1: Lithostratigraphy and lithological description of drillcore M-08-78 (Bannatyne, 1978). Abbreviation: TVD, true vertical depth.

TVD (m)	Thickness (m)	Description
0.0–3.98	3.98	**Quaternary sediments**
		Clays and shales
3.98–75.11	71.13	**Colorado Group**
3.98–34.03	30.05	**Asvhille Formation**
		Black to grey carbonaceous shale, interbedded with silt lenses and laminae in lower section
34.03–75.11	14.97*	**Swan River Formation**
		Light grey to black kaolinitic to carbonaceous shale, interbedded with glauconitic sandstone, pyritic sandstone and calcareous sandstone

*Measured recovered core

Figure GS2019-7-2: *Photograph of the Swan River Formation in drillcore M-08-78 (Bannatyne, 1978). Lowermost shale beds of the Ashville Formation occur near the top of the interval, underlain by sandstones and carbonaceous shales of the Swan River Formation. Arrow indicates up direction in core. Scale bar in centimetres. Star denotes location of the fossilized leaf-bearing nodule. Yellow dashed line denotes contact between Ashville and Swan River formations. Abbreviations: A.F, Ashville Formation; c.s., carbonaceous shale; S.R., Swan River Formation; s.s., sandstone.*

Fossilized leaf

The pyritized leaf was found on a bedding surface within a pyritized concretion, which occurred at an approximate depth of 50.85 m in drillcore M-08-78. The singular leaf is approximately 9 mm long by 4 mm wide (Figure GS2019-7-3). Carbonized plant fragments are abundant on this bedding surface as well. The concretion is composed of pyritized glauconitic siltstone to sandstone. The fossil leaf is a single pinnule from a pteridophyte frond leaflet, based on venation (Dr. D. Greenwood, pers. comm., 2018). The fossil most likely belongs to the family Osmundaceae (Dr. E. Koppelhus, pers. comm., 2019).

Discussion

The Swan River Formation was deposited in marine and terrestrial environments (Nicolas, 2009). Lowermost unconsolidated silts and sands and sandstones were most

Figure GS2019-7-3: *Photomicrograph of bedding surface within a pyritized glauconitic sandstone concretion at 50.85 m. The fossil leaf is pyritized, and surrounded by scattered fragments of unidentifiable black carbonized woody plant material.*

likely deposited in terrestrial conditions such as incised drainage systems and paludal environments, whereas uppermost glauconitic sands were most likely deposited in marginal marine conditions (McNeil and Caldwell, 1981; Leckie et al., 1994; Bamburak and Christopher, 2004).

This is the first reported Cretaceous terrestrial fossil leaf in Manitoba. Marine faunal assemblages are more common, such as the largest mosasaur in Canada discovered near the town of Morden, and other specimens of Cretaceous actinopterygians (fish), cheloniids (turtles), plesiosauria (marine reptiles), lepidosauria (reptiles), crocodilians (crocodiles) and aves (birds), which are featured in museum displays across the province.

The fossilized pteridophyte leaf indicates that terrestrial flora existed in Manitoba during the mid-Cretaceous. Preservation of delicate plant material may suggest preservation of more robust terrestrial animal skeletons is likely.

Economic considerations

Terrestrial lithofacies within the Swan River Formation offer a unique paleontological perspective of the Swan River Formation as a potential host of terrestrial fossilized fauna. Future fossil discoveries could positively impact paleontological-based tourism and research, as well as provide new paleoenvironmental information important to understanding the depositional setting of this formation.

Acknowledgments

The author would like to thank D. Greenwood from Brandon University and E. Koppelhus from the University of Alberta for their assistance in identifying the fossil leaf. Thank you to N. Anderson and C. Epp for their assistance with core viewing. Also, M. Gauthier and C. Böhm are thanked for their review of this report.

References

Bamburak, J.D. and Christopher, J.E. 2004: Mesozoic stratigraphy of the Manitoba escarpment; Manitoba Industry, Economic Development and Mines, Western Canada Sedimentary Basin/Targeted Geoscience Initiative II, Winnipeg, Manitoba, September 7–10, 2004, Field Trip Guidebook, 83 p.

Bannatyne, B.B. 1978: Industrial minerals drill program; *in* Report of Field Activities 1978, Manitoba Department of Mines, Resources and Environmental Management, Mineral Resources Division, p. 127–130.

Glass, D.J. (ed.) 1990: Lexicon of Canadian Stratigraphy, Volume 4, Western Canada; Canadian Society of Petroleum Geologists, Calgary, Alberta, 772 p.

Guliov, P. 1967: Part 1, Lower Cretaceous (middle Albian) foraminifera from Saskatchewan from a locality in southeastern Saskatchewan; Saskatchewan Department of Mineral Resources, Report 105, 60 p.

Leckie, D.A., Bhattacharya, J.P., Bloch, J., Gilboy, C.F. and Norris, B. 1994: Cretaceous Colorado/Alberta Group of the Western Canada Sedimentary Basin; *in* Geological Atlas of the Western Canada Sedimentary Basin, G.D. Mossop and I. Shetsen (comp.), Canadian Society of Petroleum Geologists, Calgary, Alberta, and Alberta Research Council, Edmonton, Alberta, p. 335–352.

McNeil, D.H. and Caldwell, W.G.E. 1981: Cretaceous rocks and their foraminifera in the Manitoba escarpment; Geological Association of Canada, Special Paper No. 21, 439 p.

Natural Resources Canada 2019: Weblex Canada: lexicon of Canadian geological names on-line; Natural Resources Canada, URL <https://weblex.nrcan.gc.ca/weblexnet4/weblex_e.aspx> [September 2019].

Nicolas, M.P.B. 2009: Williston Basin Project (Targeted Geoscience Initiative II): summary report on Mesozoic stratigraphy, mapping and hydrocarbon assessment, southwestern Manitoba; Manitoba Science, Technology, Energy and Mines, Manitoba Geological Survey, Geoscientific Paper GP2009-1, 19 p.

Nicolas, M.P.B., Matile, G.L.D., Keller, G.R. and Bamburak, J.D. 2010: Phanerozoic geology of southern Manitoba; Manitoba Innovation, Energy and Mines, Manitoba Geological Survey, Stratigraphic Map SM2010-1, 2 sheets, scale 1:600 000.

Paterson, D.F. 1968: Jurassic megafossils of Saskatchewan with a note on charophytes; Saskatchewan Department of Mineral Resources, Report 120, 135 p.

Playford, G. 1971: Palynology of Lower Cretaceous (Swan River) strata of Saskatchewan and Manitoba; Palaeontology, v. 14, p. 533–565.

United States Geological Survey 2002: Shuttle Radar Topography Mission, digital elevation model, Manitoba; United States Geological Survey, URL <https://dds.cr/usgs.gov/srtm/version2_1/SRTM3/North_America/>, portions of files N48W88W.hgt.zip through N60W102.hgt.zip, 1.5 Mb (variable), 90 m cell, zipped hgt format [March 2003].