Current Status of the Cretaceous Stratigraphic Nomenclature of Southwestern Manitoba

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ABSTRACT

The Cretaceous System that forms much of the Manitoba Escarpment was deposited during two major cycles of marine sedimentation, near the eastern margin of the Western Canada Sedimentary Basin (Figure 1). The current nomenclature of southwestern Manitoba's stratigraphic succession (Figure 2), in ascending order, follows.

The Swan River Formation comprises 75 m of mainly fine grained sand or sandstone, with minor silt and light to dark grey kaolinitic clay (Figure 3). Its type locality is located northeast of Swan River, Manitoba. The formation unconformably oversteps rocks of Jurassic, Devonian, Silurian and Ordovician age.

The Ashville Formation type locality is situated along the Wilson River near Ashville, Manitoba. Its lower contact is a disconformity. The Ashville formation consists of grey-black, noncalcareous shale, with subordinate amounts of silt, sand and calcarenite; and has a maximum thickness of 115 m. The Fish Scale zone, at the base of the Upper Ashville (or Belle Fourche) Member (Figure 4), marks the division between the Early and Late Cretaceous time in Manitoba. Where possible, the Lower Ashville Member is subdivided, in ascending order, into the Skull Creek, Newcastle and Westgate members).

The Favel Formation comprises olive-black, chalk-speckled calcareous shale, argillaceous limestone and calcarenite, with a maximum 40 m thickness. The formation conformably to nonconformably overlies the Ashville Formation. Its type locality is situated on the East and West Favel river valleys, near Minitonas, Manitoba. The Favel Formation usually includes both its lower Keld (Figure 5) and upper Assiniboine (Figure 6) members, but the upper member has been noted to be absent at some localities.

The Carlile Formation, which disconformably overlies the Favel Formation, was only recently recognized in southwestern Manitoba. The Carlile consists of the Morden Member (Figure 7), a 55 m (max.) thick facies-controlled basal noncalcareous carbonaceous shale; overlain by the Boyne Member (Figure 8), a 75 m (max.) thick calcareous, speckled and chalky shale. The Carlile composite reference section is in northern Montana.

The Pierre Shale unconformably overlies the Carlile. The 340 m thick noncalcareous formation is subdivided, in ascending order, into the Gammon Ferruginous (Figure 9), Pembina (Figure 10), Millwood (Figure 11), Odanah (Figure 12), and Coulter (Figure 13) members. The Gammon is hard black shale with claystone concretions; and weathers dark reddish brown. The Pembina is grayish black carbonaceous shale with numerous thin white to pink nonswelling calcium bentonite beds. The Millwood is popcorn-weathering, semi-swelling bentonitic shale with ironstone concretions. The Odanah is hard black to dark greenish grey siliceous shale, which weathers into thin steel grey conchoidal fragments, with purplish manganese-stained fracture surfaces. The Coulter is a light grey to buff, bentonitic clayey silt. The Pierre Shale type section is near Pierre, South Dakota.

The Boissevain Formation is the uppermost Cretaceous formation in Manitoba. The formation was named after Boissevain, Manitoba, situated just north of its type area. The 33 m thick Boissevain consists mainly of unconsolidated cross-bedded buff quartz-rich medium-grained "salt and pepper" sand; and usually has large calcareous sandstone concretions present in outcrop (Figure 14).

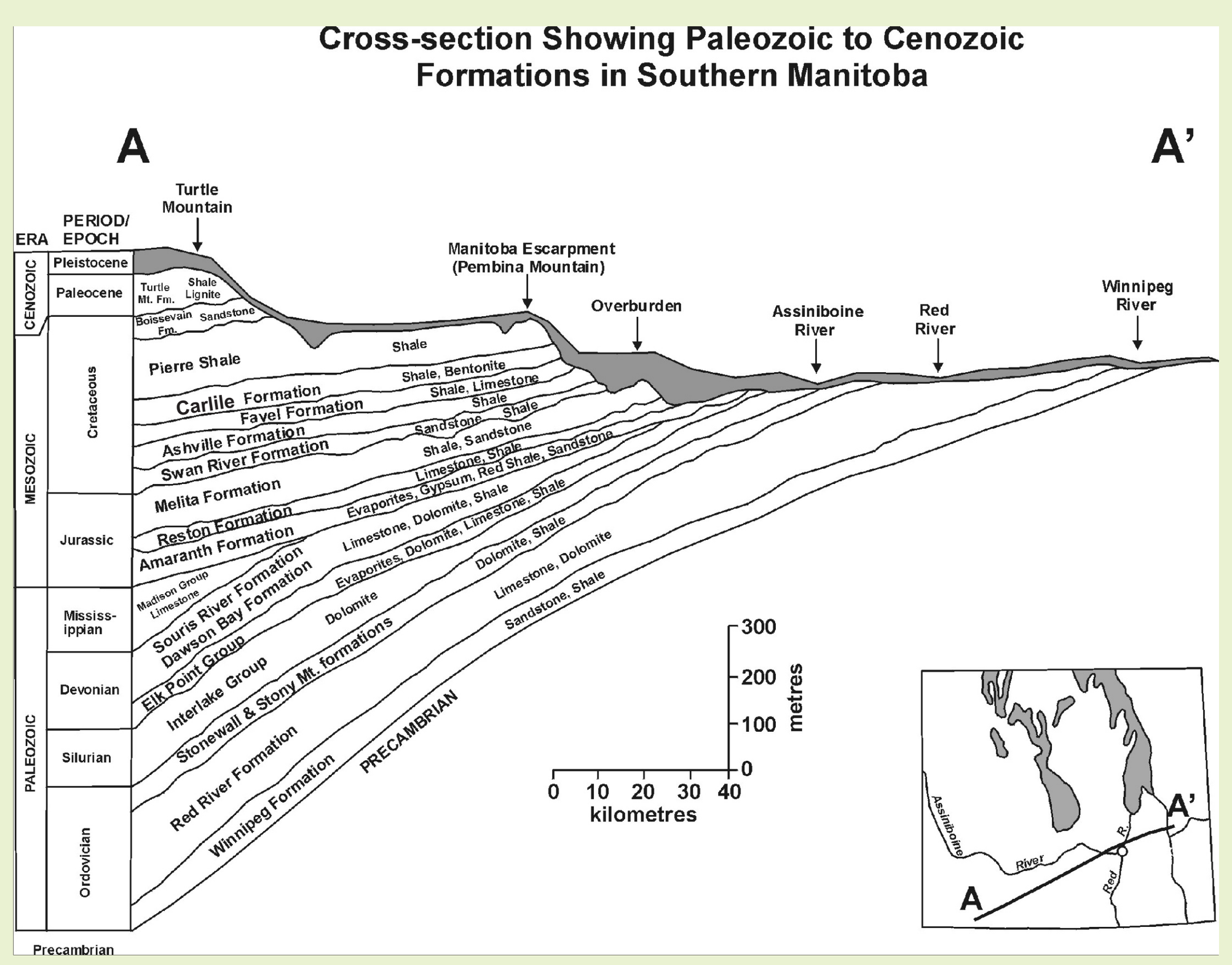

Figure 1: Cross-section of Paleozoic to Cenozoic formations in southern Manitoba.

Figure 3: Swan River Formation, Outcrop Section 57 of McNeil and Caldwell (1981, p. 349, 350), part of composite type section (component-lectostratotype), west bank of the Swan River, 5-10-37-26W1 (1993-06-08).

Figure 4: Ashville Formation, Belle Fourche Member, near Outcrop Section 66 of McNeil and Caldwell (1981, p. 357, 358), part of composite type section (component-lectostratotype), north bank of the Wilson River, 14-14-25-21W1 (2009-08-22).

Figure 5: Favel Formation, Keld Member, east bank of Sclater Creek, 14-15-34-23W1 (2007-07-03).

Figure 6: Favel Formation, Assiniboine Member, south bank of Swan River, 13-1-35-29W1 (2009-08-21).

ERA	PERIOD	EASTERN SASKATCHEWAN	MANITOBA SUBSURFACE	MANITOBA OUTCROP
CENOZOIC	Quaternary	glacial drift	glacial drift	glacial drift
	Tertiary	Wood Mountain Formation	Turtle Mountain Formation: Peace Garden Member	Turtle Mountain Formation: Peace Garden Member
		Ravenscrag Formation	Turtle Mountain Formation: Goodlands Member	Turtle Mountain Formation: Goodlands Member
MESOZOIC	CRETACEOUS	MONTANA GROUP: Frenchman Formation		
		MONTANA GROUP: Whitemud Formation	Boissevain Formation	Boissevain Formation
		MONTANA GROUP: Eastend Formation	Pierre Shale: Coulter Member	Pierre Shale: Coulter Member
		MONTANA GROUP: Bearpaw Formation	Pierre Shale: Odanah Member	Pierre Shale: Odanah Member
		MONTANA GROUP: Belly River Formation	Pierre Shale: Belly River "marker" / "lower" Odanah Member	
		MONTANA GROUP: Lea Park Formation	Pierre Shale: Millwood Member	Pierre Shale: Millwood Member
			Pierre Shale: Pembina Member	Pierre Shale: Pembina Member
		MONTANA GROUP: Milk River Formation	Pierre Shale: Gammon Ferruginous Member	Pierre Shale: Gammon Ferruginous Member
		COLORADO GROUP, upper: Niobrara Formation		
		COLORADO GROUP, upper: Carlile Formation: Boyne Member	Carlile Formation: Boyne Member	Carlile Formation: Boyne Member: Chalky Unit
				Carlile Formation: Boyne Member: Calcareous Shale Unit
		COLORADO GROUP, upper: Carlile Formation: Morden Member	Carlile Formation: Morden Member	Carlile Formation: Morden Member
		COLORADO GROUP, upper: Second White Specks	Favel Formation: Assiniboine Member	Favel Formation: Assiniboine Member: Marco Calcarenite
			Favel Formation: Keld Member	Favel Formation: Keld Member: Laurier Limestone
		COLORADO GROUP, lower: Belle Fourche Formation	Ashville Formation, upper: Belle Fourche Member	Ashville Formation, upper: Belle Fourche Member
		COLORADO GROUP, lower: Fish Scale Formation	Ashville Formation, upper: Fish Scale Zone / Base of Fish Scale marker	Base of Fish Scale marker
		COLORADO GROUP, lower: Westgate Formation	Ashville Formation, lower: Westgate Member	Ashville Formation, lower: Westgate Member
		COLORADO GROUP, lower: Newcastle Formation	Ashville Formation, lower: Newcastle Member	
		COLORADO GROUP, lower: Viking Sandstone	Ashville Formation, lower: Skull Creek Member	Ashville Formation, lower: Skull Creek Member
		COLORADO GROUP, lower: Joli Fou Formation		
		MANNVILLE GROUP: Pense Formation (P4)	Pense "P4" marker	
		MANNVILLE GROUP: P2+P3 (lithological tops of sand)	Swan River Formation	Swan River Formation
		MANNVILLE GROUP: Cantuar Formation		
		Success Fm: S_2 Member	Success Formation (S_2)	Success Formation (S_2)equivalent
	JURASSIC	Success Fm: S_1 Member	Waskada Formation	
		Masefield Shale		
		Rierdon Formation	Melita Formation: Upper Melita Member	
		Shaunavon Fm: Upper Member	Melita Formation: Lower Melita Member	
		Shaunavon Fm: Lower Member		
		Gravelbourg Fm: Upper Member	Reston Formation: Lower Gravelbourg "marker"	Reston Formation
		Gravelbourg Fm: Lower Member		
		Watrous Formation: Upper Member	Amaranth Formation: Upper (Evaporite) Member	Amaranth Formation: Upper Evaporite
	TRIASSIC	Watrous Formation: Lower Member	Amaranth Formation: Lower (Red Beds) Member	Amaranth Formation: Lower Red Beds
PALEOZOIC	PERMIAN			St. Martin Igneous & Metamorphic Complex

Figure 2: Mesozoic and Cenozoic stratigraphy of eastern Saskatchewan and of the subsurface and outcrop belt of southwestern Manitoba (Nicolas, 2009, Figure 2).

Figure 7: Carlile Formation, Morden Member, west side of roadside ditch, 16-10-01-05W1 (2008-08-26).

Figure 8: Carlile Formation, Boyne Member, north valley wall of Roseisle Creek (a tributary to the Boyne River), 1-14-6W1 (2008-08-27).

Figure 9: Pierre Shale, Gammon Ferruginous Member, east bank of Vermilion River, 7-23-23-20W1 (1999-07-06).

Figure 10: Pierre Shale, Pembina Member, north side of road allowance, 4-7-1-5W1 (2004-09-10).

Figure 11: Pierre Shale, Millwood Member, southeast flank of Mount Nebo, 4-18-4-6W1 (2007-09-29).

Figure 12: Pierre Shale, Odanah Member, south wall of Brown aggregate shale quarry, 15-1-1-6W1 (2004-09-10).

Figure 13: Pierre Shale, Coulter Member, gully (now rehabilitated) on south side of PTH 3, 14-35-2-19W1 (1971-08-05).

Figure 14: Boissevain Formation, along old Great Northern railway cut and adjacent to Boissevain reservoir, 9-7-3-19W1 (1971-05-15).

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