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Megafaunal Zones in Alberta Mississippian and Permian*

Twelve faunal zones are proposed for the thick sequence of beds lying between the top of the Devonian and the base of the Mesozoic in Alberta. Of these, eleven lie within the range of time represented by the Mississippian of the type region, the remaining one is of Permian age. No beds of undoubted Pennsylvanian age have been seen in the southern Alberta Rocky Mountains or in the adjacent subsurface.

The lower four zones are grouped under a single time stratigraphic term for which the name Banffian is proposed; this includes strata equivalent to the Kinderhook and probably part of the Osage of the standard Mississippia Valley section. It corresponds with the Banff formation at the type section at Banff. The remaining Mississippian zones, of which the youngest is the *Spirifer leidyi* zone of late Chesterian age, are grouped together under the term Rundlian. Strata assigned to the Rundlian include the whole of the Rundle group. The lithological junction of the Banff and Rundle is not necessarily at the close of the Banffian.

The proposed zones, together with their relationship to the lithological sequence, are shown in the table. The rock succession is neither abundantly nor uniformly fossiliferous and there are some major unfossiliferous intervals which materially hinder accurate correlation, especially in the early Rundlian. Faunal assemblages representing the Kinderhook, Osage, Meramec, and Chester of the Mississippi Valley undoubtedly occur in Alberta, but there are some gaps, notably the apparent absence of the older Chester faunas. It is not known yet to what extent these gaps are due to inhibited migration, facies control, or stratal non-sequence.

	Rocky Mountain Formation, Permian	
	1. *Plagioglypta canna* zone	Norquay member, lower beds
	Rundle Group, Mississippian	
RUNDLIAN	2. *Spirifer leidyi* zone	Tunnel Mountain formation, upper beds
	3. *Spirifer increbescens* zone	Tunnel Mountain formation, lower beds
	4. *Faberophyllum languidum* zone	Mt. Head formation
	5. *Faberophyllum araneosum* zone	Mt. Head formation
	6. *Ekvasophyllum inclinatum* zone (This zone includes two or more "Lithostrotion" beds)	Mt. Head formation
	7. *Spirifer forbesi* zone	Turner Valley formation, lower part
	8. *Camarotoechia cobblestonensis* zone	Pekisko formation
	Banff Formation, Mississippian	
BANFFIAN	9. *Spirifer rowleyi* zone	
	10. *Leptaena analoga* zone	
	11. *Spirifer marionensis* zone	
	Exshaw Formation, Mississippian	
	12. *Goniatite* zone	

The proposed zonal scheme is put forward as an interim working hypothesis, based on presently available information. It will be subject to modification and revision as further paleontological data become available.

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Mississippian Microfaunas—Their Stratigraphic and Paleogeographic Significance

Mississippian sediments in Western Canada contain several microfossil zones which can be effectively used in correlation and interpretation of the geology in this area. Three distinctive genera, *Paraparchites, Cribroconcha,* and *Richterina,* characterize widespread zones which are of stratigraphic value. Representative fossils from these zones are illustrated and shown in relation to their associated lithology. Their distribution is discussed together with some interpretation of their significance regarding overlap, facies changes, and condensation over shelf areas.

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Stratigraphy of Madison Group of Montana and Wyoming

Lithologic sequences characterized by distinct evaporite cycles are recognized in the Madison group of Montana and Wyoming. Throughout the basinal area of Montana and North Dakota, the

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cycles are represented by vertical variations from oölitic-fragmental and normal marine limestone (or dolomitized equivalents) to evaporitic rocks including anhydrite, locally halite, and associated cryptocrystalline or dense carbonates. Within the Wyoming shelf, the cycles exhibit only partial development in which the evaporitic interval is thinly represented by primary cryptocrystalline or dense dolomite. Dolomitized limestones (fine to coarse crystalline dolomites) generally form the marine intervals in the shelf areas.

By recognition of these lithologic cycles, the Lodgepole, Mission Canyon, and Charles formations may be correlated to their respective eroded edges in Wyoming, South Dakota, and north-central Montana.

Mississippian sedimentation commenced earliest in the Williston basin and central Montana trough with the deposition of black shales (Bakken formation) followed by dense limestones and shales (lower Lodgepole). Preceding and accompanying the initial marine transgression on the Wyoming shelf, minor terrestrial to near-shore marine clastic deposition took place in the Black Hills area (Englewood formation). Widespread marine deposition formed normal marine and fragmental-oölitic limestones which were subject to dolomitization in the shelf areas (upper Lodgepole, lower Pahasapa, and Guernsey formations).

Marine limestone and dolomite sedimentation, interrupted by two episodes of evaporite precipitation, resulted in the development of the Mission Canyon formation and the superjacent evaporites of the basal Charles, and their equivalents in the Pahasapa formation of the Black Hills area.

Restoration of normal marine conditions and development of a complex evaporite cycle followed (Charles formation, excluding basal evaporites and uppermost few beds of the Pahasapa).

Big Snowy clastics were deposited in Chester time in the basinal areas of Montana. In areas to the south, pre-Amsden, pre-Minnelusa, or pre-Pennsylvanian weathering and erosion affected the Mississippian beds. In north-central Montana, pre-Middle Jurassic erosion strongly truncated the upper Madison strata.

Oil occurrence in the Madison group is related to the two main provinces of deposition. In general, the oil from the basinal or limestone province is of relatively high gravity, whereas that from the dolomite or shelf province is of much lower gravity.

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Mississippian Lithologic Sequence in Southern Saskatchewan

Mississippian rocks of southern Saskatchewan comprise in descending order, the Charles, Mission Canyon, Lodgepole, and Bakken formations. However, in the Wood Mountain area of southwestern Saskatchewan, the Charles is absent as a result of pre-Jurassic erosion and at Carievale, in southeastern Saskatchewan, only the basal anhydrite bed of the Charles has been preserved. Cyclically deposited chalk, oölitic limestone, and bioclastic limestone comprise the Mission Canyon formation which may be subdivided into six members. The Lodgepole comprises argillaceous limestone, dense siliceous limestone, primary chert, and calcareous shale. The Bakken formation consists of two black bituminous shale members with intervening siltstone.

The origin of the various rock types is an outgrowth of this study, and criteria are presented for the recognition of evaporitic dolomite.

Differential weathering of the chalk members, as compared with the much harder limestone and evaporitic dolomite units, probably has a marked influence on the topography of the erosion surface of the Mississippian sub-crop.

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Stratigraphy of Lodgepole Formation, Virden Area, Manitoba

The increasing importance of Virden-Roselea and North Virden oil production has made it desirous that a workable subdivision of Lodgepole stratigraphy be undertaken for this area and for adjoining regions wherever correlation is satisfactory. The present paper proposes a member breakdown of the Lodgepole of the Virden area, and describes these units in some detail from type wells of the vicinity.

Due to lithologic variations resultant from changes in depositional environment within the preserved portion of the Lodgepole of the eastern Williston basin, the proposed stratigraphic units are applicable in general only to the eastern portion of the Manitoba and northern North Dakota sections. Recognizable correlation becomes increasingly difficult and unreliable rather abruptly westward of a northerly-trending narrow zone of demarcation. Correlation east of this zone, however, is generally good and can be referred readily to the Virden type section. Despite the limited areal extent of application, the economic importance of this region warrants systematic stratigraphic subdivision.