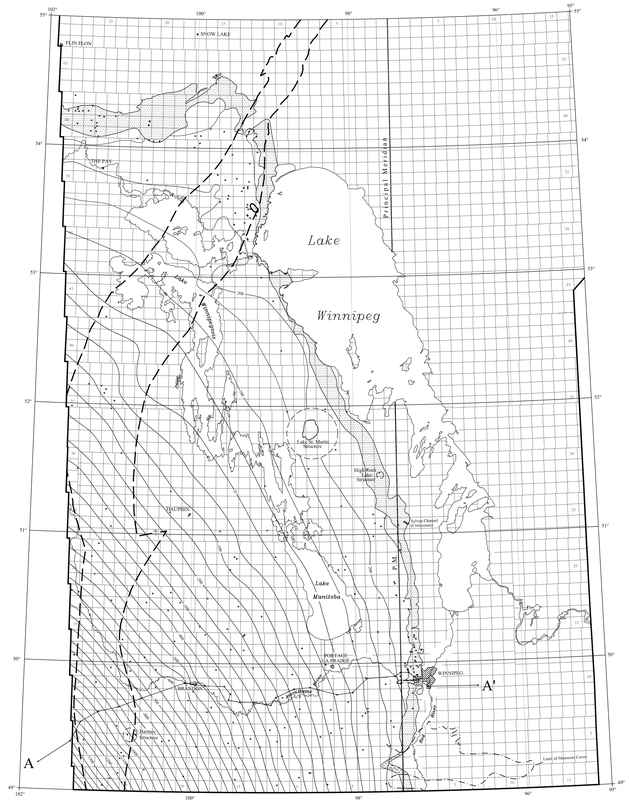
Manitoba
Energy and Mines
GEOLOGICAL SERVICES BRANCH

GEOLOGY OF THE ORDOVICIAN STONY MOUNTAIN FORMATION IN MANITOBA

Stratigraphic Map Series OSM - 1

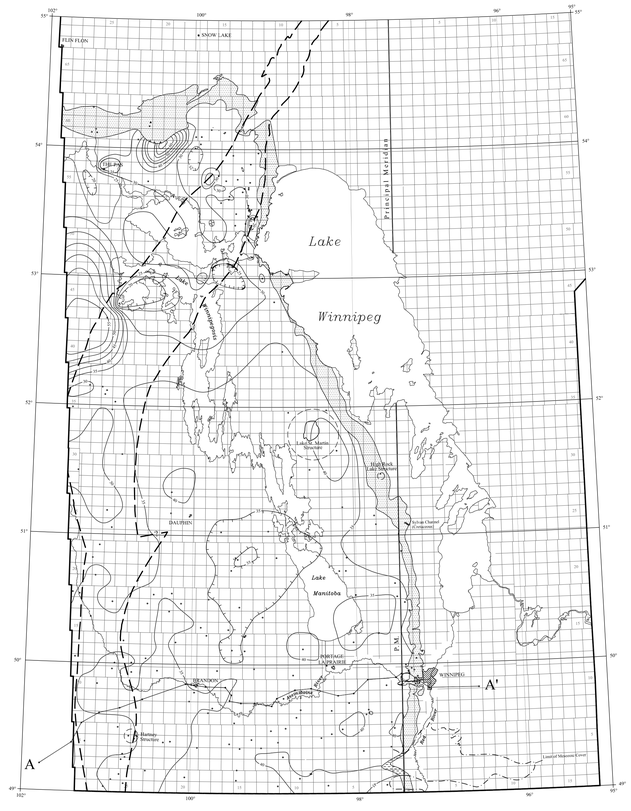
Structure Contour Map



0 25 50 75 100 km

1 : 2 000 000

Isopach Map



0 25 50 75 100 km

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STONY MOUNTAIN FORMATION

Geological Framework

Ordovician carbonates were part of a large depositional province that extended from the Hudson Platform to the east and northeast, to New Mexico to the south (Norford *et al.*, 1994). The Lower Ordovician shelf craton was emergent at that time. In mid-Upper Ordovician time, a major transgression inundated the entire continental area.

The regional depositional (isopach) trends for Ordovician strata in southwestern Manitoba are approximately east-west to slightly northeast. The easterly trend is evident for all Ordovician strata. This trend is markedly discordant to the present structural trend, and to the overall Williston Basin depositional trends. This may be the result of a higher rate of subsidence in the Manitoba portion of the basin. Slight structure contour deviations along the trend of the Churchill Superior Boundary Zone (Birdtail-Waskada Axis in southwestern Manitoba) can be seen in the Stony Mountain structure contour map.

The rate of basinward thickening (i.e., basin differentiation) decreased progressively throughout Ordovician time. In addition, the interbedding of calcareous and dolomitic lithologies suggests that a cyclical fluctuation of depositional conditions (eustatic effect?) has been superimposed on the overall pattern of basin subsidence (tectonic effect).

Stratigraphy

In Manitoba, the Stony Mountain Formation is divided into three members, where discernable. They are, in ascending stratigraphic sequence: the Gunn, Penitentiary and Gunton members. A fourth member, the Hartaven Member, is present at the base of the sequence in Saskatchewan and in southwest Manitoba, and consists of high-purity limestone. The Williams Member was once included within the Stony Mountain; however, standardized correlations established for the new Atlas of the Western Canada Sedimentary Basin (Norford *et al.*, 1994) placed the Williams into the overlying Stonewall Formation. The Stony Mountain Formation sharply overlies the Red River Formation with a possible slight disconformity and is overlain by the Stonewall Formation with apparent conformity.

The Gunn Member consists of greyish-red to purplish-grey, fossiliferous, calcareous shale with interbeds of relatively clean, fossiliferous limestone. The Penitentiary Member consists of yellowish- to reddish-grey, fossiliferous, argillaceous dolomite. These two members comprise the lower Stony Mountain. The upper Stony Mountain (Gunton Member) consists of a buff, finely crystalline, sparsely fossiliferous, nodular bedded dolomite that is relatively uniform in thickness and lithology.

The Stony Mountain Formation thins from approximately 50 m in the south, to about 30 m at its northern limit of occurrence, a relatively low rate of thinning of only about 7% per 100 km (Bezys and McCabe, 1996). This is reflected in a lithofacies change in the lower part of the formation, from interbedded limestone and calcareous shale (i.e. Gunn-type lithology) in the south, to dolomite (Penitentiary-type lithology) in the north. Differential compaction related to the shaly component of the Stony Mountain Formation probably acted to reduce the apparent rate of northward thinning. This could explain, in part, the rather pronounced lithofacies change resulting from an apparently low degree of basin differentation, or basinward thickening.

The Gunn Member exposures seen at the City of Winnipeg Quarries in the Town of Stony Mountain represent a basinal facies. Drilling has shown that the Gunn-type lithology (*i.e.*, the interbedded limestones and calcareous shales) thins rapidly to the north and disappears within 60 km. These beds are replaced laterally by burrow-mottled argillaceous dolomites similar to those of the Penitentiary Member. Thus the vertical outcrop succession seen in the quarries reflects the regional north-south facies variation. The Gunn Member maintains a relatively uniform nodular dolomite lithology throughout the outcrop belt.

Although the above-noted regional northward thinning affects all Ordovician units, not all of the stratigraphic units show prominent lithofacies changes. The upper-most Gunton Member is relatively uniform throughout the outcrop belt and consists mainly of dolomite. In the subsurface in Saskatchewan, the Gunton Member is capped by the Gunton Anhydrite and represents one of a series of cyclical evaporitic deposits in the basin (Kendall, 1976). Deposition of the dolomites appear to have occurred under at least partially restricted, relatively shallow water conditions, suggesting a fluctuating eustatic overprint on the continuing tectonic differentiation of the Williston Basin.

Economics

One oil and gas show in the Stony Mountain Formation is reported from the 8-20-9-6W (B.A. Morisseau) in Manitoba. The Gunton Member of the Stony Mountain Formation is extensively used in the Stonewall area as a source of crushed stone for the City of Winnipeg The near-surface exposure of the member is most prominent along the Gunton Escarpment, trending due north just north of the City of Winnipeg and east of the Town of Stonewall. Approximately 2 million tonnes of stone was extracted in 1994 (approximately $ 5 million worth of stone) (Bezys and Bamburak, in prep.)

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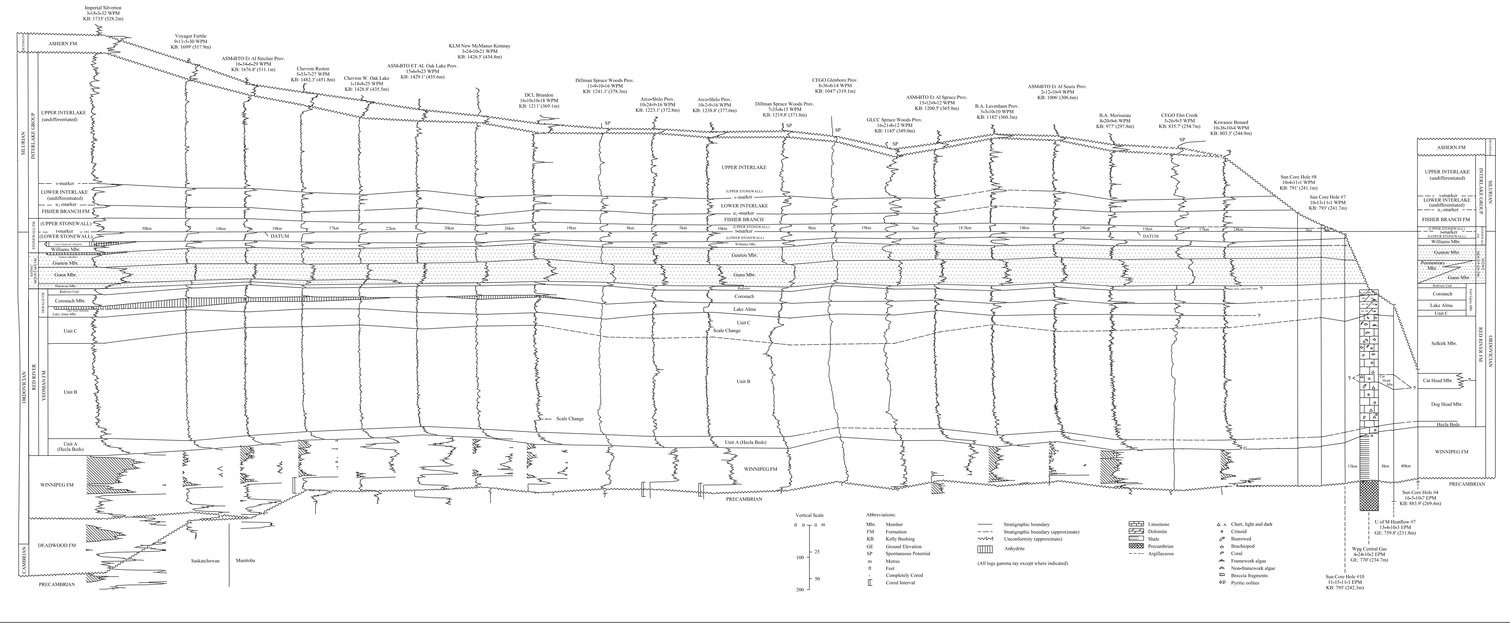
LEGEND (1 : 2 000 000 maps)

- Stony Mountain outcrop belt
- Stony Mountain subcrop belt
- Control well *
- Isopach Map contour interval (5 m)
- Structure Map contour interval (50 m) (sea-level datum)
- A A' Stratigraphic cross section
- Churchill Superior Boundary Zone

* Both confidential and non-confidential wells were used in the construction of these maps; only non-confidential wells are depicted.

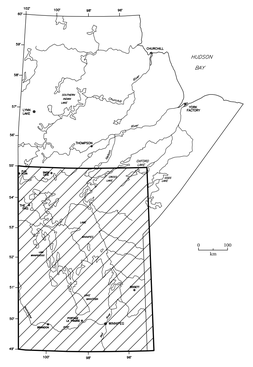
Stratigraphic Cross Section

A



A'

Location Map



Geology by: R.K. Bezys
Compilation by: R.K. Bezys and G.G. Conley
Cartography by: M.E. McFarlane

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