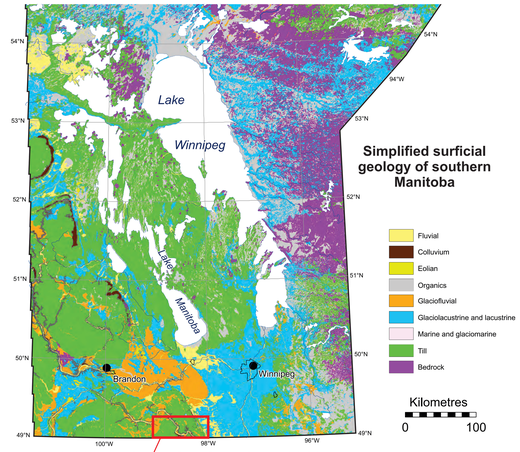
Quaternary Geology of the Pembina Valley area (NTS 62G1, 62G2)

Hodder, T.J. and Gauthier, M.S.

Introduction

The Manitoba Geological Survey (MGS) conducted 4 weeks of Quaternary field work in the Pilot Mound and Morden NTS areas (62G1, G2) during the 2016 field season. The objectives of this project are to:

- document the geomorphology, stratigraphy and distribution of surficial materials;
- produce aggregate potential and depth to bedrock derivate maps; and
- sample glacial sediments (till) to investigate compositional patterns; and
- interpret the glacial history of the area.



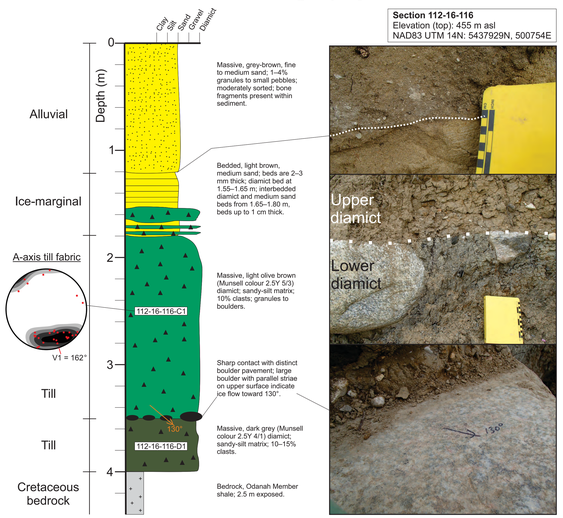
Simplified surficial geology of southern Manitoba

- Fluvial
- Colluvium
- Eolian
- Organics
- Glaciofluvial
- Glaciolacustrine and lacustrine
- Marine and glaciomarine
- Till
- Bedrock

Kilometres
0 100

1:50 000 scale surficial geology 2016 mapping area

Till Stratigraphy



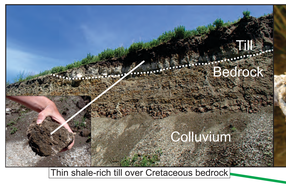
Section 112-16-116
Elevation (top): 455 m asl
NAD83 UTM 14N: 5437929N, 500754E

Section 112-16-116 is an example of a two-till statigraphy observed within the map area.

The regional surficial geomorphology, till-fabric and striated boulder pavement indicates the upper-till was deposited during a southeast ice-flow phase (~140°). The lower till was likely deposited by a prior ice-flow event. Till provenance results will aid in interpreting the origin of this lower till unit.

Surficial Geology

Till Deposts



Thin shale-rich till over Cretaceous bedrock

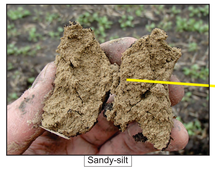
Carbonate-rich till

Lake Aggasiz Deposits

Boulder lagged erosional scarp

Bedded sand and gravel beach deposit

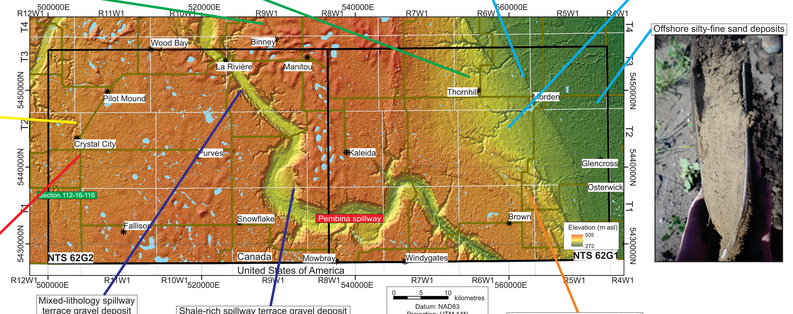
Glacial Outwash Deposits



Sandy-silt

Esker Deposits

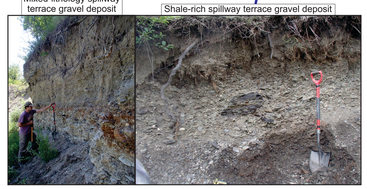
Shale-rich sandy gravel esker deposit



Offshore silty-fine sand deposits

Mixed-lithology spillway terrace gravel deposit

Shale-rich spillway terrace gravel deposit



Spillway Terrace Deposits

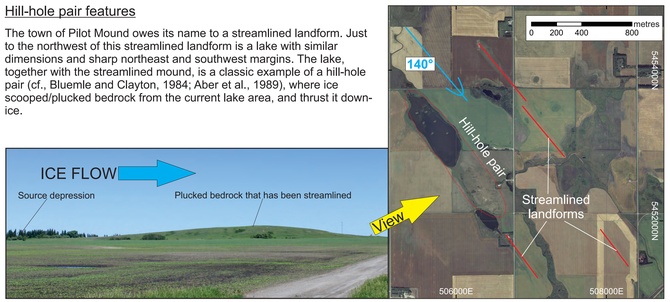
Cross-bedded gravel beneath till

Buried Outwash Deposits

Glaciotectonism

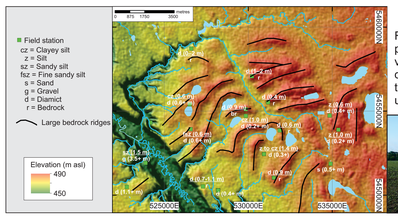
Hill-hole pair features

The town of Pilot Mound owes its name to a streamlined landform. Just to the northwest of this streamlined landform is a lake with similar dimensions and sharp northeast and southwest margins. The lake, together with the streamlined mound, is a classic example of a hill-hole pair (cf., Bluemle and Clayton, 1984; Aber et al., 1989), where ice scooped/plucked bedrock from the current lake area, and thrust it down-ice.

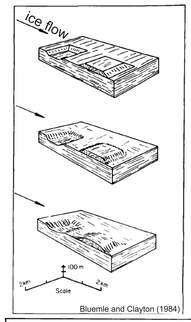


Large transverse bedrock ridges

Field observations indicate that these landforms are primarily composed of shale bedrock, with an overlying veneer of till. Similar transverse landforms have been described in North Dakota and have been interpreted to be formed as a result of glacial thrusting of the underlying bedrock (Bluemle and Clayton, 1984).

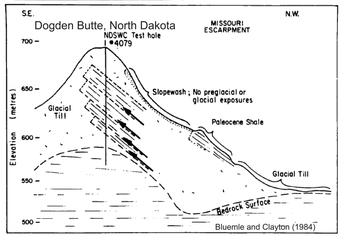


Formation processes



Left: Hill-hole pairs consist of a discrete hill of ice-thrusted material, situated a short distance down-ice of a depression similar in size and shape. The hills can often be remoulded or streamlined. The depression is often filled in with sediment or a lake.

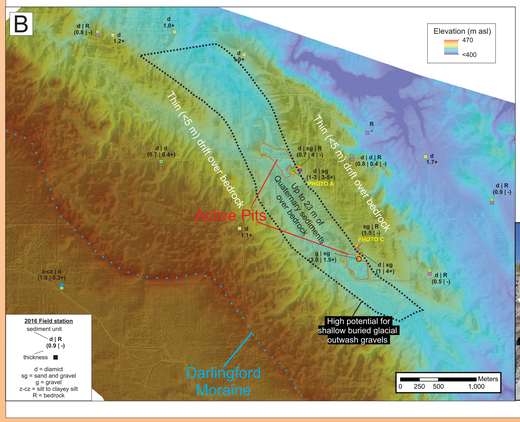
Below: Example of glacial thrusting of the local bedrock along the Missouri escarpment. Escarpments ridges are often sites of glaciotectonic activity.



Aggregate Resources

- The majority of sand and gravel deposits in the map area have a high shale content (e.g., eskers, spillway terraces) and are poor-quality aggregate resources.
- Beach deposits and coarse glacial outwash deposits are the highest quality aggregate resources.

A.) Field investigations at two active pits documented 0.5-4.0 m of till overlying sand and gravel. These pits were initially identified by previous aggregate mapping (Young, 1993), but the resource extent is unknown.



B.) Detailed LiDAR elevation model centered 3.5 km northeast of Brown. This LiDAR elevation model shows that these active pits are within a trough.

Field observations and well records indicate that this trough contains up to 23 m of Quaternary sediments. The higher elevations to the northeast and southwest are regions of thin drift over bedrock.

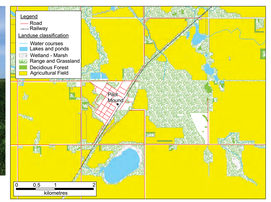
Preliminary interpretations indicate there is a high probability of shallow buried gravels within this trough.

C.) Field example of sand and gravel over bedrock.

Landuse Planning and Agricultural Capability

Most of southern Manitoba is classified for either agriculture, ranch or grassland landuse. In addition to mapping aggregate potential, surficial geology can be used to help re-classify land uses, and/or re-assess the current agricultural capability (based on limitations due to soil properties and landscape features and climate).

Loamy soils, deposited in Lake Agassiz, lead to this agricultural land having a good agricultural cabability.



Stony soils, corresponding to till from a certain source area, lead to this agricultural land having a poorer agricultural cabability.

Future Work / Releases

- Production of 1:50 000 scale surficial geology maps of the Morden (62G1) and Pilot Mound (62G2) NTS areas
- Production of an aggregate derivative map
- Open file release with analytical results and an interpretation of the Quaternary history of the region

Acknowledgements

The authors thank A. Schmall and J. Macdonald from the University of Manitoba for providing excellent field assistance throughout the duration of the project. They also thank C. Epp, E. Anderson and N. Brandson from the MGS for logistical assistance throughout the field season.

References

Aber, J.S., Croot, D.G. and Fenton, M.M. 1989: Glaciotectonic landforms and structures; Kluwer Academic Publishers, Dordrecht, Netherlands, 200 p.
Bluemle, J.P. and Clayton, L. 1984: Large-scale glacial thrusting and related processes in North Dakota; Boreas, v. 13, p. 279–299.
Young, R.V. 1993: Aggregate resource inventory of the Rural Municipality of Stanley; Manitoba Energy and Mines Branch, Aggregate Report AR92-3, 62 p.