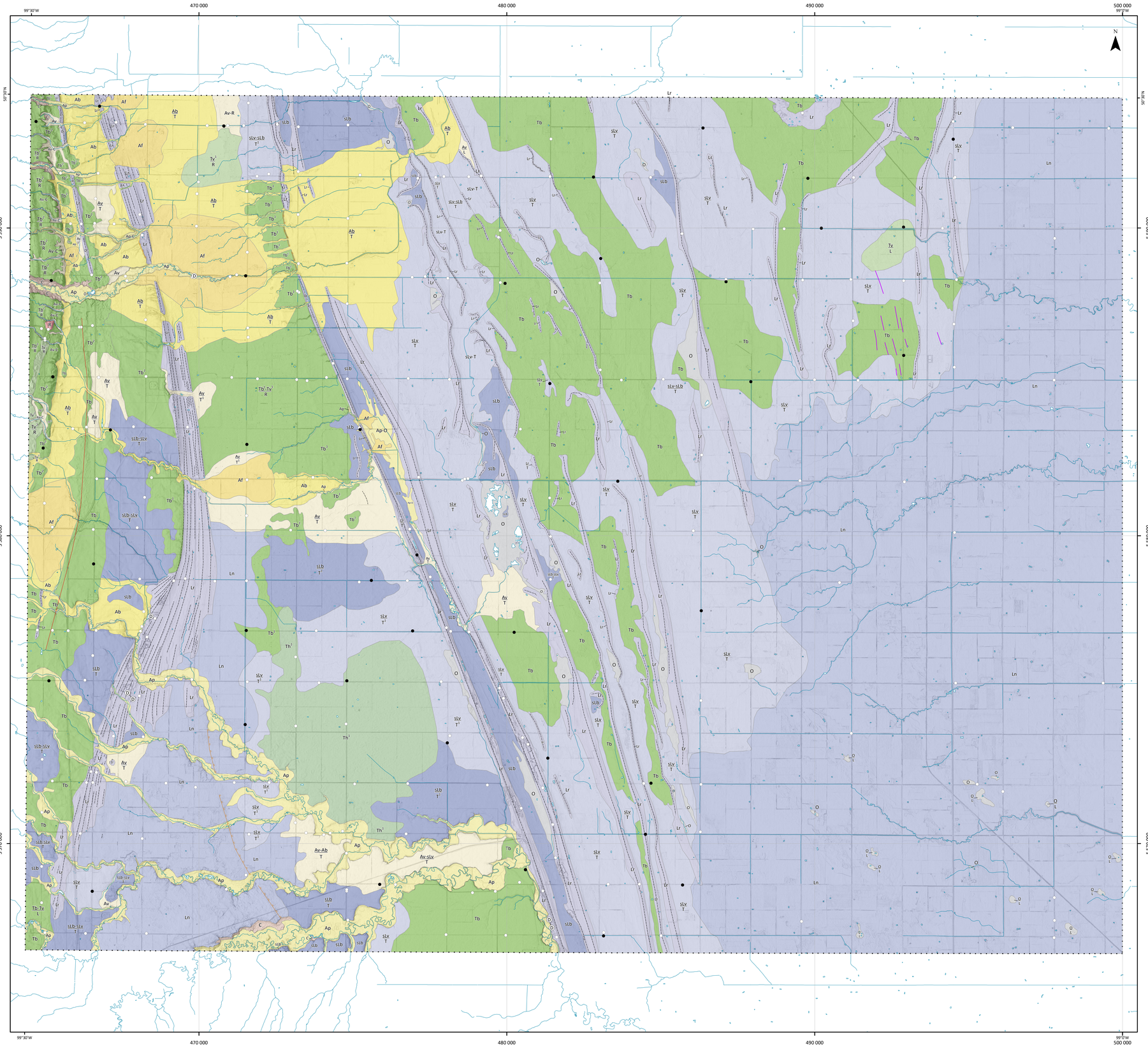
Geoscientific Map MAP2020-1

Surficial geology of the Arden area, Manitoba (NTS 62J6)



Legend

QUATERNARY

SURFICIAL DEPOSITS

HOLOCENE

NONGLACIAL ENVIRONMENTS

O — **ORGANIC DEPOSITS:** Undifferentiated peat and muck; 1 to greater than 5 m thick; formed by the accumulation of plant material in various stages of decomposition; generally occurs as flat, wet terrain (swamps and bogs) over poorly drained till deposits.

C — **COLLUVIAL AND MASS-WASTING DEPOSITS:** Undifferentiated grain size, deposited along the slopes of meltwater corridors and modern rivers.

ALLUVIAL DEPOSITS: Sediment transported and deposited by streams and rivers. Includes well-sorted stratified gravel, sand, silt and organic sediments occurring in channel and overbank deposits (e.g., postglacial floodplains and fans).

Af — **Alluvial fan sediments:** Sorted gravel, sand, silt and minor organic detritus; moderate to poorly-sorted, commonly stratified; formed subaerially when a high-power channel enters a zone of reduced stream power such as the plains below the Manitoba escarpment.

Ap — **Alluvial floodplain sediments:** Sand, silt, clay, minor gravel and organic detritus; massive to stratified, greater than 1 m thick; forming active floodplains close to river and stream level; includes meander channels, scroll marks, and terraces too small to show at this map scale.

Ab — **Alluvial blanket sediments:** Sorted sand, silt, clay, minor gravel and organic detritus greater than 1 m thick; forming floodplains; includes terraces too small to show at this map scale.

Av — **Alluvial veneer sediments:** Sorted sand, silt, clay, minor gravel and organic detritus less than 1 m thick; forming floodplains close to river and stream level.

EARLY HOLOCENE

L — **LACUSTRINE DEPOSITS:** Sand, silt and minor clay deposited within Lake Agassiz; includes well-sorted sand to sandy-silt deposited in the near-shore environment, and sand and gravel deposited in beaches.

Lr — **Lacustrine deposit, ridged:** Sand and gravel; massive to stratified; greater than 1 m thick; deposited in beach ridges at the shorelines of Lake Agassiz.

Ln — **Lacustrine littoral and nearshore sediments:** Sand and silt; massive; commonly between 1 and greater than 6 m thick; deposited in shallow-water lacustrine environments.

sLv — **Lacustrine nearshore veneer:** Silty fine sand to medium sand with minor clay; massive to stratified; 0.2 to 1 m thick; drapes the existing topography; deposited in a nearshore or littoral environment.

sLb — **Lacustrine nearshore blanket:** Silty fine sand to medium sand with minor clay; massive to stratified; continuous cover 1 to 2 m thick that drapes the existing topography; moderately to imperfectly-drained; deposited in a nearshore or littoral environment.

NOTE: In areas where the surficial cover forms a complex pattern, the area is coloured according to the dominant unit and labelled in descending order of cover (e.g., R-Tv). Where underlying stratigraphic units are known, areas are coloured according to the overlying unit and labelled in the following manner:

$$\frac{L}{Tb}$$

For example, $\frac{Lv}{T}$ indicates lacustrine veneer overlying till.

Multiple modifiers may be combined to clarify the detailed geology (e.g. Tb^1).

LATE WISCONSINAN

GLACIAL ENVIRONMENTS

T — **TILL DEPOSITS:** Diamicton; massive; unsorted to poorly-sorted; deposited in subglacial environments. The till contains variable proportions of locally-sourced shale and eastern- and/or northern-sourced rock (carbonate and granitoid). T refers to highly calcareous till with a dominant carbonate and granitoid composition (>90 ct. % carbonate/granitoid clasts), T^1 refers to weakly to moderately calcareous till that contains black shale detritus (2 to 98 ct. % local Favel Formation clasts), and T^2 refers to weakly calcareous till with a high proportion of local siliceous shale detritus (>50 ct. % local Odanah Formation clasts).

TILL VENEER: Diamicton; massive; unsorted to poorly-sorted; discontinuous cover less than 1 m thick that drapes the existing topography; deposited by ice.

Tv — Highly calcareous till with a dominant carbonate and granitoid composition.

Tv^1 — Weakly to moderately calcareous till that contains black shale detritus.

Tv^2 — Weakly calcareous with high proportion of siliceous shale.

TILL BLANKET: Diamicton; massive; unsorted to poorly-sorted; continuous cover 1 to 2 m thick that drapes the existing topography; deposited by ice. Occasional thinner patches of till may occur.

Tb — Highly calcareous till with a dominant carbonate and granitoid composition.

Tb^1 — Weakly to moderately calcareous till that contains black shale detritus.

Tb^2 — Weakly calcareous with high proportion of siliceous shale.

HUMMOCKY TILL: Diamicton; greater than 1 m thick; consisting of approximately equidimensional hills and depressions with moderately high relief; deposited by melting of stagnant ice; forming distinctive circular hummocks with a central depression or brain-like pattern ridges; commonly referred to as doughnut moraine in the Canadian Prairies.

Th^1 — Weakly to moderately calcareous till that contains black shale detritus.

PRE-QUATERNARY

BEDROCK

R — **Mesozoic rocks:** Shale bedrock shallowly buried or at surface near the Manitoba escarpment. Bedrock may be exposed in road and ditch cuts or at surface.

Symbols

- Beach ridge
- Minor moraine
- Trimline
- Iceberg scour
- Limit of mapping
- (D) Sample age
- Field site with till sample
- Field site without till sample

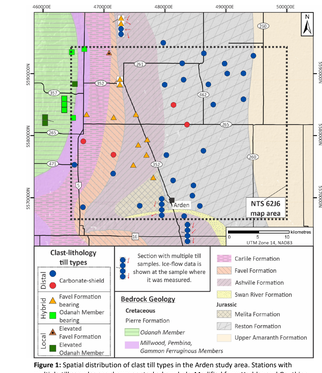


Figure 1: Spatial distribution of clast till types in the Arden study area. Stations with multiple till samples are shown as stacked symbols. Modified from Hodder and Gauthier (2019).

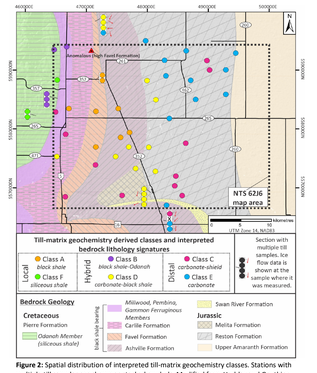


Figure 2: Spatial distribution of interpreted till-matrix geochemistry classes. Stations with multiple till samples are shown as stacked symbols. Modified from Hodder and Gauthier (2019).

Descriptive notes

Surficial geology of the Arden area, Manitoba (NTS 62J6)

Previous mapping

This mapping builds on previous surficial geology mapping conducted by the Manitoba Geological Survey (MGS) (Mihychuk and Groom, 1979a) and Western Ground-water Consultants Ltd. (Sinclair and Phimister, 1981). Mihychuk and Groom (1979a) mapped a large area of the Riding Mountain uplands and the Neepawa area. This mapping included the western half of NTS 62J6 and was published as a 1:50 000 scale preliminary map (Mihychuk and Groom, 1979b). Mihychuk and Groom (1979b) field stations targeted sand and gravel sites to assist in the delineation of aggregate resources. The original field notes for this work were archived by the MGS, and data from surface field sites and backhoe stations were digitized and used during this study to assist with surficial geology mapping. Sinclair and Phimister (1981) published an inventory of sand and gravel in the Westlake area based on 1:50 000 scale surficial mapping, which included part of this map area. Mapping was primarily focused on delineating aggregate resources from airphoto interpretation and field observations. Soil maps have been produced for the study area by the Manitoba Soil Survey. A reconnaissance (1:126 720 scale) map (Ehrlich et al., 1958) covers the entire map area, whereas a detailed (1:20 000 scale) map exists for the Rural Municipality of Westbourne (Langman, 1984). A reconnaissance-scale (1:250 000) surficial materials compilation map was produced by the MGS (Matile and Keller, 2004). This map was derived from the existing soils maps for NTS 62J and airphoto interpretation of the area.

Methods

The surficial geology of the Arden area was interpreted from orthoimages with a raster resolution of 0.5 m and LiDAR elevation data for the Whitemud River watershed (Manitoba Land Initiative, 2018). Mapping was completed using Summit and ArcGIS software. Field studies used local road access during a three-week period in the summer of 2015 and a two-day period in the summer of 2018. A total of 237 field sites were visited to ground truth the surficial geology mapping and collect till samples. At each site, the sediments present, as well as geomorphic and terrain characteristics, were noted.

Sample age sites consist of radiocarbon (Hodder and Gauthier, 2019) and optically stimulated luminescence (Teller et al., 2018) age measurements.

Till composition

The composition of till was studied in detail (Hodder and Gauthier, 2019) and is classified according to the clast-lithology (Figure 1) and till-matrix geochemistry composition (Figure 2). To summarize, till in the map area is classified according to the concentration of local- and distal-derived detritus. Similar, but not identical, till provenance conclusions can be drawn from the spatial pattern of clast-lithology and till-matrix geochemistry proxies (Figures 1 and 2).

Noncalcareous tills with elevated concentrations (>90 ct. %) of siliceous shale derived from the Odanah Member are situated on the Manitoba escarpment overlying Odanah Member bedrock. Weakly calcareous hybrid tills with a mix of local (> 50 ct. % siliceous shale) and distal (< 50 ct. % carbonate/shield) detritus are situated on or east of the Manitoba escarpment (Figures 1 and 2). Till with an elevated signature (> 90 ct. %) of local Favel Formation bedrock is situated in the northwest region of the map area and Favel Formation bedrock was observed to subcrop along stream cuts nearby (Figure 1). Down-ice (SSE) of this till sample, the till contains 2–19 ct. % Favel Formation clasts and is interpreted as a hybrid till consisting of varying proportions of local- and distal-derived detritus. The till-matrix geochemistry signature of till is considered to be a more sensitive proxy to the incorporation of black shale detritus because this bedrock type is easily comminuted below the size fraction used in clast-lithology counts. As such, the till-matrix geochemistry delineates a larger footprint of till with a black shale compositional signature (Figure 2). Distally derived tills composed of Phanerozoic carbonate and Precambrian granitoid detritus are situated in the east and southwest regions of the map area. The reader is referred to Hodder and Gauthier (2019) for additional information and discussion of till composition.

Geology by T.J. Hodder and M.S. Gauthier (2015 and 2018 field seasons)

Aerial imagery and LiDAR data interpretation by T.J. Hodder and M.S. Gauthier

Cartography/GIS by A. Santucci

Suggested reference:

Hodder, T.J. and Gauthier, M.S. 2020: Surficial geology of the Arden area, Manitoba (NTS 62J6); Manitoba Agriculture and Resource Development, Manitoba Geological Survey, Geoscientific Map MAP2020-1, scale 1:50 000.

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Langman, M.N. 1984: Soils of selected areas in the Rural Municipality of Westbourne; Canada Department of Agriculture, Manitoba Department of Agriculture and University of Manitoba, Canada-Manitoba Soil Survey, Report D-51, 218 p.

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Matile, G.L.D. and Keller, G.R. 2004: Surficial geology of the Neepawa map sheet (NTS 62J), Manitoba; Manitoba industry, Economic Development and Mines, Manitoba Geological Survey, Surficial Geology Compilation Map SG-62J, scale 1:250 000.

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Teller, J.T., McGinn, R.A., Rajapara, H.M., Shukla, A.D. and Singhvi, A.K. 2018: Optically stimulated luminescence ages from the Lake Agassiz basin in Manitoba; Quaternary Research, v. 89, p. 478–493.

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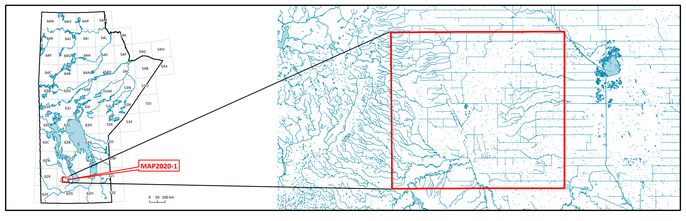
Location Map



Manitoba