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

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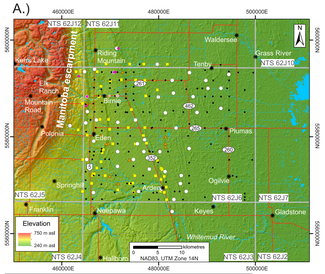
1. Introduction

Quaternary geology investigations were undertaken in the summer of 2015 in the Arden NTS area (62J6), southwestern Manitoba. Three weeks of fieldwork activity included surficial geology mapping, stratigraphic logging of Quaternary sections and till sampling for geochemical, lithological and kimberlite-indicator-mineral (KIM) analyses.

The specific goals of this project are to
- document the geomorphology, stratigraphy and distribution of surficial materials;
- improve the understanding of regional ice-flow phases; and
- sample glacial sediments (till) to investigate compositional patterns (dispersal trains).

A.)



B.)

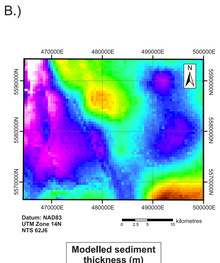


Figure 1: A.) The study area is the Arden NTS map sheet (NTS 62J6). Field sites from a previous 1979 MGS field season are also being incorporated. **B.)** Calculated sediment thickness of the map area using a surface digital elevation model and the MGS current 3D bedrock surface (500 m resolution)

2. Bedrock geology and previous KIM sampling

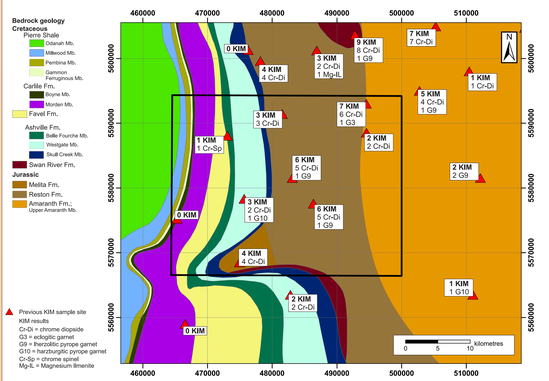
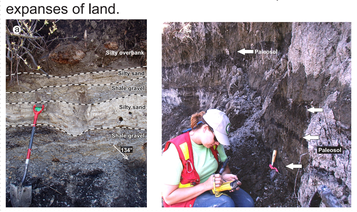


Figure 3: Bedrock geology of the Arden (62J6) and the surrounding region (modified from Nicolas et al., 2010). Previous kimberlite-indicator-mineral (KIM) sample sites and results are also depicted (Matile et al. 1996; Garrett et al., 2008). The KIM classification system used was Grütter et al. (2004) for garnets and Thorleifson and Garrett (1993) for non-garnet minerals.

Twenty additional KIM samples were collected in the Arden area during the 2015 field season. The results and location of samples will be released at a further date.

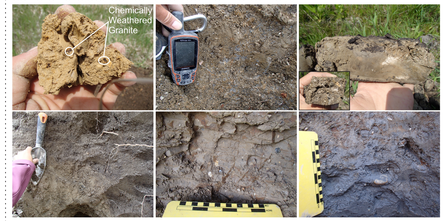
3. Surficial geology map units

Alluvial deposits: consist of silt, sand, gravel and organic material, are deposited within streams, rivers and as fans when water flows over wide-open expanses of land.



Beach deposits: typically consist of interbedded sand and gravel, of 1–12 m local relief. The prominent beaches near Arden are correlated with the upper and lower Campbell beaches.

Till deposits: tills in the study area display variations in colour, lithology and texture. The tills are primarily distinguished in the field by color: variably yellow-brown, grey-brown mottled, light to dark brown and blue-grey. Matrix texture varies from clay to silty sand and clast content varies from 5 to 20%.



Lacustrine offshore and deltaic deposits: glacial Lake Agassiz deposits, consisting of massive, brown, silty fine sand to fine sand.

4. Preliminary till geochemistry results

K-means clustering, an exploratory data analyses technique, was conducted to understand geochemical relationships. This analysis was run using ioGAS software after a log centered ratio transformation was conducted to avoid the effects of closure on the dataset (Grunsky, 2010).

Analysis was completed using a suite of 50 elements that were analyzed by ICP-MS after a near total digestion of the <63 µm fraction of till samples, with the exception of As, which was analyzed by ICP-MS following a partial digestion. Sample 15112TH153C01, was removed from the dataset, because it was anomalously high in a wide array of elements. The significance of this sample is currently being investigated.

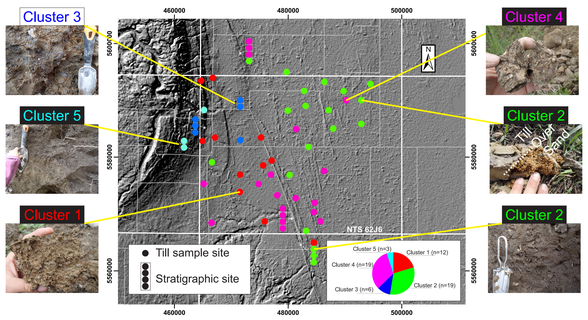


Figure 4: Cluster analysis results. There is a clear spatial distribution between the till samples. Similiarities between the physical appearances of the tills, yet contrasting geochemical properties, highlights the necessity to rely on clast lithology and geochemistry analyses for distinction. As exemplified by cluster 2, stratigraphic relationships need to be understood for ice-flow reconstruction (e.g. cluster 2 geochemical properties can be produced by both south or southwest ice-flow, thus cluster samples results are not necessarily a result of the same ice-flow phase). The relationship between till provenance and geochemical results will be further investigated with clast-lithology count results.

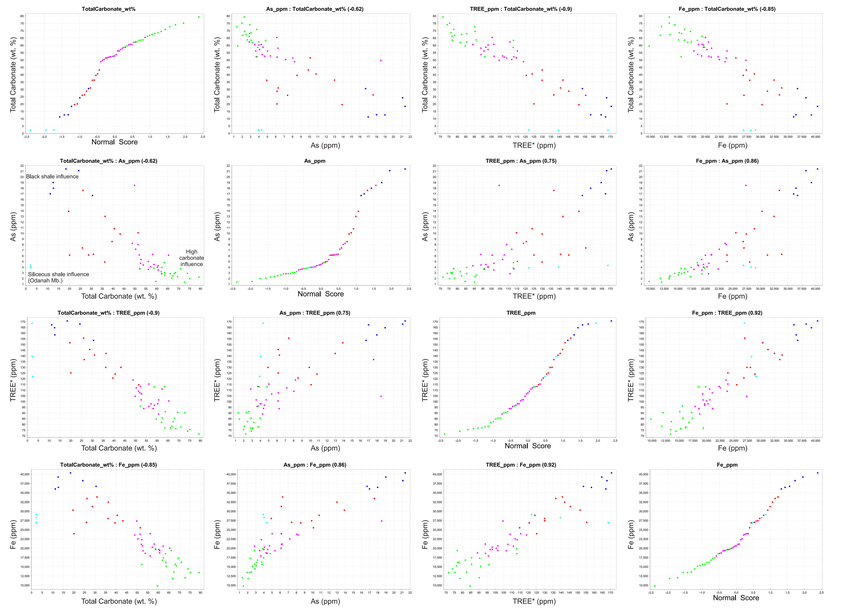
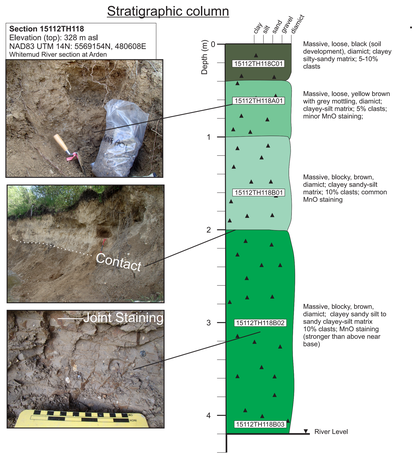


Figure 5: Scatter plot matrix of selected analyses. Samples are clasified according to the results of the cluster analysis.

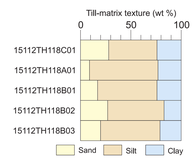
TREE* = Total Rare Earth Elements [near total digestions ICP-MS] = La + Ce + Pr + Nd + Sm + Eu + Gd + Tb +Dy + Y + Ho + Er + Yb

5. Preliminary Quaternary stratigraphy

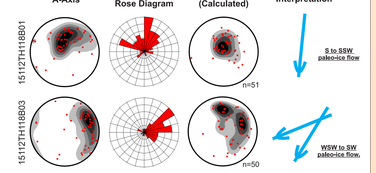
Stratigraphic column



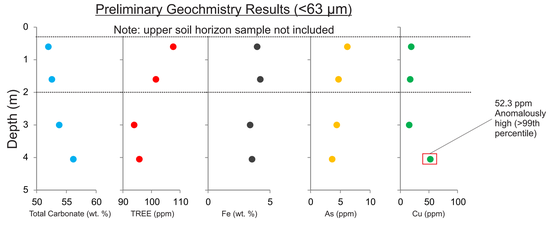
Lab Textural Results



Till Fabric Results



Preliminary Geochmistry Results (<63 µm)



Naturally occurring sections of Quaternary sediments are logged for lithology, texture and colour. Till fabric (orientation of elongate clasts) measurements are conducted to assess paleo-ice flow during deposition. Fabric measurements are necessary in thick drift areas of Manitoba, where bedrock outcrops are rare. Till samples are collected for geochemical, textural and lithological (pending) analysis. This multi-proxy approach provides the basis for interpreting the Quaternary stratigraphy. An example from the Whitemud River, Arden, MB is presented.

6. On-going work

- Clast lithological counts of till samples are being conducted to understand till provenance and assist geochemical interpretations.
- Surficial mapping utilizing air-photo interpretation and field observations is on-going. Release of a 1:50 000 map of the Arden area (NTS 62J6) will be the final product. An aggregate potential map will be derived from the results of this mapping.

7. Economic considerations

Ongoing surficial geological studies aim to provide a detailed framework for direction, timing and nature of major and minor ice-flow events in the region. This is a necessary task to encourage drift prospecting in regions where bedrock outcrops are rare; such as in southwest Manitoba. Detailed mapping of the surficial geology will aid infrastructure and agricultural planning, highlight prospective regions for aggregate resources and provide a framework to understand the hydrogeology of the region. The Arden area is a large supplier of high-quality aggregate and understanding the Quaternary geology of the area will enhance future resource development.

8. Acknowledgements

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