How surficial geology data can help you

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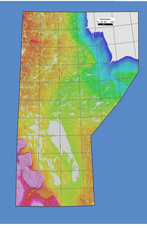
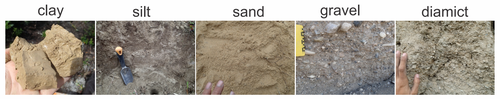


Surficial geology maps provide information on:

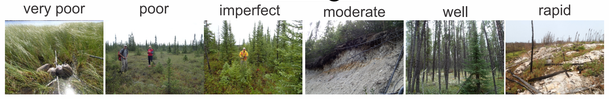
Areal distribution of different sediment types

clay | silt | sand | gravel | diamict



Drainage

very poor | poor | imperfect | moderate | well | rapid

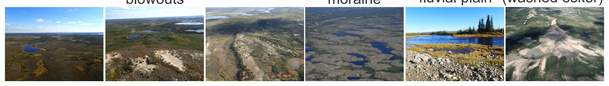


Geologic origin (genesis)

bedrock | glaciolacustrine over till | glaciofluvial | till: basal | till: ablation/melt-out | marine | organic

Geomorphology (landform)

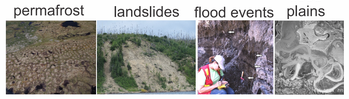
organic plain | active eolian blowouts | eolian dunes | ribbed moraine | active fluvial plain | marine beaches (washed esker)



wave-cut escarpment | meltwater channel | raised beach | crevasse ridges | streamlined landforms | spillways

Hazards

permafrost | landslides | flood events | flood plains



Till composition

shield | mixed | carbonate

Paleo Ice-flow

erosional indicators | depositional indicators

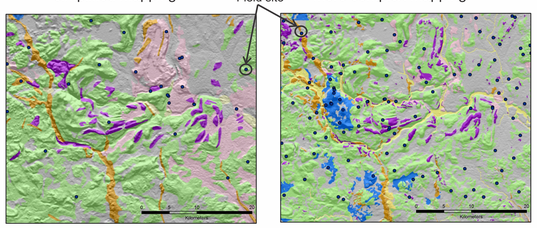
Caution about scale: Derivative products and infrastructure decisions MUST be made using the appropriate scale map.

1:500 000 scale map
-fewer field sites
-regional map data
-simplified mapping

Vs.

1:50 000 scale map
-more field sites
-more map detail
-more complex mapping

Field site



1:50 000 scale maps may be useful for regional projects, while 1:20 000 to 1: 5 000 scale maps will provide more accurate data for property-scale projects

Questions surficial geology can help to answer

Where to find the correct sampling material for drift exploration

Right of way routing (pipeline, powerline, road)

Hazard mitigation and/or avoidance during planning and construction
-susceptibility to flooding, erosion (slope or surface), gullying, landslides, slumps, debris flows

Aggregate resource management
-sand and gravel locations, size of potential deposits
-field site data can provide detailed grainsize information

Construction-material sourcing (clay caps, carbonate-rich sediment, etc)

Initial outline of engineering characteristics (layering, plasticity, ground ice presence, depth to bedrock, boulder content....)

Land capability for agriculture (stonieness, clay content, relief, drainage)

Ecology and wildlife inventories (physical basis for soil and biophysical studies)

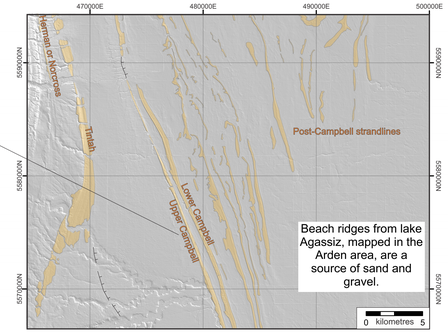
Groundwater (aquifer delineation, groundwater protection, identification of recharge areas)

Aggregate

Aggregate potential maps can be generated from surficial geology maps, by highlighting polygons classified as:
-esker, kame, terrace (glaciofluvial)
-delta, fan-delta, fan (glaciolacustrine, glaciomarine, glaciofluvial)
-beach ridge (glaciolacustrine, glaciomarine)
Post-glacial (fluvial, alluvial, lacustrine, marine) deposits may also provide aggregate.

*Variations such as clast size, abundance and quality (granitoid vs carbonate) as well as degree of sorting, mean that any 'potential aggregate' polygons must be field-verified to confirm quality.

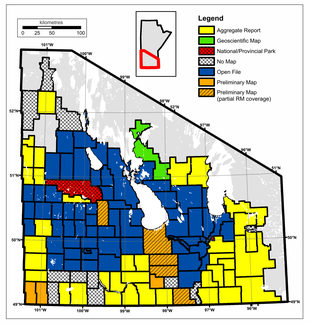
Exposure of beach sand and gravel.

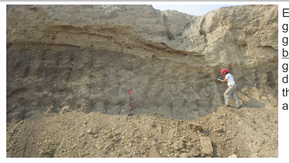


Compiling and digitizing of all pre-existing aggregate publications in Manitoba is currently in progress.

The index map below provides an overview of aggregate publications in southern Manitoba. All reports and maps are available for free download online.

www.gov.mb.ca/iem/geo/surficial/aggregate.html





Exposure of glaciofluvial gravels beneath glacial (till) deposits in the Morden area.

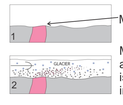
Shale gravels exposed within a terrace, along a spillway in the Pembina Valley area.

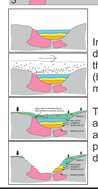
Esker sediments composed of shale sand and gravel in the Pembina valley area. [poor aggregate resource]

Drift prospecting

(Modified from GSC Open file 7261)

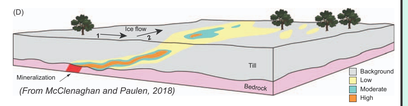
The mineral and chemical composition of till samples can be assessed for anomalous element and/or mineral enrichments, which can then be traced back to the bedrock source.





In this example, a glacier can only form a dispersal train from mineralized outcrop at the surface. If the mineralization is buried (by sediments or different bedrock) there may not be a dispersal train.

This means that [1] a single till sample anomaly may signify buried mineralization, and [2] buried mineralization may be present in areas where drift prospecting did not find any anomalies.

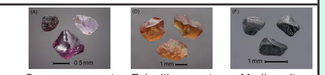


Paleo-ice flow and the relationship to dispersal
In Manitoba, the net dispersal of multiple ice-flow events MUST be considered. Till dispersal is a complex relationship between erosion, transportation and deposition. One, or all, of these processes occurred during each ice-flow phase. In the above example, both the surface (flow 2) and the buried (flow 1) orientations must be taken into account in order to locate the buried mineralization. Drift prospecting projects in Manitoba must not assume that the 'obvious surface' ice-flow orientation is automatically the direction of dispersal.

Examples of ice-flow phases in Manitoba, compiled by the MGS.

Diamonds

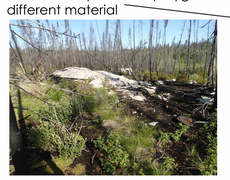
Diamond exploration samples the heavy mineral fraction of till to find kimberlite indicator minerals (KIMs, from *McClenaghan and Paulen, 2018*). KIM's are present in Manitoba.

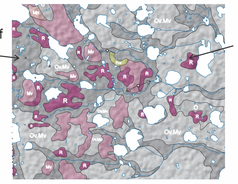


Bedrock outcrop location

The majority of Manitoba is covered by Quaternary sediments. Surficial geology maps capture the location of bedrock outcrops, and can be a good source to use when planning a bedrock field project. Keep in mind that older pre-GPS maps may have "suggested" rather than actual locations.

Point
Small outcrop within a polygon of different material





Polygon
Bedrock outcrop large enough to appear at the map scale

*Remember that maps are a mixture of air-photo interpretation and ground-truthing. Data is 99% trustworthy only if there is a field-site symbol. If not....user beware.

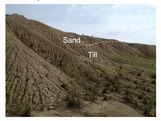
Hazard

Surficial geology maps can be used as a 'first pass' method of assessing:

a) **Erosion potential**, based on soil texture and slope.

Erodibility Classification	Soil Type	Soil Erodibility Rating
Most	Silt	High
	Silty Loam	High
	Silty Clay	High
	Silty Sand	High
	Sandy Loam	Medium
	Silty Clay Loam	Medium
	Sandy Clay Loam	Medium
	Silty Clay	Medium
	Sandy Clay	Low
	Clay	Low
	Heavy Clay	Low
	Loamy Sand	Low
	Sand	Low
	Poorly Graded Gravel	Low
Least	Well Graded Gravel	Low

Source: Adapted from Alberta Transportation (2003)



Once the vegetation cover is removed, the sediment is exposed to water erosion through overland/groundwater flow.

Each sediment type responds differently to erosion.

b) **Terrain stability**, based on identification of existing colluvial deposits, and/or landslides.

Slump within marine clays, and resulting earthflow over stronger till; Churchill River (summer 2014)

Runout zone within Quaternary sediments, near South Knife Lake (summer 2013).

Slump and earthflow within Quaternary sediments, above Paleozoic bedrock; Churchill River (summer 2014).

Manitoba