AN OVERVIEW OF SOILS IN QUÉBEC: FORMATION, VARIABILITY AND CHALLENGES

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SOIL CLASSIFICATION

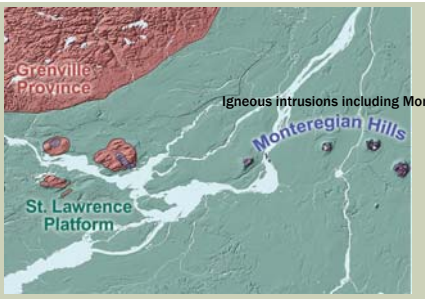
- **Nine Mineral Orders and one Organic Order** – based on the nature of the soil environment and the effects of the dominant soil forming process examples **Podzols, Brunisols etc**
- Note that 90% of Canadian soils are unlikely to be cultivated.
- The Canadian system classifies soils found only in Canada and is not meant to be comprehensive.

RELATIONSHIP OF CANADIAN SYSTEM TO OTHER SOIL CLASSIFICATION SYSTEMS

Canadian	USA	FAO
Regosolic	Entisol	Fluvisol, Regosol
Brunisolic	Inceptisol, some Psamments	Cambisol
Podzolic	Spodosol, some Inceptisols	Podzol
Luvisolic	Boralfs & Udalfs	Luvisol
Gleysolic	Aqy-suborders	Gleysol, Pansol
Chernozemic	Boroll, some Vertisols	Kastanozem, Chernozem
Solonetzic	Mollisol & Alfisol,Natric great group	Solonetz
Vertisolic	Verticals	Vertisol
Cryosolic	Pergelic subgroups	Gelic
Organic	Histosol	Histosol

RECENT GEOLOGIC EVENTS IN SOUTHERN QUÉBEC - SOURCE OF THE PARENT MATERIAL

ROCKS FROM THE GRENVILLE PROVINCE ARE FROM A MOUNTAIN RANGE 1500 TO 900 MILLION YEARS OLD



MONTEREGIAN HILLS

- Mount Royal, Mount St Hilaire, Rougemont, and others of the Monteregian Hills were formed by slow cooling igneous intrusions – this magma cooled under the surface – 125 million years ago
- There were some volcanoes but these have all disappeared leaving only the magma chambers and conduits

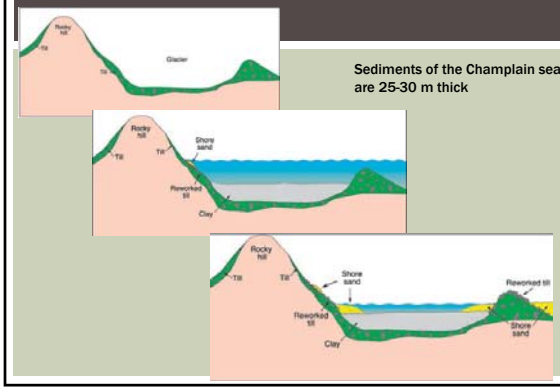
THE GLACIERS

- Between 1.6 million years and 10,000 years ago there were successive glaciations covering all of this region
- The weight of the glaciers, between 2 to 3 km thick depressed the crust of the earth
- Note: the glaciers also eliminated all of the earthworm species in Quebec – what exists came with the European settlers. The spread and increase in earthworm population has accelerated soil formation and removed the forest organic surface layer

THE CHAMPLAIN SEA

- The depressed landscape allowed the invasion of the sea – called the Champlain sea which covered most of this area and left behind other fine clay material
- As the earth's crust rebounded "Isostatic rebound" the sea retreated leaving behind lakes http://www.geopanorama.rncan.gc.ca/montreal/images/anim2b-petit-ok-eng.gif

GLACIERS AND THE CHAMPLAIN SEA



Sediments of the Champlain sea are 25-30 m thick

COMMON SOIL ORDERS IN EASTERN CANADA

Profiles and description

GLACIAL TILL PARENT MATERIAL :

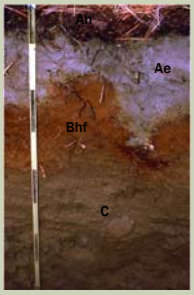
LANDSCAPE - BRUNISOL

BRUNISOL

Good to imperfect drainage, moderate oxidizing conditions developed under forest or grass – Ah, (Ae) and only a Bm - brownish or structured, C but not a Bt or Podzolic B

LANDSCAPES- PODZOL

PODZOL



- well to imperfectly drained soils that have developed under conifers, mixed forests - dominate conifers, mostly in cold and temperate climates on acid parent materials
- the soils have a podzolic B horizon in which characteristic accumulation products are organic matter (fulvic acid) combined with iron (Fe) and aluminum (Al). The materials form coatings on the sand and silt sized particles
- podzolic B consists of one or more Bh, Bhf, Bfh or Bf (h = humus and f = iron)

LANDSCAPE- LUVISOL

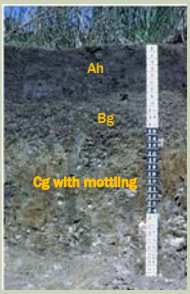
LUVISOL

- well to imperfectly drained soils, developed under either deciduous, mixed deciduous - conifers or boreal forests - the dominate vegetation is forest
- moderate and cool climates, moist, parent material neutral to alkaline
- have an eluviated Ae and an illuvial textural Bt (deposition of silicate clay)
- LFH, Ah, Ae, Bt, C

LANDSCAPE- GLEYSOL

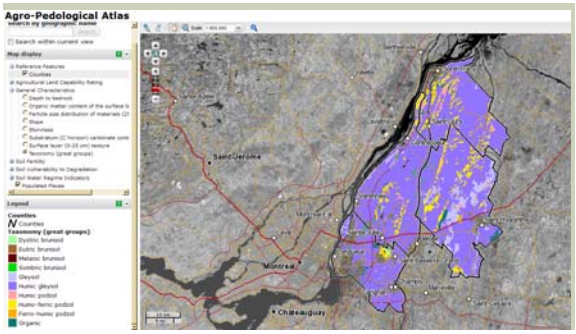
these soils need sub-surface drainage to improve the water movement - otherwise they cannot be easily cultivated

GLEYSOL

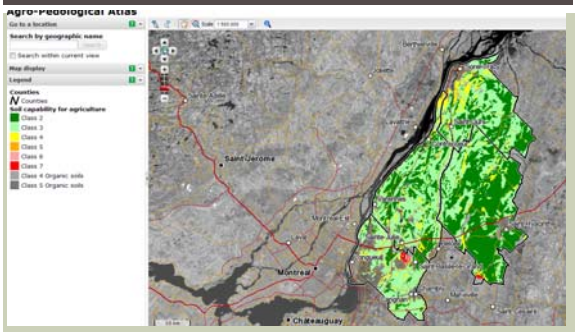


- these soils are saturated with water and are under reducing conditions continuously or during some part of the year unless they are artificially drained
- original vegetation can vary
- but the B and C horizons will show signs of "gleying" - reducing conditions - mottling have to have a Bg and a Cg
- LFH, Ah, (Ahe) Bg (Btg), Cg

EAST OF MONTREAL – GENTLE SLOPE, CLAYS, INTENSIVE AGRICULTURE



SOIL CAPABILITY FOR AGRICULTURE MAIN RESTRICTION IS EXCESSIVE WATER

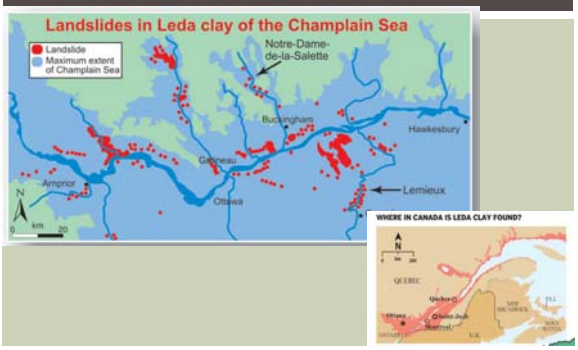


GLACIERS AND LANDSLIDES -

LANDSLIDES

- Parts of Quebec and Ontario along the old edges of the Champlain sea are prone to landslides – the St Lawrence and Ottawa valleys
- Within 60 km of Ottawa there have been 250 landslides
- These landslides are caused by potentially unstable material called “Leda clay” – HOWEVER the “clay” part is incorrect

EXTENDS ALONG THE ST LAWRENCE VALLEY AS WELL



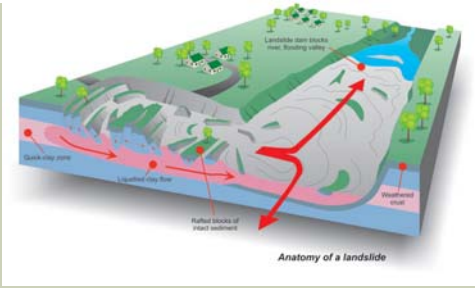
LEDA CLAY

- This material is comprised of clay and silt **sized** particles of bedrock (silt between 0.05-0.002 mm and clay is less than 0.002 mm)
- This material has not been chemically altered
- It settled to the bottom of the Champlain Sea and due to the salt content of the water, the particles were attracted to each other.
- They formed a loose but strong framework that holds a large amount of water – salts (charged) were essential to the structure

AFTER THE SEA RETREATED

- After the sea retreated these materials were subject to steady removal of the salts by water moving through the system
- If disturbed these leached Leda "clays" which still hold a large amount of water, will suddenly liquefy and flow – (the structural stability given by the salts is gone)
- Disturbances can be river erosion, high rainfall or snow melt, earthquakes (and these are common in this region) and human activities such as construction

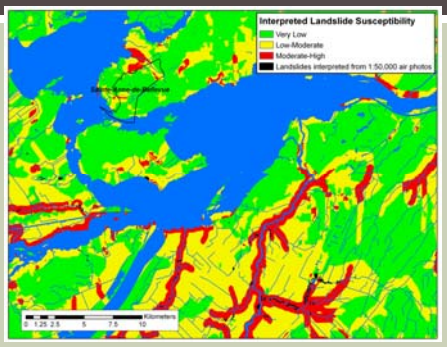
A FAMILY AND HOUSE WERE LOST TO A LANDSLIDE IN ST JUDE IN MAY 2010



http://nationalpostnews.files.wordpress.com/2010/05/na0512_landslide-eps.jpg

Aerial view of the 1993 Lemieux landslide, Ontario taken 4 days after the event. The flood waters of the South Nation River, which rose 12 m to overtop the debris dam, have inundated the mouth of the landslide scar. The town of Lemieux was abandoned in 1991 because of instability below ground

LANDSLIDE POTENTIAL AROUND MONTREAL



CHALLENGES

- Climate change – extreme events – warming weather will change soil dynamics
- Loss of Land to urbanization
- Intensification of land use
- Land Classification for agriculture – limited amount in Québec
- Leaching loss of nutrients through the subsurface drains