Introduction

Geology is the study of the earth, its history and its life as recorded in the rocks. Extensive studies of the geology and hydrogeology of this area provide a valuable information base, an appreciation of which is necessary to have success in challenging areas such as:

- maintenance of safe drinking water
- disposal of municipal and industrial wastes
- deep subsurface storage of petroleum products

Facts

A Simplified Overview of the Geological Strata Underlying Lambton County

<table>
<thead>
<tr>
<th>Formation</th>
<th>Thickness (m)</th>
<th>Approx. Age (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glacial Till</td>
<td>20 – 50</td>
<td>9,000 – 14,000</td>
</tr>
<tr>
<td>limestone – mainly calcium carbonate, dolomite</td>
<td>300 – 400</td>
<td>360 – 415 million</td>
</tr>
<tr>
<td>Sedimentary Salt</td>
<td>300 – 400</td>
<td>415 – 455 million</td>
</tr>
<tr>
<td>e.g. sodium chloride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedimentary Rock</td>
<td>500 – 700</td>
<td>455 – 490 million</td>
</tr>
<tr>
<td>dolomite – alternating layers of calcium and magnesium carbonates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metamorphic Rock</td>
<td>Unknown</td>
<td>&gt;590</td>
</tr>
<tr>
<td>million</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.g. granite</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Key Words

- aquifer - locally, a thin discontinuous layer of water-bearing gravel/sand, 30 to 35 meters below ground level
- bedrock - the solid rock underlying surface deposits
- hydrocarbon - a compound composed of hydrogen and carbon eg. methane (the main component of natural gas)
- metamorphic - rock that has been formed by the action of great heat and pressure within the earth
- paleozoic - denoting the lowest fossil - containing strata and thus the earliest complex forms of life
- sedimentary - rock formed by consolidation of sediment that was deposited in layers

Monograph L1
A Geological Cross-section of Lambton County

**Formations**

- **Glacial Till**
  - Probably deposited during the recession period of the Wisconsin glacier (beginning about 80,000 years ago and ending about 5000 B.C.). Hydraulic conductivity of unweathered clay averages 0.003 metres/year. Landfills can be suitably located in areas of clay deposits.  
- **Interface Aquifer**
  - The upper bedrock (one to two metres) is weathered and fractured; this area forms an Aquifer which is a source of potable water for much of Lambton County.
- **Kettle Point/Hamilton/Dundee**
  - Oil and gas-bearing; interbedded shales and limestones of the Hamilton Group and the overlying black, bituminous shales of the Kettle Point formation provide a thick, low-permeability cap to the Dundee formation. The Dundee Formation, mainly limestone and dolomite, bears gas and oil in Lambton County.
- **Detroit River Group**
  - Composed of limestones and dolomites with some interbedded gypsum and anhydrite; liquid wastes have been injected into this area; Ont. reg. 341 permits injections of brine only.
- **Bois Blanc/Bass Island**
  - A relatively impermeable barrier between the Salina formation and the Detroit River formation.
- **Salina**
  - Composed of alternating beds of salt, dolomite, shale, and gypsum. The largest salt beds, at a depth of approximately 600 metres, contain man-made caverns which are used for storage of hydrocarbons.

**Monograph L1**

Vandenberg, A. et al, 1977, figure 30

Middleton, T.A. et al, p 21

see Monograph L4
Fossils - Visible Traces of Organisms That Lived in the Geological Past

Fossils are often named after the areas in which they have been found. Arkona and Thedford are sources of Devonian fossils.

<table>
<thead>
<tr>
<th>Period</th>
<th>Group or Formation</th>
<th>Lithology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miss.</td>
<td>Drift</td>
<td>clays, gravels</td>
</tr>
<tr>
<td></td>
<td>Port Lambton</td>
<td>sandstone, shale</td>
</tr>
<tr>
<td>Kettle Point</td>
<td></td>
<td>shale</td>
</tr>
<tr>
<td></td>
<td>Dundee</td>
<td>limestone</td>
</tr>
<tr>
<td></td>
<td>Detroit River</td>
<td>dolomite, cherty limestone</td>
</tr>
<tr>
<td></td>
<td>Lucas Amherstburg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bois Blanc</td>
<td>dolomite with shale interbeds</td>
</tr>
<tr>
<td>Bass Islands</td>
<td></td>
<td>shaly dolomite, anhydrite, salt</td>
</tr>
<tr>
<td></td>
<td>Salina</td>
<td>dolomite, anhydrite, salt</td>
</tr>
<tr>
<td></td>
<td>Guelph-Lockport</td>
<td>dolomite</td>
</tr>
<tr>
<td></td>
<td>Clinton</td>
<td>dolomite, silty shale</td>
</tr>
<tr>
<td></td>
<td>Cataract</td>
<td>sandstone, shale, dolomite</td>
</tr>
<tr>
<td></td>
<td>Queenston</td>
<td>silty, shaly dolomite</td>
</tr>
<tr>
<td></td>
<td>Meaford Dundas</td>
<td>shale, dolomitic interbeds</td>
</tr>
<tr>
<td></td>
<td>Collingwood</td>
<td>shale</td>
</tr>
<tr>
<td></td>
<td>Trenton</td>
<td>limestone</td>
</tr>
<tr>
<td></td>
<td>Black-River</td>
<td>dolomite, limestone, shale and silty limestone</td>
</tr>
</tbody>
</table>

Dating systems indicate that some 400-350 million years ago, what is now Ontario was probably covered by warm salt seas. These seas contained a rich variety of creatures which included:

A- brachiopods
B- rugosan corals
C- tabulate corals
D- trilobites

Photograph provided by: Biology - Earth Science Museum, University of Waterloo
Local Geology Relative to Environmental Concerns

Potable Groundwater

Approximately 90% of the water wells in Lambton County are drilled into the interface aquifer, the remainder intersect local sandy deposits at shallower depths within the glacial till. The aquifer is the water source for some 15,000 people in Lambton County. In general, restoration of contaminated groundwater quality is difficult and extremely expensive; protection of groundwater quality is therefore essential.

Hazardous Waste Disposal

Because groundwater flow through clay is either very slow or absent, the St. Clair Clay Plain is considered suitable for containment of wastes. Lambton County has a licenced commercial hazardous waste disposal site which is recognized as one of the best in the country. Along with other regions of Ontario, this area is faced with the growing need to reduce the generation of waste.

Underground Storage

The safety associated with underground storage has led to widespread use of caverns by petrochemical and processing industries for storage of products and intermediate feedstocks such as propane, butane and ethylene. The underground caverns in the Sarnia-Windsor area, which range in size from 92,000 to 250,000 cubic metres, are located in the Salina formation. Caverns are constructed in the salt formation(s) by a solution-mining process. The rock salt has extremely low permeability and porosity; these properties make it a good storage medium.

Conclusion

This monograph simply opens the door to the fascinating world of the ground beneath our feet and to some of the challenges that must be met in order to maintain a healthy environment. More information is readily available in the references listed below.

Resources

Brigham, Robert J., 1971, Structural Geology of S. W. Ontario and S. E. Michigan
Freeze/Cherry, 1979, Groundwater
Husain, Muin, Waterloo U., Origin and Persistence of Pleistocene and Halocene Water in a Regional Clayey Aquitard and Underlying Aquifer in Part of S.W. Ontario.

Information Compiled by:
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* materials from this monograph may be reprinted
* references are available in our Resource Centre
* additional copies of this monograph are available from the Sarnia-Lambton Environmental Association or on-line at www.sarniaenvironment.com
Monograph L1

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