

Geology/Environmental and Technology Studies 120

Introduction to Environmental Geology

Field trip to aquifer innards

Our study of groundwater movement through geologic materials has two parts, a dynamic part and a static part. In the dynamic part of the investigation, we will conduct a pump test on the field near Carleton's west gym to see ground water movement in action. In the static part of the project, we will study two local bedrock aquifers, one from the Cambrian Jordan Formation and the other one from one of the Ordovician carbonate units, probably the Galena Group.

Stop 1: Water Tower in Red Wing, exposure of the Jordan sandstone. The Jordan sandstone is the aquifer that yields drinking water for much of southeastern Minnesota, including Northfield, St. Olaf and Carleton, each of which has a separate well or wells.

You might be interested in knowing that there are some variations in water quality within the Jordan aquifer, depending on the location of water wells with respect to directions of ground water flow. For instance, St. Olaf College has recently switched from their own water system to the City of Northfield's because of slightly higher radon concentrations in the wells at St. Olaf. All water systems are required to report water quality information to customers each year. If you are interested in seeing Carleton's most recent report, contact the facilities office. For another jurisdiction, first check the appropriate web pages and then contact the public works office.

At this stop, we will take a quick tour of the site, noting the characteristics of the sandstone, including bedding, grain size, sorting, sedimentary structures (cross beds, intraclasts), cementation patterns, and the brown liesegang bands that are prominent below the water tower.

Working in groups, each person will draw a detailed sketch (with a scale between 1:1 and 1:3) of a section of the outcrop about 0.5 * 0.5 m. The sketch should show bedding surfaces, changes in grain sizes, liesegang patterns, sedimentary structures, etc. You should be able to use your sketch to comment on the relative vertical and horizontal permeabilities of the beds, impediments to water movement, how water movement may have changed as the unit was deposited and then altered, and other subjects related to groundwater flow.

Stop 2: Carbonate rock outcrop on Goodhue County 14, south of Sogn. This exposure is either the Platteville Limestone or part of the Galena Group. Both are Ordovician carbonate units that are potentially good aquifers in terms of their permeability, although the Platteville is too thin in most places to be a useful source of water. After touring the exposure, you and your group will want to make sketches of a section showing the beds, the fractures and any solution enlargement of fractures that is visible. Based on your observations at Stop 2 and Stop 3, what are the main differences in the way water flows through sandstones and carbonate rocks and what are the implications of these differences for pollution and water quality? Note that the (older) Prairie du

Chien formation is also a carbonate unit and is probably hydrologically connected to the Jordan sandstone in many places in Minnesota.

At its extreme, carbonate weathering, especially solution along fractures, leads to "karst topography," a term encompassing surface features such as sinkholes, blind streams, towers and pinnacles, etc. as well as subsurface features such as caves. Southeastern Minnesota has its share of karst topography, as illustrated in the air photo of the Fountain (I have several copies in the bus). It is a hotly debated question as to whether karst features are developed in the Ordovician units of the Northfield area. The problem is further complicated by the long intervals of rock exposure and erosion that took place **within the Ordovician period itself**, leaving some possible karst features buried under other, younger units. You can read more about this fascinating topic in these two short leaflets from the Minnesota Geological Survey's "Minnesota at a Glance" series:

ftp://mgssun6.mnngs.umn.edu/pub2/mnglance/Mn_Karst.pdf

ftp://mgssun6.mnngs.umn.edu/pub2/mnglance/Paleozoic_bdrk.pdf

These require Adobe Acrobat, a plug-in that you can download for free.

(Other Minnesota-at-a-Glance leaflets [p. 25]: <http://www.geo.umn.edu/mgs/currentpubs.pdf>)

Assignment: Write a paper of 500-750 words (two to three pages) describing how groundwater flows through different materials. Your audience should be the general public, similar to a newspaper column such as those written by the County Extension Agents or the "In My Opinion" columns published in the Northfield News. (You might want to check back issues for some examples.) Your purpose is to try to explain to the readers the information about ground water location and movement that they would need to evaluate problems with groundwater quantity and quality. You should draw heavily and specifically on the observations made at Red Wing, Sogn and on the soccer field (pump test). As you prepare your paper, you may want to consult your textbook in the lab and perhaps some websites such as this one from the Minnesota Pollution Control Agency: <http://www.pca.state.mn.us/water/groundwater/index.html>

- but remember that no one wants to read "textbook-ese" in the newspaper. Your paper can be accompanied by sketches, which should be simple and clear enough for newspaper graphics.