Adventures in Geologic Mapping

By Jon Kim- Vermont Geological Survey

Hogback Mountain in Bristol

As one drives southward along Route 116 into the Town of Bristol, an ancient fault lies near the base of the hills to your left (east) and kilometer-scale folds form the steep ridge (Hogback Mountain) to the right (west). About 450 million years ago, the rocks to the east were pushed over those to the west along the Hinesburg Thrust Fault, during a major mountain-building event. Approximately 14,000 years ago, both the Route 116 and Monkton Road valleys were filled by a deep glacial lake. The Vermont Geological Survey (VGS) and Norwich University partner will be constructing geologic maps of the bedrock and surficial (glacial) deposits in this general area during the 2013 field season. For the 12th year, interns from the University of Vermont and Middlebury College will accompany the VGS mappers for 8 weeks, and all will conduct senior thesis research based on this experience. Work began on this project in 2012. The VGS receives funding for these mapping projects through the U.S. Geological Survey STATEMAP program. In order to be selected for mapping, towns or other public entities annually apply to a Vermont STATEMAP committee that competitively evaluates proposals. The Bristol Conservation Commission proposed mapping in their town to help address the issues of groundwater quantity and quality and sand and gravel availability.

The Town of Bristol from Bristol Cliffs. The flat surface that Bristol is built on is a delta that formed near the shoreline of the glacial lake discussed above.

Geologic mapping involves walking everywhere possible in the field area and examining and classifying the rocks or surficial deposits at up to 1000 sites. For bedrock mapping, a position is taken with a GPS unit at each outcrop/ledge, small rock samples are broken off with a hammer so that the minerals within can be identified with a magnifying lens, and measurements of layers, faults, and folds are taken with a compass and recorded. With surficial mapping, the deposits are examined by digging with a shovel or drilling with a hand auger and described as to their layering, grain size, and composition. A map is constructed by "connecting the dots" between similar rock types or surficial deposits across the landscape.

Measuring beds at Bristol Falls.

The "Anticline" in Bristol, a large upfold of quartzite.

Ultimately, all geologic data collected in the field is assembled in the office, using Geographic Information Software (GIS), into separate bedrock and surficial maps. For each map, a cross section is drawn that depicts what one would see at depth in the third-dimension. For examples of our geologic maps, see the http://www.anr.state.vt.us/dec/geo/ofreps.htm website.

Concurrently with the mapping, volunteers from Bristol will assist us with the location of water wells with GPS units. Of the ~100,000 private wells in the statewide DEC database, only ~10% have accurate locations. Once the maps are completed, they are integrated with data from all accurately-located groundwater wells (depth to bedrock, well depth, well yield, and static water level) in the field area. From this process, derivative maps that depict the thickness and character of the surficial deposits, areas of higher and lower well yields, and generalized "water table" flow directions are made. In addition, we will sample groundwater from 25-30 wells in the field area for water quality, with the help of the Middlebury College intern and their faculty advisor. We routinely analyze for arsenic, uranium, lead, manganese, hardness, and alkalinity among other analytes.

The VGS and Middlebury College partners have found that groundwater from ~25% of the bedrock wells completed in certain rock formations above the Hinesburg Thrust, between Williston and Hinesburg, have elevated naturally-occurring radioactivity levels. Our work in the Bristol area will also focus on radionuclides in groundwater. In addition to the current Bristol project, the VGS has also evaluated the groundwater resources of East Montpelier, Craftsbury, Charlotte, Williston, Brandon, and Woodstock.