Geothermal Energy Project Update

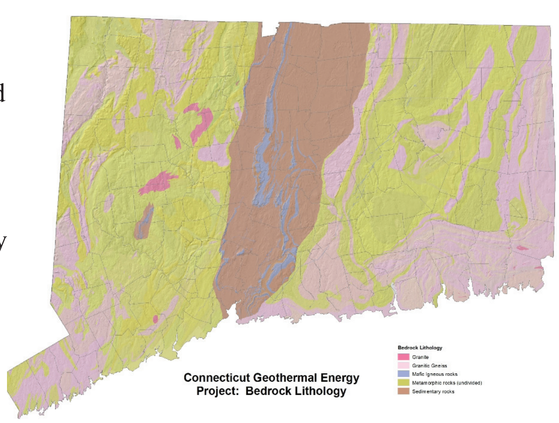
by Teresa Gagnon

The 2011 spring newsletter of Tracks and Trails (vol. 27, no. 2) included the article "Geothermal Energy in Connecticut?" which discussed the early stages of a three-year collaborative project to study the geothermal potential of Connecticut and Massachusetts. The project was financed through an interstate grant from the Department of Energy (DOE) through the American Association of State Geologists (AASG). This project is part of a 50 state effort to contribute information to the National Geothermal Data System (NGDS).

The project is now complete, and the data and a resulting map series have been published. While near-surface Enhanced Geothermal Systems (EGS) already exist in Connecticut, the main goal of this project was to look at the future potential for large scale deep (3 to 6 km, roughly 2 to 4 mi) geothermal resources that would produce enough heat to run a power plant large enough to serve a community.

We know that the earth gets warmer as we go deeper into the interior in New England at a rate of about 25°C per km (or 1.2-1.65 degrees Fahrenheit per 100 feet) of depth. This is known as the geothermal gradient. We wanted to investigate CT geology to determine where the rocks and sediments are naturally warmer due to radioactive decay of isotopes uranium (U), potassium (K), and thorium (Th) in minerals. If we could find rocks at the surface with these isotopes and project their presence deep into the earth through geologic mapping and other geophysical information, we could pinpoint areas where higher temperatures would be closer to the earth's surface, thus greatly reducing the cost of a geothermal installation.

Connecticut's granites and granitic gneisses were the primary focus of this study because of their greater probability of containing radioactive isotopes. Samples were also collected from other metamorphic and igneous rocks from central CT. A total of 55 bedrock units were targeted and 242 samples were collected. Rock chemistry, density and thermal conductivity of the bedrock samples were used to calculate heat production, heat flow, and thermal profiles at depth. **Figure 1** is a map which shows the location of the 5 rock types (lithology) identified for the purposes of this study.



The secondary focus of this study involved the collection and analysis of unconsolidated sediments above the bedrock. Using glacial geology maps of CT, 20 units were targeted for the collection of 100 sediment samples. Thermal conductivity measurements were made and physical profiles of sediment (grain size, sand, silt, clay percent, bulk density, porosity) were created. Information obtained from this part of the study will provide assistance for better design of near surface EGS.

A geothermal resource map series summarizing the data produced in this study has been compiled. The series includes heat production, inferred heat flow, thermal conductivity, and thermal profile maps for bedrock, and a thermal conductivity map for sediments. All data and mapping are available through the National Geothermal Data System. The maps are also available on the Department of Energy and Environmental Protection Connecticut Geological Survey website. http://www.ct.gov/deep/geology, in the Energy area.

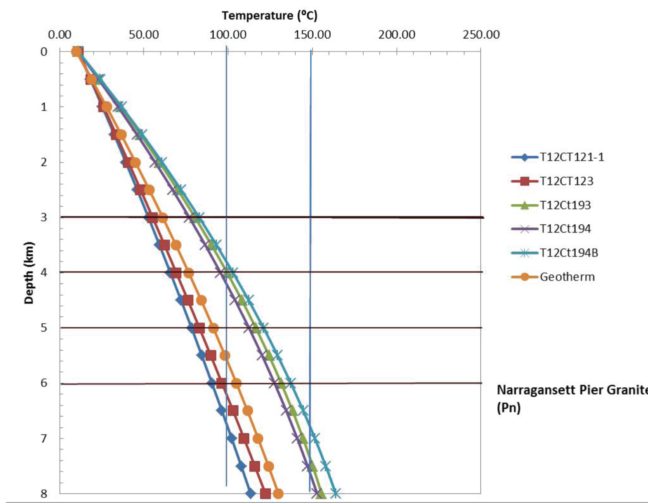


Figure 2 is the Inferred Temperature at Depth Profile for five samples from one bedrock unit (Narragansett Pier Granite) and the average geothermal gradient of New England. Each curve on the graph was generated using the rock chemistry for an individual sample of the unit. The vertical lines at 100° and 150°C represent the desirable temperature range for steam production. Horizontal lines at 3, 4, 5 and 6 km depths are drawn to highlight temperature values for these target depths. 3 of the 5 rock samples are above the geothermal gradient curve and pass through the desired heat production zone at 4 km. They show temperature ranges suitable to convert groundwater to steam and therefore are promising geothermal source rocks.

Thermal profile models generated for other rock units in this study show that 25 percent of the samples yielded an inferred temperature profile greater than the regional geothermal gradient. These results indicate that areas with highest potential heat flow values are in rock units of southeastern CT bedrock. Additional research in this area is required to provide enough data to adequately characterize these geologic units for geothermal potential. A more detailed summary which includes a discussion of the sedimentary portion of this study is in progress and will be available on the Connecticut Geological Survey website!