Geothermal Resources in New York State and Pennsylvania

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Resource Assessment

By: Andrea Aguirre, Tim Reber, Elaina Shope, George Stutz

Due to increased drilling for unconventional natural gas in Pennsylvania and New York State, these areas have benefited from the compilation of data from over 8,000 new wells containing valuable temperature-depth (BHT) information. These were used to create a set of maps showing subsurface thermal gradient, surface heat flow, depth to the 80˚C and 150˚C, as well as expected temperatures at any depth to 10 km.

Depth to 80˚C Isotherm

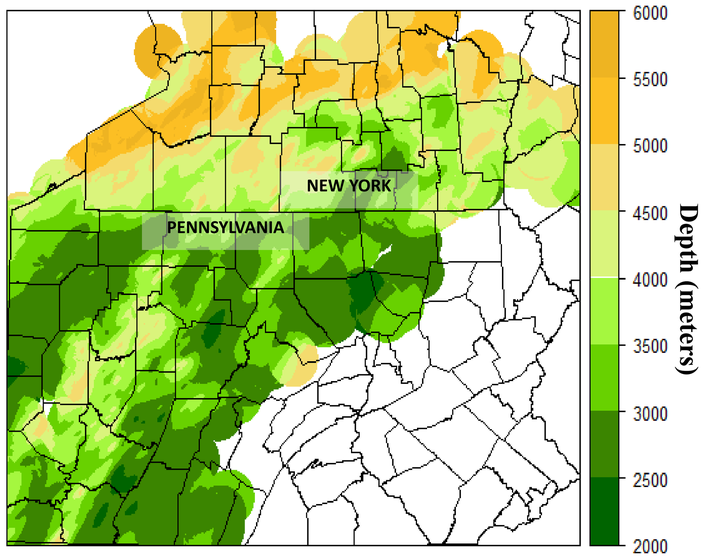

Figure 1. Required depth (meters) to 80˚C isotherm for the utilization of low grade resources in both direct thermal use and combined heat and power applications for New York and Pennsylvania.

Expected Temperature (˚C) at 6km

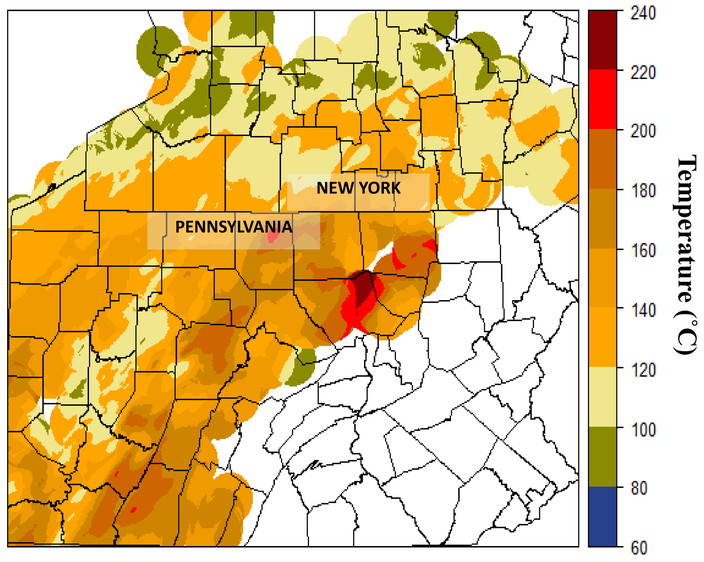

Figure 2. Expected temperature (˚C) at today's economical drilling depth of 6 km for New York and Pennsylvania.

Spatial Variability and Uncertainty Analysis

- Statistical and spatial analyses to assess variability and uncertainty associated with produced maps
- Implementing outlier detection techniques and testing prediction mapping processes that allow the construction of standard error of the mean
- Constructing cross sections to depict variability and establish a 95% confidence interval that contains true sample mean

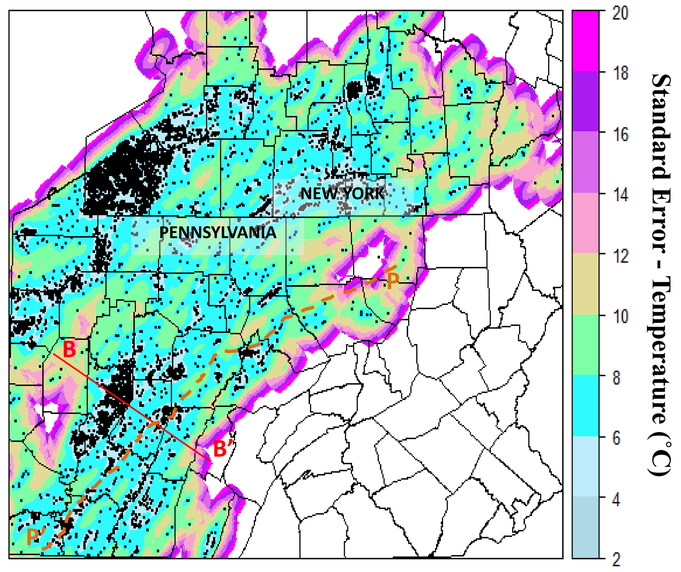

Figure 3. Standard error of the expected temperature (˚C) from figure 2. Individual well locations shown as black points. *Data sources: SMU, PA Geological Survey, NYS Museum, NYSDEC, 2011; 2012.*

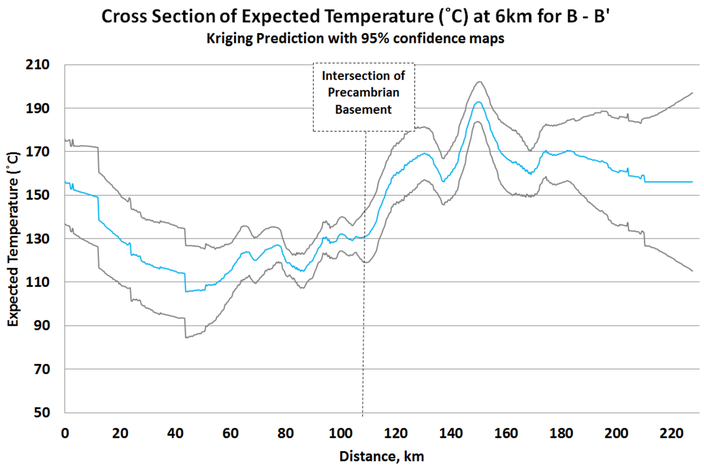

Figure 4. Cross sections for line B – B' (red line in figure 3) with 95% confidence intervals.

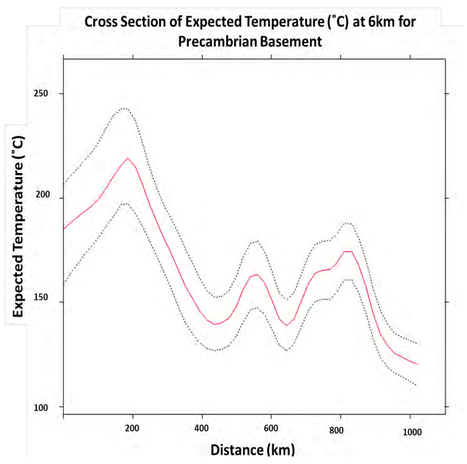

Figure 5. Cross sections for Precambrian Basement (dashed line in figure 3) with 95% confidence intervals.

Evaluation of EGS for District Heating

By: Tim Reber

- Even though the western U.S. has some of the highest temperature gradient, many regions on the east coast have promising resources at attainable depths.
- New York and Pennsylvania have temperatures reaching 150ºC at 5.5 km depth, which can be utilized for district heating systems in an economical manner.

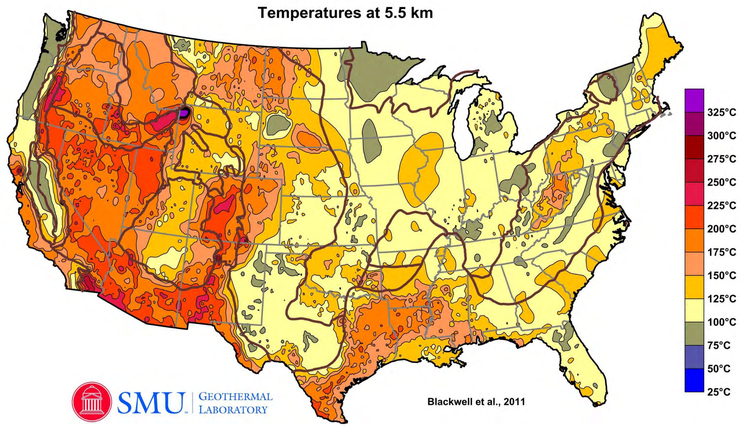

Figure 1. Expected temperature (˚C) at 5.5 km for the conterminous United States. *Source: Blackwell et al., 2011.*

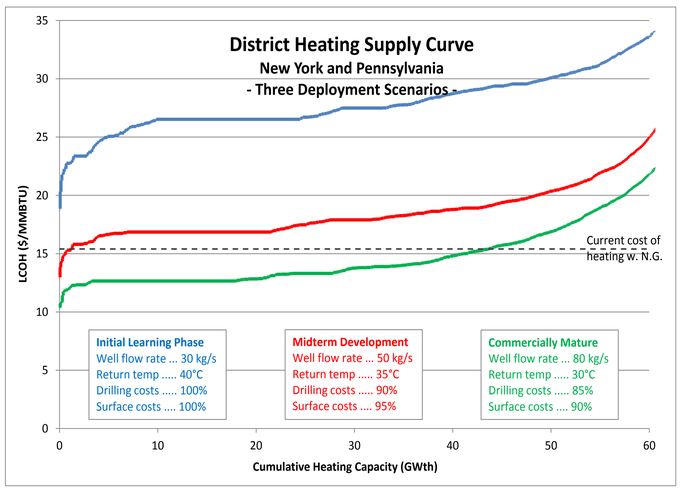

Figure 2. Estimated levelized cost of heat (LCOH) from EGS in New York and Pennsylvania against cumulative installed heating capacity for three technology cases.

- As more capacity is installed, lower grade resources and communities with a lower demand density will have to be tapped, increasing their LCOH.
- At today's low natural gas prices and with today's technology (blue line), GDH is unlikely to compete with natural gas.
- As EGS technology matures (red and green lines), or if natural gas prices increase (as they almost certainly will), the competitiveness of GDH will increase significantly.

- Size of circles represent the total heating capacity in each community.
- Color of circles represent the estimated LCOH.
- Places with higher heating requirements tend to have lower LCOHs.

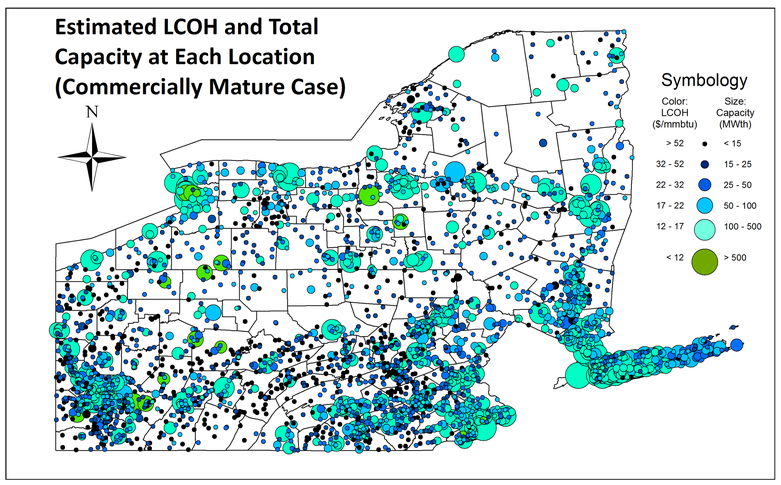

Figure 3. Estimated LCOH and total generating capacity for all communities in New York and Pennsylvania given the commercially mature technology case.

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