East Texas Geothermal Reservoir Study for New Deep Direct Use Application

Preliminary Data Analysis Results

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ABSTRACT

Direct use of geothermal energy has historically been limited to small capacity applications producing low value and low grade thermal heat. These traditional direct use applications often do not utilize the full potential of low to mid grade (50 to 150 °C) geothermal heat, resulting in a waste of the produced thermal energy. This study is part of the DOE funded Deep Direct Use research project examining turbine inlet cooling as a new deep direct use application that will fully harness low to mid grade geothermal heat, and turn low-enthalpy and low-value geothermal energy into a high-value product by increasing the efficiency of a natural gas turbine. As part of this project, the SMU Geothermal Laboratory is producing a high resolution heat flow map of the study area, high resolution temperature versus depth maps of the study area, quantifying potential reservoir(s) size and flow parameters, and evaluating local permitting regulations related to geothermal well drilling. Presented here are the current results of the data compilation and analysis.

BACKGROUND

- The study area is a 20 km radius around the Eastman Chemical Company Plant in Longview, Texas—a chemical processing facility that has an on-site natural gas turbine used to produce electricity and low grade heat for chemical processing
- East Texas is known to have high but locally variable subsurface temperatures (Figure 1), which could aid in increasing the efficiency of the natural gas turbine (Blackwell et al., 2010).
- Previous studies have produced general information on the reservoir production potential, which we will expand through examination of well logs and production of cross sections (SMU Geothermal Lab, 2017)
- General Geology is understood but complicated because of the Sabine Uplift. Cross sections will be made to connect the East Texas Oil Field with the East Texas Salt Basins (Adams, 2009; Foote et al., 1988, Halbouty and Halbouty, 1982)
- Current stage of this study is compiling geothermal data (both temperature and reservoir characteristics) to produce high resolution heat flow, subsurface temperature, and reservoir analyses of the Longview, Texas, region

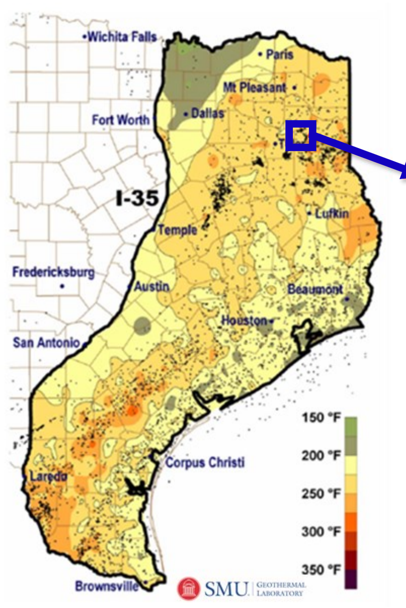


Figure 1. Sub-surface temperature of East and South-Central Texas at 9,000 feet depth (Blackwell, et al., 2010). The study area highlighted with the blue square has regionally high temperatures, but more data points are being added as part of this project to increase the resolution of the heat flow and temperature-vs-depth maps.

SMU TASK - RESOURCE CHARACTERIZATION

Task	Task or Subtask	Milestone Number	Milestone Description	Milestone Verification Process
1.1	Resource data compilation	M1.1	Initial assessment of geothermal resource and plant suitability	Listing of existing subsurface data cross-referenced to the case study location (Eastman Chemical near Longview)
1.2	Review and assess well data	M1.2	Database of well and other subsurface data	Compile available study-area data into a workbook using headings as defined in relevant content models, including: Well Fluid Production and Heat Flow
1.5	Calculate RPI	M1.3	Tabulated RPI results for the selected areas	Database of Reservoir Productivity Index (RPI) results for identified wells within approx. 10-km radius zone of interest around selected plant site.
1.6	Permitting assessment	M1.4	Permitting assessment	Report documenting relevant federal, state, and local permitting required for geothermal development at the selected case-study locations.

CURRENT RESULTS

- 121 heat flow points from SMU and 991 geothermal gradient points from BEG within 20 km of the Eastman Chemical Company power plant (Figure 2) (SMU Geothermal Lab, 2017)
- 3 identified reservoirs - the Cotton Valley, Pettit, and Rodessa - overlap with the study area, which include general reservoir information such as main rock type, volume, porosity, permeability, fluid type, and historical average monthly production (SMU Geothermal Lab, 2017)
- 1934 unexamined wells with well logs (no .LAS) within a 20 km radius of the Eastman Chemical power plant, ~800 have been examined for bottom hole depth and temperature (Figure 3).
- All NGDS content models have been downloaded and are being examined for data overlap with the study area

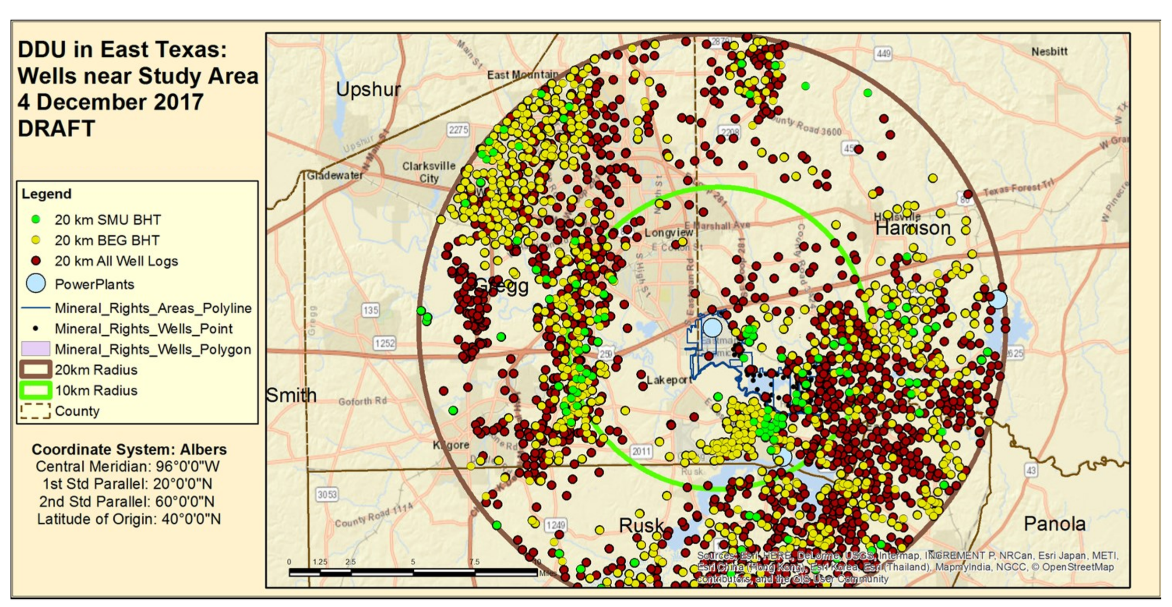


Figure 2. Current map of the study area showing SMU heat flow, BEG BHT, and wells with well log locations within 20 km of the Eastman Chemical Company power plant.

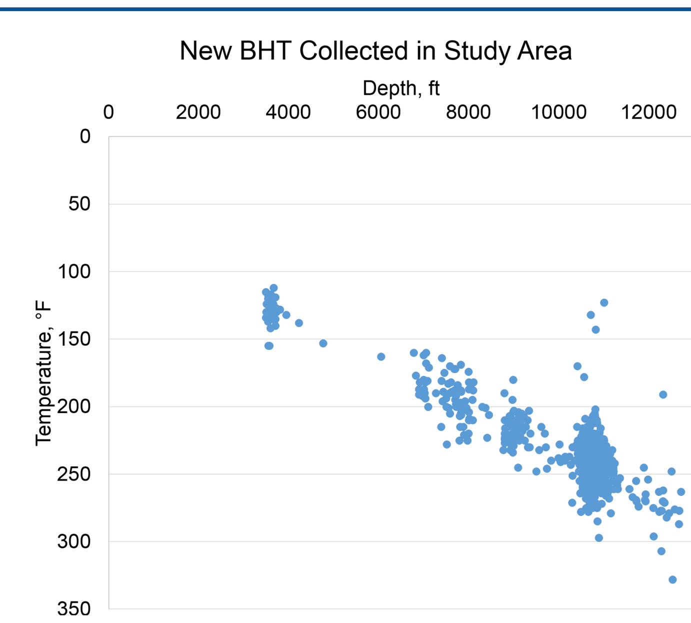


Figure 3. Approximately 800 of the 1934 wells with well logs have been examined for temperature, bottom hole depth, and log type. Some temperature data are anomalous and will need further examination.

FUTURE WORK

1) Reservoir Mapping

a) Well log analysis and stratigraphic correlation (Figure 4) to produce structural and sequence stratigraphy cross sections (Figure 5) and to map reservoirs, thickness, and spatial distribution

2) Reservoir analysis

a) Theoretical volumetric calculation of fluid flux potential based on porosity, permeability and reservoir thickness

b) Realized total fluid flux of reservoirs based on G10 reports/production curves (Figure 6)/other available data?

3) Permitting

a) Documentation of relevant federal, state, and local permitting regulations (Figure 7) for drilling and development of a geothermal project - will research using resources like OpenEI (Figure 8) (OpenEI, 2018)

4) Analysis of other factors required for understanding of reservoir modeling? [Suggestions welcome]

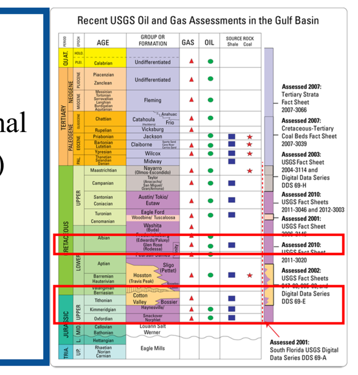
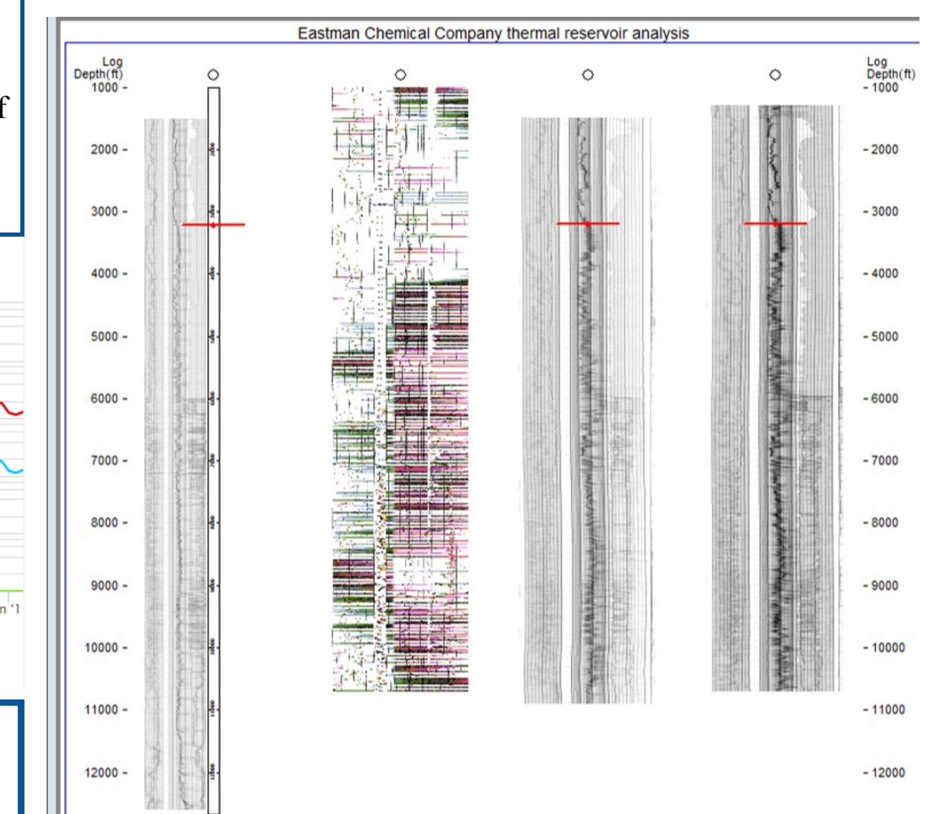


Figure 4. Logs will be used to analyze potential reservoirs within the local stratigraphy (right, red boxes) for geothermal potential (USGS, 2017). Well logs (below) will have formation tops picked (red lines) and correlated from well to well to create cross sections. Some wells will be too low resolution for interpretation.



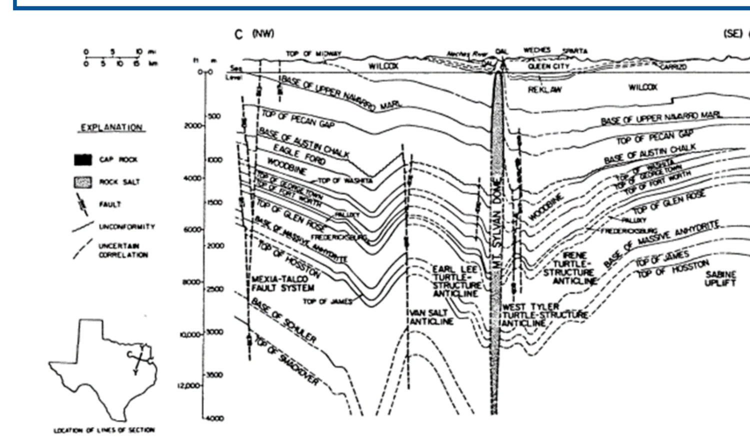


Figure 5. Example of a regional cross section of the East Texas Basin (from Foote et al., 1988). Cross sections for this project will focus on detailed study area correlation instead of large scale regional correlations.

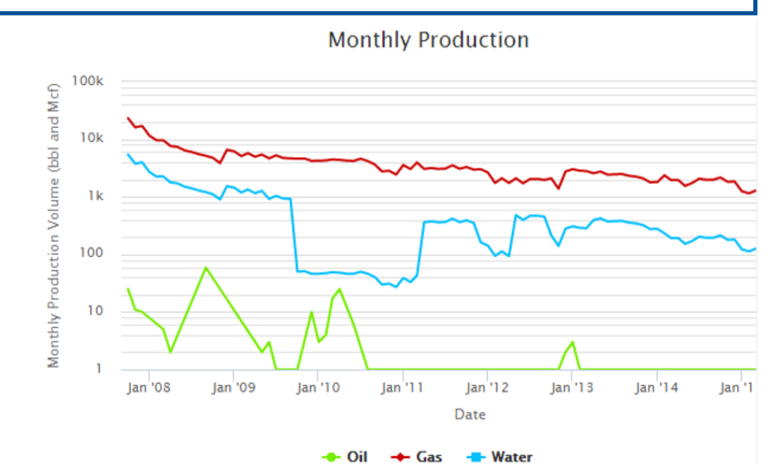


Figure 6. Example production history curves for a well within the study area (from Drillinfo.com, 2018). This production history, where available, provides reliable information to estimate the total fluid flow potential within a given reservoir at a specific location.

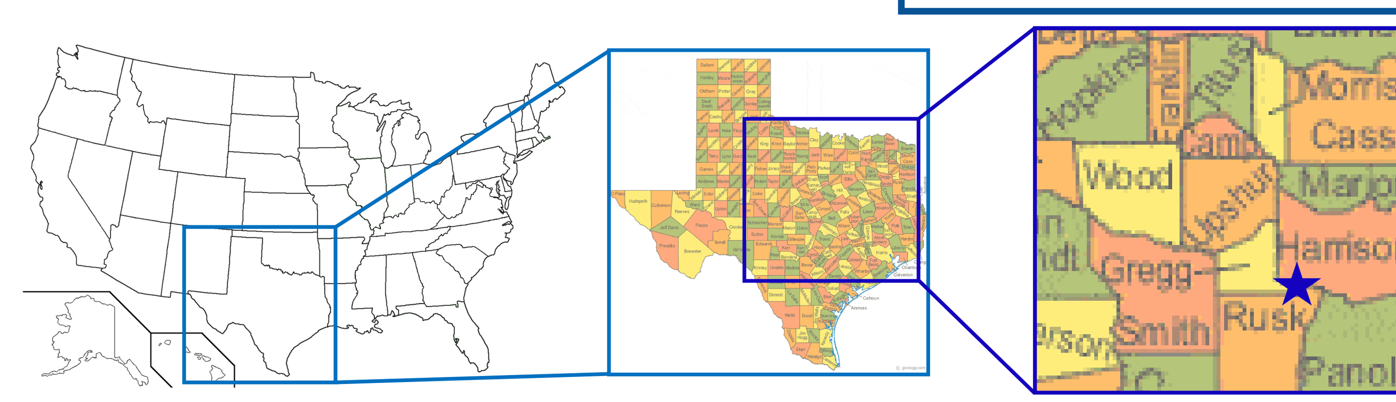


Figure 7. Permitting regulations will be examined at the Federal (Left), state (center), and county (right) levels and summarized to provide a framework of how to permit a geothermal development within the project's study area. The study area site is approximated by the blue star.

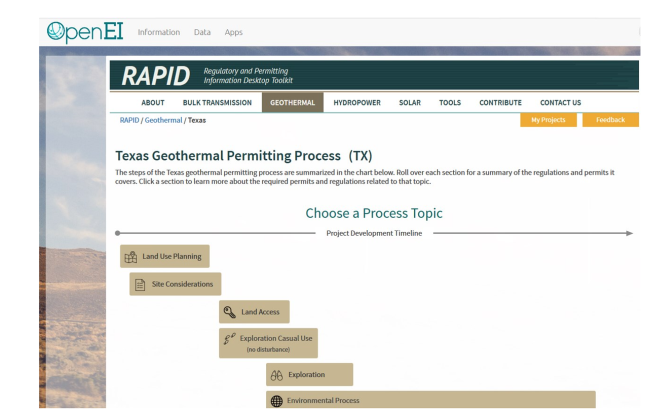


Figure 8. Image of the OpenEI regulatory and permitting information desktop toolkit (OpenEI, 2018). OpenEI already has much of the permitting information - this project will add any missing information such as county specific regulations.

SUGGESTIONS?

Some thoughts we could still use help on - Where can we get more/better porosity and permeability? What programs do a good job of reservoir modeling? Where can we get .LAS files within our study area at low to no cost? Are there other large scale databases we should examine? Any and all suggestions are welcome! If no one is here, please email comments to jbatir@smu.edu.

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