**ABSTRACT**

The U.S. Department of Energy is currently funding a broad consortium of institutions to develop a new National Geothermal Data System (NGDS) for assessing the geothermal resources of the United States. During the 1970s, cruise maps of heat flow were produced. Numerous wells have since been drilled in the Illinois Basin region, of which bottom hole temperatures (BHTs) were recorded during the drilling process. Unfortunately, the bottom hole temperatures have never been viewed on high-resolution maps. We compiled bottom hole temperature data from geothermal wells and created a detailed database that contains observations of temperature from more than 25,000 wells in Indiana, Illinois, and Kentucky. This database provides a substantial increase in information on the thermal state of the subsurface. Quality control of the data was based on reduction of duplication, correction of erroneous depths or temperature, and elimination of faulty data acquisitions. For Indiana and Illinois, many shallow bottom hole temperature values of exactly 100°F were removed from the database because they resulted from the field operator using depth charts to assign a BHT value, rather than an actual observation of temperature at depth. The BHT values at depths between 3,000 and 12,900 feet were corrected using the Harrison equation to account for error related to the circulation of drilling fluids and better represent an equilibrium, or in-situ, temperature. Geothermal gradients were calculated for each well by using a mean ambient surface temperature at the well location from values obtained from the PRISM Climate Group. Mean geothermal gradients were also calculated for specific geologic intervals. Updated maps of geothermal gradients and temperature anomalies throughout the Illinois Basin show a higher resolution of subsurface thermal conditions than earlier products. Preliminary results for this study suggest that higher gradient heat flows occurred at shallow depths whereas low gradient heat flows occurred at deeper depths.

**OVERVIEW OF STUDY AREA**

- **HYDRAULIC FLOW POTENTIAL**
- **TEMPERATURE CORRECTIONS**

**TEMPERATURE CORRECTIONS**

- **SHALLOW VERSUS DEEP GRADIENTS**

**OBJECTIVES**

- Provide a method to process data from three different states into a standardized, quality-controlled database for the Illinois Basin region
- Provide better understanding of heat flow in the subsurface

**REFERENCES**


Forrest, Joseph, L. Marucci, and P. Scott, 2007, Geothermal gradients and subsurface temperatures in the northern Gulf of Mexico: Search and Discovery Article #10083, 15 p.


**METHODS**

- Three datasets were reviewed for duplicate entries, missing data, and currently erroneous data.
- Other records were considered to be obviously inaccuracy and were removed from the datasets.
- All well locations were projected to a consistent coordinate system, UTM X Y, NAD83, Zone 15.
- Applied temperature corrections using the equation of Harrison et al. (1982) to big header BHT values with an associated depth range of 3,000 to 12,900 ft to provide a more accurate in-situ well temperature map.
- Gridded data of annual maximum and minimum temperatures (1971-2006) from the PRISM Climate Group were used to create an average annual surface temperature map.
- Calculated a mean geothermal gradient for each well - the surface temperature was calculated from the corrected BHT and divided by the depth.
- A filter was used to mapping records with respect to depth formation. This reduced effects from lithology and depth when comparing the gradients.
- The gradients were examined for values that deviated from the general trend in the region.

**RESULTS**

- The R-squared value for corrected temperatures is almost 4% higher than non-corrected temperatures suggesting the Harrison equation provides a better fit to the data.
- The commonly used estimate or national average of 1 deg ft/100 ft appears to be consistently low for the Illinois Basin region in which gradients greater than 4.0 deg ft/100 ft were calculated during this study.
- The new geothermal database of the Illinois Basin indicates that the mean geothermal gradient is 2.58 deg ft/100 ft for the region.
- Lower gradients appear at deeper depths with minimum gradients found at the heart of the basin, creating a bull’s eye effect of higher gradients in shallower wells around the basin margin.
- Low thermal conductivity sediments may be enhancing temperature gradients due to a thermal gradient effect.
- P-values indicate a difference in gradient means between deep geologic formations and shallow formations, which may be due to ground water flow patterns.
- Shallower units such as the Pennsylvanian and Mississippian suggest advective heat transport may be significant from shallow groundwater flow systems, while the deeper units such as Knox and Mazon sand indicate that conduction is the most dominant process.

**DEVELOPMENT OF NEW GEOTHERMAL DATABASE FOR THE ILLINOIS BASIN**


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**PROBLEM**

The bottom hole temperature datasets from Illinois, Indiana, and Kentucky were created by different people with different intentions for using the data and therefore had inconsistencies between them.

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