Geothermal mapping project reveals large, green energy source in coal country

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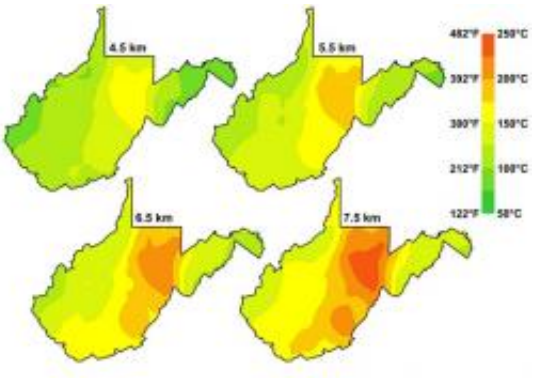

This illustration demonstrates subsurface temperatures at various depths in West Virginia from 4.5 km to 7.5 km, indicating the hottest geothermal resources for further exploration.

(PhysOrg.com) -- New research produced by Southern Methodist University's Geothermal Laboratory, funded by a grant from Google.org, suggests that the temperature of the Earth beneath the state of West Virginia is significantly higher than previously estimated and capable of supporting commercial baseload geothermal energy production.

Geothermal energy is the use of the Earth's heat to produce heat and electricity. "Geothermal is an extremely reliable form of energy, and it generates power 24/7, which makes it a baseload source like coal or nuclear," said David Blackwell, Hamilton Professor of Geophysics and Director of the SMU Geothermal Laboratory.

The SMU Geothermal Laboratory has increased its estimate of West Virginia's geothermal generation potential to 18,890 megawatts (assuming a conservative 2% thermal recovery rate). The new estimate represents a 75 percent increase over estimates in MIT's 2006 "The Future of Geothermal Energy" report and exceeds the state's total current generating capacity, primarily coal based, of 16,350 megawatts.

Researchers from SMU's Geothermal Laboratory will present a detailed report on the discovery at the 2010 Geothermal Resources Council annual meeting in Sacramento, Oct. 24-27. A summary of the report is available online.

The West Virginia discovery is the result of new detailed mapping and interpretation of temperature data derived from oil, gas, and thermal gradient wells – part of an ongoing project to update the Geothermal Map of North America that Blackwell produced with colleague Maria Richards in 2004. Temperatures below the Earth almost always increase with depth, but the rate of increase (the thermal gradient) varies due to factors such as the thermal properties of the rock formations.

"By adding 1,455 new thermal data points from oil, gas, and water wells to our geologic model of West Virginia, we've discovered significantly more heat than previously thought," Blackwell said. "The existing oil and gas fields in West Virginia provide a geological guide that could help reduce uncertainties associated with geothermal exploration and also present an opportunity for co-producing geothermal electricity from hot waste fluids generated by existing oil and gas wells."

The high temperature zones beneath West Virginia revealed by the new mapping are concentrated in the eastern portion of the state (Figure 1). Starting at depths of 4.5 km (greater than 15,000 feet), temperatures reach over 150°C (300°F), which is hot enough for commercial geothermal power production.

Traditionally, commercial geothermal energy production has depended on high temperatures in existing subsurface reservoirs to produce electricity, requiring unique geological conditions found almost exclusively in tectonically active regions of the world, such as the western United States. Newer technologies and drilling methods can be used to develop resources in wider ranges of geologic conditions. Three non-conventional geothermal resources that can be developed in areas with little or no tectonic activity or volcanism such as West Virginia are:

• Low-Temperature Hydrothermal — Energy is produced from areas with naturally occurring high fluid volumes at temperatures ranging from 80°C (165°F) to 150°C (300°F) using advanced binary cycle technology. Low-Temperature systems have been developed in Alaska, Oregon, and Utah.

• Geopressure and Co-produced Fluids Geothermal – Oil and/or natural gas produced together with hot geothermal fluids drawn from the same well. Geopressure and Co-produced Fluids systems are currently operating or under development in Wyoming, North Dakota, Utah, Louisiana, Mississippi, and Texas.

• Enhanced Geothermal Systems (EGS) – Areas with low natural rock permeability but high temperatures of more than 150°C (300°F) are "enhanced" by injecting fluid and other reservoir engineering techniques. EGS resources are typically deeper than hydrothermal and represent the largest share of total geothermal resources. EGS is being pursued globally in Germany, Australia, France, the United Kingdom, and the U.S. EGS is being tested in deep sedimentary basins similar to West Virginia's in Germany and Australia.

"The early West Virginia research is very promising," Blackwell said, "but we still need more information about local geological conditions to refine estimates of the magnitude, distribution, and commercial

significance of their geothermal resource."

Zachary Frone, an SMU graduate student researching the area said, "More detailed research on subsurface characteristics like depth, fluids, structure and rock properties will help determine the best methods for harnessing geothermal energy in West Virginia." The next step in evaluating the resource will be to locate specific target sites for focused investigations to validate the information used to calculate the geothermal energy potential in this study.

The team's work may also shed light on other similar geothermal resources. "We now know that two zones of Appalachian age structures are hot – West Virginia and a large zone covering the intersection of Texas, Arkansas, and Louisiana known as the Ouachita Mountain region," said Blackwell. "Right now we don't have the data to fill in the area in between," Blackwell continued, "but it's possible we could see similar results over an even larger area."

Blackwell thinks the finding opens exciting possibilities for the region. "The proximity of West Virginia's large geothermal resource to east coast population centers has the potential to enhance U.S. energy security, reduce CO2 emissions, and develop high paying clean energy jobs in West Virginia," he said.

SMU's Geothermal Laboratory conducted this research through funding provided by Google.org's RE

More information: Read the related scientific paper.

Provided by Southern Methodist University