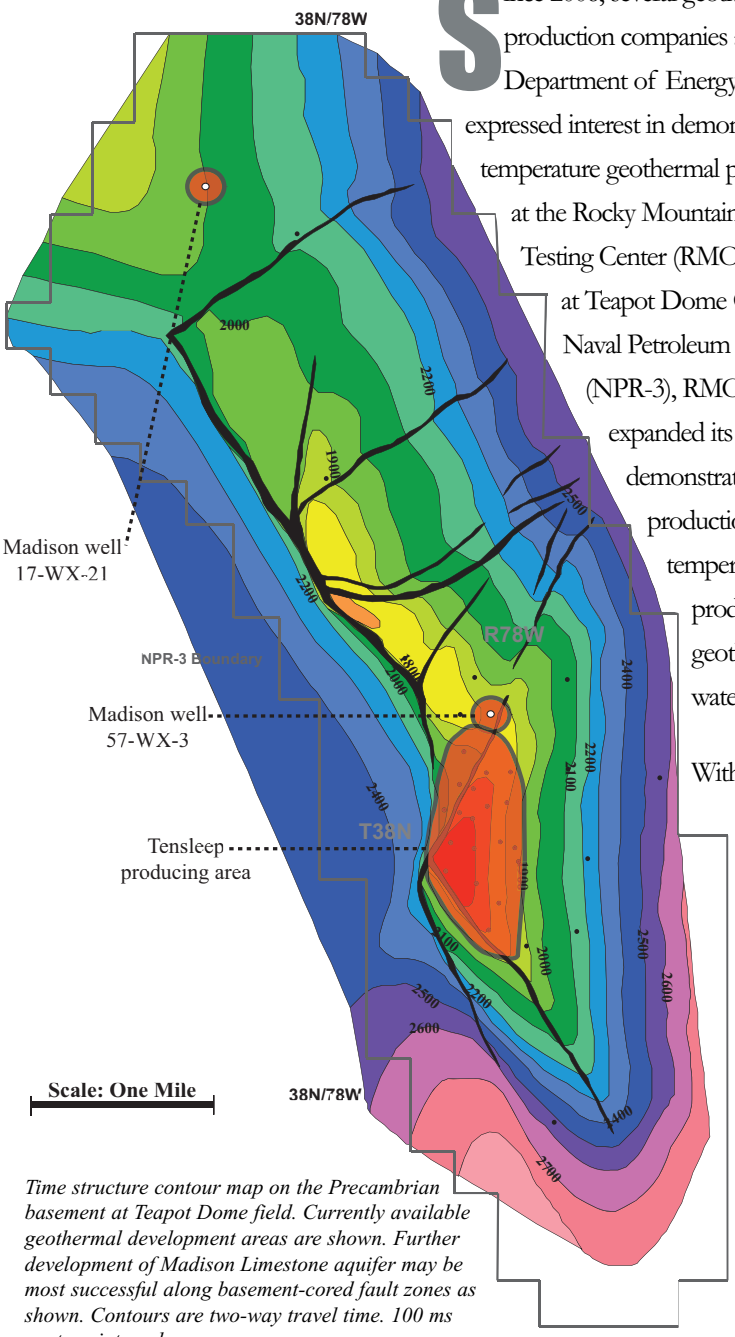
GEOTHERMAL TESTING



Time structure contour map on the Precambrian basement at Teapot Dome field. Currently available geothermal development areas are shown. Further development of Madison Limestone aquifer may be most successful along basement-cored fault zones as shown. Contours are two-way travel time. 100 ms contour interval.

Since 2006, several geothermal power production companies and the Department of Energy have expressed interest in demonstrating low-temperature geothermal power projects at the Rocky Mountain Oilfield Testing Center (RMOTC). Located at Teapot Dome Oilfield in Naval Petroleum Reserve No. 3 (NPR-3), RMOTC recently expanded its testing and demonstration of power production from low-temperature, co-produced oilfield geothermal waste water.

With over 1,000 existing well-bores and its 10,000-acre oil field, RMOTC offers partners the unique opportunity to test their geothermal technologies while using existing oilfield infrastructure.

RMOTC's current low-temperature geothermal project uses 198°F water separated from Tensleep Formation oil found at depths of about 5,200 feet. Previously, like all oil fields in Wyoming, when NPR-3's produced water was disposed of, all heat energy value was lost.

An abundance of relatively fresh, hot water (180°-200°F) is produced in association with the Pennsylvanian Tensleep oil. Prior to surface discharge, the water is cooled to about 70°F. Water supply wells drilled to the underlying Mississippian Madison Limestone Formation have yielded rates exceeding 20,000 BWPD on flow at formation temperatures projected to be about 230°F.

Artesian flow of the NPR-3 geothermal system is the result of forced convection of hot water at great depth recharged in the Big Horn Range located 90 miles to the northwest. The Big Horn recharge area represents a hydraulic head of about 4,000 vertical feet above the NPR-3 surface.

Pumping in the Madison Formation could increase water production rates by a factor of two to four. Fractured Precambrian basement granitic rocks at depths of 7,000 feet and more may yield substantially larger volumes of water at temperatures exceeding 250°F.

Further development of the geothermal resource may result in production of deeper and hotter aquifer rocks below the oil-producing zones. The geothermal gradient of 30°F per 1,000 feet of depth at NPR-3 is significantly higher than the average for the nearby geologic region.

Teapot Dome's geological structure is a typical north-west-trending Laramide asymmetrical drape fold, bounded on the west by a basement-involved blind thrust fault. Commercial oil production occurred in the early 1920s for a brief period, followed by a long shut-in period. NPR-3 was opened to full field development in 1976.

Contact

For more information about these opportunities or to discuss your testing needs, contact RMOTC toll-free at 888.599.2200, or visit the website at www.rmotc.doe.gov.

Office of Fossil Energy

Potential for accelerating geothermal energy development using oilfield infrastructure

With the existing geologic structure at RMOTC, promising potential exists for Enhanced Geothermal Testing (EGS). The field also has two reliable water resources for supporting low-temperature geothermal testing. RMOTC can support multiple field-scale geothermal testing and demonstration and has the capability to provide project management off site.

Enhanced Geothermal Systems (EGS)

RESOURCES, CAPABILITIES, AND POTENTIAL

- The top of the granite basement rock is at a depth of approximately 7,000 feet.
- The temperature in the granite at 9,000 feet is an estimated 300°F. This is sufficient for geothermal testing but requires validation. The temperature estimate assumes the abnormal geothermal gradient that exists in the Tensleep and Madison formations continues to this depth.
- RMOTC has the infrastructure and experience to conduct testing with commercial clients' developing projects.
- EGS testing potential includes the drilling and completion of geothermal wells; stimulation of the hot rock; and testing of EGS systems of injection and production. The test of CO2 as an EGS fluid could also be done.

Low-temperature geothermal application

TENSLEEP FORMATION

- The Tensleep Battery has up to 60,000 barrels per day (bpd) of hot water available. Temperature at the produced water tank is about 195°F. The treatment ponds at the battery are permitted for up to 75,000 bpd. The infrastructure required for testing currently exists at RMOTC.
- A low-temperature geothermal project using a 250-kW Organic Rankine Cycle unit is underway at RMOTC and is scheduled to continue through 2011.
- A second unit of the same size and at the same location would provide for side-by-side comparison. Using the current configuration, the comparison would last for about 2-3 years.

MADISON FORMATION

- Madison well 17-WX-21 is a flowing well producing 20,000 to 25,000 bpd of about 210°F water. This rate needs to be evaluated. The potential exists to increase the water volume by installing an electric submersible pump (ESP).
- Madison well 57-WX-3 is a flowing well producing about 6,000 bpd with potential for more.
- The Madison and Tensleep formations are identified in the site-wide Environmental Assessment (EA)as potential geothermal demonstration sites.
- The infrastructure to support low-temperature geothermal testing around 17-WX-21 exists: a supply well; a hot water tank; a building; and easy access to the electrical grid.
- The building at 17-WX-21 could contain three smaller (up to 50 KW) units for side-by-side comparison testing. The flowing hot water supply is marginal to operate three 50kW systems at the same time.
- Most of the geothermal units require water cooling. The use of Little Teapot Creek water for cooling is being considered for a project that is presently in the planning stage.

RMOTC

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