geoconvention
Virtual Event
September 21-23
2020
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Subsurface Characterization Methods For Multilateral Closed Loop Geothermal Systems. Case Study of Field Scale Technology Demonstration Project in Alberta, Canada.

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Summary

The production of heat and electricity from geothermal energy is an old concept and has been around since the early 1900's. However, many geothermal projects are plagued by high up-front exploration costs and have financing difficulty because of the geological risk, namely low permeability, and many do not make it past the exploration phase.

The concept of producing geothermal energy from true multilateral closed loop systems, whereby there is zero interaction with the formation, seeks to solve the problem of permeability risk.

True closed loop systems extract heat through the process of conduction which has challenges such as limited conductive heat transfer through rock and high drilling costs of multilateral wells. Eavor has designed and successfully executed a system to address these issues through the drilling of long, closed loop multilateral wells in sedimentary basins. This system can produce heat and power at temperatures up to 180 degrees Celsius.

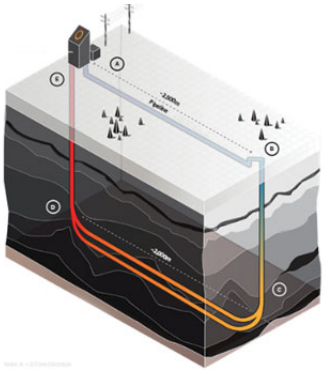

Figure 1: Schematic of Eavor Lite Pilot

This paper demonstrates; standard geological and geophysical work flows for oil and gas prospecting can be applied in closed loop geothermal settings for the determination of geothermal gradient, rock characterization and for field scale validation of thermal conductivity.

The Jurassic sands of the Rock Creek Member of the Fernie Group were targeted for the purpose of heat harvesting through a multilateral closed loop system. The Rock Creek is an active hydrocarbon resource play northwest of the Technology Demonstration Project (TDP) and is characterized as a nearshore marine sand in the vicinity of the TDP.[1]

Methods, Procedure, Process

[1] Losert, J., (1986). Jurassic Rock Creek Member in the Subsurface Edson Area (West-Central Alberta), Alberta Research Council Open File Report 1986-3, 39 p.

Subsurface characterization involves a multidisciplinary approach of stratigraphic correlation, structural mapping, determination of heat gradient and rock petrophysics. Many sedimentary basins are highly explored for oil and gas, CO2 sequestration, geothermal and mining applications. Therefore, data is readily available for analysis. The following chart illustrates a

typical workflow when prospecting.

Results, Observations, Conclusions

1. Expected results from the technology demonstration project include
    - Formation temperature of 75 degrees C,
    - Rock conductivity of 3.5 W/mK
    - Porosity of 6% (no perm data will be collected)
    - Annualized thermal output of 800 KWth.
2. Observations will include
    - Pre spud predictions of thermal conductivity using mineralogy can reduce thermal output risk.
3. Conclusions
    - Multi lateral closed loop systems reduce permeability risk because subsurface characterization can be performed using data available in many sedimentary basins and does not rely on the presence of high flow capacity reservoirs.
    - Oil and gas workflows are highly applicable for the generation of geothermal prospects
    - Multilateral closed loop systems are complementary to existing geothermal schemes because target zones are in sedimentary rocks with low flow capacities

Novel/Additive Information

- Implications for reduction in exploration costs and the overall bankability of early stage geothermal projects
- Field scale measurement of thermal output using a conductive heat transfer mechanism in sedimentary rock within a closed-loop multilateral system

Acknowledgements

The author would like to acknowledge the following: Chinook Consulting (Well-site, geo-steering), AGAT labs (triaxial testing, petrography), Petrel Robertson (3D seismic interpretation) and Enlighten Geosciences (rock mechanics) for their technical contributions to the success of the Eavor Lite pilot.