Progress at the Paralana EGS Project in South Australia

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The Paralana EGS Project, located 600km north of the city of Adelaide in South Australia, provides a natural laboratory for the development of an Engineered Geothermal System (Figure 1). Anomalously high heat production basement rocks provide the local heat source and are overlain by a thick sedimentary package, informally termed the Poontana Basin (Figure 2), within a favourable in situ stress regime. Early exploration drilling indicates an elevated geothermal gradient and heat flow at the project site. Petratherm Limited, in joint venture with a major oil and gas (Beach Petroleum) and power industry energy utility (TRUenergy), are initially seeking to build a 3.75 - 7.5 MWe commercial power development to supply a local mine.

A local microseismic monitoring network has been deployed to record background seismicity prior to drilling of the first deep well into the resource, which commenced drilling on the 30th June 2009. An innovative strategy for development of the EGS reservoir is planned, involving massive hydraulic stimulation of multiple target zones within the sedimentary overburden. This paper will provide a technical update on progress at the Paralana EGS site.

Keywords: Geothermal, Stimulation, Drilling, Micro seismic monitoring.

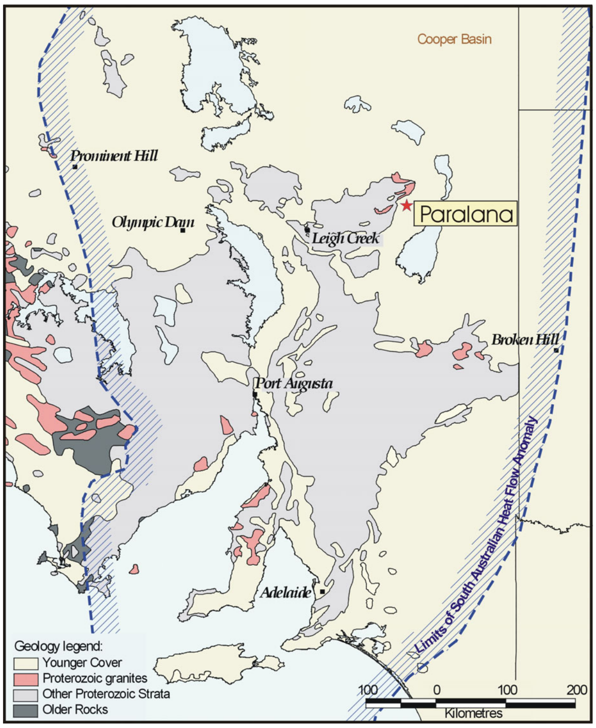

Figure 1: Regional Locality Map and extent of SAHFA (SAHFA modified from Neumann *et. al* . 2000)

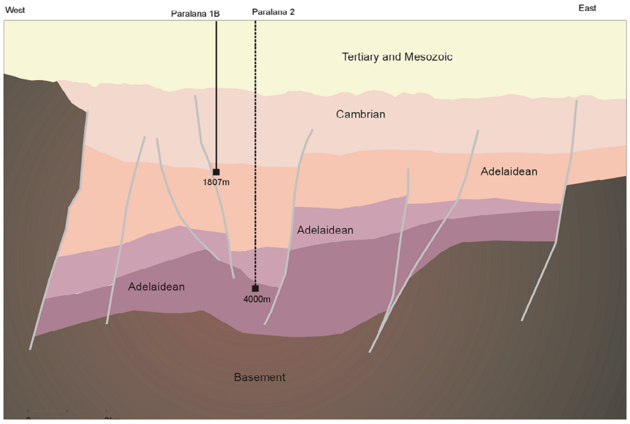

Figure 2: Cross-section of the informally termed Poontana Basin

Heat exchanger development plan – the HEWI model

One of the principal limiting factors in commercialising EGS has been the inability to manufacture a heat exchanger of sufficient size and fluid production rate. Existing technical difficulties in achieving a robust sub-surface heat exchanger in EGS applications generally relate to the practice of developing the sub-surface heat exchanger within the heat producing granite rock. Granite is by nature an impermeable and mechanically strong rock. As a result it is inherently difficult for fluid to flow through granite, or to mechanically fracture the rock to develop an effective reservoir artificially. By comparison, the rocks which make up the overlying insulating sediments tend to have greater naturally occurring porosity and permeability, are mechanically weaker, and more susceptible to induced chemical and mechanical stimulation if enhancement of the reservoir is required.

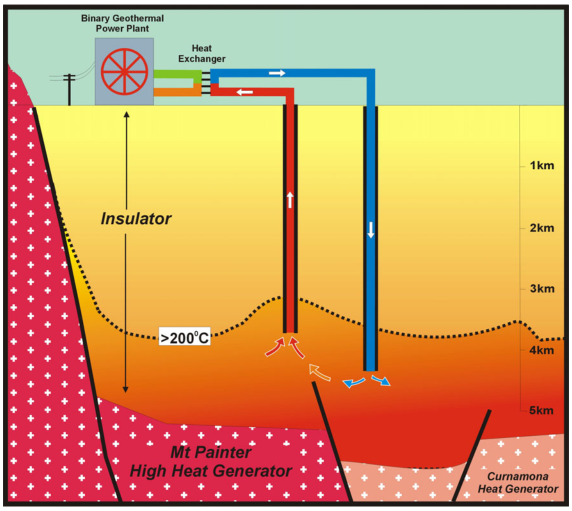

Figure 3: Schematic diagram demonstrating the basic concept of an Enhanced Geothermal System using the HEWI (Heat Exchanger Within Insulator) model

The Heat Exchanger Within Insulator (HEWI) model (Figure 3) aims to exploit naturally permeable and porous insulating sedimentary rocks above the granite heat source. Where intrinsic permeability is inadequate, the HEWI approach will deliver greater control over the reservoir development through the hydraulic stimulation of these units. This strategy more closely approximates the systems successfully used in petroleum reservoirs and conventional geothermal projects. This enables the application of techniques for stimulation and geochemical mitigation developed in these industries.

Multi-Zone Stimulation

Historical hydraulic fracture stimulations have generally been single massive stimulations in an open hole. The limitation of this method is that the operator has minimal control over the location and distribution of the developing fracture network, with most fractures propagating at the base of the casing shoe near the top of the open hole section. The inability to selectively initiate propagation of fractures in the remaining open hole section means the development of the heat exchanger has been severely compromised.

Given that the development of a complex, thick, interconnected fracture network is the optimal configuration for the engineered reservoir, it follows that undertaking multiple stimulation operations initiated at different levels in the well could achieve the desired outcome. Such an operation would enable greater control; both in terms of the location of initiation of fracturing in the well bore, and the potential to develop stacked multiple fracture horizons within suitable single or multiple geological units.

Drilling Status

In 2007 Petratherm established a joint venture with Beach Petroleum who elected, under the terms of the Joint Operating Agreement, to "operate" the drilling and stimulation of the Paralana #2 well. This was designed as an injection well, allowing drilling comfortably within current technical limits. Selection of a rig capable of drilling to the target 4000m depth and handling the casing strings of the well design demanded a 2000 HP rig and the joint venture contracted Weatherford Drilling International to provide a new-build rig. Rig delivery was delayed by manufacturing capacity and subsequently by Hurricane Ike's effects on the US Gulf. Manufacturing was transferred to Dubai and the rig was delivered to site in May 2009 Rig-up and final certification allowed spud on the 30th June 2009 (the time of writing this abstract).

Figure 4: WDI Rig #828 at Paralana #2 Location

The well is designed as an injection well, with an 18-5/8" x 13-3/8" x 9-5/8" x 7" casing programme. A 20-3/4"-3k x 13-5/8"-5k x 11'-10k wellhead assembly will be installed with an 11"-10k x 7-1/16-10k adaptor-seal flange allowing installation of a full-bore 7-16"-10k valve for stimulation and later installation of a 4-16" xmas tree. All casing annulus seals are RCS metal-to-metal with preliminary elastomer seals in the slip and seal assemblies.

Figure 5: Paralana #2 Wellhead at Wood Group Warehouse after inspection

Drilling is planned to take approximately four months and will be followed with logging of the 8-1/2” section and casing. The 7” casing will be set to total depth and cemented to surface. Preliminary reservoir modelling and well log results will be used to identify the units to stimulate and to develop final plans for the stimulation programme.

A local microseismic monitoring network deployed in late 2008 to record background seismicity prior to drilling was augmented in October 2009 with additional sondes placed in deeper boreholes to provide the planned level of monitoring and data acquisition for the stimulation programme.

Stimulation of the Paralana #2 well is expected to commence later in 2009.

TRUenergy joined the joint venture in 2008 and will provide power generation, transmission and marketing resources to the project’s development.

References

Neumann, N., Sandiford, M., & Foden, J. (2000) Regional geochemistry and continental heat flow: implications for the origin of the South Australian Heat Flow anomaly. Earth and Planetary Science Letters, 183, 107-120.