Australia's first hot dry rock geothermal energy extraction project is up and running in granite beneath the Cooper Basin, NE South Australia.

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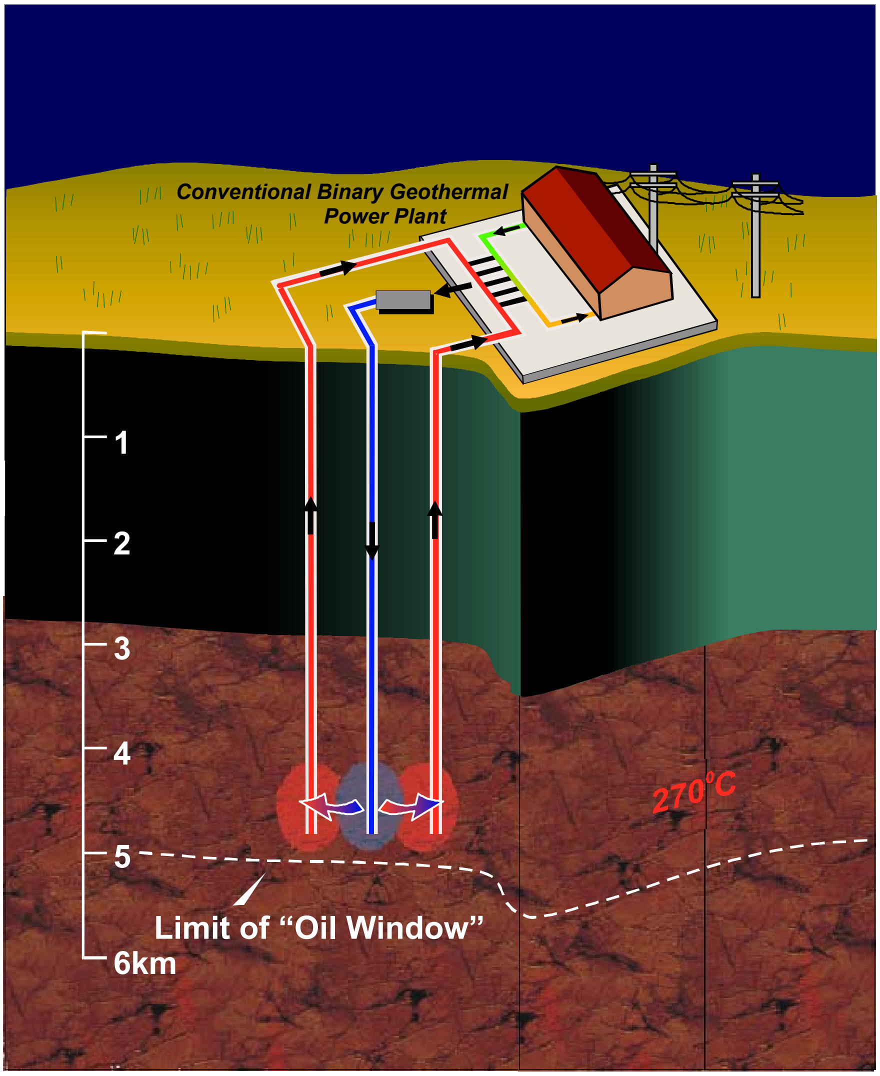
Australia's deepest onshore well, Habanero 1, is currently being drilled into hot granite in the basement to the late Carboniferous to Permian Cooper Basin in NE South Australia. The total depth of the well is programmed at 4900m approximately 1200m into the granite. The well is being drilled by Geodynamics Limited to extract heat from the rock to generate renewable electricity without greenhouse gas emissions. Evidence from existing Cooper Basin gas exploration wells that have drilled into the basement in the area, plus seismic and gravity data indicate that granite underlies the deepest part of the Basin over an area of approximately 1000 km^2.

Economic models have been developed based on the cost of developing the project, running costs, amount of energy extracted and efficiency of electricity generation. A demonstration plant consists of a continuously circulating system of one injection well and two production wells spaced 500m apart. For such a system, circulating at 100 litre/second and producing at 245°C, the break-even electricity cost is modeled to be 6.2 cents per kWh, considerably cheaper than current wind power costs and equal to the cost of large scale hydro-power generation. For large-scale production involving drilling 37 wells over an area of 6.25 km^2, and producing 275 MWe, the cost is close to 4 cents per kWh. This is approximately the same cost as current new-entry coal-fired generation. The electricity generated from these developments would attract green incentives known as Renewable Energy Certificates (REC's), which are likely to be valued at around 4 cents per kWh. The 275 MWe plant could effectively generate power at zero cost, and, at a sale price of 4 cents per kWh the plant would generate revenue of $96 million per year. Geodynamics Limited has raised $20 million to prove the energy extraction process based on these attractive economic analyses.

The temperature at the top of the granite, at 3700m depth, is approximately 240ºC. The temperature gradient in the granite is expected to increase the rock temperature by ~3ºC for every 100m into the granite. The high temperatures at these depths relate to a number of independent geological conditions coinciding in the area:

(1) the presence of low conductivity sediments overlying the granite,
(2) the optimal thickness of these sediments which allows access to hot rock without needing to resort to the expensive drilling equipment required for drilling beyond 5km depth,
(3) a granite chemistry containing relatively high abundances of radiogenic elements giving high heat productivity (high heat production or HHP granite),
(4) the previous unroofing of the Palaeozoic granite which resulted in brittle unloading features, and
(5) the existence of high tectonic stresses in the sediments and granite leading to low fluid permeability, conductive heat flow and minimised heat loss by convection



Heat extraction from granite benefits from the large volumes of relatively homogeneous rock and the presence of interconnected joint sets caused by cooling and unloading.

Evidence from drilling into the granite so far, including information from offset wells, indicates that the granite is a medium to coarse grained, reduced granite with relatively high abundances of radiogenic elements. The heat generation capacity, based on these abundances, is in the range 7-10 watts/m^3, around 3 times higher than typical granite. The granite was originally a two-mica granite with accessory tourmaline, but it has suffered from extensive burial metamorphism since being covered by the sedimentary blanket. Effectively all the biotite has been altered to chlorite, and plagioclase has been altered to albite+calcite+hydrated Ca-silicates. Widespread alaskite dykes and irregular bodies invade the coarser grained normal granite. The granite was previously dated using zircons as Carboniferous, but new monazite dating to be carried out in this project is expected to provide a better age estimate.

Evidence from borehole imaging logs indicate that sub-horizontal joints and fractures dominate the fracture systems in the granite. These fractures are expected to make ideal pathways for fluid flow and heat extraction. In an operation known as hydraulic stimulation the fluid permeability of these fractures is increased by pumping water into the fractures at high pressure. This enhanced fluid pressure causes optimally oriented fractures to exceed the critical state for slip. The resulting micro-earthquakes are mapped with an acoustic monitoring network. For the current project, a network of 4 shallow, 3 moderate depth, and one deep well has been constructed. Mapping of micro-earthquake hypocenters with this network will then provide the basis for positioning the production wells. Similar projects overseas have shown that following slip, the permeability of a granite joint is enhanced by many orders of magnitude.

The hydraulic stimulation of Habanero 1, the positioning and drilling of the Habanero 2 production well, and the conduction of a circulation test between two wells is expected to be carried out over the next 12-18 months as a "Demonstration of Economic Heat Extraction" of Australia's unique geothermal resources.