

## Geothermal Exploration License 98 Annual Report for 2003

### Introduction

GEL 98 was granted to Geodynamics Limited on 2nd October 2001. The first years work program resulted in fixing the location of Habanero 1, the first deep geothermal well to be drilled in Australia. In the second year's program up to 1 October 2003, Habanero 1 was completed along with the ancillary activities such as development of the acoustic monitoring network and provision of water supply.

### Brief history of Habanero 1 well.

The well was spudded at 8AM on 15 February 2003 using Century Rig 27. The rig was released on 14 October at a total depth of 14,504 ft. The main components of the well history are as follows:

<b>Event</b>	<b>Day</b>	<b>Depth (ft)</b>
Spud 17 ½ inch hole	15 Feb	0
Cement 13 3/8 inch casing	18 Feb	933
Drilling ahead 12 ¼ inch hole	20 Feb	933
Completed 12 ¼ inch section	10 March	7,404
Cement 9 5/8 inch casing	11 March	7,382
Drilling ahead 8 ½ inch hole	13 March	7,382
Reached granite basement	18 April	12,034
Completed 8 ½ inch section	29 April	13,615
Cement 7 inch casing	6 May	13,566
Drilling ahead with 6 inch hole	9 May	13,566
Lost cones from bit	11 May	13,809
Influx requiring high mud weight to kill well	12 May	13,810
Loss of 425 bbls of 11.8 ppg mud	13 May	13,810
Rig placed on stand-by for pressure control equipment	19 May	13,810
Rig back in operation	2 July	13,810
Drill string parted at 10,135ft	14 July	13,810
Fish below 10,135ft retrieved	21 July	13,810
Drilling recommences with 15.2 ppg mud	27 July	13,810
Influx of 50 bbls of water requires killing	2 August	14,170
Losses of 150-200 bbls during kill procedures with 15.9 ppg mud	3 August	14,170
Attempt to kill well with 15.6 ppg mud, losses of 265 bbls before drill string plugged with LCM	6 August	14,170
Bullhead well with 15.6 ppg mud at 200 psi above wellhead pressure of 3,500 psi. Well killed	1 Sept.	14,170
Drill pipe stuck at 14,039 ft	8 Sept.	14,170
Pipe free from mechanical stick	11 Sept.	14,170

Drilling ahead	14 Sept.	14,170
Drilling completed at 14,504 ft	17 Sept.	14,504
Set 4½ inch tubing into casing packer at 10,200 ft, packer leaking	26 Sept.	14,504
Site under suspension awaiting second casing packer	2 Oct.	14,504
Rig back in operation	10 Oct.	14,504
Set 4½ inch tubing into second casing packer at 10,142 ft	12 Oct.	14,504
Rig release	14 Oct.	14,504

Almost all of the trouble that was had in the well was related to overpressures in the granite fracture system encountered in the 6 inch hole section.

### Acoustic Monitoring network

The monitoring network was designed to be centrally symmetrical around Habanero 1. There are 8 wells in the network as shown in figure 1. The wells are:

- 1/ McLeod 1; abandoned Santos gas exploration well drilled in 1983.
- 2/ MW1-3: wells approximately 2 km from Habanero 1, drilled to 850m depth.
- 3/ WA1-4: wells approximately 5 km from Habanero 1, drilled to 100m depth.

The locations of the wells are shown in the following table, including Darby's Bore a water bore not used for acoustic monitoring. Locations are based on differential GPs readings carried out by Dynamic Satellite Surveys. Accuracy in 3 dimensions is within 100mm, and in one dimension 50mm.

Well	MGA Easting	MGA Northing	AHD71 Elev. (m)	GDA94 Latitude	GDA Longitude
Habanero 1*	475808	6923179	65	-27.8158	140.7546
Darby's Bore	475914.37	6922585.00	57.89	-27.82115460	140.75543744
McLeod #1	476234.96	6923290.82	66.44	-27.81478859	140.75870674
MW1	475830.04	6925012.95	51.99	-27.79923486	140.75463047
MW2	474590.39	6921573.63	52.71	-27.83026026	140.74197245
MW3	477176.21	6921733.91	66.70	-27.82885987	140.76823367
WA1	472223.08	6926492.68	49.42	-27.78580679	140.71804801
WA2	470961.38	6922491.03	47.25	-27.82190471	140.70514365
WA3	475553.02	6918268.10	60.33	-27.86011857	140.75167968
WA4	479055.00	6926945.20	74.79	-27.78184571	140.78740344

\* location using hand held GPS only

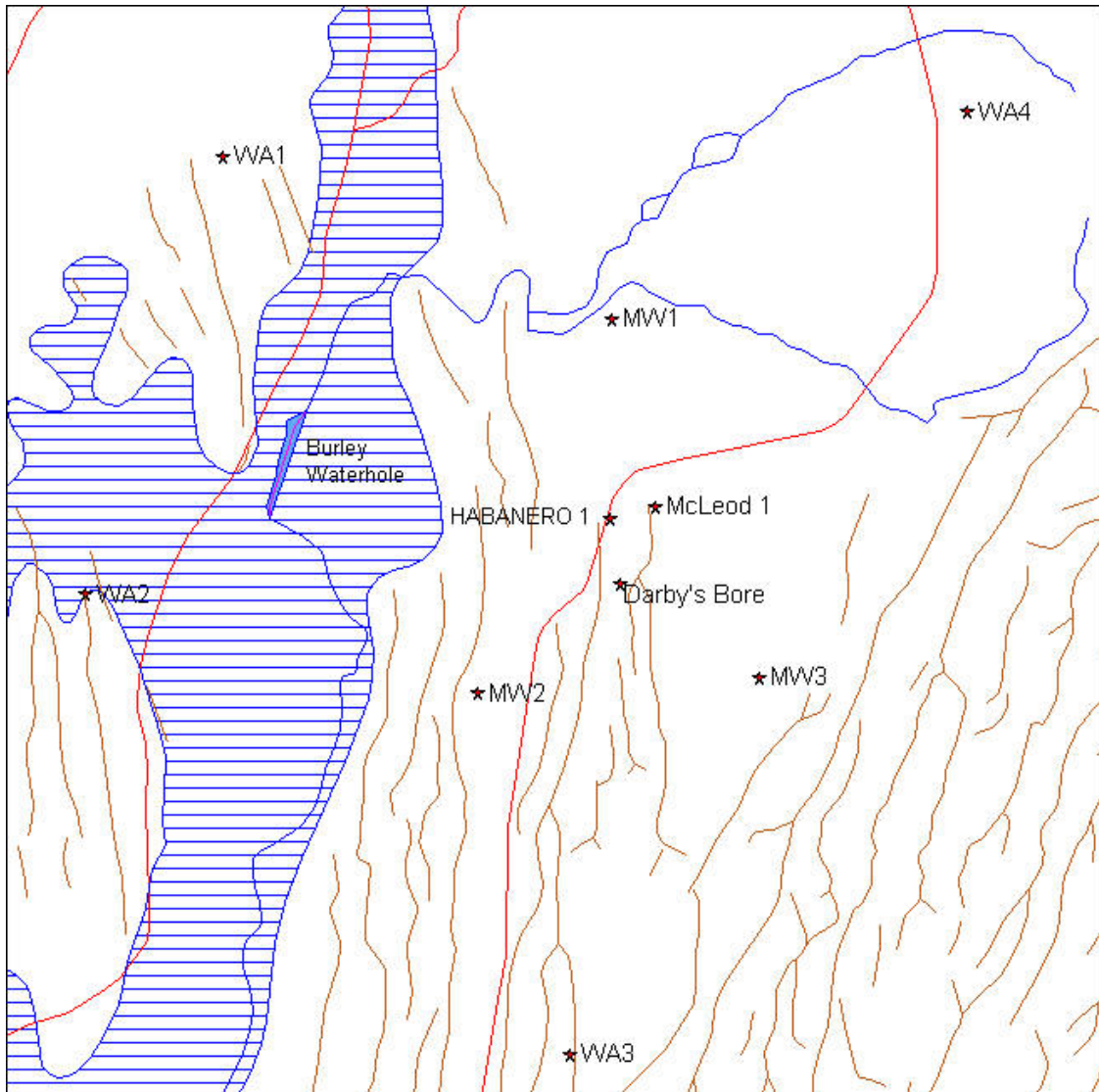


Figure 1. Location of Habanero 1 and acoustic monitoring wells. The MW wells are 2km from Habanero 1, and the WA wells are 5 km from Habanero 1. Innamincka is 8 km NNW of Habanero 1, just beyond the top of the figure.

The WA wells were drilled by Seisdrill in February-March 2003, and acoustic monitoring sensors deployed and tested in March (see appendix 1: attached report on deployment). The sensors (Figure 2) were manufactured by the Central Research Institute of the Electric Power Industry of Japan (CRIEPI). They contain a 3-axis geophone array, with each geophone having a sensitivity of 1.6 volts/cm/second. The sensors are similar to ones used at the Ogachi Hot Dry Rock test site operated by CRIEPI. CRIEPI is supporting our project as a continuation of HDR activity for the Institute after the Ogachi site was closed in 2002. Once the sensors had been tested the amplifiers at the wellhead were removed and stored at Habanero 1 until the time of the hydraulic stimulation.



Figure 2. CRIEPI 3-component acoustic emission sensors deployed in WA network.

The MW wells were drilled by Condamine Drilling Pty Ltd in March and April 2003. Each well was drilled to 850m so as not to intersect the underlying Mackunda Formation. The top 60m covering the Lake Eyre Basin sediments were cased with 7 inch steel casing. The acoustic monitoring sensors were built by Auslog of Brisbane (Figure 3), and deployed as each well was drilled. Each sensor contains a triaxial array of six geophone elements (2 for each direction). The geophone elements are Geospace, model GS-20DX, with sensitivity of 0.346 volts/cm/sec. As two geophone elements are wired in series, the total sensitivity is 0.692 volts/cm/sec. Amplification using 12 volt power supply was initially trialed at the Habanero 1, but was later installed at the wellheads. Gain of up to 10,000 is available from the amplifiers.

The Auslog sensors were deployed on Baker Atlas 7 conductor cable (figure 4).



Figure 3. Sensors built by Auslog for MW wells.



Figure 4 . Deployment of MW well sensor using Baker Atlas.

## Operations in McLeod 1 well

1/ Santos abandonment and perforation for water.

McLeod was to be used as a dual purpose well, for accessing the Great Artesian Basin for water supply, and to be used as a deep monitoring well in the acoustic monitoring network. The well contained a tubing completion that had to be removed and the bottom of the well abandoned by cementing up to a depth of 8184 ft (2494m). This operation was carried out by Santos in February 2003. In early March 2003 the Namur Sandstone was perforated using Baker Atlas 4½ inch predator guns at 5 SPF. Four 10 ft intervals were perforated:

5880-5890 ft

5976-5986 ft

5986-5996 ft

6026-6036 ft

The operation was carried out by Santos. Unfortunately water did not flow, for a number of possible reasons:

1/ perforation through two strings of casing

2/ thick section of cement due to washout of sandstone during drilling

3/ debris reduces permeability around perforation hole

It is possible that water could be obtained by swabbing the well, but the 5 inch well head does not allow access of 6 inch swabbing cups. The shut-in wellhead pressure is approximately 50 psi, a figure expected for the aquifer.

2/ Deployment of acoustic monitoring sonde.

In August 2003 a high temperature 3-axis sensor was deployed to a depth of 7520 ft (2292m) on 7 conductor Baker Atlas cable (Figure 5). The tool is the property of Tohoku University, Japan. It was originally built with funds from the Japanese Government for deployment in the Hijiori Hot Dry Rock test site, where it performed for several years. The tool then belonged to NEDO (New Energy and Industrial Development Organisation), and was donated to Tohoku University after the Hijiori project was terminated. The tool was refurbished by Japex to withstand the pressure and temperature (150°C) in McLeod at 2300m depth.

The tool contains 3 Geospace high temperature (200°C) HS-1 geophone elements (sensitivity 0.453 volts/cm/sec) and high temperature pre-amplification with 10,000 gain. The tool is deployed in cased hole with a motor-driven locking arm. Its signal was confirmed by striking the casing at the wellhead.

All monitoring tools were connected to a seismic monitoring shack at Habanero 1 with shielded 6 conductor surface cables kindly donated by CRIEPI. These cables came in 200m lengths with male and female couplings at each end.

By the end of September 2003 the monitoring network was completely installed and ready for the commencement of hydraulic stimulation in Habanero 1.



Figure 5. Deployment of NEDO acoustic monitoring sensor in McLeod 1 well on 24 August 2003. The housing for the locking arm is visible just above the centre of the tool.

### **Water supply**

The failure of the McLeod well to provide water provided a dilemma. Fortunately Coopers Creek was flowing strongly at the time, so permission was granted to collect up to 80,000 cubic metres of water from the Creek while it was flowing

over the causeway at Innamincka. As an intermediate storage facility, the water was pumped 6 km to Burley Waterhole (Figure 6). From here it will be pumped 3 km to the Habanero 1 well site (see also figure 1). The pipeline route for the water supply was examined by an Aboriginal Heritage Clearance survey in March 2003, and a further survey in June 2003. The June 2003 survey resulted in a slight change of route from Burley Waterhole to Habanero 1 that avoided crossing a number of sand ridges.



Figure 6. Water stored in Burley Waterhole. View looking north towards Cooper Creek. The Strezlecki Track is on the left side of the picture.

## Reporting Against Requirements of the Petroleum Act 2000

### ***(a) Summary of the regulated activities conducted under the licence during the year***

The regulated activities for the year are set out below:

Activity	Site	Timing
Drilling	Habanero 1	Feb-October
Logging	Habanero 1	1-2 May
Logging	Habanero 1	12 July
Logging	Habanero 1	19-21 September
Drilling and access	WA1 to WA4	Feb-March
Drilling and access	MW1 to MW3	March-April
Surface disturbance	Site for pumping from Cooper Creek and Burley Waterhole	May-Oct
Surface disturbance	Pipeline from Cooper Creek	May-Oct

### ***(b) Report for the year on compliance with the Act, these regulations, the licence and any relevant statement of environmental objectives***

Habanero 1 Well Notification and Bridging document was submitted to PIRSA on the 10th January 2003. Conditional Approval to drill was granted on the 21st January 2003.

A Prespud meeting was held at Innamincka on the 12 February 2003. A HAZOP was also conducted on the 13 February 2003.

The Cooper Creek/Burley Waterhole water abstraction and Pipeline Construction and operation SEO was submitted on 31 March 2003.

Geodynamics, as a new and junior operator, has been classified as high supervision by the Department. Notices of non-compliance with the Petroleum Act 2000 were received on two occasions relating to inspections of our field operations. One was received on 16 June. It required action to clean up the sites at completed monitoring wells, including fencing off mud pits not yet rehabilitated, and to provide a higher standard of bunding around a fuel tank at the Coopers Creek pump site. The second notice was received on 2 Sept. With regard to GEL98, it related to some small deficiencies in the cleanup of the monitoring wells, and the late arrival of daily drilling reports. In all cases Geodynamics acted very quickly to make sure that the concerns were alleviated.

The Annual Report was not completed within 2 months after the end of the license year as laid down by Regulation 33, and some logging information was also not received within the 2 month period from the date of logging.

***(c) Actions to rectify non-compliance with obligations imposed by the Act, these regulations or the licence, and to minimise the likelihood of the recurrence of any such non-compliance; and (d) a summary of any management system audits undertaken during the relevant licence year, including information on any failure or deficiency identified by the audit and any corrective action that has, or will be, taken.***

Geodynamics is putting into effect significant changes to its management system for undertaking activities under the Petroleum Act. The company has employed a Manager of Logistics and Compliance whose role will be to specifically track our activities under the Act and ensure that we comply with all Regulations. Computer based tracking systems are being implemented.

***(e) List all reports and data relevant to the operation of the Act during the relevant licence year.***

Report	Date
Habanero 1 Well Notification and Bridging document	10 January
Cooper Creek/Burley Waterhole water abstraction and Pipeline Construction and operation SEO	31 March
Daily drilling reports	Daily from 15 February to 1 October
Wireline logging report CBIL/GR/DSL/TTRm 4CAL/GR/TTRm	1 May
Wireline logging report SBT/CCL/GR	13 July
Habanero 1 Stimulation Programme (Stim. 1&2) Process Hazard review	17 September
Wireline logging report CBL/GA/TTRm	19 september

***(f) Report of incidents reportable to the Minister under the Act and regulations***

Prior to Geodynamics accepting control of the Century Rig 27 at Habanero 1, there were two reportable accidents listed in the table below.

Date	Name	Incident	Notifiable PIRSA	Notifiable DAIS
27-Jan-03	Sreve Harris	H2S Exposure	Yes	Yes
28-Jan-03	Martin Whitu	Fractured Legs	Yes	Yes

***(g) Report on any reasonably foreseeable threats that reasonably present, or may present, a hazard to facilities or activities under the licence, and a report on any corrective action that has, or will be, taken.***

The overpressures in the granite fracture network will mean that a wellhead monitoring and maintenance program will have to be implemented for the longer term.

***(h) Operations proposed for the ensuing year***

The extent of trouble drilling Habanero 1 as a consequence of the discovery of high overpressures in the fracture network in the granite has delayed our stage 1 program. The hydraulic stimulation of the open hole section of the well has been completed at the time of writing, and has been a major success. The overpressures hindering drilling the first well, combined with the overthrust stress field, have meant that subhorizontal fractures have been naturally slipped in geological time. These major fractures are already highly permeable

Attempts to stimulate a higher zone (stimulation number 2) are currently being attempted. In any case the first stimulation zone is much larger than expected, so the planning of the second (production) well is in full progress. It is intended to commence this well in approximately April 2004.

**Expenditure for year 2**

Commercial in Confidence