Geoscience Australia's Onshore Energy Security Program: progress by the Geothermal Energy Project

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Abstract

Geoscience Australia's $58.9M 5-year Onshore Energy Security Program began in 2006 and includes a new Geothermal Energy Project.

The project aims to assist the development of a geothermal industry in Australia by: providing precompetitive geoscience information, including acquisition of new data; informing the public and government about Australia's geothermal potential; providing technical advice to government; and partnering with industry in international promotional events for the purpose of attracting investment.

This abstract gives a brief summation of activities undertaken by Geoscience Australia within the Onshore Energy Security Program, principally those of the Geothermal Energy Project.

Keywords: data acquisition, modelling, Geothermal Play Systems

The Geothermal Energy Project

Following consultation with industry and State and Northern Territory geological surveys, a number of activities were identified where GA could either fill gaps where no other organisation was able to fulfil, or could complement activities by other partners.

Advice to government

Geoscience Australia (GA) is a prescribed agency within the Department of Resources, Energy and Tourism. GA provides advice to government on geoscience-related matters, including resources. GA participated in the development of the Geothermal Industry Development Framework and Geothermal Industry Technology Roadmap. GA was involved in the program design and subsequent technical assessment of the Geothermal Drilling Program. GA co-authored (with ABARE) the geothermal chapter of the Australian Energy Resource Assessment. GA has been involved in the development of the Australian Code for Reporting of Exploration Results, Geothermal Resources and Geothermal Reserves, and sits on the Joint AGEA-AGEG Code Committee for the purpose of one day compiling and reporting geothermal resource and reserve estimates in the same way as is done for mineral and oil & gas commodities.

OZTEMP

GA has released OZTEMP, an updated dataset and map of predicted temperatures at 5 km depth, available from the project's webpage (www.ga.gov.au/minerals/research/national/geothermal). Extensive QA/QC was conducted on the dataset of bottom hole temperatures, and where available new data was included. For the map, the OZSeeBase dataset was used (FrOG Tech, 2006), and the Bureau of Meteorology's Mean Annual Average Air Temperature (BoM 2010) was also used with a correction for surface temperature. For the first time, heat flow data was also incorporated into the map.

Data acquisition

There is a paucity of temperature-specific data in Australia, and to address this GA has established a capability for measuring surface heat flow via thermal gradient logging and thermal conductivity measurement.

Thermal gradient logging

Without the possibility of drilling new holes, GA has worked with State geological surveys and minerals exploration companies to access exploration and water bores. Figure 1 shows the distribution of logged bores as of July 2010.

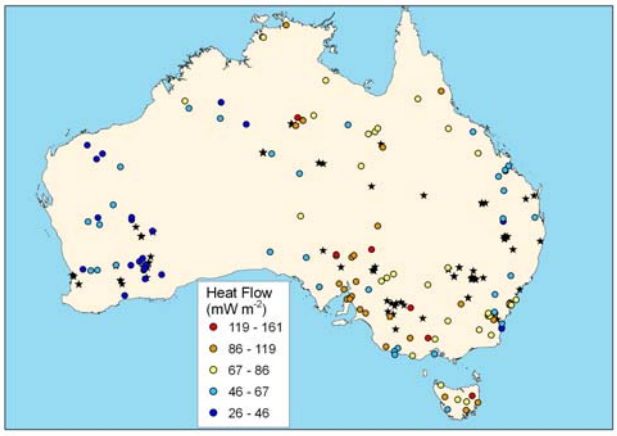

Figure 1. Map showing existing heat flow measurements for the Australian continent, and the distribution of bores logged for temperature by Geoscience Australia (black stars).

Thermal conductivity

GA operates an Anter 2022 Unitherm thermal conductivity meter and associated sample preparation equipment. Project staff have been involved in establishing operating procedures for the instrument, a process which has included inter-lab comparison testing with Torrens Energy, Hot Dry Rocks Pty Ltd, and Southern Methodist University. In addition, GA has engaged Hot Dry

Rocks Pty Ltd to measure two batches of samples.

Samples have been taken from the majority of the bores measured by Geoscience Australia for their thermal gradient, as well as other bores for 'stratigraphic' conductivity values.

Promotion

Undoubtedly the greatest impediment to the development of the Australian geothermal industry since the Global Financial Crisis has been the lack of capital investment. Geoscience Australia has participated in "Team Australia Geothermal" events at the Geothermal Energy Expo, Reno 2009, and the World Geothermal Congress, Bali 2010. The collaboration of industry, government and associations has been aimed at portraying Australia as a favourable investment destination.

Resource assessments

In 2007 GA produced an estimate of the contained heat above 150°C in the top 5 km of the Australian crust. Understandably this produced a very large estimate of energy. To provide a more relevant estimate 1% of the thermal resource was assumed to be accessible and convertible, and this equates to ~26,000 years of energy consumption (Budd et al., 2009).

The production of the Australian Energy Resource Assessment highlighted the need for a better understanding of Australia's geothermal resources potential. This contrasts with other renewable energy resources where the knowledge-base is quite advanced. There is a need for geothermal to be better understood so that it can be compared more directly to other energy sources. With a limitation on the availability of temperature data, other geoscience datasets must be used to inform or derive estimates of geothermal resource potential.

Geothermal Play Systems

As mentioned above, there is a paucity of temperature-specific data publicly available in Australia. There is, however, a wealth of high-quality geoscientific data available throughout the country, much of which can be used to make assessments of geothermal potential from a conceptual view point. Like some companies and other organisations, GA has developed 2.5D and 3D methods for processing geological, geophysical and geochemical data to produce resource potential assessments and estimates. A 'systems' approach has been utilised to enable these data sets to be used as 'mappable proxies' to estimate heat production and thermal insulation at regional scales (Budd et al., 2009). Conceptual and empirical methods of developing the Geothermal Play Systems approach have been pursued, and are still in development.

3D thermal modelling

Through a Primary Industries and Resources South Australia (PIRSA) Australian Geothermal Energy Group (AGEG) Technical Interest Group 9 Tied Grant, a thermal calculation module was built for GeoModeller software by Intrepid Geophysics (Siekel et al., 2009). This has been used to develop thermal models of the Millungerra Basin (unpublished), and the Cooper Basin (such as Gibson et al., 2010).

We have also undertaken synthetic thermal modelling tests. This involved the development of a synthetic grid of granites buried under flat-lying sediments that was used to model the effects of changing thermal and geometric variables (one at a time). Modelled variables include thermal conductivity, heat production and density of the sediments and granite, as well as the thickness, radius and depth extent of the granites and total sediment thickness. This has resulted in 5,400 individual test models, and we are in the process of interpreting these results. These interpretations will then serve as a guide for a first-pass assessment of thermal potential of the whole content based on estimates of granite size, basin geometry and composition (Meixner, 2009).

North Queensland Energy Assessment

A GIS-based approach was used to qualify the Hot Rock and Hot Sedimentary Aquifer geothermal systems of northern Queensland (Huston, 2010).

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