Australian Government

Geoscience Australia

GEOTHERMAL RESOURCES IN AUSTRALIA – Status and Research Needs

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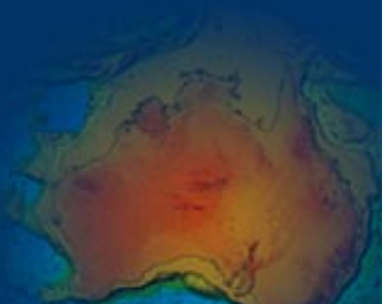
Geothermal Energy Industry Roundtable



Australian Geothermal Resources

- Status – present usage, understanding of resource, present activity
- Using geothermal for base-load electricity generation
- Direct uses of geothermal energy
- Geological impediments to uptake
- Geoscience Australia's Onshore Energy Security Program

Status – The Australian Resource

Little use of geothermal power presently:

- Electricity generation occurs only at Birdsville (Great Artesian Basin) – 80 kW
- Some direct use – spas, baths, building & pool heating

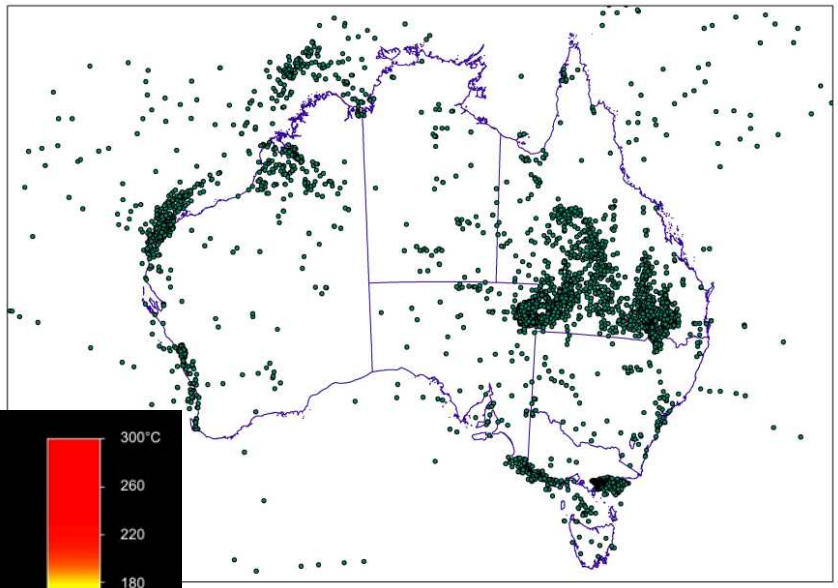
However, the Australian resource is potentially huge:

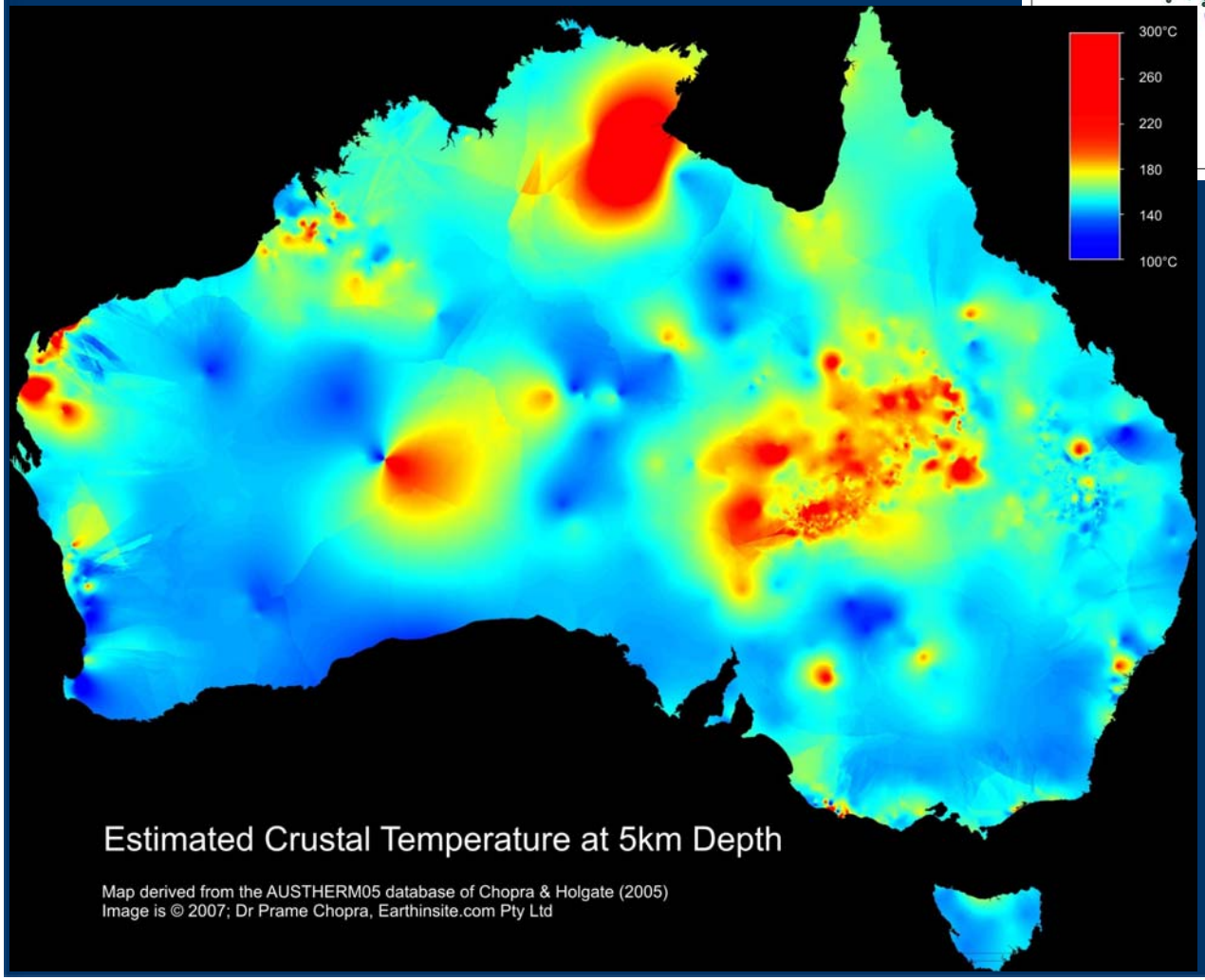
- Australian geology is different to countries that presently generate large amounts of electricity from geothermal energy
- Vast 'Hot Dry Rock' resources
- Great Artesian Basin provides a huge hydrothermal resource
- Unknown low temperature resource suitable for direct use

Geothermal identified in Onshore Energy Security Initiative

- New Geothermal Energy project at Geoscience Australia

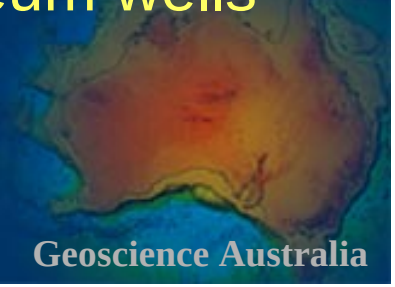
5km Temperature Map





→ Some areas oversampled, most areas undersampled

→ Most data from Petroleum wells

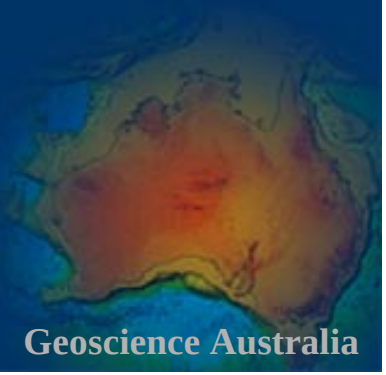


Present Activity

- Electricity generation - exploration
  - → rapid growth in activity
  - →16 companies
  - → $570M in associated works programs (2002–2012)
- Hot Dry Rock – most in South Australia
- Hydrothermal – Great Artesian Basin, Mt Gambier-Otway Basin
- Minor activity in developing new spas
- No known activity in direct industrial use

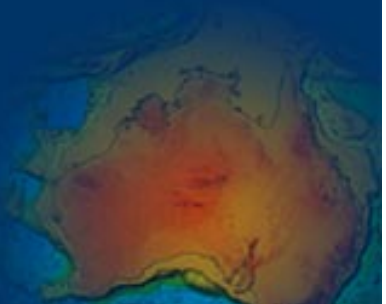
Base-load electricity generation

- Hot Dry Rock: insulated hot rocks at depths of >3.5 km at temperatures >200°C
  - → Geodynamics >280 MW at Innaminka SA,
  - → PetraTherm 520 MW at Paralana SA etc.
- Hydrothermal utilising the Great Artesian Basin resource
  - → Pacific Hydro 400 MW at Birdsville Track SA

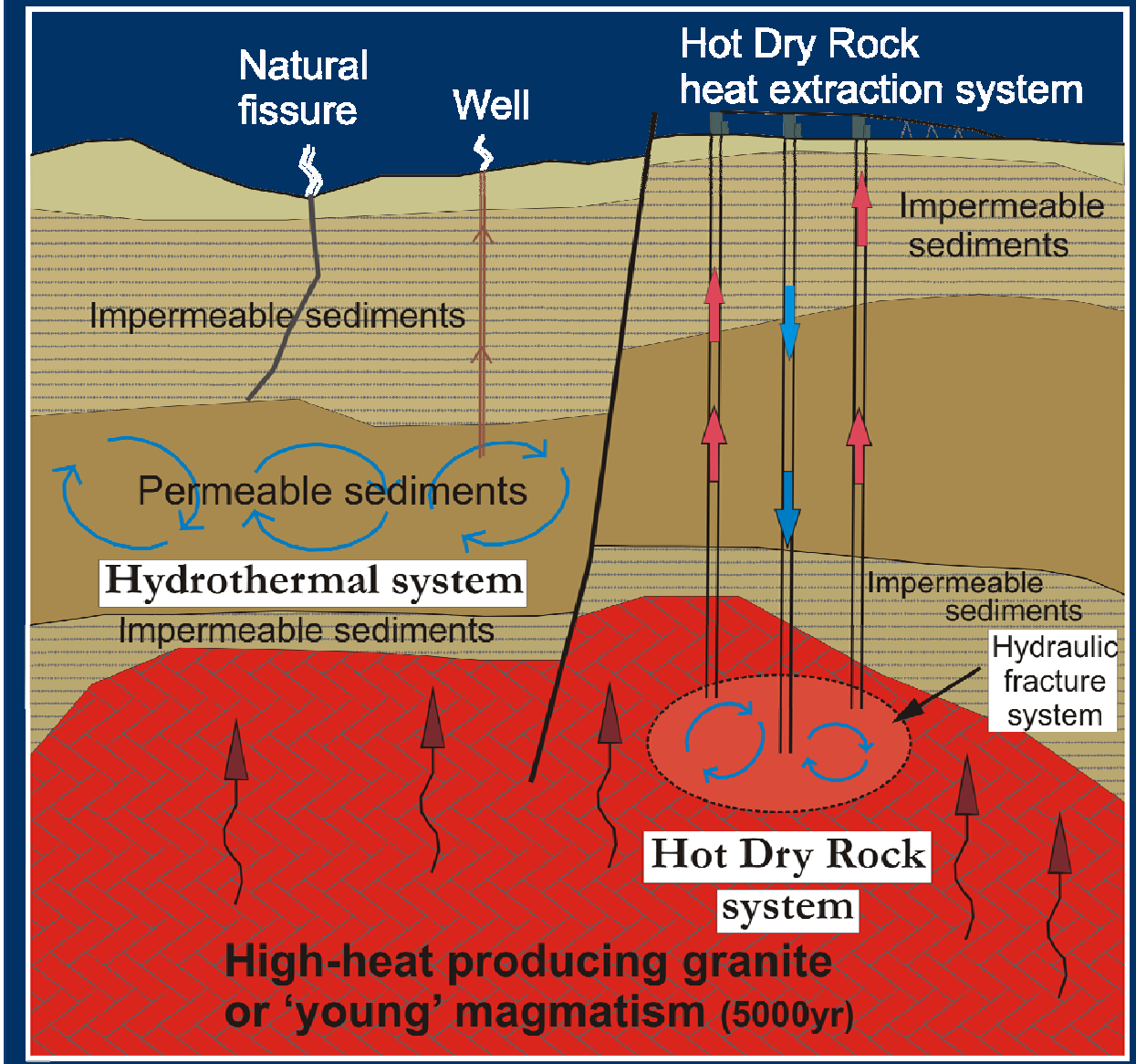


Advantages of HDR Geothermal

1. Can provide base-load
2. Be ramped up to provide peak loads within minutes
3. Be scaled i.e. more injection and extraction holes, additional plant, more power from the one location
4. Utilised properly, geothermal in Australia will be renewable, sustainable, and low-emission



Electricity generating geothermal systems



Hydrothermal system:

Heated by radiogenic high-heat producing granite (HHPG), or 'recent' magmatism

Artesian waters e.g. GAB

Hot Dry Rock system:

HHPG, overlain by low thermal conductivity sediments

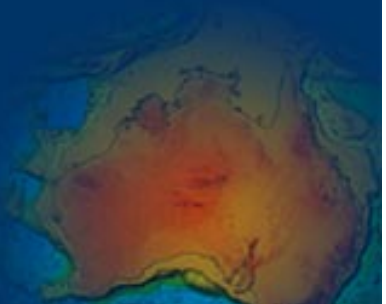
Heat exchange reservoir needs to be artificially enhanced

Direct uses suitable for Australia

- Direct-use of geothermal heat is more energy efficient than indirect use for electricity production
- Already used for artesian baths and spas (tourism), swimming pool heating, space heating, ground-source heat pumps (e.g. Geoscience Australia building)
- Industrial pre-heating (e.g. pre-warming water prior to steaming for coal-fired power station, drying)
- Seawater desalination by distillation – generates fresh water
- Can displace high-emission power sources
- New technologies will increase applications e.g. cooling

Geological impediments to uptake

- Australian situation has little potential for ‘traditional’ active margin geothermal (compared to New Zealand, Iceland, western USA)
- Hot Dry Rock model is novel: no-one has succeeded in making the entire system work – Australia is leading the world
- Remoteness of HDR resources increases costs of transmission
- Paucity of appropriate geothermal data



Geoscience Australia's Onshore Energy Security Program

$58.9 Million over five years (2006-2011)

Three ways to map heat:

1. **Heat flow**

   → Make new heat flow measurements in conjunction with State / Territory geological surveys

2. **Temperature at depth**

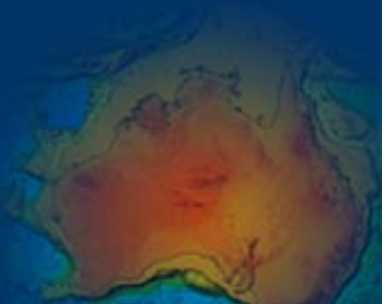
   → Create a geothermal database and information system, including methods for calculating temperature at depth

3. **Modelling based on source & trap**

   → Map buried hot granites in 3D using geophysics in conjunction with other OESP activities, and calculate heat resource using geological constraints

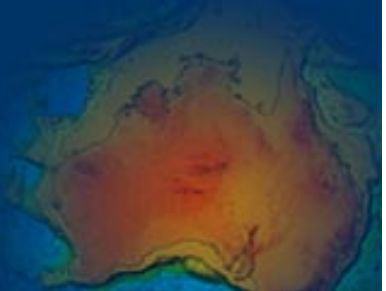
Geoscience Australia's Onshore Energy Security Program (continued)

- Contribute to other Federal Government programs, e.g. Australian Greenhouse Office's Renewable Energy Atlas
- Investigate hydrothermal power generation opportunities
- Participate in development of Resource/Reserves definition scheme
- Promote areas suitable for direct use of geothermal heat

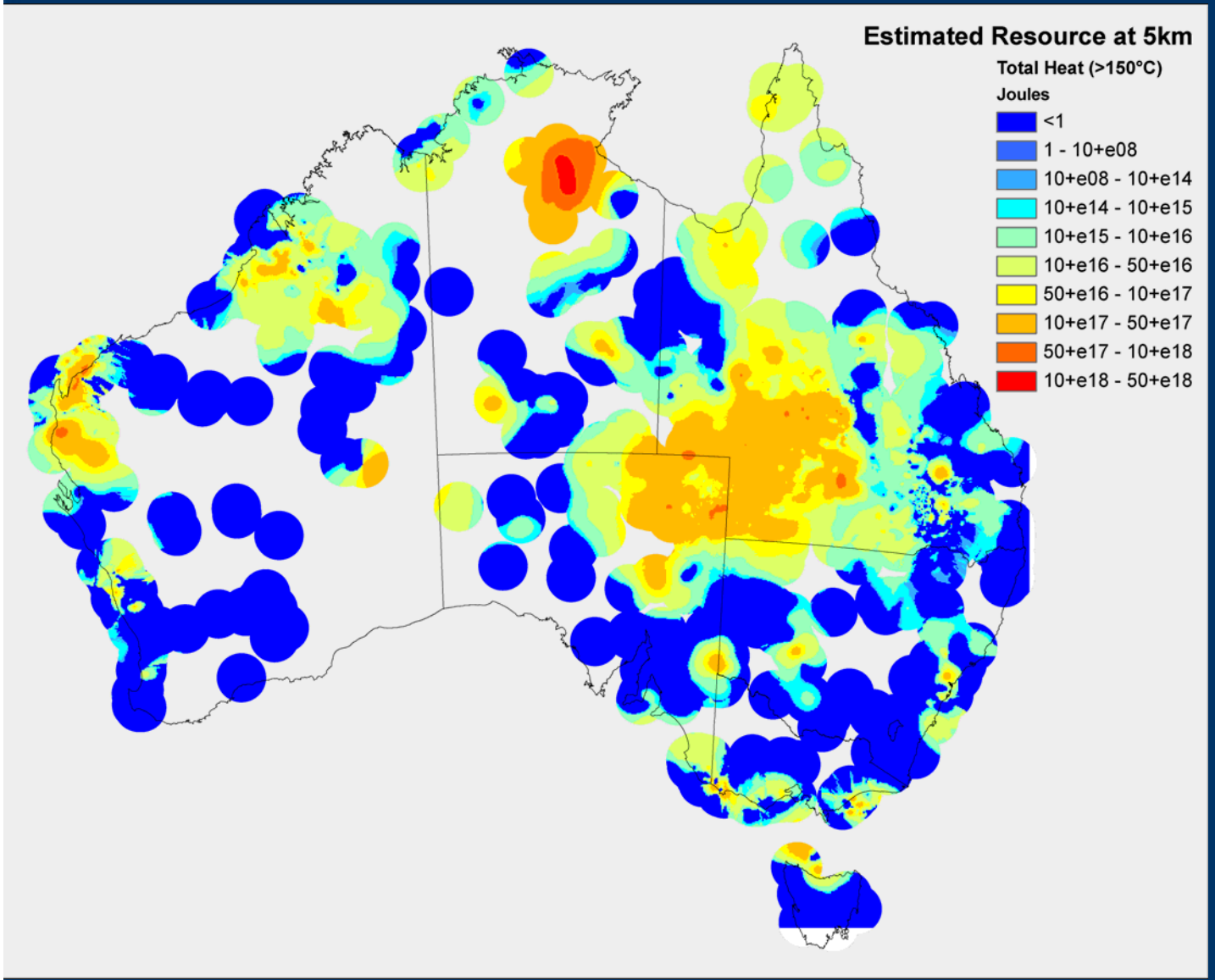


Geoscience Australia's Onshore Energy Security Program (continued)

- From existing data – geothermal resources near population centres are low temperature
- Work in conjunction with State and Territory governments (surveys) to investigate heat flow close to market
- Raise public awareness of geothermal resources, for power generation and direct uses



The Promise of Geothermal



Indicative Resource map

Calculated between 5 km (lower) and 150°C isotherm (upper)

Resource calculated on a 5x5 km grid

Maximum distance from datapoint = 100 km

Minimum resource = **1.2 x 10^{23} Joules** (~20,000 x 2004-2005 consumption)