

Geophysics at CSIRO

In a previous edition of *Preview* I commented on how easily one can be overwhelmed by the vastness of the CSIRO internet resources. Thanks to Merrin Fabre and Ben Clennell, the following attempts to unravel some of the online CSIRO resources related to 'geophysics'.

CSIRO's geophysics capabilities (<http://www.csiro.au/science/geophysics.html>) perform a number of activities to aid in:

- mineral exploration;
- increasing recovery rates of oil and gas reservoirs;
- monitoring and verification of carbon dioxide storage; and
- geological modelling of sedimentary sequences for exploration.

Initiated by CSIRO in 2003, the National Research Flagships program (<http://www.csiro.au/partnerships/NRF.html>) is one of the largest scientific research endeavours ever undertaken in Australia, with the total investment to 2010–11 expected to be close to A\$1.5 billion. Ten Flagships are currently in operation, and form the umbrella to many CSIRO enterprises. As one example, the Centre of Excellence for 3D Mineral Mapping (<http://www.csiro.au/partnerships/C3DMM.html>) within the Minerals Down Under Flagship has partnered with government and industry to form a centre of excellence to develop three-dimensional mineral maps of the Australian continent. Those seeking existing geophysical data should visit the Geophysical Archive Data Delivery System (<http://www.geoscience.gov.au/bin/mapserv36?map=/>

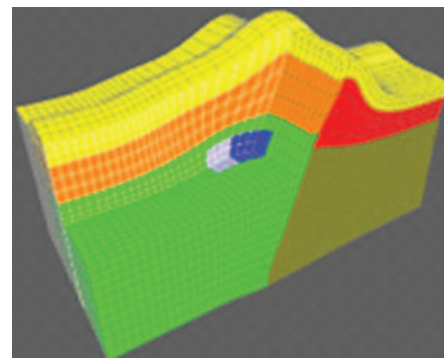
public/http/www/geoportal/gadds/gadds.map&mode=browse). This system provides magnetic, radiometric, gravity and digital elevation data from Australian National, State and Territory Government geophysical data archives.

I admit I found it confusing trying to establish via the vast CSIRO web area which Flagships contained what geophysical activities, but a few geophysical topics are touched upon below.

The pursuit of practical three-dimensional electromagnetic inversion for exploration has culminated in the P223F, or Practical Three-Dimensional (3D) Inversion for Exploration project (<http://www.csiro.au/science/Practical-3D-Electromagnetic-Inversion-For-Exploration.html>). P223F was the ninth project for AMIRA International, an industry association which manages collaborative research for members of the global minerals industry. In 2010 it was made open source (<http://p223suite.sourceforge.net/>).

Other lesser-known but interesting activities within the CSIRO umbrella relate, for example, to the use of radar for gold exploration (<http://www.csiro.au/resources/using-radar-assist-exploration.html>) or near-surface mapping (<http://www.csiro.au/science/Siropulse-Radar.html>), and seismic-while-drilling (<http://www.csiro.au/news/ElectronicEars.html>).

The section on 'Energy' (<http://www.csiro.au/science/Energy.html>) begins with a mission of 'Helping Australia move to a clean, secure energy future



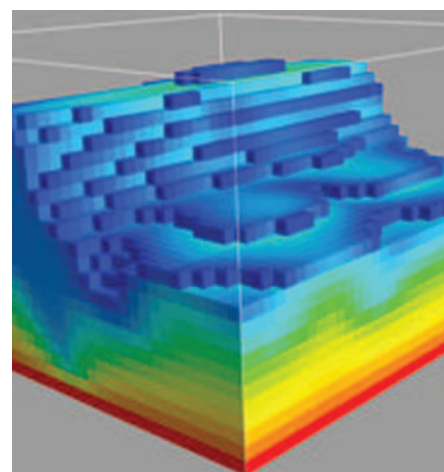
3D finite element mesh for complex earth EM modelling.

and maximise the wealth from our resources'. 'Energy from oil and gas' (<http://www.csiro.au/science/OilGas.html>) addresses four topics: petroleum systems, enhanced oil recovery, flow assurance and unconventional gas. Notable pages include 'Petroleum geosciences' (<http://www.csiro.au/science/Petroleum-geoscience.html>) and 'Technologies to improve drilling performance' (<http://www.csiro.au/resources/Drilling-performance-technologies.html>).

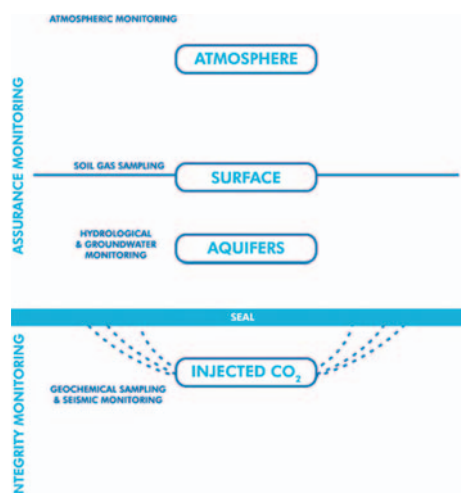
CSIRO is the largest single participant in the Australian Government's Cooperative Research Centres (CRC) Program which is helping advance the commercialisation and utilisation of Australian research and development (<http://www.csiro.au/org/CSIRO-and-CRC-Program.html>). The 'CO2CRC' is one of 26 CRCs (of 48) in which the CSIRO participates. Reducing greenhouse gas emissions through carbon dioxide storage (<http://www.csiro.au/science/CO2-geological-storage.html>) is probably an area in which Australia



Dielectric rock testing at CSIRO laboratories.



Geothermal 3D model of heat flow.



Schematic of the various elements of CO₂ monitoring.

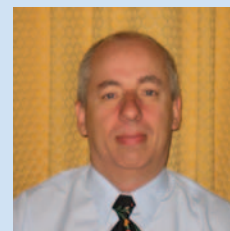
leads the world. The CO2CRC Otway Project (http://www.csiro.au/science/CO2-geological-storage--ci_pageNo-7.html and <http://www.co2crc.com.au/>

otway/monitoring.html#monitoring) is Australia's first demonstration of the deep geological storage or geosequestration of carbon dioxide (CO₂).

On the 'clean' energy front, geothermal (<http://www.csiro.au/science/Geothermal-energy.html> and <http://www.csiro.au/org/geothermal.html>) is an emerging science with many efforts underway. Based at the Australian Resources Research Centre (ARRC) in Perth, the Western Australian Geothermal Centre of Excellence (WAGCOE: <http://www.csiro.au/partnerships/WAGCOE.html>) is a joint venture partnership between CSIRO, The University of Western Australia and Curtin University of Technology. It was established in February 2008 with funding support of A\$2.3 million from the Government of Western Australia.

Indeed, a visit to the ARRC building in Perth is recommended. Any visitor will be impressed by the size and facilities for

rock mechanics and testing (<http://www.csiro.au/resources/Rock-mechanics-testing.html>). Several other laboratories are also present, including of course many highly qualified CSIRO personnel. Maybe they can help you navigate the CSIRO web resources, which I still find overwhelming and confusing. But the rewards to anyone sufficiently motivated are a cornucopia of geophysics-related information.



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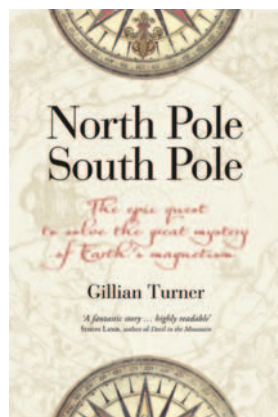
North Pole, South Pole: The epic quest to solve the great mystery of earth's magnetism

by Gillian Turner

Publisher: AWA Press, Wellington, New Zealand, 2010, 274 pp.

RRP: \$35.00 (paperback),

ISBN: 9780958275002



Gillian Turner, the author of this book, has made a career in geophysics at the Victoria University of Wellington, New Zealand, initially upon the basis of research in paleomagnetism. Over the years she has been a frequent visitor to the paleomagnetic laboratory at Black Mountain developed in Canberra by the Australian National University, and also used extensively by Geoscience Australia and others. In terms of academic influence (very much one of the threads of the book) Turner was a research student of Roy Thompson and Ken Creer at the University of Edinburgh, Scotland. Creer in turn, earlier in the 1950s, was a student of Keith Runcorn at the University of Cambridge in England. Gillian Turner herself was an undergraduate at Cambridge; indeed in an essay she wrote there on 'our magnetic planet' one can see the genesis, decades later, of this fine book.

Gillian Turner has thus walked on paths where many of the past giants of geophysics have walked. This familiarity perhaps gives her the feeling of friendliness with them which comes through in this book. She has a great interest in, knowledge of, and gift for writing about the history of science. The depth of research and understanding in the book carries a great enthusiasm with it. It cannot help but teach the reader much about modern geophysics. It is just the book to enthuse a young person, interested in the physics of the world around them.

It is a book on geomagnetism, and indeed wider geophysics, quite like no other. It is aimed at a wide audience, and maintains a high level of academic rigour. Its purpose is to tell a remarkable story about the discoveries and observations of magnetic fields. The story can be traced back to mankind's earliest recorded history, and the story covers the full sweep of human history, and especially the development of science. There is the profound sub-plot of a phenomenon, for centuries shrouded in superstition and magic, being brought into the light of explanation by modern science.

Before the Introduction there is a list of 'Main Characters'. This feature is like the programme notes of good theatre, and sets the strong literary and artistic theme of the book. In the alphabetical order of this list, Petrus Peregrinus (13th century) is followed by Paul Roberts (born 1929), illustrating beautifully how this book seamlessly joins the past and the present.

The book then very naturally tells the story in historical order. Fifteen chapters start with the myth of Magnes, and end with a very non-mythical Chapter 15 on the geodynamo. In between, we meet a whole series of giants. They come alive so well because the author has clearly done her own research regarding them, and not relied on others' accounts.

Thus, to give examples, accounts of the contributions of Gilbert (physician to Queen Elizabeth I), Halley, Maxwell, Gauss and Faraday are just some of the mileposts which lead on to the contributions, in the last fifty years, of Bullard, Irving, Morley, Vine and Glatzmaier.

At the end of the book there is an Epilogue, a Glossary and a Short Bibliography. A beautifully selected collection of historical illustrations grace the text.

The author reflects her natural outstanding teaching abilities in the apparently informal nature of the book, and its appeal to the general reader. However behind the very friendly text, with quite complicated physics explained without equations, is the firm grip of learned research, and the great care taken in the book's production.

In summary, the book breaks new ground in grafting the remarkable developments of 20th century geophysics on to the well-established history of classical electromagnetic physics. The earlier pioneers, whose names are so well known as to be perpetuated in the names of electromagnetic units, are introduced in a very likeable and human way. Then many of the 20th century scientists, who made the discoveries of continental drift, geomagnetic reversals, sea-floor spreading, and plate tectonics, are known personally to the author. These modern-day giants pick up the story which started millennia ago with the mythical figure of Magnes, and carry it through to the satisfying culmination of the (numerical) demonstration that a dynamo in the core can produce Earth's magnetic field, and its reversals.

Most people familiar with the history of geomagnetism will have their background knowledge significantly deepened from this book. The student will gain a wonderful perspective of the development of science, by following the thread of magnetism through much of the recorded history of mankind.

This book is very timely. We are now one decade into the 21st century, and the 1900s are 'last century'. It is indeed time for the historic developments in geomagnetism, which occurred particularly in the latter half of the 20th century, to be welded-on to the established physics which last century's students knew well: the physics of Coulomb and Ampere and company. This book does this welding-on in a very learned and seamless way. The research behind the history has been painstaking.



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November			2010
11–13 Nov	5th International Conference on Applied Geophysics http://www.sc.psu.ac.th/Department/physics/Geophysics2010.html	Phuket	Thailand
15–17 Nov	KazGeo 2010: Where Geoscience Meets the Silk Road http://www.eage.org	Almaty	Kazakhstan
21–24 Nov	GeoNZ 2010 – Joint Conference of the Geoscience Society of New Zealand and the New Zealand Goethermal Workshop http://www.geonz2010.co.nz	Auckland	New Zealand
December			2010
8–10 Dec	GEO India 2010: 2nd South Asian Geosciences Conference and Exhibition http://www.aeminfo.com.bh/geoindia2010	Greater Noida	India
13–17 Dec	AGU Fall Meeting 2010 http://www.agu.org/meetings	San Francisco	USA
January			2011
16–19 Jan	Borehole Geophysics Workshop: Emphasis on 3D VSP http://www.eage.org	Istanbul	Turkey
April			2011
3–8 Apr	European Geosciences Union General Assembly 2012 http://meetings.copernicus.org/egu2011	Vienna	Austria
10–14 Apr	SAGEEP 2011: Information Exchange for Near-Surface Geophysics http://www.eegs.org/sageep	Charleston	USA
May			2011
23–26 May	73rd EAGE Conference & Exhibition incorporating SPE EUROPEC 2011 http://www.eage.org	Vienna	Austria
June			2011
22–24 Jun	International Workshop on Advanced Ground Penetrating Radar 2011 http://www.congressa.de/IWAGPR-Workshop-2011	Aachen	Germany
August			2011
28 Aug – 2 Sep	Geosynthesis 2011: Integrating the Earth Sciences Conference & Exhibition http://www.sbs.co.za/geosynthesis2011	Cape Town	South Africa
September			2011
12–14 Sep	Near Surface 2011 http://www.eage.org	Leicester	UK
18–23 Sep	SEG International Exposition and 81st Annual Meeting http://www.seg.org	San Antonio	USA
October			2011
24–26 Oct	IGCP 5th International Symposium: Submarine Mass Movements and Their Consequences http://landslide.jp	Kyoto	Japan
February			2012
26–29 Feb	22nd ASEG Conference and Exhibition 2012: Unearthing New Layers http://www.aseg2012.com.au	Brisbane	Australia
August			2012
5–10 Aug	34th International Geological Congress http://www.34igc.org	Brisbane	Australia

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Please note that this is a non-profit activity carried out by the ASEG SA/NT Branch committee only for ASEG members. The prices have been specially negotiated with the wineries and are not available through commercial outlets. Compare prices if you wish but you must not disclose them to commercial outlets.

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ASEG Price \$140/case (usually retails at around \$228/case)



Bremerton 2009 Verdelho - Langhorne Creek

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ASEG Price \$120/case (usually retails at around \$204/case)



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