

by Ian B. Lambert

Showcasing the geology, resources and innovative geoscience approaches “Downunder”: the 34th International Geological Congress

Geoscience Australia, Secretary General 34th IGC

Introduction

Since its inception in 1878, the International Geological Congress (IGC) has grown progressively in size and stature to become the largest global geoscience meeting, attracting thousands of delegates from over a hundred countries. The International Union of Geological Sciences (IUGS) is the scientific sponsor of the IGC, which is generally held every four years and is sometimes referred to as the Geoscience Olympics, given that quite a few congresses have been held in the Olympic month and year. That is the case for the 34th IGC, which is being hosted by the Oceania region (Figure 1) in Brisbane, Queensland, Australia, during 5–10 August 2012 (www.34igc.org).

This Special Issue of *Episodes* is designed to stimulate interest in the 34th IGC by describing the geological framework and evolution of the Oceania region and highlighting the geology of many of the areas where field trips are being offered. This article provides an overview of geological highlights, research and teaching in the region, before outlining features of the Congress.

Geological features of Australia

While Australia is proudly a ‘new world’ country, it is also known as the oldest continent. As much as the antiquity of its rocks, this is because of the age of its landscapes, with which Aboriginal Australians – the longest surviving continuous culture on Earth – have a powerful connection.

Western Australia is dominated by the Archean Pilbara and Yilgarn cratons. It is home to the oldest dated minerals in the world (c. 4.4 Ga detrital zircons from Jack Hills) in the northern Yilgarn Craton, the oldest identified microfossils and stromatolites (in c. 3.5 Ga chert near Marble Bar in the Pilbara Craton). Western Australia also has evidence of probable Archean meteorite impacts; world class Au and Ni provinces in late Archaean greenstones, diamonds and a magnificently exposed Devonian carbonate reef system in the Kimberley region; the vast Hamersley Iron Formations of the earliest Proterozoic; major bauxite and mineral sand resources in the SW; oil and gas fields on the NW Shelf, currently underpinning our LNG exports; Holocene stromatolites; and pristine modern coral reefs.

The central strip of Australia is dominated by Proterozoic basement terranes and Phanerozoic sedimentary cover. This is a region characterised by high crustal heat flow and “hot” granites; it contains Australia’s first pilot hot rock energy project. It has major U, Cu–Au (including the huge Olympic Dam mine) and Pb–Zn–Ag mineralisation (including Mount Isa, Century, Cannington and McArthur River);

oil and gas fields in Paleozoic and Mesozoic basins; the Acraman impact horizon; the Wolfe Creek impact structure; Neoproterozoic glacial horizons; ancient fossil macro-organisms in the Flinders Ranges that are the basis for the recognition of the Ediacaran Period; very ancient internal drainage rivers; and several opal fields and other gem and semi precious stone (e.g., sapphires, jade) localities. Tourist icons – including Kakadu in the north, and the world’s largest monolith at Uluru (Ayers Rock, in the Uluru-Kata Tjuta National Park) in the arid centre – combine spectacular scenery with ancient Aboriginal culture. The Ranger U mine is an interesting example of effective management of a mine surrounded by the World Heritage listed Kakadu National Park.

The eastern part of Australia is dominated by Phanerozoic rocks. This is where pioneering work was done on the origin of various types of granites and on lithosphere evolution based on mantle xenoliths in Cainozoic volcanic rocks. Queensland has several sites with well preserved fossils of large mammals and dinosaurs, and some large lava caves. Fascinating insights into climatic changes and early human habitation have been found, most notably Mungo man in a lake system in southwestern New South Wales. The Mesozoic–Cainozoic Great Artesian Basin stretches across much of eastern Australia. It hosts groundwaters as old as 2 Myr in what is otherwise an arid continent.

There are vast black coal reserves in Queensland and New South Wales and major brown coal reserves in Victoria. Queensland also has oil and gas fields, including a rapidly growing coal seam methane sector, and large good quality oil shale deposits. The first petroleum giant fields exploited in Australia are in marine environments off Victoria, and there are a series of basins with largely untested petroleum potential along the southern margin of Australia. Onshore Victoria also houses Australia’s successful geological carbon storage (CCS) demonstration project, in the Otway Basin.

Australia is unique in having warm ocean currents down both its east and west coasts. Spectacular coastal scenery abounds, from the World Heritage listed Great Barrier Reef which fringes much of the Queensland coast, to the Great Ocean Road of southern Victoria, which is the eastern part of the largest south-facing coast in the world. This wave-dominated coast is home to many endemic marine species. The northern coast in contrast occurs in tropical waters and is dominated by tides. A far lower percentage of endemic species occur here, with many species shared with Australia’s northern neighbours.

The island of Tasmania, cut off from the mainland by rising sea-levels c. 6 ka, is characterised by late Proterozoic to Mesozoic geology.

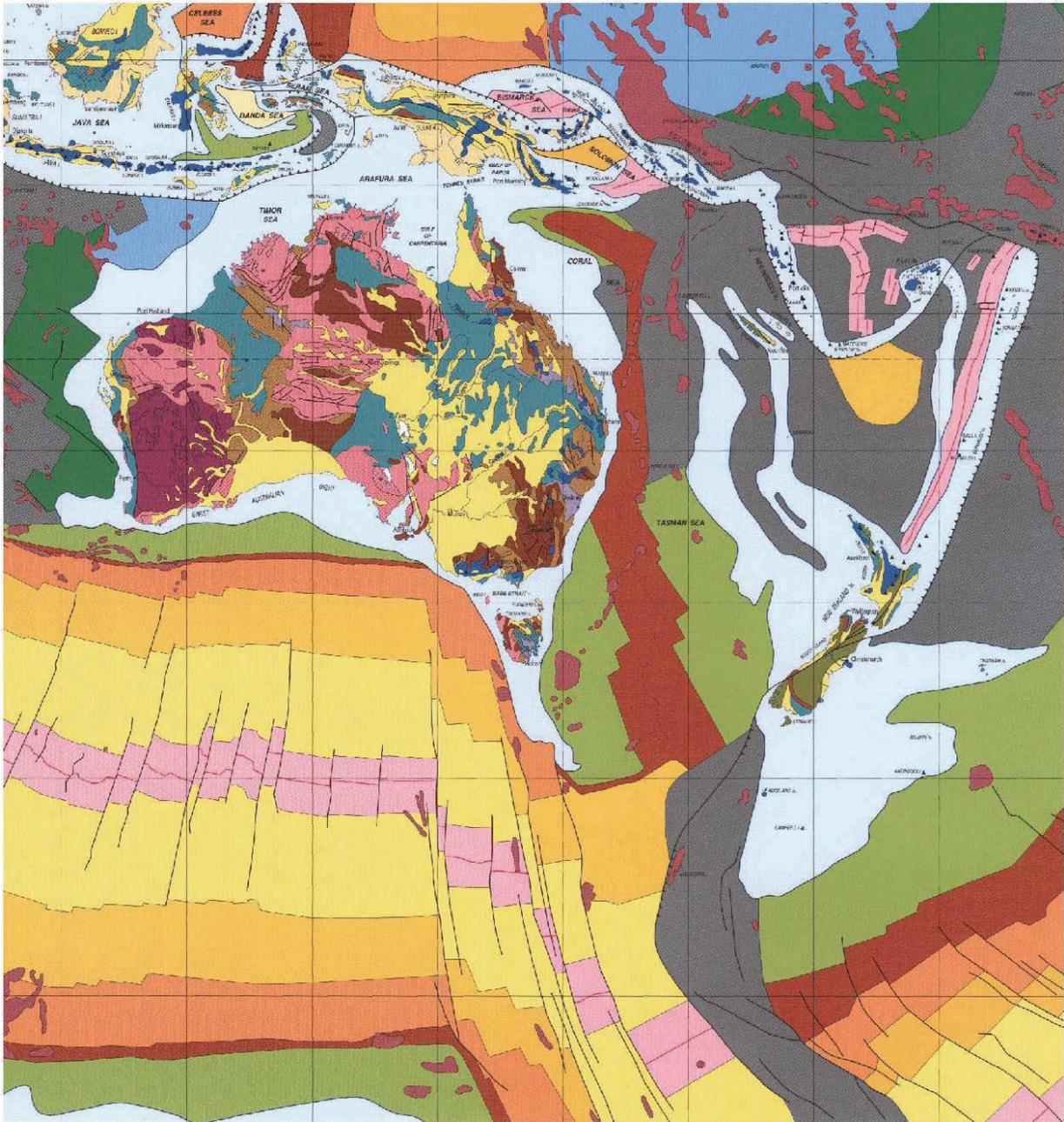


Figure 1 Oceania and environs. Extract from *Geological Map of the World* (Commission for the Geological Map of the World).

Jurassic dolerites, with spectacular landforms, are related to dolerites in Antarctica and South Africa. Scenic wilderness areas abound, including glacially sculpted mountains and lakes and old growth forests.

Australia's unique scenery and its flora and fauna, is complemented by excellent food and produce, including many varieties of world-recognised outstanding wines.

Geological setting of Oceania

New Zealand and New Guinea and other island countries around the eastern and northern margins of the Australian Plate are located in geologically active settings (Figure 1).

New Zealand straddles the Australian and Pacific plates, whose Mesozoic separation from Australia is detailed in the spreading centre

on the floor of the Tasman Sea. The country is noted for its spectacular alpine geology, glaciers, volcanic and geothermal landscapes, strong Maori and British heritages, sheep and some excellent wines. It also has unique fauna and flora. In marked contrast to Australia, it had no mammals other than bats until man came.

New Guinea also exhibits fascinating alpine and volcanic geology in a tropical setting. It features major ophiolite belts, active tectonism and volcanism, uplifted coral terraces, Au and Cu mines. Additional attractions in remote areas include colourful tribes maintaining traditional cultures and customs.

There are many smaller volcanic and coral reef dominated islands dotted through the region from Indonesia to Fiji. New Caledonia, a charming blend of French and Melanesian cultures, is known for its ultramafic rocks which have weathered to form major lateritic nickel deposits, and the ancient floras preserved on its scenic islands.

Australia was long part of supercontinents, such as Rodinia, Nuna and Kenorland. It only became a continent in its own right when it finally broke from the remnants of Gondwana (Antarctica), beginning in the Jurassic. Since then Australia has been part of the fastest moving crustal plate, insulated by extensive areas of oceanic crust from active continent-continent and ocean-continent collision zones, in marked contrast to New Guinea and New Zealand.

The split between Australia and Antarctica was complete by 34 Ma. The geological features of Antarctica include Precambrian gneisses, dry valleys, volcanic activity and the world's largest land glacier. Australian and New Zealand geoscientists have had a long involvement in geoscience research in Antarctica. Recent work has focused on geophysical surveys of the continental shelf, and paleoclimatic trends through detailed studies of cores in ice and offshore sediment.

Through the Cenozoic, intraplate volcanic activity migrated from N-S in at least three parallel tracks down the eastern strip of Australia and beneath the Tasman Sea. During the same period the continental shelf of the Queensland coast became an ideal environment for coral growth leading to massive reef development in the world's largest modern coral reef system, the Great Barrier Reef.

Australia was not subjected to the Cenozoic orogenic activity which occurred in New Guinea and New Zealand. The Australian Continent also escaped the major recent glaciations that scraped surficial materials from wide areas of the northern continents. Its last period of extensive valley and continent-wide glaciation, reflected by striated pavements, U-shaped valleys, and diamictites, occurred during the late Carboniferous and early Permian. From the Mesozoic, there was widespread deposition of riverine, lacustrine and shallow marine strata over older bedrock coupled with climatic desertification due to rapid northward plate motion, culminating in the vast sand dune system in the arid interior of Australia.

The geologically stable setting of Australia has formed and preserved its unusually deeply weathered and topographically subdued landscapes, and the bold reddish hues of the 'outback'. The extensive blanket of weathered rocks and sediments – the regolith – can be several hundred metres thick. The physical and chemical properties of the widespread regolith materials, including groundwaters, can be quite different from surficial materials of other countries typified by shallow cover over fresh bedrock.

The properties of the regolith have to be understood for effective mineral exploration, land/water management and infrastructure planning. Some approaches and technologies used in other developed countries must be modified to take account of the different conditions, and this has been a driver to develop innovative approaches and technologies in Australia. A high proportion of Australia's agricultural production comes from the SE and SW of Australia, where groundwater quality and quantity, and inter-relationships with surface waters, are of concern. Geoscience research is increasingly being brought to bear in efforts to better understand and manage the range of issues involved.

Geoscience research and teaching

Geoscience in Australia and New Zealand is motivated by several prime factors: continuing to play major roles in meeting global demand for a range of mineral and energy commodities, providing solutions to societal challenges such as groundwater quality and management,

satisfying a thirst for new knowledge to understand better the world we live in, making informed land use decisions, building large cities and infrastructure, natural hazards and emergency management.

There is increasing acknowledgement that the outcomes of geoscientific research sustain economies and help safeguard communities. Geoscientists have vital roles to play in multidisciplinary systems approaches to underpin important decisions and policies addressing the major challenges.

Geoscientists are increasingly linked into advances in web technologies and data transfer standards that are making geological and geospatial data more accessible, including for purposes beyond the original incentive for their collection. They are increasingly benefiting from rapid increases in available computing power and in open source processing algorithms which are facilitating analyses and modelling of large and diverse datasets. Combined, these new developments are rendering multidisciplinary approaches much more effective and transparent.

Geoscience research in Australia is carried out within universities, government agencies such as Geoscience Australia and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), industry, Cooperative Research Centres, Special Research Centres, Major National Research Facilities and State and Territory Geological Surveys. In New Zealand, geoscience activities are conducted in Crown Research Institutes, notably GNS Science, and universities. In both countries industry research builds on government funded programs.

A strategic approach, involving separation of funding for research infrastructure from research programs which use the infrastructure, is proving effective and engendering good collaboration in Australia. While the number of geoscience departments in universities has decreased over the past two decades, the standard of teaching and research is high in Australia and New Zealand. Enrolments in Australian tertiary institutions are buoyant, driven in significant part by a very strong resources sector, which is driving the strong national economy. In Australia and New Zealand, geologists from numerous countries are conducting research and exploration projects.

The universities of Papua New Guinea and New Caledonia offer geoscience courses and research.

Outline of 34th IGC

As a large and prestigious event, the 34th IGC will provide an excellent opportunity to catch up on advances in international geosciences and to meet and network with leading professionals in the global geoscience community. In addition to a very wide ranging and interesting scientific program, many business meetings will be held during the IGC.

Brief descriptions of some of the features of the IGC follow and detailed information is available at the Congress's website: www.34igc.org.

Organisation

The organising body for the 34th International Geological Congress is the Australian Geoscience Council Incorporated (AGC). The AGC is a Council of Presidents of the major Australian geoscientific societies, and is the peak representative body for the 7000 or so members of the geosciences profession in Australia.

The number of Australians participating in the Brisbane Congress will be maximised by integrating meetings of the major Australian geoscientific societies into the IGC.

The 34th IGC Organising Committee comprises leading Australian geoscientists, representatives of the main geoscience societies and the Chief Executive of New Zealand's GNS Science.

Carillon Conference Management, based in Brisbane, was appointed in 2008 as congress manager.

The venue

The IGC will occupy the entire Brisbane Convention and Exhibition Centre, an excellent state-of-the-art venue in an attractive cultural and entertainment precinct. This offers ample space for over 30 concurrent scientific symposia, poster displays and a large exhibition under one roof.

Scientific Programme

Under the overall theme "Unearthing our Past and Future: Resourcing Tomorrow", the 34th IGC will have a scientific programme covering all facets of the geosciences. It has been designed to appeal to academics, government officials and resource industry representatives in equal measure. The full scientific programme encompasses c. two hundred Symposia grouped under 37 Themes. Of particular note are the plenary "hot topic" sessions, which will cover future minerals, energy and water resources; the geological record and climate change; energy in a carbon-constrained world; living with natural hazards; and the geosciences addressing major challenges of the 21st century.

Workshops and Short Courses

Some thirty professional development workshops and short courses are being offered, covering a wide range of topics.

In addition, three training workshops are being organised for selected participants from low income countries: (i) Sustainable mining in Africa; (ii) Geological sequestration of carbon dioxide;

and (iii) Capacity building in risk modelling for natural hazards in the Asia-Pacific region.

Field trips

The 34th IGC is offering c. 40 field trips to areas of geological interest across Australia, New Zealand, Papua New Guinea and New Caledonia. A bonus for those travelling to the IGC from Europe and Asia is a trip to Langkawi Global Geopark in Malaysia.

Exhibition

The Congress will feature a major geoscientific exhibition (GeoExpo), which will occupy two exhibition halls and extend into the corridor spaces outside these halls. There will be a wide range of exhibitors – from resource companies, geosurveys and service providers to scientific publishing houses.

Through the GeoExpo and the scientific programme, Russia and China are jointly releasing and promoting the results of a decade of collaborative geological mapping and geophysical surveys in central and eastern Asia. These are expected to be of considerable interest to many delegates.

Concluding remarks

The 34th IGC offers an unparalleled opportunity to experience the geology and innovative scientific endeavours of a fascinating region, while networking with international leaders in all aspects of the geosciences. Despite the current economic uncertainties, outcomes of geoscientific endeavour will continue to underpin real growth in this part of the world: this is your chance to part of it by attending the 34th IGC. We are extending a warm welcome to geoscientists from around the world to come to Brisbane in August 2012.

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