Australian Institute of Geoscientists

AIG NEWS

Quarterly Newsletter No 94 November 2008

STRATIGRAPHIC CONTROLS ON STRUCTURES AND MINERALISATION IN CENTRAL VICTORIA 4: LOCKINGTON

Abstract

This is the fourth in a series of papers discussing the stratigraphic controls on structures and gold mineralisation in Victoria. Mineralisation was discovered beneath the Murray Basin at Lockington in 2005. Lockington has a shale-dominated succession with more shale than at any other location discussed in this series. Like Fosterville and Bendigo, Lockington has linked systems of shale-hosted laminated quartz veins and thrusts that propagate from fold hinges and truncate fold limbs. However, Lockington also has shallow west-dipping faults that are pervasive and cross both limbs of folds in a similar fashion to that seen at Ballarat East. These tend to be the faults that host Fosterville-style mineralisation. Lockington shares a mixture of fault styles seen at Bendigo, Fosterville and Ballarat East. While numerous gold intersections have been encountered during drilling at Lockington, a major structural host to economic mineralisation is elusive.

Introduction

Central Victoria is a world-class orogenic gold province where faults and folds within Ordovician turbidites host gold and associated mineralisation. Such turbidites occur across most of Victoria and in the field comprise monotonously interbedded sandstones and shales, although facies variations and lateral discontinuity of individual beds are characteristic at a local scale. This study of Lockington (Fig. 1) follows a review of the Bendigo, Ballarat East and Fosterville goldfields by Boucher *et al.*, (2008a, b, c).

It has long been tantalising to explore for a world-class orogenic gold deposit under the shallow Murray Basin sediments north of Bendigo, Fosterville and St Arnaud. However it was not until late 2003 that Gold Fields Australasia Pty Ltd commenced a concerted effort to explore a 5,000 km^2 area north of Bendigo. Initially, geophysical structural interpretation and depth to basement modelling using water bore data delineated zones of interest. Soil geochemical work identified gold and silver anomalies south of Lockington and traverses of air core holes were drilled to sample the top of the Ordovician basement at 70 to 100 metres depth. This work delineated seven parallel trends mineralised in gold, arsenic and antimony, three of which were selected for diamond drill testing in 2005. The longest trend (at Lockington East) extends for 9 km and is open at both ends. A total of 31 diamond holes have been drilled to 500 m downhole into these three trends over a strike length of 2 km at Lockington South, and on two sections

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Figure 1. Location map showing the turbidite-hosted gold deposits discussed in this series of papers.

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3 km apart at Lockington East. Fosterville-style mineralisation was intersected in the first hole and provided an impetus for exploration. From the first hole, detailed sedimentological and structural logs were constructed and utilised to generate subsequent drill targets. Mindful that each turbidite-hosted gold deposit in central Victoria occurs in a different structural setting (as demonstrated by Boucher *et al.*, 2008a, b, c), drill targeting was model-guided rather than model-driven and continually sought the ingredients unique to Lockington.

As at Fosterville, no attempt has yet been made to formally name stratigraphic units at Lockington. Instead a coded numbering system has been used to identify units (Fig. 2). Lockington successions are given the prefix 'LO', thick shales are denoted as 'SH' and amalgamated channel-sands 'CH'. The 'shale-topped sands' (STS) above and below the channel-sands are designated 'TS' and 'LS' respectively. A package from the top of a shale to the top of the next shale above is considered analogous to a formation and is assigned a number for the combined LS/CH/TS/SH facies (Fig. 2).

Stratigraphy-guided drill targeting

The first diamond hole at Lockington, LODH001, passed through 90 m of Tertiary Murray Basin sediments before intersecting 170 m of west-dipping Ordovician turbidites. LODH001 encountered units LOSH22 through to LOLS16 (Fig. 2) on the west limb of the Friesian Anticline (Fig. 3). Patchy Fosterville-style mineralisation (up to 7.7 m @ 4.24 g/t) occurred within STS down the hole. It is rare to get good mineralisation on west limbs at Fosterville and prospectivity was considered to be high at Lockington if a structural site equivalent to the Phoenix Fault could be found. Numerous thick shales with bedded laminated quartz veins were intersected in LODH001. It was hoped that these would act as a guide to mineralisation where they crossed folds, as seen at Fosterville and Bendigo. At Fosterville, the best mineralised faults are linked to laminated quartz veins hosted by thick shales above synclines (Boucher et al., 2008c). LODH002 and LODH006 were drilled to the west of LODH001 but failed to locate a syncline. The west-limb beds are almost vertical (Fig. 3) and given that the syncline had not been located, this target model was deemed too deep to justify drilling.

Later drilling to the east located the Friesian Anticline and Syncline. Based on the Fosterville model, prospective positions were drilled but

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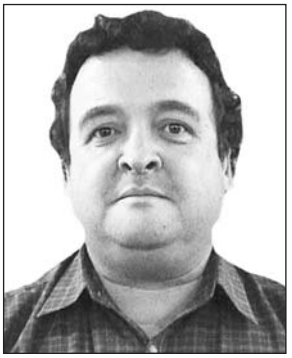

WHAT A DIFFERENCE a few months can make! The recent fallout from the economic dominoes falling throughout the world and the consequent depressed outlook for economic growth and commodity demand has had an immediate impact on exploration and mining in the form of reduced activity and decreased employment prospects throughout the industry.

An ongoing campaign to attempt to protect exploration in particular, through initiatives such as flow through shares similar to those introduced in Canada some years ago, has yielded few positive outcomes to date and will require increased effort to retain traction while the politicians and regulators are distracted by other concerns.

It remains to be seen whether and to what extent commodity demand in China, India and other developing nations will help to maintain prices and production levels in the short to medium term. The argument that a long-term reduction in commodity demand is both unlikely and undesirable due to the potentially serious domestic social upheaval it would have the potential to create in developing economies seems to be logical and we can only wait to see if it is, hopefully, correct.

AIG's public policy efforts have clearly, and I believe correctly, been focussed on education and professional development initiatives over the past 12 to 18 months, but geoscientist employment has not been forgotten and will continue to receive attention as the current economic situation unfolds.

The Commonwealth government's proposed "carbon pollution reduction" scheme is also a very serious issue to be dealt with. Critically, we cannot afford to see science sidelined by economics. I was placed in, what for me is a somewhat strange position, of having to agree with Senator Dr Bob Brown when he made this point very strongly in the media a few weeks ago. Climate change is not, principally, an economic problem. Understanding the science of the issue is paramount so that its potential impacts can be assessed rationally and logically and the need for appropriate actions fully understood. Economic modelling, like any form of modelling, in itself does not constitute facts. Models are predictions, based on an interpreted understanding of processes and often limited observations. Geoscientists regularly deal with this sort of situation in, for example, geophysics or resource estimation and are well aware, through both training and extensive experience, of the limitations of modelling techniques. The public don't have the benefit of this experience.

In this issue there are several articles and reports dealing with problems in geoscience education evident throughout the world and what this may mean for the availability of trained geoscientists in the near future. Australia is far from alone in failing to attract sufficient numbers of talented students to geoscience studies and careers. The potential solutions to this problem are far from clear, but it is worth putting forward a few suggestions.

1. It seems abundantly clear that current funding models for Tertiary geoscience education are just plain wrong. We must accept the fact that geoscience is more difficult and expensive to teach than other sciences. Students need time in the laboratory - in the field - so that they have an opportunity to make critically important observations and develop interpretive skills. This argument has been accepted for agricultural sciences. It makes no sense to accept the proposition for what, essentially, is an applied Earth science and ignore the same arguments in the case of the fundamental science on which it is based.
2. Undergraduate students don't travel for their education, so geoscience courses must be widely available.
3. Individual departments must have a "critical mass" of both staff and students. It isn't satisfactory to maintain a small cadre of academic staff who critically do not have the means, resources and necessary interaction with kindred professionals needed to deliver educational outcomes and facilitate their own continued professional development. The measures used to gauge the effectiveness of academics in our universities simply aren't appropriate for geosciences.
4. Recognise the importance of undergraduate teaching as an activity in its own right. Good teachers may not be prodigious researchers and vice versa. Teaching is a fundamental role of universities. The use of research output of academics as a principal performance metric is seriously flawed.
5. The need for comprehensive geoscience education to be available at universities should not be at issue. We are continually being told that two of the most critical issues facing Australia are climate change and water resources. Geosciences are central to both. How do you expect to make progress on either without the skills required to deal with them?

Industry could do more by supporting initiatives like Earth Sciences WA and TESEP, formed to ensure students are exposed to geoscience at school prior to reaching university which, despite being modest in scope, are still not fully funded.

The lobbying and enquiries associated with this issue seem endless. The Commonwealth government has a very simple way forward. Stop stuffing around, accept the clearly presented, obvious need for well resourced geoscience departments throughout Australia and deal with the problem. Today would be good.

There have been some both positive and quite disconcerting developments recently in mining and exploration regulation. The lifting on restrictions on uranium exploration and mining in Western Australia will be widely welcomed while legislation to ban oil shale exploration and mining in parts of Queensland could be seen to represent an increase in sovereign risk. This may have potentially broader negative consequences for explorers generally, possibly unintentional but nonetheless real. Is the environmental impact assessment processes so flawed that legislation of this form is necessary? This appears to be yet another case of the role of science being downgraded.

You will no doubt be aware that there have been discussions between AIG and the Geological Society of Australia (GSA) regarding a possible merger between the two organisations. There are a number of reasons why this is being considered, amongst which a belief that there are too many geoscience societies in Australia, and a merger would create a more effective and

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no significant mineralisation was located, demonstrating that even though the mineralisation at Lockington is similar to that at Fosterville, its structural setting is different. Mineralisation is usually found in shallow west-dipping reverse faults similar to those seen at Ballarat East (Boucher *et al.*, 2008b). Most of the 31 holes drilled so far intersected significant mineralisation.

Lockington stratigraphy

Most of the drilling has been along the Friesian Anticline where a stratigraphic succession 350 m thick has been identified (Fig. 2). Thick shales dominate the succession and there is significantly more shale at Lockington than at Fosterville, Bendigo and Ballarat East. Channel sands occur near the top of the succession. Almost all shales contain significant bedding-parallel, laminated quartz veins, however the continuity of these is not known. Similarly, there has not been enough drilling to ascertain variations in stratigraphic thickness as have been established at Fosterville and Bendigo.

The thicker shales (LOSH14, 17 & 20) host bedding-parallel laminated quartz veins that control the main linked fault systems. There are not enough data at this stage to demonstrate how many thrust fault systems propagate from the bedding-parallel faults and it is possible that they all do.

Stratigraphic controls on the development of veins, faults and folds

Bedding-parallel, laminated quartz veins are common at Lockington within thick shale hosts. Stockwork quartz occurs close to major faults and is especially well developed in sand units.

Mappable linked faults occur between bedding-parallel laminated quartz veins within LOSH14 and LOSH17, and also between LOSH14 and LOSH20 (Fig. 3). There are not enough data to ascertain if faults propagate from other laminated quartz veins. The linked fault style is similar to that seen at Fosterville and Bendigo. Like Fosterville, the thicker shales generate the largest faults - although the fault displacements at Lockington reach only 20 m whereas the key faults at Fosterville have 150 m displacement.

A second series of faults is west-dipping and crosses both fold limbs, similar to the situation seen at Ballarat East (Boucher et al., 2008b). These faults tend to be mineralised. They often have only a couple of metres of displacement which can be detected solely by detailed stratigraphic mapping revealing one or two faulted-out beds. STS successions are mineralised where crossed by such faults, whereas the thick shales are not usually. Targeting of these structures is difficult given the large volume of thick shales in the overall succession. It is probable that west-dipping faults offset all other structures and are younger than the folds and the main linked-fault system, although more data are needed to confirm this. It is likely that there are significantly more of these faults than shown in figure 3. Only LODH006 and LODH022 intersected channel sands cut by an interpreted west-dipping fault.

Based on Ballarat East, this should be a good structural site for mineralisation. LODH006 intersected 2.0 m @ 2.47 g/t in this position and LODH022 similarly intersected 2.5 m @ 4.17 g/t indicating a target worthy of further drilling.

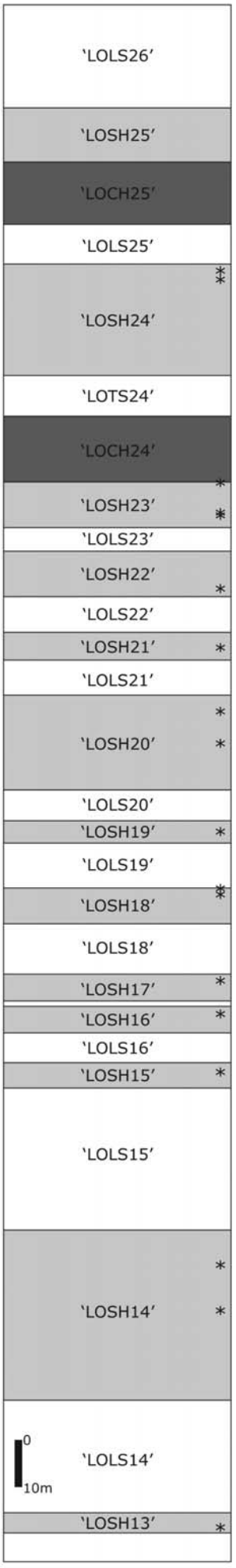

Figure 2. Stratigraphic column highlighting thick shale units (pale grey), channel sands (dark grey) and major bedding-parallel, laminated quartz veins (*)

Folding and fault styles at Lockington

The Friesian Anticline and Syncline (Fig. 3) are upright chevron folds with interlimb angles of 30° and 40° respectively. A domal structure culminates within the drilled area and hinge lines plunge gently to the north and south. To the east, the Holstein Syncline is a steeply inclined open fold with an interlimb angle of 80 o to 90 o and where drilled is plunging gently to the south.

Lockington has linked fault systems similar to those seen at Fosterville and Bendigo plus pervasive west-dipping faults like those at Ballarat East. It has been proposed that the lack of thick shales at Ballarat East allowed folds to be tighter than at Bendigo (Boucher *et al.*, 2008b) and therefore faults crossed bedding rather than slipping along it. At Lockington, it appears that bedding-parallel slip occurred in the early stages of folding, represented by laminated quartz veins. It is likely that once the west limb of the Friesian Anticline approached a vertical orientation, faults propagated across the limb rather than along bedding. The west-dipping faults tend to be the mineralised and are likely to be the latest faults.

Conclusions

Gold is present at Lockington in Fosterville-style fine-grained disseminated arsenopyrite mineralisation. Linked faults propagating from laminated quartz veins within thick shales similar to those found at Fosterville and Bendigo occur here. However, these tend not to be mineralised. Low-displacement, pervasive west-dipping faults like those at Ballarat East are present as well. These faults are probably younger and host the majority of the mineralisation. Only 31 diamond holes have been drilled at Lockington on broadly spaced sections. While economic gold-bearing structure(s) have yet to be recognised, the number of gold intersections and the volume of the unexplored area indicate there is plenty of potential for a major deposit.

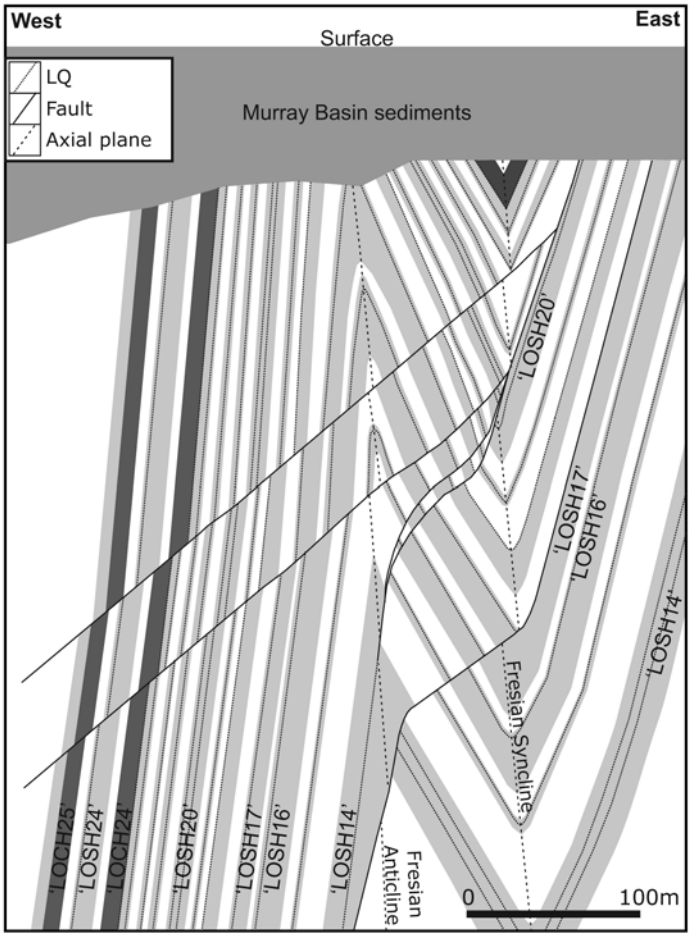

Figure 3. Section 5981900mN showing major shale and channel-sand units, key faults and laminated quartz veins (LQ's).

Acknowledgements

This paper would not have been possible without the support of Gold Fields Australasia, and thanks are due to Aaron Wehrle, Regional Geologist, Gold Fields Australasia for valuable comments and edits.

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From Your President

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representative public voice for geoscientists rank amongst the most important. The current status of this proposal is that there have now been several meetings to discuss the proposition and the form that the merged entity would take. It is no simple task to effectively merge two very different organisations while building on the best attributes of each organisation in creating an even better one. At present, both AIG and GSA are seeking independent advice on the legal processes required for a merger, which will be completed prior to representatives of both organisations meeting, probably in the new year, to decide on the feasibility of the proposal and whether to proceed with developing a detailed proposal and plan to be considered by both AIG and GSA members. It goes without saying that AIG members will be kept fully informed and will be able to participate in the process, and be provided with the information needed to make an informed decision should any decision to proceed be made.

Andrew Waltho

Lexical Jokes

Cashtration (n.): The act of buying a house, which renders the subject financially impotent for an indefinite period of time.

Ignoranus: A person who's both stupid and an a-hole.

Intaxication: Euphoria at getting a tax refund, which lasts until you realize it was your money to start with.

Reintarnation: Coming back to life as a hillbilly.

Bozone (n.): The substance surrounding stupid people that stops bright ideas from penetrating. The bozone layer, unfortunately, shows little sign of breaking down in the near future.

Foreploy: Any misrepresentation about yourself for the purpose of getting laid.

Giraffiti: Vandalism spray-painted very, very high.

Sarchasm: The gulf between the author of sarcastic wit and the person who doesn't get it.

Inoculatte: To take coffee intravenously when you are running late.

Hipatitis: Terminal coolness.

Osteopornosis: A degenerate disease. (This one got extra credit.)

Karmageddon: It's when everybody is sending off all these really bad vibes, and then the Earth explodes, and it's a serious bummer.

Decafalon (n.): The grueling event of getting through the day consuming only things that are good for you

Glibido: All talk and no action.

Dopeler effect: The tendency of stupid ideas to seem smarter when they come at you rapidly.

Arachnoleptic fit (n.): The frantic dance performed just after you've accidentally walked through a spider web.

Beelzebug (n.): Satan in the form of a mosquito, that gets into your bedroom at three in the morning and cannot be cast out.

Caterpallor (n.): The color you turn after finding half a worm in the fruit you're eating.

The Washington Post has also published the winning submissions to its yearly contest, in which readers are asked to supply alternate meanings for common words. And the winners are:

coffee, n. the person upon whom one coughs.

flabbergasted, adj. appalled by discovering how much weight one has gained.

abdicate (v.): to give up all hope of ever having a flat stomach.

esplanade (v):. to attempt an explanation while drunk.

willy-nilly (adj.): impotent.

negligent (adj.): absentmindedly answering the door when wearing only a nightgown.

lymph (v.): to walk with a lisp.

gargoyle (n.): olive-flavored mouthwash.

flatulence (n.): emergency vehicle that picks up someone who has been run over by a steamroller.

balderdash (n.): a rapidly receding hairline.

testicle (n.): a humorous question on an exam.

rectitude (n.): the formal, dignified bearing adopted by proctologists.

pokemon (n.): a Rastafarian proctologist.

oyster (n.): a person who sprinkles his conversation with Yiddishisms.

circumvent (n.): an opening in the front of boxer shorts

Anonymous

Found: The Hottest Water on Earth

Catherine Brahic

04 August 2008, NewScientist.com news service
Journal reference: Geology (DOI: 10.1130/G24726A.1)

THE HOTTEST KNOWN WATER on Earth has been discovered issuing from black smokers deep in the Atlantic Ocean (Footage courtesy of MARUM/Andrea Koschinsky).

Even Jules Verne did not foresee this one. Deep down at the very bottom of the Atlantic Ocean, geochemist Andrea Koschinsky has found something truly extraordinary: "It's water," she says, "but not as we know it."

At over 3 kilometres beneath the surface, sitting atop what could be a huge bubble of magma, it's the hottest water ever found on Earth. The fluid is in a "supercritical" state that has never before been seen in nature. The fluid spews out of two black smokers called Two Boats and Sisters Peak.

Koschinsky, from Jacobs University in Bremen, Germany, says it is somewhere between a gas and a liquid. She thinks it could offer a first glimpse at how essential minerals and nutrients like gold, copper and iron are leached out of the entrails of the Earth and released into the oceans.

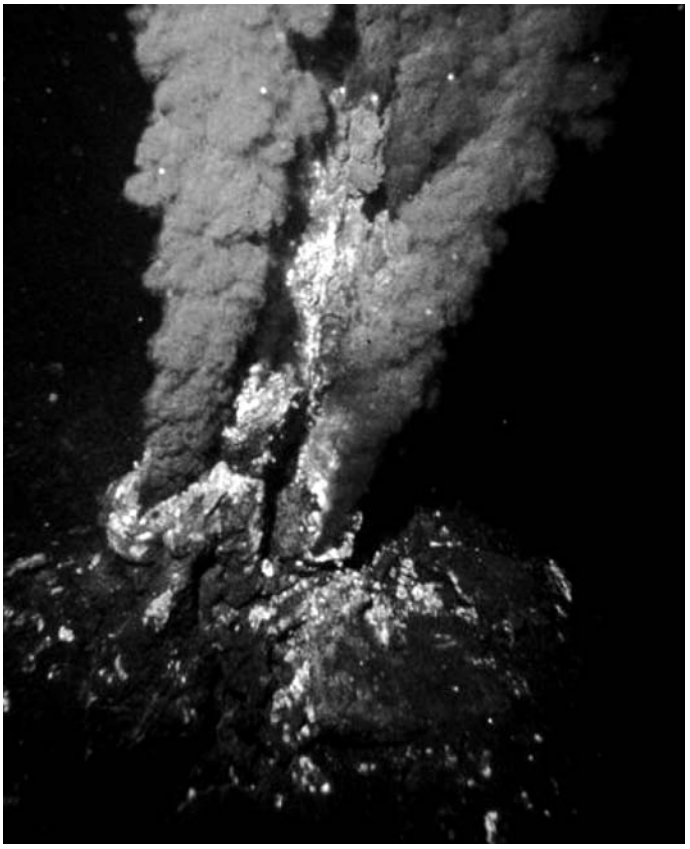
Liquids boil and evaporate as temperature and pressure rise. But push both factors beyond a critical point and something odd happens: the gas and liquid phase merge into one supercritical fluid. For water, this fluid is denser than vapour, but lighter than liquid water.

Hot 'bubble'

Water and seawater have both been pushed past this critical point in labs, but until Koschinsky and her colleagues sailed to just south of the Atlantic equator in 2006, no-one had seen supercritical fluids in nature. Geochemists suspected that if they were to find them anywhere, they would be coming out of very deep hydrothermal vents.

In 2005, a team of scientists including Koschinsky visited 5° south, as part as a six-year project to investigate the southern end of the mid-Atlantic Ridge. There, they discovered a new set of vents, which they revisited in 2006 and 2007, lowering a thermometer into them each time.

Computer models suggest that the fluid that comes out of these black smokers initially seeps down into surrounding cracks in the seabed, gradually getting deeper and hotter as it approached the Earth's magma. Eventually, at 407 °C and 300 bars of pressure, the water becomes supercritical.



A black smoker (Image: NOAA)

Because supercritical water is far less dense than liquid water, it shoots up to the seabed like a bubble and it is spat out into the ocean through vents.

Powering life

From their first visit in 2005, the team found temperatures in the vents were at least 407°C, and even reached 464°C for periods of 20 seconds.

Supercritical water leaches metals and other elements out of rock far more efficiently than liquid water or vapour. Gold, copper, iron, manganese, sulphur and many more are brought out of the Earth's guts when the water is ejected from the black smokers.

Some, such as sulphur, provide energy to the locally adapted organisms, which have no light to power a food chain. Manganese is similarly used as an energy source by microbes higher up in the water column. Iron is essential for the growth of all phytoplankton.

Koschinsky estimates up to half the manganese and one tenth of the iron found in the oceans could come from vents. But because supercritical fluids have never been observed in nature, little is really known about how this happens.

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Found: The Hottest Water on Earth

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Melting equipment

"We stand to greatly improve our models of fluid circulation and heat and mass transfer," says Margaret Tivey, a geochemist at the Woods Hole Oceanographic Institute (WHOI) in Massachusetts.

Because of the extreme conditions, computer models are the only way of understanding the processes that drag elements out of the seafloor at hot vents. "It's not yet possible to drill into active vents," explains Koschinsky. "Temperatures are so high, much of drilling equipment would melt and joins would not work anymore." The data from the new vents will be invaluable in testing the models.

"The findings are significant," says Dan Fornari, also of WHOI. "The high temperature of the venting is especially interesting as this [mid-ocean ridge] does not spread very rapidly."

The Pacific spreads faster than the Atlantic, bringing magma closer to the seabed. For this reason, geochemists expected to find supercritical seawater there too. "So one can presume that this portion of the south mid-Atlantic ridge is in a very magmatic phase and has been for a few years," adds Fornari.

'Dry as a biscuit'

In the Pacific, vents tend to cool after a year or so, but it is likely that the Two Boats and Sisters Peak have been active since an earthquake shook the region in 2002. "The magma body underneath is probably enormous," says Koschinsky.

Her colleague Colin Devey of the University of Kiel in Germany is not so sure. "The explanation could be that there's lot of magma, but after a few more years of high temperatures, it's going to get to the point where it will be embarrassing how much magma there needs to be to maintain them for that long."

He thinks the long-standing temperatures could indicate something more fundamental. The fact that vents cool much more quickly in the Pacific could indicate the crust there is much more water-logged than it is in the Atlantic, where it could be "dry as a biscuit".

"If that turns out to be the case then we will have taken down a very, very Holy Grail," says Devey. ▲▲

The Mineral Industry in Victoria

DURING THE YEAR 2008 the Victorian Branch Committee of the AIG was contacted by a number of members identifying problems with the amount of time involved in getting approvals for Work Plans on Exploration and Mining Licences, and the associated costs to the industry. The committee, feeling that such negative impressions cannot be good for the Industry in Victoria, decided to test this dissatisfaction among a wider membership.

The test was based on responses to a questionnaire emailed to members resident in Victoria, and other geologists and industry persons who are on the GPIC-Bendigo email list. Responses were received largely by email within 2 weeks of the initial mail-out in late August.

The respondents in accompanying emails overwhelmingly welcomed this initiative of the Victorian Branch. Many respondents felt that the Work Plan process was too onerous, and consequently their enthusiasm for working in Victoria was affected.

The results show that dissatisfaction with the Work Plan process is widespread. At the Resources Victoria Conference in late August, the Executive Director (M&P) emphasised the improvement in closure times for Work Plan Approvals, so whether justified or not, the dissatisfaction should be addressed.

The main issues of concern to respondents are inconsistencies between offices and officers involved in the approval process (within the DPI and other departments), timely communication of issues associated with the applications, and the complexities of preparing a Work Plan. Respondents also felt that the DPI was not doing enough to promote the industry among the community, and within other departments.

Suggestions for improving the situation include the introduction of templated Work Plans, more workshops with industry and departmental involvement, and a more pro-active department.

The VIMP program, RVD Initiative and new data supply were recognised by geoscientists as a definite encouragement to mineral exploration. Some DPI officers were named as providers of exemplary assistance in completing Work Plans. ▲▲

Complaints, Complaints, Complaints

What a difference a few months makes! The optimism that the resources sector would weather the financial storm in the safe harbour of Chinese metal demand has been replaced by doom and gloom, with much of the mineral exploration industry going into capital hoarding mode, and mine development plans being put on hold until banks and punters regain the appetite for debt and equity respectively. The collateral damage to our superannuation and other personal investments is now expanding to include increasing unemployment among AIG members in the lead-up to the holiday season.

However, this is not the time for embellished reporting of exploration results, resources and reserves in order to attract the interest of the few punters left in the resource equities market. In general, reporting standards during the "boom" have been reasonable and the Complaints Committee hopes that standards during the downturn will be maintained, if not improved on. We are looking forward to a break during the festive season!

Current complaints

Files on three complaints recently investigated by the Complaints Committee have been passed on to the Ethics and Standards Committee for decision.

A thanks

At the end of 2008, I take the opportunity to thank members of the Complaints Committee, those who took the time to make complaints, and respondents to complaint allegations for assisting AIG in maintaining ethical standards during 2008.

Despite the economic gloom, have a great Christmas and New Year.

Rick Rogerson
Chairman, Complaints Committee

Editor's Desk

This is the last AIG News for 2008 and what a year it has been, from the euphoria of the Beijing Olympics to the Wall Street Crash and the election of the next president of the U.S., and the latest crash in commodities will affect AIG members.

It is sad to hear of the passing away of Ross Kennedy on the 30th of October, 2008; Ross was most famous for his discovery of the RedRoss nickel mine near Widgiemooltha - Terry Barclay and Tim Hopwood share some memories in this AIG News.

This issue focuses on the parlous state of geosciences education and the log jams in getting anything approved in the mining industry.

Andrew Waltho attended a recent conference on this issue and notes the enormous task of attracting students to study geology, especially in light of the latest crash in commodities, does not augur well for us. To make matters worse, it seems to be a worldwide problem though I would not include China in this situation given the prodigious number of geoscientists graduating from their universities as a previous AIG News highlighted in issue 89.

"Constipated approvals processes" is how Norman Moore, MLC, Minister for Mining and Petroleum described the situation in Western Australia when addressing the Australian Nickel Conference at the Sheraton Hotel during 22-23 October. The minister also pointed out that Western Australia, as an exploration risk, is now the worst in Australia, and 12th overall in the world. AIG Victoria branch did a recent survey for Victoria and also noted a similar delay in the approvals process. From one decision making authority eight or nine years ago to at least seven today in Western Australia highlights the present situation in which an enormous amount of duplication and increase in workloads for all concerned, including government. One reaction I got from a senior DOIR officer was for the mining industry to innovate!

Climate change continues to be a topical issue and criticism based on geological considerations, is starting to have an effect - the most recent being an excellent presentation by Professor Ian Plimer to the Sydney Mining Club on 6 November.

Antipodal Hotspots and Bipolar Catastrophes: Were Oceanic Large-body Impacts the Cause?

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Abstract

One aspect of the hotspot distribution that has received little attention is its antipodal character. Of 45 "primary" hotspots found in most hotspot compilations 22 (49%) form antipodal pairs within observed hotspot drift limits (? 20 mm/yr). In addition, the available ages, or possible age ranges, for both hotspots of an antipodal pair tend to be similar (? 10 Myr difference) or overlap. Monte Carlo simulations indicate that the antipodal primary hotspots' locations and ages are not due to chance at the > 99% confidence level ($p<0.01$). All hotspot pairs include at least one oceanic hotspot, and these are consistently opposite those hotspots related to large igneous provinces (LIPs) and continental volcanism. A mechanism of formation is considered in which minor hotspot volcanism is induced at, and flood basalt volcanism is triggered by seismic energy focused antipodal to, oceanic large-body impact sites. Because continental impacts are expected to have lower seismic efficiencies, continents possibly acted as shields to the formation of antipodal hotspot pairs. Published numerical models indicate that large oceanic impacts (10-km-diameter bolide) generate megatsunami capable of altering coastal depositional environments on a global scale. Past impact-generated megatsunami, consequently, could have left widespread stratigraphic records, possibly misinterpreted as indicating large rapid changes in eustatic sea level, and widely disrupted continental and marine sediment reservoirs responsible for abrupt changes in the isotopic composition of seawater. Phanerozoic mass extinction events, therefore, might have resulted primarily from catastrophic megatsunami in a dominantly oceanic hemisphere and the near contemporaneous effusion of vast quantities of noxious gases from flood basalt eruptions in a dominantly continental one.

The above abstract is taken from a most interesting paper that brings up an unusual idea. The purpose of this short review is to expose fellow members of the AIG to some of the more important ideas expressed in the paper, and to encourage others to read this and other articles on the same subject.

Hot spots and their possible causes are discussed and defined as a relatively small area of volcanism. Models of hot spots have to take into account large igneous provinces (LIP) as well as areas as simple as a single volcano. The central purpose of the paper is to discuss the premise that hot spots and LIP's are possibly formed from large-body impacts or bolides, and these often have an antipodal hotspot.

A list of the prominent LIP's, related hotspots, and antipodal hotspots has been made and is included as Table 1 from the text. Reconstructions using continental drift, and the age of the hotspots

	Hotspot	Lat.(°)	Lon.(°)
1	**Afar** (Ethiopian)	11 N	43 E
2	Amsterdam I.	38 S	78 E
3	Ascension[2]	8 S	346 E
4	Azores	38 N	332 E
5	Balleny Is.	67 S	163 E
6	Bouvet I.	54 S	3 E
7	Bowie Smt.[1]	53 N	225 E
8	Canary Is.	28 N	344 E
9	Cape Verde Is.	16 N	335 E
10	Cobb Smt.[1]	47 N	229 E
11	Comores	12 S	43 E
12	Crozet I.	45 S	51 E
13	Darfur	13 N	24 E
14	Discovery Smt.[1,2]	42 S	0 E
15	E. Australia	38 S	143 E
16	Easter I.	27 S	251 E
17	Eifel	50 N	7 E
18	Fernando Noronha[1]	4 S	328 E
19	**Galápagos Is.** (Caribbean-Colombian)	0 N	269 E
20	Guadalupe I.	29 N	242 E
21	Hawai`i	19 N	205 E
22	Hoggar[1]	23 N	6 E
23	**Iceland** (North Atlantic)	65 N	343 E
24	Jan Mayen	71 N	352 E
25	Juan Fernandez Is.	34 S	278 E
26	Kerguelen Is.	49 S	69 E
27	Lake Victoria	3 S	36 E
28	Lord Howe I.[1]	31 S	159 E
29	Macdonald Smt.	29 S	220 E
30	**Marion I.** (Madagascar)	47 S	38 E
31	Marquesas Is.[1]	10 S	222 E
32	Mt. Erebus	77 S	167 E
33	New England Smt.[1]	28 N	327 E
34	Pitcairn I.[1]	26 S	230 E
35	Raton	36 N	256 E
36	**Réunion** (Deccan)	21 S	56 E
37	St. Helena[1]	17 S	352 E
38	Samoa	14 S	187 E
39	San Felix	26 S	280 E
40	Society Is.	18 S	211 E
41	Tasman Smts.[1]	39 S	156 E
42	Tibesti	21 N	17 E
43	Trindade I.[2]	21 S	331 E
44	**Tristan da Cunha**[2] (Paraná-Etendeka)	37 S	348 E
20	Yellowstone (Columbia River)	44 N	249 E

has resulted in the pairs as listed. The circular distance between the pairs is listed in degrees, and it is quite close to 180o in many instances. These data suggest the idea of antipodal hot spots. The main error in determining the antipodal character is in determining the actual age of initiation of the hot spots. Generally, at least minimum the minimum age is available.

Table 1 lists LIP's, their associated hot spots, and their corresponding antipodal hotspots.

Various articles that list and classify hot spots are cited and discussed. A total of 45 "primary" hot spots have been compiled and used in this article. Of these, 7 of the 8 most prominent hot spots which are associated with young LIP's have hotspots that are antipodal within conservative drift limits. There is a further list of 30 Oceanic hotspots with near antipodal sites listed as Table 3 of the Appendix which is also reproduced here.

A series of Monte Carlo simulations has been done on these data, and without going into the mathematics, (which eludes the writer) the results demonstrate that the antipodal pairs, with their similar ages and opposite locations, are at least 99% certain of not being due to chance. All pairs are characterized by one oceanic point which is always opposite either a LIP or continental volcanism.

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Left: Table 1: 'Primary' hotspot locations

Compiled from the intersection of Vogt's list [1] (as published by Pollock et al. [2]) with those of Sleep [3], Davies [4], Steinberger [5], Richards et al. [6], and Crough and Jurdy [7] (see table 2 in the EPSL Online Background Dataset1). Bold text indicates those hotspots most likely initiated by flood-basalt volcanism (bold-italic text; Table 1).

1 No documented activity in the Holocene; see [8].

2 No antipodal volcanic feature identified in the Pacific Ocean.

Antipodal Hotspots and Bipolar Catastrophes: Were Oceanic Large-body Impacts the Cause?

Oceanic Site	Location		Age (Ma)	Antipodal Site	Location		Age (Ma)	Ang. Dist.(°)	Drift (mm/yr)	Distance to next htspt (km)
	Lat.(°)	Lon.(°)			Lat.(°)	Lon.(°)				
Kerguelen	49 S	69 E	~29-24[1]	Yellowstone	44 N	249 E	~17[2]	175	~19	1440 / 560
Marquesas	10 S	222 E	~36[3,4]	Afar	11 N	43 E	~31[2]	179	~3	1440 / 440
Jan Mayen	71 N	352 E	≤50[5]	Mt. Erebus	77 S	167 E	~40[6]	174	~17	780 / 330
Balleny	67 S	163 E	≥36[7]	Iceland	65 N	343 E	~62[2]	178	~4	780 / 780
Lord Howe	31 S	159 E	>50[8]	Canary	28 N	344 E	~65[8]	175	~9	890 / 560
Guadalupe	29 N	242 E	>25[8]	Réunion	21 S	56 E	~67[8]	170	~10	890 / 780
Cobb	47 N	229 E	>40[8]	Crozet	45 S	51 E	≥20[9]	178	<6	780 / 1000
Tasman	39 S	156 E	>50[8]	Azores	38 N	332 E	≥60[9]	177	<6	890 / 1110
New England	28 N	327 E	≥60[9]	E. Australia	38 S	143 E	>50[8]	169	<20	1220 / 1110
Bowie	53 N	225 E	>30[8]	Marion	47 S	38 E	~90[2]	173	~9	440 / 1000
Raton	36 N	256 E	?	Amsterdam	38 S	78 E	~110?[10]	177	~3	780 / 1440
Lake Victoria(?)	3 S	36 E	?	Hawai`i	19 N	205 E	>100[8]	161	<26	560 / 3660
Pribilof Is.	57 N	190 E	~2[11]	Bouvet	54 S	3 E	≥1[6]	175	-	670 / 220
Society	18 S	211 E	~5[8]	Bayuda[1]	18 N	34 E	~4?[12]	177	~66	670 / 890
Pitcairn	26 S	230 E	~8[8]	Bazman-Taftan	28 N	61 E	≥2[13]	170	-	1000 / 890
Ewing Crater[2]	14 N	222 E	≥7-11[14]	Comores	12 S	43 E	≥8[15]	175	~69	1890 / 670
Samoa	14 S	187 E	~14[8]	Aïr Massif[1]	18 N	9 E	~9?[16]	176	~32	1440 / 670
Macdonald	29 S	220 E	~19[17]	Harrat as Shamad[1]	33 N	37 E	~16?[18]	175	~29	1000 / 670
Rarotonga	22 S	201 E	~1[17]	Tibesti	21 N	17 E	~17?[19]	176	~60	890 / 440
Kavachi	9 S	158 E	?	Cape Verde	16 N	335 E	~20[8]	172	~44	1330 / 1550
Juan Fernandez	34 S	278 E	>30[8]	Unnamed (China)	36 N	92 E	?	175	<19	890 / 1330
San Felix	26 S	280 E	>30[8]	Tengchong	25 N	98 E	≥18[20]	178	<7	890 / 560
Admiralty Is.	3 S	147 E	?	Fernando	4 S	328 E	≥30[8]	173	<26	1330 / 1670
Rurutu	24 S	209 E	≥10[21]	Darfur	13 N	24 E	~35[17]	168	~38	670 / 1110
Monowai Smt.	26 S	183 E	?	Hoggar	23 N	6 E	~35[17]	176	~13	1440 / 670
Socorro[1]	19 N	249 E	>25[8]	Rodrigues[1]	20 S	63 E	≤36[22]	174	<19	1330 / 780
Campbell I.	52 S	169 E	≥11[6]	Eifel	50 N	7 E	~40[8]	169	~31	220 / 560
Afanasy Nikitin	3 S	83 E	~80-73[23]	Galápagos	0 N	269 E	~90[2]	173	~9	2660 / 3000
Caroline[1]	5 N	164 E	>30[18]	St. Helena	8 S	346 E	~100[8]	166	~16	1670 / 1220
Easter	27 S	251 E	>100[8]	Vakak Group	34 N	68 E	?	173	<8	890 / 2110

Table 3: Near-antipodal hotspots on Earth

What are the possible explanations of this? It could be symmetry of mantle convection, or it could be caused by antipodal focusing of seismic energy from bolide impacts. The latter seems to be the best option.

In conclusion, the author proposes a model where one hot spot forms at an oceanic large-body impact site and a subsequent antipodal hotspot and possibly a LIP formed from seismic focusing. Continental impact structures lack an associated antipodal hotspot, and this is ascribed to low seismic efficiencies which have apparently dissipated the energy rather than allowing it to focus on an antipodal position.

Global mass extinctions have been associated with both large-body impacts and continental LIP's by many writers. Other suggested causes of extinction have been rapid regressive and transgressive changes in sea levels and radical changes in ocean chemistry. The author suggests that large body impacts could be responsible for both of these causes. A megatsunami resulting from an impact should have a dramatic effect on coastal stratigraphic records, and should leave a near worldwide time mark. These could easily be misinterpreted as sea level falls and rises. Shifts in ocean chemistry could also be explained in this manner. The Permian-Triassic transition is given as one possible example.

Much work remains to test the model of antipodal focusing. A search for megatsunami traces in costal stratigraphic records is an important part of this work that all geologists can do. When the big one comes in, do not go to the opposite poles of the earth for safety! ▲▲

Notes as in Table 1

Distance to next htspt, angular distance to the next hotspot listed either in table 1 or 2 of the EPSL Online Background Dataset1. The average angular deviation from exact antipodality for 29 out of 30 hotspot pairs is 6° with a standard error of ±7°. In several instances, particularly in Africa, volcanism has occurred sporadically over long time intervals at the antipodal site. In the Bayuda volcanic field of Sudan, nearly antipodal to the Society hotspot, the youngest volcanism is Pleistocene in age (~2-1 Ma). The Pleistocene volcanism was preceded by 5 other episodes ranging in age from late Cretaceous (~70 Ma) to early Pliocene (~4 Ma), each separated by long intervals of time [12]. Society hotspot volcanism has coeval ages only with the early Pliocene and younger events. Similarly, volcanism occurred at the Aïr Massif during the Oligocene to early Miocene (~35-21 Ma), and was concentrated at the intersection of structural lineaments. A second magmatic event spanned late Miocene to Pleistocene time (~9-2 Ma) [17], starting close to the initial age of the Samoan hotspot (~14 Ma). Mesozoic, early Neogene (~16 Ma), and Pliocene-to-Recent volcanic events occurred at Harrat as Shamad [19] in the eastern Mediterranean region. The nearly antipodal Macdonald hotspot has an age of ~19 Ma, and is contemporaneous with the Neogene and younger events. Older volcanic rocks exposed north of the Tibesti field have an age of ~17 Ma [20], and the young volcanoes and lava fields covering Tibesti are Quaternary in age [24]; the antipodal Rarotonga hotspot also originated during Quaternary time (~1 Ma) [17].

Footnotes

1 Secondary hotspots from groupings 1-55 and 56-64 (see table 2 in the EPSL Online Background Dataset1).

2 See table 4 in the EPSL Online Background Dataset1.

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American Geological Institute - Oslo, 10 August 2008

Future of the Geoscience Workforce Workshop

Andrew Waltho, 16 August 2008

Overview

This workshop was convened by the American Geological Institute during of the 33rd Geological Congress, held in Oslo, Norway, August 2008. The workshop included presentations from public geoscience agencies, universities, professional associations and major industry employers focussed on geoscience education issues and their potential impact on the profession, public geoscience agencies, universities and industry.

Introduction

The availability of geoscientists is a global problem, except perhaps in some Asian countries, notably China and to a lesser extent southeast Asian countries including Thailand, Indonesia and perhaps India, where the public perception of geosciences is stronger than elsewhere in the world. In China, geology is considered to be a fundamental scientific discipline to which disciplines including civil engineering, applied geology, petroleum geoscience and environmental science are considered to be derivatives. Elsewhere, countries are facing the same problems that are evident in Australia:

- Few, if any, students are receiving being exposed to geology as part of their high school science studies.
- First year geoscience courses at university are not attracting students to further studies in the field in favour of their already chosen courses.
- The geoscientific workforce is ageing, especially in the public sector.
- There is a pronounced shortage of undergraduates going on to higher degree studies and academic careers.
- In many countries, undergraduate students are being induced to take up employment with mainly mineral and coal exploration companies prior to completing their undergraduate studies, mainly due to the lure of high salaries.
- Public sector salaries are invariably much lower than those being offered by industry, especially in the petroleum sector.

The experience in the USA is that students who do not continue to Masters or PhD programs after graduation, or even those who leave university before completing Bachelor degrees, do not return to complete their studies or work towards higher degrees.

Geoscientist Employment Trends

Australia may be considered to be somewhat unique in terms of the proportion of geoscientists employed in industry which, at around 75% to 80% (minerals, coal and petroleum) is much higher than in many other countries. In Europe (considering France and Germany to be typical) almost 50% of geoscientists work in the public sector (government agencies and universities) while a further 25% work in energy resources (exploration and production). Rapid employment growth is being experienced in environmental geoscience, driven by increased pressure on the management of groundwater resources and rapidly increasing demand for geoscientists in carbon capture and storage geoscience.The demand for geoscientists in the emerging CCS sector is expected to grow rapidly. Europe is placing a very high degree of reliance on the success of CCS technologies in order to meet

Kyoto commitments, which have been further increased by some European governments. In Germany for example, the anthropogenic CO2 emission reduction commitment has been increased to 40% from 2004 levels by 2020, in a country that is planning to phase out nuclear power generation by 2012. Coal will, therefore, remain and even increase in importance as a source of energy, with most European governments encouraging the development of renewable energy projects but not expecting them to have a substantial impact on the energy mix within the next decade. CCS is also expected to generate significant demand for geoscientists in the USA and Canada. The USA, while it may appear to be lagging the world in the development of public policies promoting emission reduction, is one of the largest investors in CCS and emission reduction research.

Interestingly, there has been a marked trend away from teaching applied environmental science programs in Europe, with employers strongly favouring students with stronger fundamental scientific skills and a more thorough understanding of geological systems and processes.

The rapid growth in the demand for environmental scientists expected during the 1990s and the motivation underlying the merger of geology departments into broader based departments and schools covering earth science and environment did not eventuate, at least until very recently.

The skills being sought by employers are, however, in fundamental geology and geoscience, and not in the applied skills that these departments were created to provide.

Skills and Abilities

A common set of "core" geoscience skills were considered to be desirable by both public and major private sector employers:

- Personal integrity;
- A command of English;
- Intellectual capacity;
- "Networking Skills" (an ability to be able to engage and integrate information provided or needed by professionals in both resource industries and other sectors, government, the community at large, research personnel and commercial partners);
- Mastery of fundamental Earth processes;
- Mastery of scientific method, including an ability to maintain multiple working hypotheses; and,
- Some commercial skills in order to recognise opportunities and the need for reporting of ideas, outcomes and commercial factors.

In seeking these skills, industry (and the petroleum sector in particular) has recognised the desirability of building gender, skills and cultural diversity within their workforce to increase their ability to operate effectively in any part of the world. Employers also recognise the value of professional society membership as a means of increasing the "bandwidth" of exposure to different ideas and practices received by their employees.

The desirability of adopting English as the preferred language for geoscience communication internationally has been accepted, and even acted upon in some countries. In France, for example, geoscience departments at universities are moving towards either developing bilingual delivery of courses or teaching geoscience subjects exclusively in English. A similar trend is developing amongst some institutions in China where more than 50% of postgraduate students are studying in China from other countries, notably from Africa.

Concerns expressed by employers included:

- A lack of field experience;
- Too much specialisation in undergraduate geoscience courses;
- Parochialism and a lack of mobility;
- A lack of business sense; and
- A lack of work ethics and professionalism.

Geoscience societies were a particular target for criticism in relation to the latter issue. Policies of not granting full membership to graduate geoscientists were perceived to be elitist by young professionals and a source of negative perception of the role of professional societies and institutes. The practice was questioned strongly by both academics and employers.

Specific Issues Affecting Geoscience Education

There are a few specific issues recognised as affecting geoscience education in the USA that are also evident in Australia:

- Students are generally unwilling to travel to undertake geoscience studies. The experience in the USA appears to be similar to the situation in Victoria that followed the closure of the geology course at La Trobe University.
- Geoscience is recognised as an expensive course to teach. An undergraduate geoscience student at the University of Nevada costs $20,000 to teach per annum, as opposed to a liberal art undergraduate who costs less than $3,000 per annum.
- Geoscience departments face extreme cost reduction pressures. This has contributed directly to a reduction in laboratory based training in petrology, mineralogy and economic geology and, more seriously, in a near complete removal of fieldwork from geoscience courses. Some US universities are producing geoscience graduates with little or no field experience of any sort, let alone training in mapping skills.

The lack of field experience is also attributed to the litigious culture evident in the USA and the cost of obtaining insurance to cover field based programs.

Geoscientist Availability

There is effectively no geoscientist unemployment globally at present. In many countries up to 50% of geoscientists have taken up non-geoscience careers where their skills are valued indirectly or experiences acquired post-graduation are valued by employers in other fields, notably in finance and commerce, and in management. The cyclical nature of exploration and mining has contributed to this in Australia. The experience globally is that geoscientists who gain employment in other fields do not return.

The USA faces a particular problem with geoscientist availability in the public sector. Government policies severely restrict the employment of non-US citizens in the public sector. More than half of the students at US universities are consequently ineligible for employment by government agencies.

A surplus of geoscientists is currently being trained in China and a number of southeast Asian countries. Their ability to take up employment in other countries is hampered by immigration constraints in many countries and a lack of fluency in English.

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Public Geoscience Agencies

Public geoscience agencies, including the USGS, BRGM and British Geological Survey (BGS) are facing problems of:

- An ageing workforce (in the USGS and BRGM, more than half of the geoscientists are within 10 to 15 years of retirement;
- Constrained budgets and low salaries are preventing the replacement of staff who retire or resign; and,
- Mapping programs are suffering from an inability to recruit personnel with field experience.

The USGS has addressed these problems, at least in part, by implementing a cooperative mapping program, where universities are allocated specific mapping projects to be undertaken by small groups of students with close academic supervision, that are jointly funded (50:50) by the USGS and the university. This program is in its twelfth year, with students who participated in the early years of the program and went on to academic careers are now applying for projects for their own students.

The South African Problem

Additional problems are being faced by South African geoscience agencies, universities and industry due to:

- An exodus of professionals from the country;
- A very poor perception of career opportunities in Africa by internationally trained geoscientists; and,
- The high mortality rate associated with AIDS affecting all sectors of the population.

A speaker from the University of Witwatersrand had a very dismal view of the future of geosciences (and other scientific and engineering disciplines) in Africa, to the extent where universities and companies would be unable to train and recruit geoscientists required to meet the needs of the public sector and industry in only a handful of years.

Conclusions

The geoscience profession is facing a number of acute challenges. Of particular concern is the:

- lack of students electing to undertake geoscience studies;
- high incidence of students leaving university prior to completing their studies, induced by high salaries being offered by industry;
- inability of the public sector to offer salaries required to compete with industry;
- increasing lack of field experience possessed by recent graduates; and,
- lack of professionalism / interest in professional issues evident amongst many recent graduates.

These issues require urgent consideration and action by the geoscience profession, where professional societies and institutes will need to play a leading role.

Copies of the presentations from the workshop are being compiled and will be distributed to attendees by AGI. ▲▲

Vale Ross (RedRoss) Kennedy - Some Tributes

ROSS KENNEDY passed away in Perth on Thursday 30th October 2008 after complications associated with his long battle with a rare form of leukemia.

He will be long remembered as a great contributor to the Australian mineral exploration industry as he was a key contributor to the discovery of a number of nickel and gold deposits in Western Australia and Africa. Furthermore, there are many exploration geologists currently working in the industry today, myself included, who learnt so much from working with Rosco. He was a great believer in the simple principal that orebodies are found in the field.

I first met Rosco in 1978 when he interviewed me for a position with CRA Exploration. He had a sample of a coral from Darwin harbor with a bullet in it and wanted to know if I had any ideas as to how and where it might have formed! I passed that test and it was the beginning of a long association whilst we were both at CRAE and then later when we both worked in the exploration industry in Perth.

For those of you reading this piece who knew Rosco it would not be complete without a fishing story of some kind! This particular story began after the completion of a field trip in the mid 1980's to the Narrows Graben by a group of CRAE geologists. This particular area was famous for its muddies and on this occasion we purchased two beer boxes, each box containing approximately twenty muddies. Both boxes accompanied us back to Brisbane in the hold of the aircraft as rock samples! The next morning in the foyer of the Crest Hotel we decided to divide up our "catch" prior to departing to all parts of Australia. Imagine our surprise when Rosco and I upended both boxes onto a piece of plastic only to find that the muddies had not been tied up. After about twenty minutes of total chaos all the muddies had been recaptured and the associated guests and hotel management placated!

Ross was also a very proud family man and is survived by his wife Norma and his children and grandchildren.

Terry Barclay

Dear Norma and the whole Kennedy Clan,

I was very much saddened to hear last night that Ross passed away last Thursday.

I knew Ross from 1948 when he was in the same class at Gosford Primary School. I knew him subsequently at University, and through his Geological Career, in Sydney, Cairns, Darwin, Kalgoorlie (Redross Ni) Adelaide and Perth.

Ross was an admired and highly respected professional, full of human understanding, He loved his Veggie garden and his tomatoes, and enjoyed life to the full.

What more can be said of any human being?

I am sure he is happy in his "Veggie Patch in the Sky".

After dealing with various corporate wheeler dealers (Ross with Resolute, me with Robert Champion de Crespigny) Ross always said to me "Every exploration geologist needs a tame shark".

God Bless Ross.

Tim Hopwood

Tertiary Geoscience Education — What are the Big Issues? ... and What are the Solutions?

By Trevor Powell and Mike Smith
Australian Geoscience Council

IN RESPONSE TO THE widespread concern within the geoscience community and employer groups, the Australian Geoscience Council (AGC) has over the past year been examining the health of geoscience education in Australia and the demise of earth science educational opportunities, university earth science teaching departments and staffing levels.

The ability of the higher educational system to provide the appropriately trained geoscientists required by the economy and Australian society is in doubt. In 2007, only 134 Honours graduates were produced across the nation — this compares with the approximately 200 needed per annum to needed to replace and maintain current numbers of geoscientists and does not take into account any increase in demand or demographic issues concerning the current population of geoscientists.

In 2007 the AGC undertook a comprehensive survey of Australian universities to compile an *Australian Geoscience Tertiary Education Profile 2007* and convened a *National Summit on the Plight of University Geoscience Education and the Supply of Graduates*, 27th September 2007 Canberra which was attended by some 50 university, professional society, industry and employer representatives. There was a consensus that unless a national approach is taken it is unlikely that the current situation will improve and there was a significant chance of further deterioration. Based on these findings the AGC, released a discussion paper *"Towards a National Geoscience Education System — invigorating university geoscience"* and has made a submission to the Higher Education Review. In the last few months, the AGC has been actively engaged along with the national committees of our member societies, university staff and employer groups in determining ways in which the profession can mitigate this situation.

The following systemic problems have been identified:

- The declining status of geoscience in Australia
- Insufficient funding of teaching in universities and the funding model
- The lack of awareness in our secondary schools - this has to be seen in the context of the dearth of science teachers and the consequent poor engagement in secondary schools with Science, Technology, Engineering and Mathematics (STEM) which is a nationally recognized problem
- The lack of post-graduate students and replacement of academic staff
- Recruitment strategies and cyclicity in the resource industries

During its engagement with university geoscience educators, the AGC has identified the need for a national effort to build human capital in the geosciences from which all stakeholders in Australian geoscience will benefit. In so doing it has developed the following prioritised list of key issues facing tertiary geoscience education in Australia, and has developed possible strategies to address the problems facing Tertiary Geoscience Education:

Rick Rogerson, Suzy Urbaniak, geology teacher Kent Street Senior High and Yasinta Situmorang, year 12 recipient of AIG top geology student prize.

1. Increasing Recruitment into Geology

We need to encourage high school students to be aware of careers in geoscience, and to choose science, preferably including geology, in their first year at university.

Strategies to achieve this important goal include:

- Getting more geology into school courses by helping teachers to deliver earth science and, in states like SA and Tasmania, to advocate the availability of Earth and Environmental Science (EES) courses. Two important initiatives need to be supported.
  - **Earth Sciences WA** (www.sciencewa.net.au and click Earth Science WA) has been developed in Western Australia with a top priority of getting geoscience into secondary schools with the introduction of new K11-12 course in EES starting in 2007. The aim is ~25% schools and K11-12 students taking EES by 2011. It has included work on professional development for teachers and development of classroom and field materials in conjunction with the WA Curriculum Council. EES is being introduced in K8-10 science courses and to enrich other K11-12 science courses. A key driver is the strategic importance of the resources industry in WA and willingness of key institutions to collaborate and seek resource industry funding.
  - The **Teacher Earth Science Education Program (TESEP)** (www.pesa.com.au and click on TESEP) has been launched by the Petroleum Exploration Society of Australia supported by some other AGC member societies to spark student interest in EES topics and to motivate and educate keen science teachers and raise the profile of EES in secondary schools nationally. It comprises 8 Professional Development workshops for science teachers who teach Years 7 to 10, to be presented at multiple centres in all eastern/central states and territories through the years 2008-2010. It is starting in Queensland, South Australia and the ACT and will be progressively rolled out as funds permit. It is planned to engage up to 500 teachers over the next five years with the potential of reaching thousands of students. The program is supported by AGC and its member societies. The program is being delivered by professional teachers under the auspices of the Australian Science Teachers Association. A key issue is developing and maintaining the funding for the execution of the program.
- Collaborating with other initiatives.There are a number of strategies at the national level designed to address STEM deficiencies in schools. For example, the Academy of Science ***Primary Connection*** program provides teachers with the material and methodologies to help them do a better job. It has been granted an injection of $4.4 million from the Federal government. The Academy also has a secondary school program called ***Science by Doing,*** which has been allocated an additional $2 million in Federal funding. There are also other initiatives of this nature. It is crucial that efforts in geoscience education in schools be associated with these initiatives and perhaps provide materials to them.
- AGC launched its ***GeoEdLink Newsletter*** in 2007 aimed at providing a forum for coordination of and collaboration in geoscience education initiatives. This activity needs to be continued and enhanced as programs develop.
- In an increasingly competitive world for talent it is essential that incentives are provided to attract the brightest and best students into the discipline. A substantial number of significant scholarships that materially improve the financial position of students undertaking geoscience will send a powerful message that geoscience is important and that graduates are needed.

2. Surviving the Cycles of the Resources Industry: Geoscience is more than Resources

Earth Science enrolments have always experienced a delayed decline or a delayed rise in response to economic cycles of the resource sector. It is only in the last couple of years that here has been an upturn in student numbers. In addition and in the present boom students are taking jobs in the private sector after only 3 years of study with some encouragement from sectors of the industry. This is unfortunate, since most people would agree that a 4 year geoscience degree equips students better for professional employment and will create demand for more specialist education for those wishing to advance their careers.

Coping with future cycles of graduate demand may be eased by:

- Industry representative and professional bodies being more active in promoting Geoscience as a nationally strategic discipline which recognises that, although it is absolutely of fundamental importance to the development of the resources industry, it is also increasingly important as an enabling science for natural resource management - land, coasts and seas; natural hazard mitigation; groundwater resource identification and management of water

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supply, and understanding the world in which we live, including climate change.

- Ensuring that University Geoscience Departments have the capability of teaching courses which do not depend on the petroleum and mineral sectors. Those departments and courses that include hydrogeology, engineering geoscience, environmental geoscience and natural hazards must be supported as much as those that teach resource based courses.
- Encouraging the resources industry to think strategically about its recruitment needs in the face of a changing demographic environment where there will be severe competition for talent. This will require companies to work with the universities to further educate their staff in the advanced and specialist skills many will inevitably need.
- Reminding industry that it has a significant responsibility for the perception that geoscience is at best a fickle employment field and that the typical expedient of eliminating exploration staff in tough financial times leaves the industry in no position to lament a shortage of technical people when times improve.

3. Overcoming the Inadequacy of the Current Funding Model

Tertiary disciplines with a high level of close contact between staff and students during teaching receive insufficient funding from the Australian Government. Geoscience is a discipline which requires very strong observational skills, which are instilled during laboratory and field course components. The funding model based on cumulative Effective Full Time Student Load (EFTSL) does not provide enough money to pay for the necessary infrastructure to support teaching in expensive and technologically sophisticated fields like geology, geophysics and petroleum engineering.

The fundamental problem exists that teaching areas with low student numbers (such as geology) provide little money for the university. With low student numbers, more expensive science and engineering programs are not economically viable, and are thus vulnerable to closure, and have closed or been amalgamated with other disciplines resulting in a thinning out of core subjects.

Is there a solution to the university funding deficiency?

- The AGC argues in its submission to the Higher Education Review that the Government must adopt a national strategic approach to ensure that tertiary teaching capacity is maintained in important minority disciplines (including geoscience). Funding arrangements should be changed to recognise the actual costs of teaching of different disciplines and also the progressive increase in costs of teaching and teaching resources as students move through a course of study towards a major/honours degree. The AGC proposed that the university funding should comprise a base level of block funding, determined by the real costs of course delivery, plus a per student rate based on EFTSL numbers.
- The funding issues facing minority disciplines have been the subject of submissions by both the AusIMM and AGC to Government reviews over the last several years. The Higher Education Review offers the best opportunity for this matter to be addressed, although the outcome is not known at the time of writing. The AGC will continue its advocacy in partnership with interested parties for solutions to the fundamental systemic issues in university funding, but it is inevitably long term and uncertain in outcome.
- A vigorous research activity necessarily contributes to the viability of university departments particularly if the full cost of research is supported. Industry can assist the viability of geoscience department significantly by establishing and co-funding research into topics of direct relevance to the company and utilising the attractively priced skills of university staff who are active in the particular field of interest.

4. Addressing the Fragmentation of Effort and the Issue of Critical Mass

The Commonwealth funding method forces departments to be self-focused in competing with other disciplines in their institution, and selfish in struggling to survive by capturing and holding on to students. The exceptional skills of geoscience educators are applied in fragmented efforts throughout the country to the net detriment of Australian geoscience. This is exacerbated by the funding model where small departments are fundamentally uneconomic in teaching. In order to survive in the absence of exposure to earth science in schools, geoscience departments must maximise their exposure to students in the first year of their science degree in the expectation of attracting students into geoscience. This supports a model of a large number of smaller departments whereby geoscience can be exposed to the greatest number of first year science students.

Can the fragmentation of effort be reduced?

- The concept of networking the capture of students at regional centres and feeding them to appropriately skilled large departments may have merit. This requires a change in the culture of retention of students at all cost, and an acceptance of student mobility.
- The CRC approach to research has proven that a combined effort yields better results. In funding research, the Government clearly recognises and rewards collaborative efforts. It seems logical that the same incentive should be built into the funding of teaching. This would require the rejuvenation of initiatives such as the Victorian Institute of Earth and Planetary Sciences (VIEPS) and the development of similar collaborative initiatives in major population centres. It could allow universities to develop strengths in key sub-disciplines and to develop viable teaching and research strengths, without having to maintain a full suite of disciplines necessary to teach a full degree.

Many universities lack the staff to teach some sub-disciplines, or key aspects of some topics - examples include geophysics, economic geology, coal geology hydrogeology, engineering geoscience and petroleum geology (as well as mining engineering and metallurgy). As discussed above there will be an increasing demand for specialist education of those who have entered industry with basic degrees.

How can specialist topics be delivered more effectively?

- The model of industry providing resources for teaching of specialist courses relevant to a particular industry at Honours and Masters levels has been adopted by the Minerals Tertiary Education Council. It is only relevant if there is a robust undergraduate system to build on and if specialist teachers are available which in the current resources boom is becoming increasingly problematic. It seems

inevitable that industry or government specialists will have to become increasingly involved in teaching the specialist topics required for advanced courses. In combination with the need for advanced education to those in the workforce, specific arrangements will be needed between employers and universities for this to occur and may require changes in the way course options and degree structures are offered.

- The utilisation of Information and Communication Technology (ICT) may enable collaboration between many departments in the live, simultaneous and interactive delivery of specialist topics. Inevitable challenges in both the equitable funding of such teaching and the scheduling of collaborative teaching should be overcome to meet the needs of Australian geoscience. This could reduce the teaching load of some staff and might assist the survival of small departments and the effective use of specialists. Existing multi-campus lecture capabilities such as the Access Grid Technology used in the Faculty of Science at Monash University provide an example of such collaborative teaching.
  - The field of geophysics is taught at relatively few universities, and even at these institutions, the academics tend to be specialised in certain areas of geophysics. This topic could be developed as a case study of ICT teaching in Australia, perhaps under the auspices of the Australian Society of Exploration Geophysicists.

5. Reducing the Cost of Geoscience Teaching

The expense of maintaining laboratories, including microscopes and specimens, and the cost of field excursions have always been problems for earth science departments and under current funding models and current historical student loads render many departments uneconomic.

Can teaching costs be reduced?

- Many of the suggestions outlined above are targeted at improving the cost structure of tertiary geoscience education whilst maintaining and hopefully enhancing it effectiveness.
- The pooling of resource through collaborative efforts may facilitate the sharing of resources that are costly or hard to maintain in concert with ideas. The provision of high quality rock samples and microscope sections might be alleviated by the use of digital files from Data Metallogenica and from the new Virtual Core Library (a CSIRO initiative led by Jon Huntington). Teaching could be designed around digital imagery of very high quality material rather than often outdated and low quality real specimens in university archives.
- University Departments which are incapable of providing field excursions for undergraduate geoscience students may be able to access external field trips. Former academic staff have indicated interest in providing excursions to proven educational field locations at minimal cost to universities, with some financial support from both industry and professional societies

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Tertiary Geoscience Education - What are the Big Issues? ... and What are the Solutions?

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Summary and Role for the Profession

The AGC's interaction with Heads of Geoscience Departments in Australian Universities leads to the conclusion that the single biggest issue facing Tertiary Geoscience Education is our topic number one "Increasing Recruitment into Earth Science".

This conclusion indicates that the best role of the professional and learned societies united under the AGC banner is to maintain its support of school initiatives such as Earth Science WA and the development of TESEP along with the e-newsletter "GeoEdLink" and by advocating the importance of earth science as a nationally strategic discipline with wide application across the resource industries and natural resource management.

Other areas of effort should also be advanced as described below.

AGC will continue to advocate that a national strategic approach should be taken by the Commonwealth government in ensuring that minor disciplines such as geoscience are supported in our Tertiary institutions. The AGC should develop and maintain a role in advocating that Earth Science Departments have the capability of teaching courses which do not depend on the petroleum and mineral sectors, including hydrogeology, engineering geoscience, environmental geoscience and natural hazards. Periodic surveys such as those undertaken in 2007 are fundamental to assessment of the health of the sector

AGC will continue to advocate that government funding arrangements should recognise the actual costs of teaching of different disciplines and the progressive increase in costs of teaching and teaching resources as students move through a course of study towards a major/honours degree. Industry support of research at Australian universities will also be strongly encouraged.

The issue of fragmentation of effort is not easily addressed nationally without a fundamental change in the approach to funding of the sector. Nonetheless the profession has a critical role in advocating to the universities the need for innovation in the way their earth science courses are delivered. AGC believes that consortia of professional groups based on the regional branches of its members and working with interested industry groups is the best way to influence the change in culture necessary - recent initiatives in Western Australia led by Jim Ross are an example to us all. The concept of networking the capture of students at regional centres and feeding them to appropriately skilled large departments has merit, provided there is a capacity to change the culture of retention of students at all cost, and to accept the notion of student mobility.

The profession has the best perspective on the issues needed to effect the necessary change to address emerging and future education needs. Whilst the AGC will continue to explore and develop ways and means to address these issues, the real challenge lies for the profession as a whole. Does it have the interest and the will to secure its future? ▲▲

For the latest in Geoscientist news, views, codes, events, employment and education visit the AIG website:
www.aig.org.au

Education Report

2008 AIG Bursary Awards

In October the AIG awarded geoscience bursaries to 18 geoscience students at Australian universities. We congratulate the following students on their awards:

- **Marissa Land**, PhD student at James Cook University, for her project: *"Canterbury Basin Drift Deposits, SE New Zealand: evidence of palaeoclimatic and oceanographic change since ~ 24 Ma".* Marissa will use her AIG Postgraduate Bursary to assist with presenting her research findings at the December meeting of the American Geosciences Union in San Francisco.
- **Ryan Portner** from Macquarie University for his PhD project: *"Sedimentology of volcaniclastic facies in a mid-ocean spreading ridge environment, Macquarie Island".* Ryan was awarded an AIG Postgraduate Bursary to present a paper at the General Assembly of the International Association of Volcanology and Chemistry of the Earth's Interior in Iceland.
- **Erin Carswell** from Melbourne University, who was awarded a Bonwick - AIG Honours Bursary for her project: *"Understanding post-glacial, basal-Ediacaran cap Dolostones: Enigmatic features, controversial origin, global significance".*
- **Glen Diemar** from the University of Western Sydney, for his project *"Supergene geochemical dispersion of antimony and an exploration model for antimony ore deposits".* Glen was awarded a SMEDG - AIG Honours Bursary and will give a presentation on his research to a SMEDG meeting in Sydney in November.
- **Erin Gray** from Curtin University, who was awarded a Geoconferences - AIG Honours Bursary for her project: *"Microstructural characterisation of olivine and implications for mantle geodynamics".*
- **Michael Hawtin** from Queensland University of Technology, who was awarded a Kagara - AIG Honours Bursary for his project: *"Volcanic facies architecture and geologic controls of the Mount Coolon epithermal system, Central Queensland".*
- **Anna McAllister** from Melbourne University, for her project: *"Stratigraphy, sedimentology and diagenesis of the Discovery Formation, Sepon District, Laos".* Anna was awarded a Digirock - AIG Honours Bursary.
- **Sandra McCullough** from Melbourne University, who was awarded an AIG Honours Bursary for her project *"A Neoproterozoic carbonate reef in the Flinders Ranges".*
- **Ben McGee** from Adelaide University, who was awarded a PIRSA - AIG Honours Bursary for his project *"Feedback between deformation & melting: A case study from the Challenger Gold Mine, South Australia".*
- **Jenna Sharp** from Monash University who was awarded an AIG Honours Bursary for her project: *"A geological study of two of the potential landing sites for the Mars science laboratory rover".*
- **Vashti Singh** from Sydney University, for her project: *"Oil migration in the Mesoproterozoic Roper Superbasin, Northern Australia: An assessment of fluid inclusions & solid bitumen".* Vashti was awarded an AIG Honours Bursary.
- **Scott Stephan**, from the University of Queensland, who was awarded a Terra Search - AIG Honours Bursary for his project: *"A structural study of the Carbine Creek area (Dajarra): Implications to the crustal architecture of the Mount Isa Inlier".*
- **Grant Cox** from the University of Adelaide, who was awarded an AIG Third Year Bursary.
- **Benjamin Hames** from the University of Western Australia, who was awarded a Consolidated Minerals - AIG Third Year Bursary.
- **Fiona High** from the University of Western Australia, who was awarded a Consolidated Minerals - AIG Third Year Bursary.
- **Clare Murdoch** from the University of Adelaide, who was awarded an AIG Third Year Bursary.
- **Christian Pike** from Ballarat University who was awarded an AIG Third Year Bursary.
- **Derek Walters** from Ballarat University who was awarded an AIG Third Year Bursary.

The AIG would like to thank all the students that applied for the AIG geoscience student bursaries. And thank you to all our bursary sponsors for their continuing support of geoscience students and the AIG student bursary program. Thank you, also, to members of the AIG Education Committee for the time and effort they contributed to reviewing the bursary applications:

Marcus Harris (AIG Councillor, WA; Chair, AIG WA State Branch)

Martin Robinson (AIG Councillor, Vic)

Graham Teale (AIG Councillor, SA)

Chris Torrey (AIG NSW) ▲▲

The Australian Geoscience Thesis Database - Free Public Release

THE AUSTRALIAN GEOSCIENCE THESIS DATABASE originated as the brainchild of Professor Allan White and Dr Amarendra Changkakoti from the University of Melbourne, and began as an AMIRA International project P874 in December 2005, concluding in January 2008, involving the kind cooperation of all Australian university geoscience departments.

Data Metallogenica, AMIRA International's global mineral deposit database, is the beneficial owner of the listing and will arrange future annual updates of the listing in cooperation with the contributing universities. AIG is a valued Foundation Sponsor of Data Metallogenica.

The sponsors of P874 were:

Anglo American, BHP Billiton, Copper Strike, CSIRO Exploration & Mining, Department of Primary Industries New South Wales, FUGRO, Geological Survey of Western Australia, Inco, Newcrest, Newmont, Northern Territory Geological Survey, Oxiana, Perilya, PIRSA, Rio Tinto, Terra Search, Vale, Xstrata, and Zinifex.

The listing of all geoscience theses from all Australian universities (over 10,500), including from those departments no longer in existence as well as all Honours theses, can be accessed in two ways:

1. Free Public Access to basic listings (searchable thesis title, author, university, year, thesis level) (http://www.datametallogenica.com /ThesisWebsite/AccessLevels/dm_thesis_databaselink.html)
2. Access to the full database, including abstracts of over 1,600 economic geology theses as well as more advanced search capabilities including mineral commodity and science discipline, is also available to subscribers of Data Metallogenica (www.datametallogenica.com) through the separate password access to DM. While not-for-profit, DM is required to be self-funding through subscription and sponsorship (individual AIG members can subscribe at a 50% discount for $110 per annum including GST).

We would be grateful if AIG members would circulate this advice to colleagues in their organisations - we hope it provides a valuable resource for all. We would also appreciate being advised of missing theses and any corrections noted.

We would also encourage AIG members to submit their thesis abstracts (if not already listed) or full digital theses, particularly on economic geology, exploration technology or key regional studies, to be posted in the database for others to have simple access to the data they painstakingly collected. Data Metallogenica already holds over 40 full text international theses in its database.

Planning is in progress to add listings of theses from other universities in other countries in the future through the proposed AMIRA International project P1018 (The Global Geoscience Thesis Database).

For further information contact Alan Goode, AMIRA International, Melbourne (alan.goode@amira.com.au).

News from the Victorian Branch Committee

THE VICTORIAN BRANCH COMMITTEE held its AGM on 8th October at the Old Colonial Motor Inn in Ballarat. The meeting was not well attended, with only a couple of members outside the committee present.

2008 AGM Chairman's Address

The 2008 year has been a moderate year of activity for the Branch. The highlight being the re-introduction of the GPIC meetings which are now being held on a regular basis.

The Branch has recently conducted a survey of members regarding processing of Work Plans, the results of which are now available to all members. After this meeting, John Mitas, Senior Mines Inspector from Minerals Regulation Branch will address the members present on issues raised in this questionnaire.

The attempts to mount both a Hydrogeology based seminar and a mining & exploration based conference along the lines of the Mines & Wines in NSW have been postponed until the New Year. On a brighter note, part of the reason for this postponement is that out members have been fully employed over the past 12 months as the commodity boom has continued. Current events suggest that some of our members may have more time to organise events in the next 12 months. However, the state of the financial sector won't result in the evaporation of our industry's problems.

Firstly, the skills shortage caused by the aging of our geological members and the lack of new graduates. This is an ongoing challenge for the AIG and we will be continuing to seek ways to encourage young people to take up geology.

Secondly the lack of major mineral discoveries world wide presents an opportunity for our members. Good work by the GSV and great progress they have made in making information about Victoria's geology available to those interested deserves congratulations. The recent work in highlighting the mineral prospectivity under alluvial cover in the north of the state is an example of this.

The ongoing drought has and will provide further opportunities for our members a well as the Carbon capture and Storage proposals being put forward by the government.

In the coming year your AIG will be looking to organise one, or both of the postponed conferences, and continue its efforts to attract new members among the ranks of recent graduates.

I would like to thank the office bearers and committee for their fine work over the past year and finally wish all our members a prosperous New Year.

The new committee for 2008-2009 was elected unopposed:

a) Chairman: **Rodney Fraser** nominated by Rod Boucher

b) Secretary: **Geoff Turner** nominated by Rodney Fraser

c) Treasurer: **Tim Evans** nominated by Rodney Fraser

d) Committee Members: Nominations from Don Cherry, Rowley Hill, John Cahill, Rod Boucher, Allan Rossiter, and Philip Kinghorn were received. Fiona Makin is accepted to the committee subject to successful application for membership to AIG.

Guest Speaker

After the meeting and between courses of the Dinner, John Mitas, Manager of Minerals and Extractive Operations, and Chief Inspector of Mines and Quarries led a discussion on Mining Approvals Process.

The discussion was lively, with many questions on the approvals process being put to John, who answered most to members satisfaction. New procedures were being put into place, or being considered to streamline the process. One consideration that was most welcomed by members was the planned introduction of a template style of Work Plan submission. The Minerals & Petroleum Regulation is also developing recommendations for the proposed Resources Industry Legislation Amendment Bill which will aim to streamline the current Act.

Overall, it was generally agreed that the discussions were most helpful, and that continuing communication between the Regulation Branch and geologists should be maintained. ▲▲

Mineral Industry in Victoria Questionnaire Analysis

Geoff Turner, RPGeo

Summary

During the year 2008 the Victorian Branch Committee of the AIG was contacted by a number of members identifying problems with the amount of time involved in getting approvals for Work Plans on Exploration and Mining Licences, and the associated costs to the industry. The committee, feeling that such negative impressions cannot be good for the Industry in Victoria, decided to test this dissatisfaction among a wider membership.

The test was based on responses to a questionnaire emailed to members resident in Victoria, and other geologists and industry persons who are on the GPIC-Bendigo email list. Responses were received largely by email within 2 weeks of the initial mail-out in late August.

The respondents in accompanying emails overwhelmingly welcomed this initiative of the Victorian Branch. Many respondents felt that the Work Plan process was too onerous, and consequently their enthusiasm for working in Victoria was affected.

The results show that dissatisfaction with the Work Plan process is widespread. At the Resources Victoria conference in late August, the Executive Director (M&P) emphasised the improvement in closure times for Work Plan Approvals, so whether justified or not, the dissatisfaction should be addressed.

The main issues of concern to respondents are inconsistencies between offices and officers involved in the approval process (within the DPI and other departments), timely communication of issues associated with the applications, and the complexities of preparing a Work Plan. Respondents also felt that the DPI was not doing enough to promote the industry among the community, and within other departments.

Suggestions for improving the situation include the introduction of templated Work Plans, more workshops with industry and departmental involvement, and a more pro-active department.

The VIMP program, RVD Initiative and new data supply were recognised by geoscientists as a definite encouragement to mineral exploration. Some DPI officers were named as providers of exemplary assistance in completing Work Plans.

What's Going Right

On reading the comments and incorporating responses to questions, the impression is that:

- Work by the department on supply of new data is generally greatly appreciated;
- VIMP program is particularly useful to the industry;
- The industry welcomes the RVD initiative;

- And exceptional assistance and cooperation from certain (named) DPI officers was noted.

What the respondents are saying

Notwithstanding the above, there are perceptions among geoscientists working in Victoria of shortcomings in the Work Plan Approval Process.

1. Individual officers and offices vary in their interpretations of what is required of a Work Plan. This applies to content, time for approvals, amount and type of assistance offered, and variation in notification time (by email/post) of deficiencies or approvals.

   This inconsistency is not confined to the DPI, but is across all departments involved in the process. Training (ongoing, as new regulations are adopted) of officers is required to ensure consistency in interpretation of the relevant Acts & Regulations.

2. The DPI should be championing the industry in its dealings with other departments, rather than relying on employees of companies to develop a case for exploration.

3. There is a strong call for streamlining the Work Plan process. The suggestion of a template Work Plan was embraced which should eliminate any inconsistencies between individuals and offices.

   Other suggestions were on the themes of improved timelines, more use of email, better coordination of site visits and inter-sectoral requirements, reduction in red and green tape.

4. There needs to be an improvement in communication between departments, and between all departments and explorers.

5. The profile of the Industry needs to be raised. There is little promotion of the Industry within the community, and the Department should take on an advocacy role. While there is a strong push in Victoria for more National or State Parks, the Industry needs a corresponding "push" for land to be reserved for the mineral resources sector.

Consequences of Current Situation

Timelines for approval processes are so protracted that companies are walking away. In this small survey, 3 of the 36 respondents have left Victoria citing onerous conditions.

Delays in approvals can result in retrenchments or stand-downs of field staff, with lost production and motivation and potential economic impact on the community.

There is unnecessary duplication of effort and expense in the preparation of Work Plans. This is because of inconsistencies between officers and offices, and other departments. It is often unclear what must be included in the Work Plan, for example which other authorities must be consulted/included.

Exploration funds are being consumed by red and green tape, which is becoming proportionally greater compared with on-ground exploration costs.

Ultimately, Victoria's full mineral potential is not being recognised or exploited, with economic consequences for the State.

Conclusions

It is recognised that this survey has some limitations. The number of respondents is small, although it is estimated to be 30% of the eligible population. Questions were based on the issues raised with the Branch Committee and these may not necessarily address the most important issues across the membership.

Even if the responses only represent the thoughts of a minority, however, this survey has brought out a number of issues and problems in the current Work Plan Approval Process that is operating in Victoria. Victoria is seen by geoscientists as a state bound up in red and green tape, with the consequences that getting on the ground to do the work that they are trained to do is becoming more expensive by the year.

While it may only take a couple of months to get an exploration licence granted, it can take much longer to get on the ground with moderate impact activities.

The time taken to prepare Work Plans, although not directly canvassed by this questionnaire, is becoming more onerous each year. New regulations and compliances introduced recently, such as WorkSafe changes, AAV Heritage Regulations, etc have added to the burden of preparation.

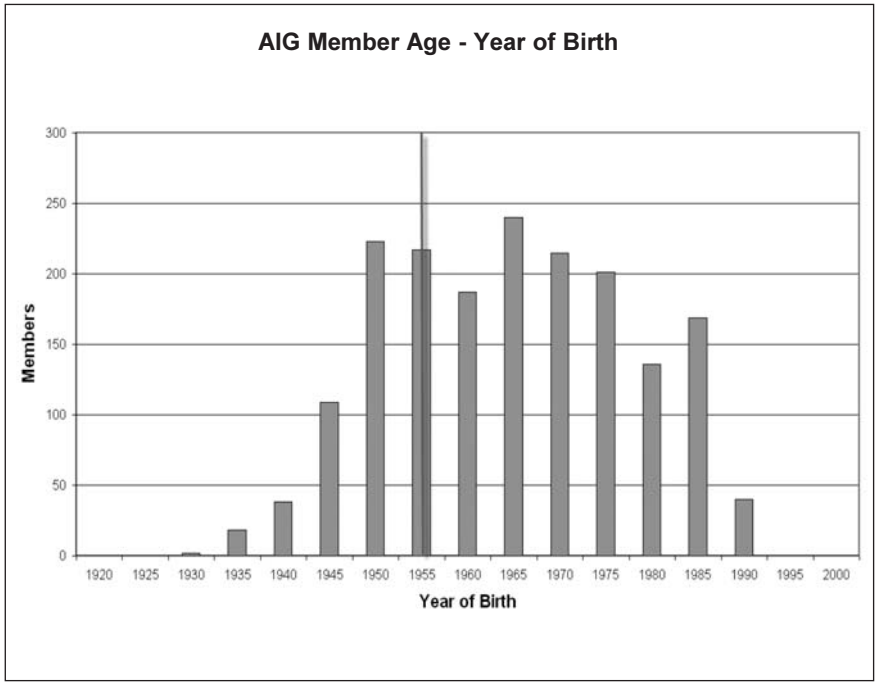
While the DPI may claim timely closure of Work Plan Applications, the respondents in the main feel that this is not the case - perhaps they are considering preparation time which is not seen or recorded by the department.

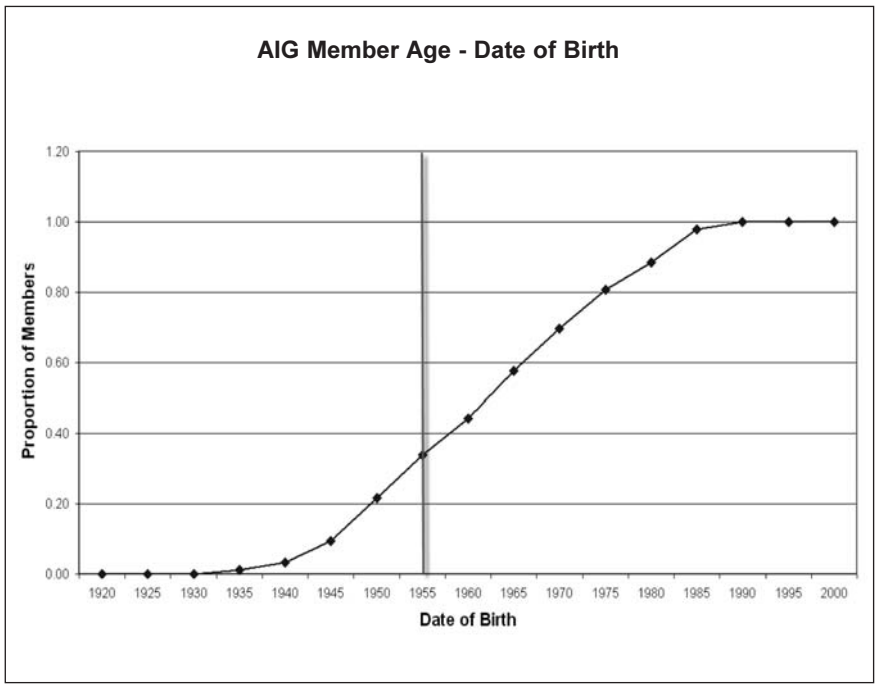
Probably the most requested "fix" is the introduction of a streamlined process, such as templated Work Plans where simple check boxes in the main are presented to the Applicant. Such templates can be supported by more detailed OH&S and Environmental Policies of the Applicant, which would need to be general, rather than specific in nature. The Work Plans used by South Australia's Primary Industries & Resources provide a good example of what is possible (http://www.pir.sa.gov.au/minerals/home/exploration/applying_for_work_approval).

One comment in the covering reply email was that after attending the DPI Information seminar in May, the respondent believed that he would have to employ a "Compliance Officer" to handle the extra workload. There should be no need for explorers to employ a "Compliance Officer". Compliance officers are not required in other States.

This survey was not intended to be a de facto Customer Satisfaction Survey for the DPI. Nevertheless clearly the geoscientific community perceives problems in its working relationship with the Department. . The AIG would therefore welcome any move by DPI to conduct its own Customer Satisfaction research. ▲▲

AIG Demographics





Member Age

AIG has a relatively young membership base:

- Only 34% of members are 55 years old or greater (much lower proportion than the geoscience workforce in USA or Europe where this proportion exceeds 50%)
- Relatively even age distribution
- Good blend of youth and experience?

Location

- 50:50 "split" of members between WA and Eastern States
- Higher level of membership in WA as a proportion of total population.

Professional Field

- Geologists dominate overall membership

Employment Sector

- Half of AIG's members work in exploration, two thirds in exploration and production.
- Potentially under-represented in public sector (or are fewer geoscientists employed in the public sector than overseas?)
- High proportion of consultants

Commodity/Activity

- A high proportion of members work in metalliferous exploration and mining

Employment Type

- Two thirds of members are in salaried full time or part time employment
- Relatively low proportion of self employed members

Gender

- Membership is male dominated

Work Location

- A high proportion of members work in their home state (or close to where they consider home to be).

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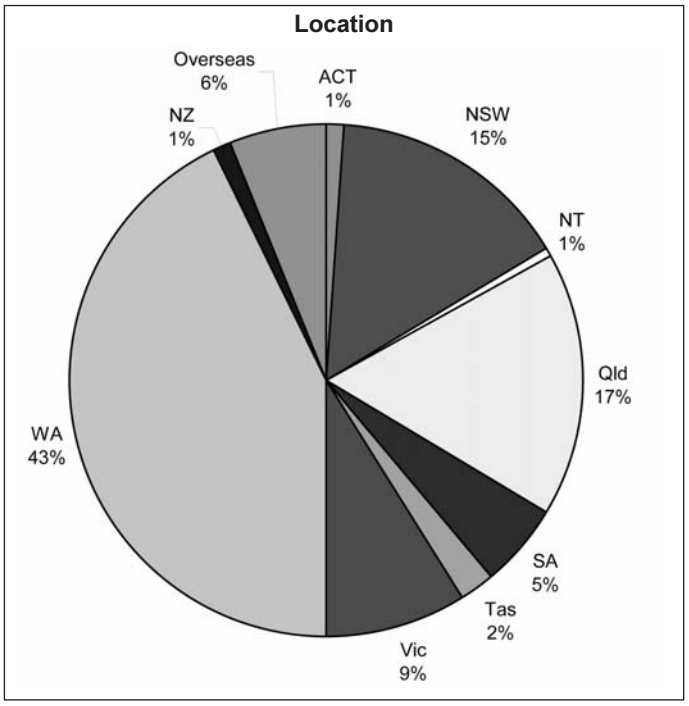

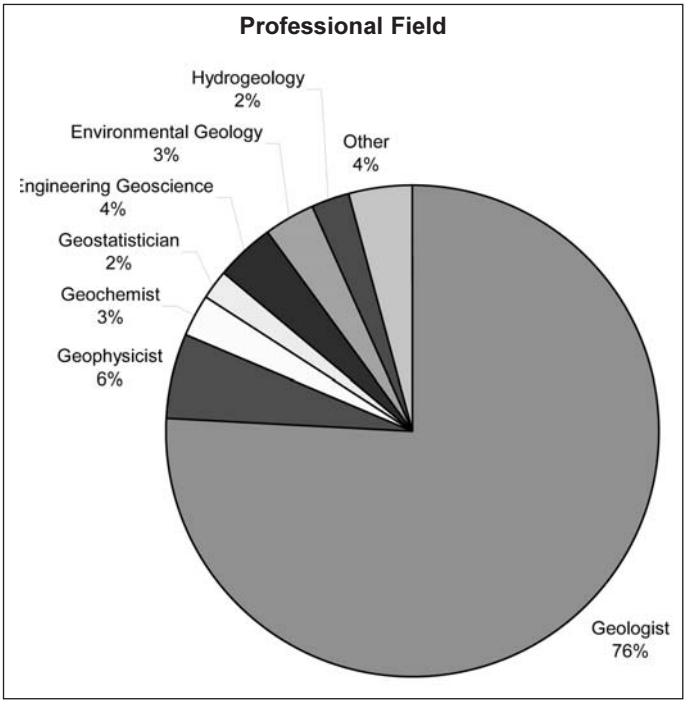

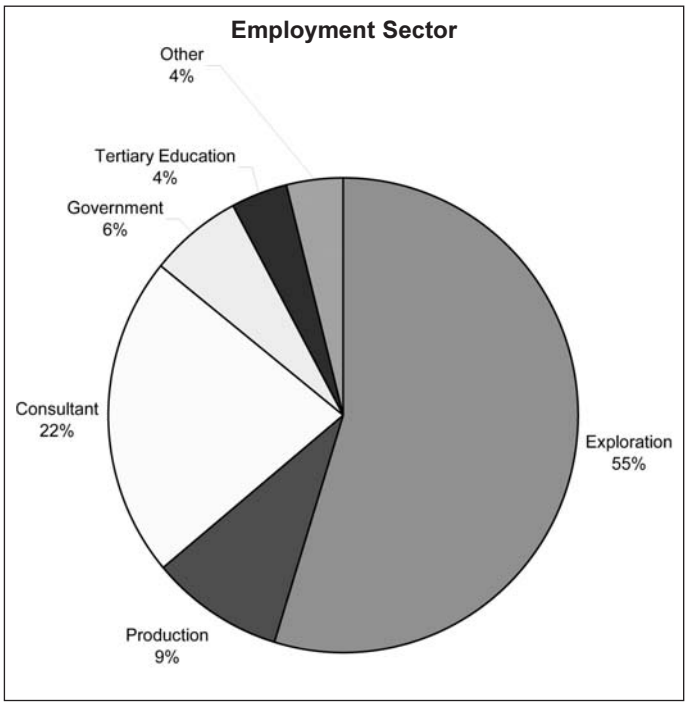

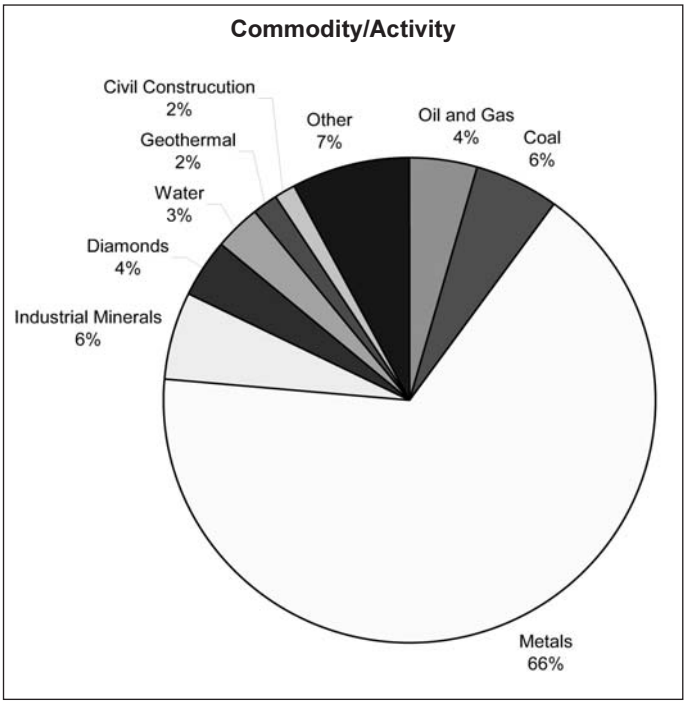

AIG Demographics

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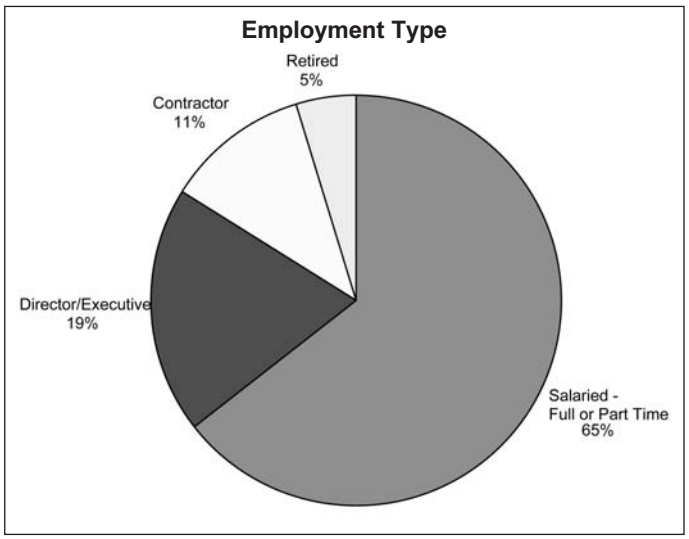

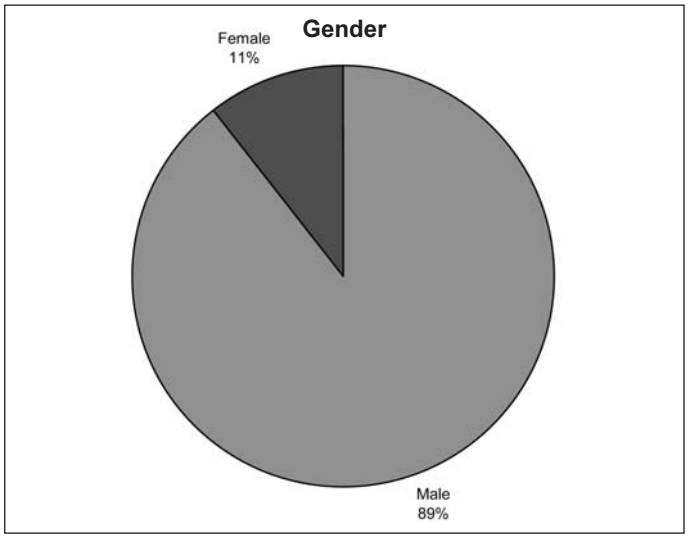

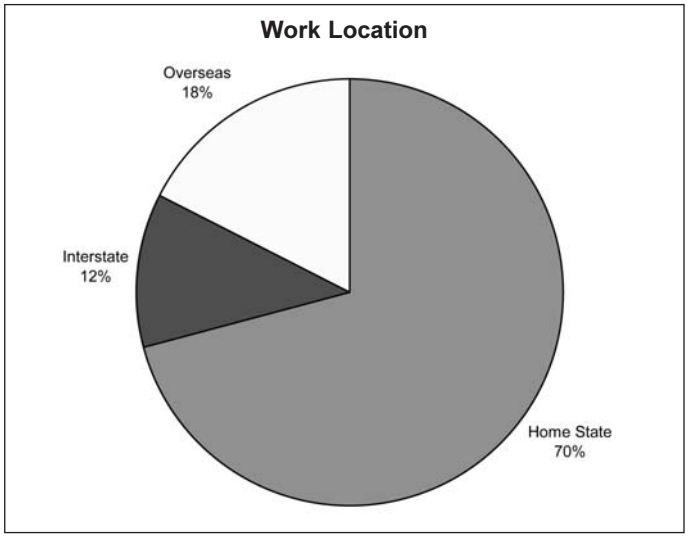

Remuneration Survey

The results of the 2008 remuneration survey are on our website – http://www.aig.org.au/recruitment/2008-remuneration-survey

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The AIG wishes to thank the following individuals and organisations for their support of the
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These bursaries are offered to geoscience students at South Australian Universities.
(General eligibility criteria and guidelines also apply.)

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(General eligibility criteria and guidelines also apply.)

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Membership Update

New Members and Upgrades at the May and July Council Meetings 2008

MEMBERS

BARWICK	Andrew	James
CARDER	Mark	Eric
CARROLL	Noel	Francis
DE BEER	Samuel	Jacobus
DE WAELE	Bert	Noel
DONNES	Grant	Edward
GELLIE	Chevaun	Colleen
GOODE	Matthew	
HARTOFILLIS	Philip	Odysseas
HAWKINS	Alan	John
HERRMANN	Scott	Anthony
HUNTER	Andrew	James
MACREA	Richard	David
MAHER	Patrick	
MAXLOW	James	
MCDONALD	Andrew	Jack
MCDOWALL	Patrick	Grant
MURPHY	Jacqueline	
NAG	Sudipta	
O'BRIEN	Reginald	Thomas
PAWLITSCHEK	Martin	Joachim
PRUMM	Horst	Edmund
ROUSSEAU	Pierre	Daniel
SANTOS	Joao Orester	Schneider
SOLANO ORE	Francisco	Javier
SOLOSHENKO	Denis	
TEAKLE	Mark	Garard
TRAUTMAN	Rachael	Leah
TULLY	Richard	Barrie

MEMBERS (CONT.)

VAN ECK	Marcel	
VREUGDENBURG	Don	Glenn
WAYE	Kyle	John
YANG	Kai	

ASSOCIATES

PENNOCK	David	Edward
PENNOCK	Rowland	Charles

GRADUATES

ADAMAS	Sean Virya	
COULLS	Robert	Mark
CRAVEN	Natalie	
GILLMAN	Charles	Russell
LAND	Marissa	
PAULSEN	Hanne	Kristin
WILLIAMS	Jodi	Elizabeth

STUDENTS

AGUSTIN	Fitriani	
BYRD	Tia	
DAHL	Kirsten	Louise
DHARMAYANTI	Dessy	
DORRINGTON	Neil	Jason
EDWARDS	Emma	Lee
GANIRON JR	Tomas	
HUNTER	Christopher	Gary
LANE	Hannah	Gay
MAHMUD	Mahmudur	Rahman
MAHON	Elizabeth	Majella
MARTIN	Cecilia	Isabel
MCCULLOUGH	Sandra	Denice
MCLENNAN	Stephanie	Margaret
MCNAMARA	Christopher	Paul
NICHOLLS	Alexei	
OWEN	Katherine	
PAUWELS	Gerhard	
PENNO	Hamish	
PIKE	Christian	Robert
REEVES	Stacie	Elaine
RHODES	Eleanor	
SALAM	Abhisit	
SEYEDMEHDI	Zahra	
WALLIS	Craig	Robert
WILSON	Robert	John
WOOD	Helen	

We welcome all new members to the AIG.

RPGeo Approval and Applicants

CANDIDATES APPROVED BY AIG COUNCIL IN SEPTEMBER 2008

Mr. Ian Laurent of Vancouver in the field of Mineral Exploration

Mr. Peter Gringinger of Melbourne in the additional field of Hydrogeology

NEW CANDIDATES PUBLISHED FOR PEER REVIEW BY THE MEMBERS OF THE AIG

Dr. Mark Hutchison of Darwin, NT, in the fields of Geochemistry, Mineral Exploration and Industrial Minerals

Dr. John Bean of Bayswater, Western Australia, in the fields of Hydrogeology and Geotechnical and Engineering

Mr. Samuel De Beer of Bedfordale, Western Australia, in the field of Mining

Mr. Andrew Hunter of Dural, NSW, in the field of Geotechnical and Engineering

Dr. Lange Jorstad of St. Leonards, New South Wales, in the field of Hydrogeology

Mr. Chen Zilong of West Perth, Western Australia, in the fields of Mineral Exploration and Regional Geology

AIG FEDERAL COUNCIL FOR 2007-2008

AIG NEWS

CONTRIBUTION DEADLINES

AIG News is published quarterly, in February, May, August and November.All items for inclusion in the newsletter for a particular issue should reach the Editor by the end of the preceding month. Avoid disappointment by contacting the Editor at least several days beforehand to advise submission of items for the newsletter.

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Text: Word Files (Please DO NOT EMBED pictures in Word, supply as separate files.)

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The **AIG Website** in currently undergoing a major update. Comments on content suggestions or new features should be directed to Andrew Waltho (andrew.waltho@bigpond.com