Australian Institute of Geoscientists

AIG NEWS

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The Unicorn Climax-type Mo Porphyry – a Urad-Henderson Analogy

Introduction

By Bernie Hochwimmer, Member

The Unicorn Mo-Cu-Ag porphyry in northeast Victoria is the first Climax-type Mo discovery in Australia and heralds a newly emerging molybdenite province within the SE Lachlan Fold Belt,(LFB), with some spatial analogies to the Urad Climax-type Mo deposit at Red Mountain, Colorado. Exploring basal sections of Unicorn may reveal analogies to basal areas of Urad, where indications of remanent high Mo grades exist, now largely destroyed by the Red Mountain Porphyry from eruptive processes.

Unicorn differs from the typical Climax-type, which only features molybdenum, in that it is a metallogenic hybrid with significant copper, and attributed to its near arc and suture tectonic

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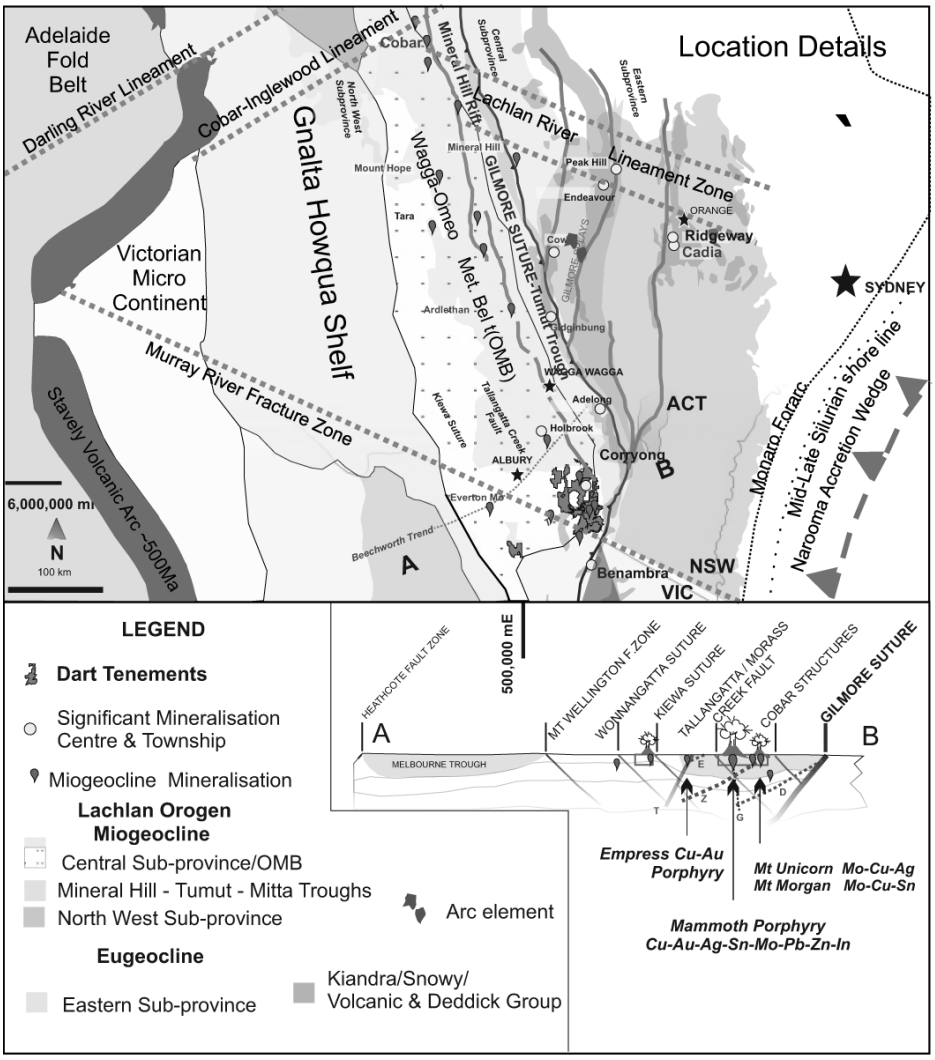

Figure 1: Tectonics

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position compared to the Typical Climax-type that generally occurs further in the back-arc; It also has higher silver content as a result of its low fluorine content. (High fluorine porphyry's generally having less than 1.5g/t Ag). The Climax-type porphyry is one of the rarer types, known mostly from only thirteen examples in the North American Cordillera, compared to hundreds of copper porphyries known worldwide. Unicorn is therefore of great importance to Australia, and Victoria in particular, by showing the discovery of a Climax-type porphyry is possible outside the North American Cordillera. The Climax-types are typically formed in extensional environments while the quartz monzonite-type Mo deposits (QM-Type), typically the most common in the North American Cordillera and other parts of the world, formed in compression environments (Laznika, 2006). Unicorn also displays one of the most important Climax-type features - stacked mineralisation shells that results from multi pulsed intrusions or multiple cupola intrusions resulting in vertically stacked ore shells such as Climax, Mt Emmons, Urad and may in addition include laterally compounded intrusive centres, such as at Henderson. Vertical growth can be underplated with new penetrative stock or over-plated as renewed growth about an existing cupola core, as in the case of Climax's porphyry rhyolite shell growth comprising the Bartlet stock. Shell growth is effected by rhyolite streams about edges of cores to apical plumes (Carten, 1988).

Mt Unicorn Mo-Cu-Ag Climax-type Porphyry

Unicorn, like all Climax-types, is hosted in a bimodal rhyolitic porphyry dome complex within which differentiated, highly siliceous, magmatic lobes grow about less differentiated cupola cores that often have micro-granitic to porphyritic granite textures. Rhyolitic textures typically range from very fine siliceous aphanites in top sections with sparse small quartz and feldspar phenocrysts, increasing porphyritic quartz and feldspar (QFP) in mid sections and basal cores with coarser matrix. This sequence may be repeated. In the Climax-type these sequences may be compounded laterally, or parts of the sequence may be repeatedly stacked vertically. Compositional variation is diagnostic of the Climax-type, verging towards either highly siliceous or potassic rich feldspar phases zoned vertically in layers or shells. Unicorn's largest siliceous layer outcrops centrally on the surface Mo anomaly within which 9 diamond holes have been drilled from shallow to moderate depths up to 575m. Locally termed the Silica Lithocap (SLC), its outcrop includes prominent silica bluffs on the NW Unicorn Ridge. It is not a true silica lithocap in the sense of barren silica expanses overlying some copper porphyry's, being highly mineralised with combined Mo-Cu-Ag, and resembles the high silica zones of the Climax and Henderson deposits. The SLC is aproned with white siliceous Pinnak Formation hornfelds, haematitic grey-yellow to red QFP, pyritic aplite, a NE ring dyke segment and Southern Collapse Breccia, all more or less molybdenum bearing. Mineralisation temperatures exceeded 600ºC, evident as high temperature quartz-Mo stockwork, often mottled grey, some containing clots and seams of potassic feldspar, sericite and hydrothermal biotite. Fine molybdenum occurs as films, grains, aggregate clots and veinlets, bordering quartz veinlets (Figure 10). Veins contain pyrite as part of the quartz-sericite-pyrite-green biotite (low Na+/H+ activity type) phyllic alteration series, after potassic-Mo, but not exclusively. This potassic-Mo-phyllic-pyrite time gap is very short or coincident at Urad (Wallace, 1978), likely a function of Urad's curtailed and disrupted near surface depositional environment, and longer at Henderson. Veins may have irregular boundaries indicative of occupying former solution channels within rhyolitic host, rather than entirely open spaces, more commonly seen with hydrothermal veins penetrating microgranite and micromonzonite core and wall rocks. Unicorn's potassic and phyllic alteration is laterally coincident, with vertical stratification, typical of the Climax-type. Some magnetite-minor rutile-sericite-quartz-haematite appears to be an early to mid alteration phase, consistent

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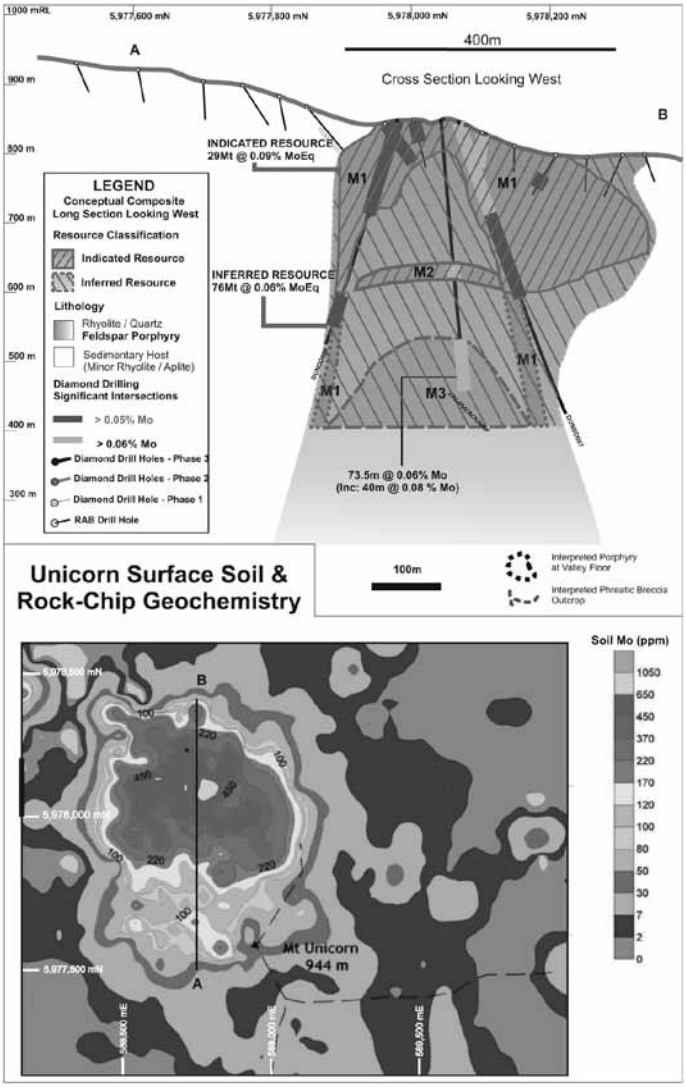

Figure 2

From Your President

(AIG President Andrew Waltho attended a one day short course on changes to, and compliance with, Canada's NI 43-101 for exploration result, resource and reserve reporting recently in Canada).

The course highlighted that Canadian securities market regulators are dealing with much the same issues as those identified in issues papers issued by the JORC Committee and Australian Securities Exchange (ASX) in Australia. The course was presented by:

Robert Holland, Chief Mining Adviser, British Columbia Securities Commission (BCSC),

Craig Waldie, Senior Geologist, Ontario Securities Commission (OSC),

Jim Whyte, Senior Geologist, OSC, and,

Cameron Bartsch, Senior Geologist, BCSC.

All of the presenters are former exploration geologists who worked primarily in Canada.

Several other AIG members, including Stella Searston and James Llorca, were part of about 200 attendees at the course that is held rarely (less than every two years), but this one was precipitated by quite significant changes to NI 43-101 last year. The course formed part of the British Columbia Exploration Roundup, an annual, provincially focussed event that this year will attract between 6,000 and 7,000 registrants (and for a provincial / state focussed event!). The conference is predominantly minerals focussed, but also includes some coal industry participation, although it competes with the Canadian Coal Association annual conference which is held each September. The number of delegates highlights the difference in scale between the mineral exploration industries in Australia and Canada.

It seems there are a number of misconceptions surrounding NI 43-101 in Australia that are commonly cited between comparisons of the NI 43-101 and the JORC Codes. This is partly due to the different regulatory systems operating in Canada and Australia. In Canada, for example, securities regulators bear primary responsibility for supervision of companies, not the stock exchanges; (ASIC is the Australian equivalent of the securities regulation agencies in Australia). A significant outcome of the Canadian system is that NI 43-101 applies to any company that issues mineral securities, not only publicly listed companies, as is the case with JORC. The other major difference is the requirement for companies to lodge comprehensive technical reports substantiating company announcements which immediately become publicly accessible documents in response to "triggers" defined in NI 43-101. In Australia there is no such requirement and announcements can be made without the supporting technical work ever being disclosed. The provincial and national securities regulators in Canada also employ geologists and engineers to actively scrutinise information provided by companies, although resources dictate that only 5 to 10% of reports and announcements are ever formally reviewed.

NI 43-101 is frequently described in Australia as being prescriptive, which is a claim not supported by examination of the Code. This perception also exists in Canada and the securities regulators have consciously attempted to make NI 43-101 more flexible and less prescriptive. They have also acted to reduce the liability of Qualified Persons, (QPs) under the code by allowing QPs to rely on information provided by "external experts" in some areas of technical specialisation. Technical reports are required to be prepared using proforma headings, but the manner in which information is analysed is not prescribed. The headings do not have to be numbered as described in NI 43-101 F1 and headings that specifically relate to particular levels of project can be omitted from reports. Flexibility has been incorporated in NI 43-101 by reference to the CIM best practice guidelines and standard definitions in significant areas, including definition of what constitutes a resource, an advanced project and the different levels of feasibility study. Lodgement of a prefeasibility study is required before a company can report ore reserves. Interestingly, the CIM guidelines oppose the use of techniques such as open pit optimisation to establish limits for resources in instances where revenue and cost assumptions have not been established for projects to even preliminary economic analysis standard.

The requirement for an independent QP is not universal. There are only three triggers requiring use of an independent QP, including release of a "maiden" resource estimate and amendment of a resource or reserve estimate by more than 100%.

Reporting of gross metal values ($ values for contained metal) is now restricted. Metal equivalents cannot be reported unless the component metal grades are also reported. Total REE oxide analyses are considered to be metal equivalents.

There is strict demarcation between commodities covered by NI 43-101 and NI 51-101 (petroleum). Groundwater is not covered by NI 43-101 but metalliferous brines are, because the products are solid mineral-derived substances. QPs are required to act to ensure that resources are reported in a material and transparent manner. Any form of gas is covered by the petroleum rules (NI 51-101), even where gas is produced by consumption of coal in UCG projects.

There were several significant points during the course that are of relevance for AIG.

1. The MAusIMM grade of member has been excluded from acting as Qualified Persons (QPs) under NI 43-101 because of the requirement by AusIMM for a minimum of three years experience for admission. AusIMM Fellows and Members who also have Chartered Professional (CP) status are permitted to act as QPs.
2. Geoscientists with U.S. State Board of Geology professional registration (ASBOG) have been excluded because the board in one U.S. state would not pursue a complaint against a member involving practice by that member outside the state in question.

   To retain reciprocal recognition, associations must:

   a. Publicly acknowledge the value of, and promote continued professional development by members.
   b. Confirm that they will pursue complaints against members irrespective of where the breach of ethics involved occurred.

AIG ticks both of these boxes.

Qualified Persons in Canada are required to have a degree in a relevant discipline and relevant experience. There is no longer any

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PROFESSIONAL DEVELOPMENT TRAINING

Geology for Non-Geologists

Brisbane	6 March
Toronto	7 March
Belo Horizonte	19 March
Vancouver	3 May
Johannesburg	7 May
Perth	9 May
Sydney	28 May

Mining for Non-Miners

Brisbane	7 March
Toronto	8 March
Belo Horizonte	20 March
Vancouver	4 May
Johannesburg	8 May
Perth	10 May
Sydney	29 May

Whittle Optimisation and Strategic Planning

Perth	7-9 March

Metallurgy for Non-Metallurgists

Brisbane	8 March
Toronto	9 March
Perth	11 May

Technical Report Writing

Brisbane	9 March
Perth	16 March
Johannesburg	10 May

Practical Variography

Perth	14 March
Johannesburg	16 March

Variography Using Supervisor
- each delegate will receive a FREE 3 month Supervisor licence

Perth:	15 March

Resource Estimation
- each delegate will receive a FREE 3 month Supervisor licence

Johannesburg	5-9 March
Perth	19-23 March
Vancouver	7-11 May

Advanced Resource Estimation
- each delegate will receive a FREE 3 month Supervisor licence

Johannesburg	16-20 April

Mine Ventilation and Cooling

Perth	26-28 March

Mining & Sampling Theory for Mine Technicians and Field Assistants

Johannesburg	2 April
Perth	20 April

Managing Mine Contracts

Perth	16-17 April

Sampling and Testing for Geometallurgical Programmes

Perth	18 April

Managing Risks and Opportunities in the Mining Industry

Perth	3-4 May

Introduction to Environmental Management

Perth	7 May

Mining Finance for Non-Finance Professionals

Perth	8 May

Advanced Financial Modelling

Johannesburg	9 May

Open Pit Mine Planning

Perth	14-15 May

Understanding the Drill and Blast Process

Perth	16 May

Introduction to Geostatistics

Brisbane	14 May
Johannesburg	18 May
Perth	18 May

Successful Sampling and QAQC of Assay Data

Perth	21-22 May
Johannesburg	21-22 May

Grade Control and Practical Reconciliation

Perth	23-24 May
Johannesburg	23-24 May

AIG MEMBERSHIP BENEFITS

Snowden offers 10% discount off professional development courses for Australian Institute of Geoscientists members

10% DISCOUNT FOR PROFESSIONAL MEMBERS

In recognition of the services offered by the associations and societies that uphold the professionalism within our global mining industry, we have decided to offer the individual members of the following professional associations a 10% discount off our public training course fees.

AIME The American Institute of Mining, Metallurgical, and Petroleum Engineers | AIE American Institute of Engineers | APEG Professional Engineers and Geoscientists of BC|AME BC Association for Mineral Exploration British Columbia | CIM Canadian Institute of Mining, Metallurgy and Petroleum | SEG Society of Exploration Geophysicists | El Instituto de Ingenieros de Minas del Perú | Instituro de Ingenieros en Minas de Chile | The AusIMM The Australasian Institute of Mining and Metallurgy | AIG Australian Institute of Geoscientists | AMEC The Association of Mining and Exploration Companies Inc | Engineers Australia | GSA Geological Society of Australia | GSSA The Geological Society of South Africa | SME The Society for Mining, Metallurgy and Exploration | SAIMM South African Institute of Mining and Metallurgy| SEG Society of Economic Geologists | IMA Indonesia Mining Association | MNMA Mongolian National Mining Association

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The Unicorn Climax-type Mo Porphyry – a Urad-Henderson Analogy

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with Henderson mid magnetite phase (Seedorf and Einaudi, 2004). Late retrograde alteration includes extensive argillite and propylitic style chlorite-epidote-carbonate-pyrite. Extensive late argillite alteration occurs at Urad and Unicorn, but not Henderson. Common greisen comprising very coarse sericite-topaz underlies Henderson in vicinity of its granite core but has not been seen at Unicorn, though rare medium grained sericite has. These features, along with very common flat fractures in the SLC, some containing gossanous pebble breccia, are all consistent with a high depositional palaeolevel for Unicorn.

In addition to hydrothermal characteristics, the Unicorn body typically displays a range of textures and veins indicative of direct magmatic fluid alteration and mineralisation from autometasomatism of very hydrous and volatile laden rhyolitic magmas. These include Universal Solidification Textures (UST's) and micrographic textures as granular or micro aplite, grading away from UST, indicative of hydrothermal fluid accumulation, prior to overpressure quenching. UST's, more often grow on magma lobe boundaries and comprise rhythmic bands of mainly quartz, sometimes orthoclase, with increasing lamina grain size and euhedral faces having terminals growing towards intrusive lobe centres (Shannon, 1982). They also occur at contacts with cores, where they may reach pegmatite proportions. Occasionally fine feathery plumose UST's of quartz and orthoclase are noted. 'Brain Rock' UST, so named from its stacked and convoluted lamina is also noted at Unicorn (Figure 11). So called "dyke UST" also occurs at Unicorn, comprising closely spaced apposing sets such as in rhyolite sill injections that may be less than 20m wide and otherwise indistinguishable on chemistry or general textures, and range down to rhyolite vein size. (They require careful attention; one boundary may

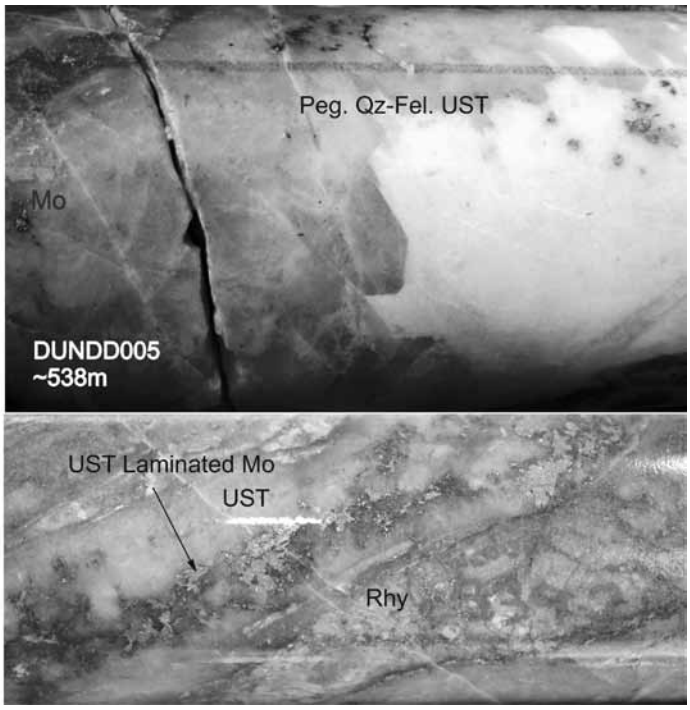

Figure 3

point toward the sill centre, the other toward the centre of the magma chamber). Rare UST are noted in some pegmatites and tin porphyries but UST's of all these styles occur only in Climax-type mined and at Unicorn and play an important role in mapping rhyolitic porphyry lobes. The Climax-type contains pure orthoclase. Albite groundmass replacement by 'pure' orthoclase was established in Unicorn's SLC via CSIRO SEM petrography confirming a pure $KAlSi_3O_8$ composition in close association with molybdenite (Purvis, 2008). This diagnostic Climax-type feature is indicative of a separate hydrothermal fluid accumulation prior to overpressure relief and fluid release. Significantly, SEM work established adularia in the SLC, indicating a rapid cool transition, supporting textural, structural and alteration attributes for Unicorn's deposition at high palaeolevel, perhaps within 1km of the surface, similar to Urad (Wallace, 1978).

Drilling of the Unicorn body shows that the central rhyolite porphyry dome mass occupies a narrow channel, resembling that of Urad's original volcanic vent. Unicorn's rhyolitic porphyry host package is entirely mineralised with arcuate bands or shells of higher grade Mo-quartz stockwork mineralisation having inverted bowl like shapes stacked vertically (Figures 2 & 6), typical Climax-type mineralisation, resulting from multiple pulsed rhyolitic porphyry injections and growths about cores or underneath former shells by underplating. In section, bi-lobed limbs of the arched mineralisation bands are steep, indicating movement of cores arching the mineralisation. This may be a function of Unicorn's confined vent channel in near surface environment, promoting vertical movement, compared with the Climax deposits three open ore arches, the Ceresco, Upper and Lower, ore zones (Figure 8), deposited in wide polygonal structure and much deeper, the Ceresco estimated at 3.1 to 3.7 km depth (Wallace, 1978). The Upper and lower arches have amalgamated limbs. High silica zones intervene between each arched mineralisation band that may be less mineralised. At Unicorn the high silica bands form part of the mineral sequence. As in all Climax deposits, extreme silica zones may be associated with lower Mo grades, but here Unicorn differs in that high silver may occur in these zones, such as large sections of DUNDD002 averaging around 9.6g/t Ag, as well as other areas with

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From Your President

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acknowledgement of "experiential learning" in lieu of formal qualifications. AIG's articles still provide for this and probably should be changed for future member admissions. We have two or three members (max) who have been admitted over a long period using the experiential learning provision. The members concerned should also be advised not to act as a QP in Canada

One additional thing I didn't mention earlier is that the Securities Commissions in Canada, in assessing Technical Reports, are looking at commitment to professional development by Qualified Persons. The metric they are using is length of membership of the relevant professional association – geoscientists who have joined a professional association immediately prior to acting as a QP are having their status questioned (if the regulators pick up on the issue). I clarified this with Craig Waldie and Jim Whyte over a few beers. This creates an issue around the practice of accepting "fast track" applications from members wanting to sign off as QPs in particular, although it's something that AIG would not be held accountable for, and it is something that applicants for membership will find somewhat futile.

In clarification of their comments about the vetting of reports, every prospectus/IPO document and accompanying technical report is thoroughly reviewed. 5% to 10% of other technical reports are also reviewed.

Andrew Waltho, Vice President
Australian Institute of Geoscientists

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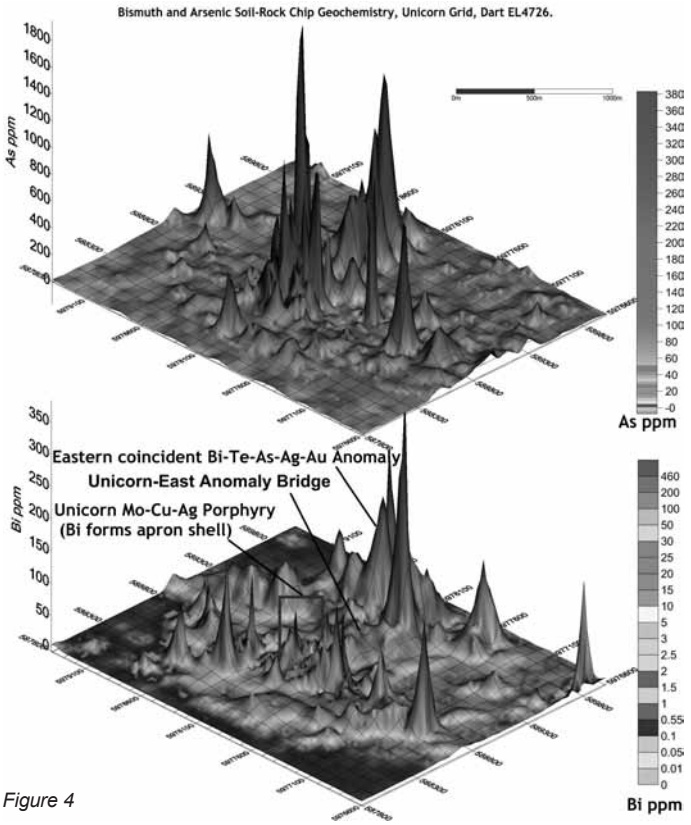

Figure 4

high Mo. Silica is also less reactive to subsequent pulses of mineralisation. Climax-type inverted bowl-shaped ore sequences relate to higher potassic altered rhyolite-QFP differentiates between each high silica zone. At Climax the deepest, most intense zone in each case passes a threshold of lower mineralisation as the highest silica zone, where nearly all pre existing rock texture is destroyed and virtually all rock minerals are replaced by silica. This is also the case for some zones within Unicorn's SLC, only very rare rhyolite breccia fragments surviving. Broadly, Henderson's high silica zones occupy low Mo grade areas above the three main broad stock centres, Henderson, Seriate and Vasquez that give rise to several differentiated ore shells lobes of various shapes. Figure 9, shows low Mo grades centred on the apices of the Henderson and Seriate stock centres which are the sites of high silica zones.

Typical of the Climax-type, both radial and concentric quartz-Mo veining occur at Unicorn, but as at Henderson, networks may also occur between prominent dense parallel sets, more widely spaced in general potassic-silica zones than in the Unicorn SLC example shown in Figure 10A of the SLC, with exceptionally dense multidirectional sets. Such vein sets are cited as proof of multiple pulsed mineral systems (Ludington, 2009), as is the combined mass of vertical alteration, and since the Climax deposit high silica zones sit at the interface of multiple ore shell growths, it is highly probable Unicorn also had a mineral arch stacked over the surface SLC, but now eroded.

The Urad-Henderson Climax Deposits, Analogies with Unicorn

The Urad and Henderson Climax-type deposits at Red Mountain, Colorado, are separate stockwork molybdenite orebodies related to an Oligocene rhyolitic subvolcanic dome referred to as the Red Mountain Complex

(Figures 7). Discovery, as a 'graphite' deposit, was made from red soil and haematitic rock shed from Red Mountain in 1879. The first shallow open cuts at Urad were made on outcropping ferrimolybdite. Urad was mined from 1918, as a delayed response to WW1 demand, till the 1970's, when work started on its depth cluster, the Henderson Mine. Urad yielded 50M pound of molybdenum when AMEX operated the mine from 1967 to 1974, at a rate around 5000 ton per day. Henderson production proper began in 1976, having produced over 1B pounds of molybdenum in Dec 2009 from 220,839,795 tons of ore (Freeport-McMoRan, 2010).

The Henderson deposit is the youngest, and deepest, underplating the Urad's deposit's base 300m deeper. Henderson comprises three main Mo bearing intrusive cupola centres, each differentiated into a number of intrusive stocks or lobes, (Figures 9) including Henderson (Arapaho, Primos, Henderson, Berthhoud lobes), Seriate (East, Seriate, Ruby, Nystrom lobes) and Vasquez (Vasquez, Ute-Dailey lobes). This compound ore complex, including the porphyritc Henderson Granite core at depth, intruded the Urad Porphyry which constitutes a weekly mineralised inter-phase between the Urad and Henderson ore systems, and occupies what may have been the original magma chamber beneath Urad. It terminates the Urad mineralisation's base, some 760m from the surface, with both gradational and intrusive contact over some 25m with the Red Mountain Porphyry. The latter intruded the overlying vent and destroyed most of the Urad mineralisation. Red Mountain Porphyry is fine to coarse grained centrally and contains both angular and rounded, milled breccia along with some rubbled Urad ore and although this is also rounded, these did not move far, possibly due to magma pulsing up and down the magma chamber. Chilled margins are not normal, suggestive of past eruptions and movement up and down that in part, or completely, destroyed the chilled margins (Wallace 1978). This demonstrates multi-pulsing in just one intrusion, even in barren magma, that is interpreted as a likely hiatus in tectonic readjustment prior to further rifting, burial and renewed episodic anorogenic energy ascent with fertile magma yielding Henderson. Hence tectonics and palaeo-depth are the controlling forces of the mineralisation.

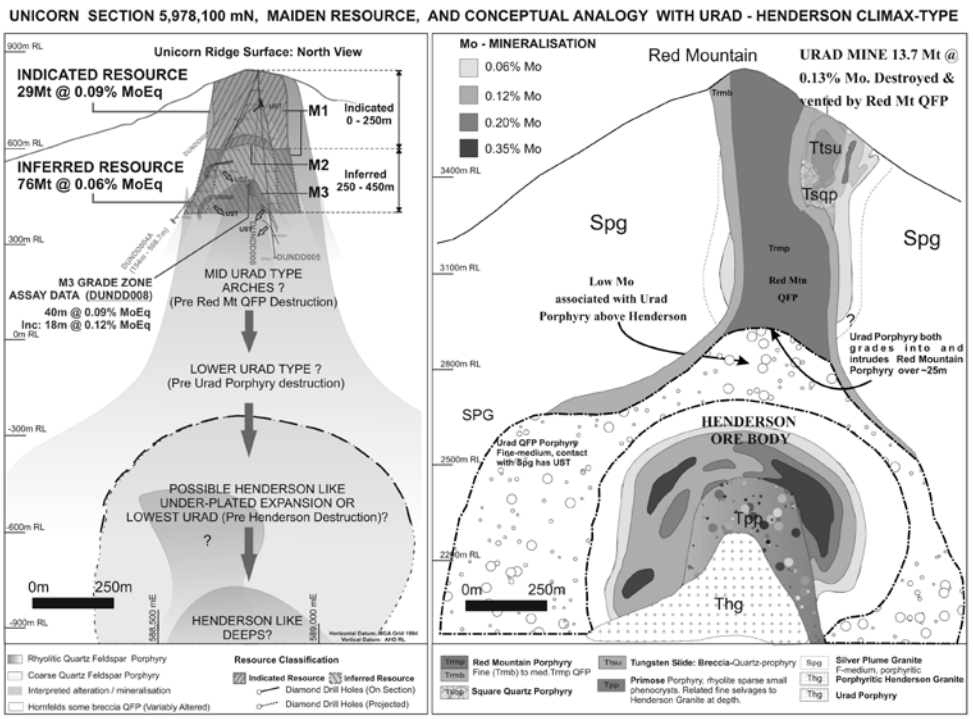

Figure 6

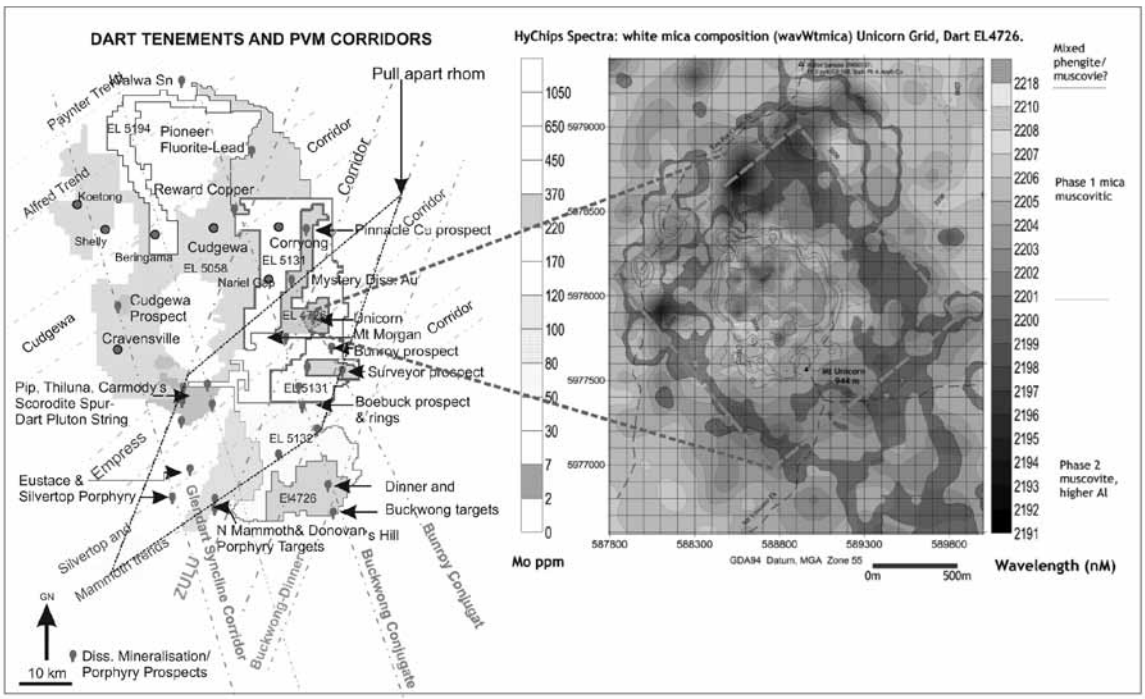

Figure 5

Red Mountain Porphyry forms a selvage to the Urad porphyry at depth; the 25m contact zone is highly altered with up to 800ppm Mo and common pyrite demonstrating increasing fertility prior to Henderson's advent. Contact with the Precambrian shows plumose feldspar UST layers from 25mm to 0.3 m wide over a zone 0.6 to 13m thick. Patches of access drifts also show quartz "Brain Rock" UST

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and both forms of UST have minor, fine, disseminated molybdenite along UST lamina. This demonstrates autometasomatism and the primary magmatic nature of molybdenum deposition, even before advent of Henderson. Clastic textures are common at Urad's surface, ranging to a depth of 380m. Urad's intrusive complex outcrops over a considerable area, around 700m long by up to 360m wide, not unlike the Unicorn body. Urad comprises the Tungsten Slide, East Knob and the Square Quartz Porphyry which is the youngest part of the Urad ore body and the only lobe to displays UST (on K level). It was centrally located before it was largely destroyed by subsequent intrusions, likely with stacked steep arches similar to Unicorn since cylindrical peripheral remnants survive at depth. It was almost certainly vented by Red Mountain Porphyry (Wallace, 1978). Radial and concentric rhyolite porphyry dykes, older than Red Mountain Porphyry, intrude the area, cutting the Tungsten Slide and Square Quartz Porphyry, and possibly relate to a precursor of the Urad Porphyry.

Deep high grade remnants of Urad, to within 300m of Henderson, indicate Urad extended deeper before its basal termination by Urad and Red Mountain Porphyries. Similar deep Urad style Mo mineralisation may occur beneath Unicorn's Ridge, particularly given the active regional and plate wide rift environment, provided no destructive Red Mountain-Urad porphyry inter-phase analogue occurs. An indication of this may be the NE ring dyke QFP, which contains tin, a late base metal phase. However lack of prolific inter-phase radial, concentric-ring dyke that heralded Urad's depth destruction through advent of the

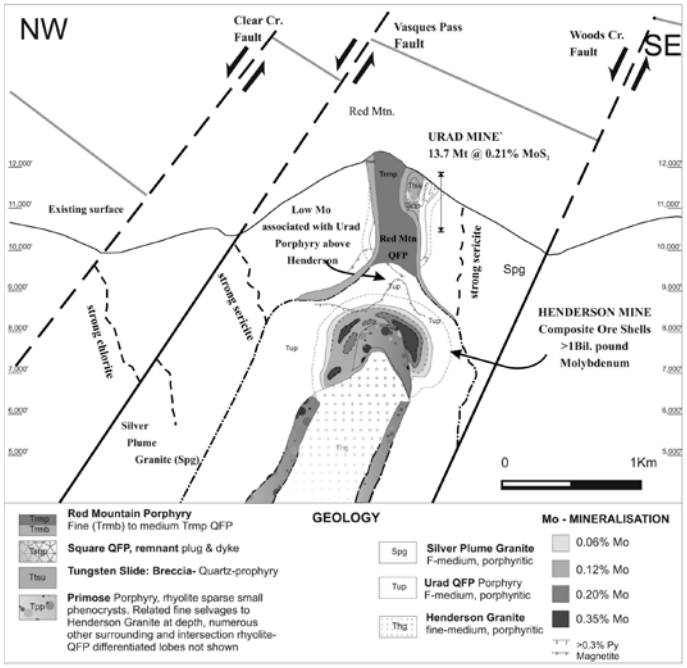

Figure 7

voluminous Urad porphyry suggests otherwise. Basal Urad style Mo mineralisation is however supported by some high grades in Unicorn drilled interesections, peaking around 0.6% Mo (Figure 2 &6) at moderate depths to around 540m. High grade mineralisation at Urad's H level corresponds to the base of the Urad ore body, though oxide ore close to or at surface had similar grades. Post Urad ore generation of Red Mountain Porphyry contains only base metals and pyrite, which also rings the system and other Climax-type porphyry's as late base metal phases, but why base metals should occur centrally in this Mo barren inter-phase intrusion is unknown. Similarly Unicorn has large base metal geochemical shells. Pyrite may be low with molybdenite: pyrite ratios ranging down to 1:10, similar to Unicorn. Pyrite forms more concentrated distal shells without molybdenite at Climax and Urad-Henderson whilst some areas of Mo stockwork contain very low pyrite. CSAMT and 3DIP geophysical indication of pyrite shells exist at Unicorn (Figure 13). As potassium was depleted, late albite alteration marks sodium entry and the end of Mo deposition associated with potassic feldspar. This is also evident at Unicorn, with late albite veining. Younger intrusive lobes at Henderson are progressively more sodic, indicating the source magma chambers composition also changed towards the end of the last intrusive stock centre, the Vasquez cycle.

The Urad Mo. orebody was first deposited at shallow depths, estimated by surface erosion and from other studies to be around 600m to 800m below the surface at the time of ore formation. By extension, Henderson's underplating, some 900m below, occurred at 1,500m to 1,800m depth (Wallace, 1978). This is almost certainly underestimated, since Henderson deposited after Red Mountain Porphyry, which destroyed most of Urad whilst sinking on extension tectonics, effecting burial. Physiochemical modelling also reveal ideal depth of 3km to 4km were necessary to effect magmatic convection, similar to depth estimates for Climax; nearing 4km. Magmatic convection cycling is necessary to account for the molybdenum in large Climax-type system (Shinohara, and others, 1995). Reconciliation of Mo in Henderson cupola stocks is vastly inadequate to account for Mo metal concentrated into intrusive via cupola differentiation (Wallace, 1978). Magma convection with a deeper magma chamber

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> 100 km^3 is needed, and created optimal lithostatic depth conditions at the convective apex to remove gas bubbles at Henderson without eruptive loss, as was the case in Urad. Gas bubbles would increase magma viscosity around fifteen fold, terminating convection to stream up Mo and hydrous volatile entrained rhyolitic magma, part of the convective cell apex pluming as rhyolite domes about cupola cores, mimicking their shape.

Tectonic, Structural and Regional Setting

The Climax-type always forms in association with very deep structures, generally tapping magmatic fluids through back arc extension tectonics that accumulate at the interface of the mantle and deep crust after a period of sialic build from subduction. The Rio Grande Rift is the archetypical example. Unicorn, situated in the back arc Omeo-Wagga-Metamorphic Belt (OMB), west of the Gilmore Suture, shares the North American A-Type peraluminous magma and deep structures in the form of the Gilmore Suture and Saltpetre Fault Zone splay. The regional magmatic suite is distinguished from volcanic arc elements as members of the Boggy Plains Super Suite (Figure 1 section A). Like the Precambrian Colorado porphyritic Silver Plume Granite (Figure 7 & 9 SPG unit), a batholith which contains the Oligocene Urad-Henderson deposits, this suite also contains elevated base metals. The SPG however is an unlikely source of reworked magma and metal for Urad-Henderson, since the base metals would need to be preferentially removed in this Mo only Climax-type; Clearly very deep magma sources are called for. Regionally this occurred during paused subduction of the palaeo-pacific plate, after a protracted build up of fluid accumulation during sialic crustal build of the OMB through the Benambra orogeny.

Climax-type igneous compositions from the interaction of mantle derived melts with high grade metamorphic rocks at the base of continental crust, (Ludington, 2010), have been mapped using trace

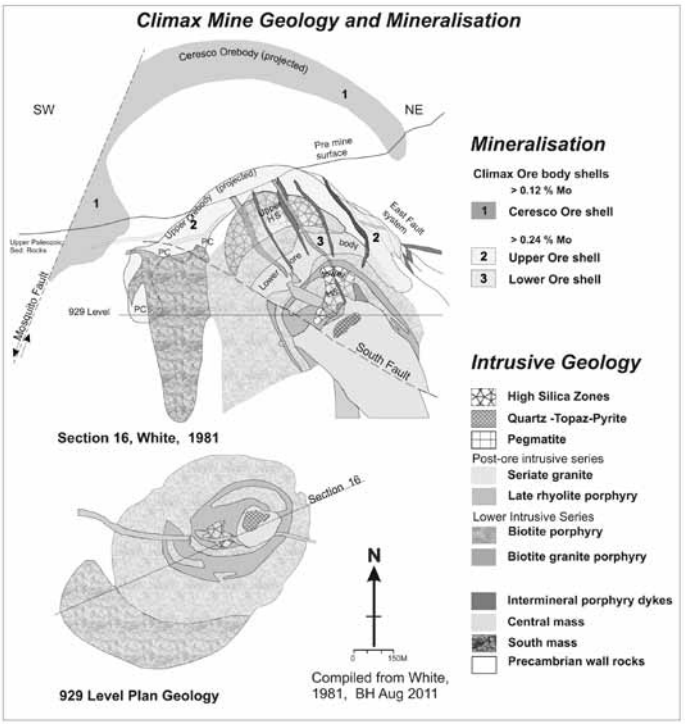

Figure 8

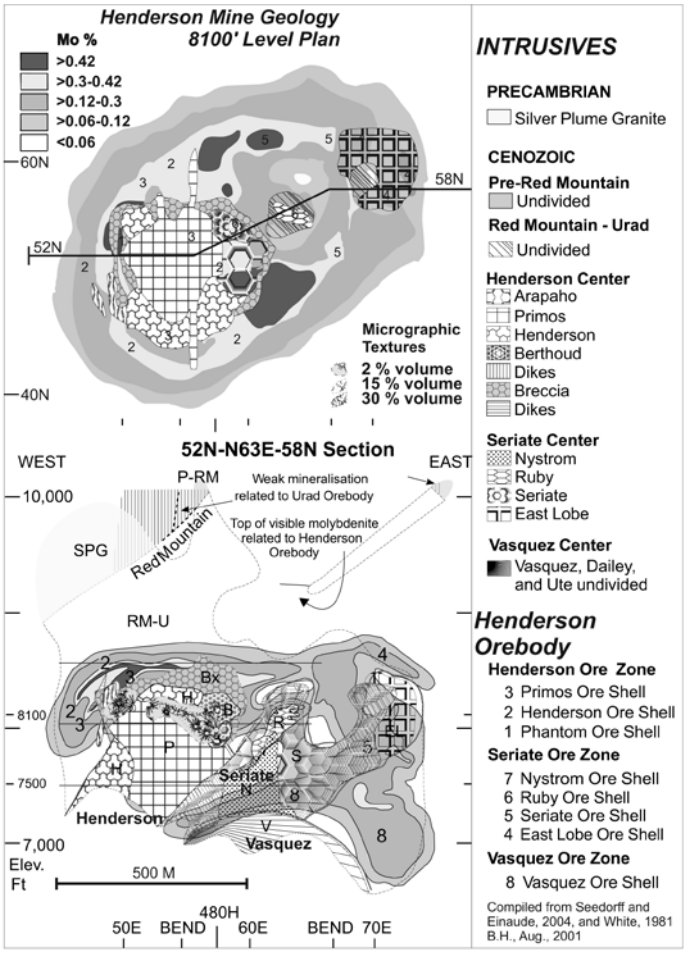

Figure 9

element indices. In North America they generally trend toward low Zr-Sr (<120 ppm Zr,< 100 ppm Sr) and high Rb and Nb (> 250 Rb, >20 ppm Nb) geochemical signatures. Unicorn diamond holes DUNDD004 to DUNDD009 averaged 63 ppm Zr and 69 ppm Sr, though Rb and Nb are lower with 158 ppm Rb and 10 ppm Nb. These samples however included wall rocks and very high silica SLC units with low values of Rb and markedly elevated in differentiated rhyolite units. Unicorns near arc and suture setting on the miogeocline-eugeocline divide would vary geochemical signatures seen in North America, further in the back arc, mixing sialic components with subducting arc contamination on rollover, simultaneously taking up eugeocline copper and silver to form Unicorn's metallogenic hybrid Climax-type. In addition LFB sialic evolution is probably halfway between New Caledonian Island Arc and the mid south west North American Cordillera Rockies which would also affect Climax-type geochemical signatures. Unicorn's structural and tectonic setting near

suture, arc and miogeocline-eugeocline boundary with similar extension is strikingly similar to the SE Alaskan setting hosting Quartz Hill, a super giant with 1.584Bt @ 0.076% Mo for 1.204Mt Mo (Laznicka, 2006). Quartz Hill is a metallogenic and lithological hybrid hosted by composite peraluminous leucogranite-monzogranodiorite and rhyolite stock that also contains Pb, Zn and Cu. It has both high silica Climax-type rhyolite Mo stockwork (with fluorine) and monzogranodiorite host characteristics (Ashleman 1997). A bimodal suite including lesser basic intrusive rocks is ubiquitous in the Climax-type. More basic compositions at Unicorn, Mt Morgan and North Mammoth prospects range from rhyodacite cores to andesite dykes. They may contain higher indium, up around 60 ppm In. Worldwide indium signifies marked rifting, such as in the Fenoscandian Shield (Sundblad, 2010). Greenland's Malmbjerg Mo deposit differs in its extreme rift setting that relates to the Cretaceous opening of the North Atlantic. In conclusion it is clear metallogenic hybrids, indeed lithological hybrids such as Quartz Hill, can form super giant deposits with variation on the typical Climax-type.

Regional mineralisation controls include cross terrane structures here from the Murray River Lineament fracture system 1 considered equivalent in terms of metallogenic importance, though with back arc style, to the Lachlan River Lineament fracture system for the Cadia and Endeavour Cu-Au porphyries in central NSW (Figure 1). Broadly they appear to define the south and north edges of the Gnalta-Howqua

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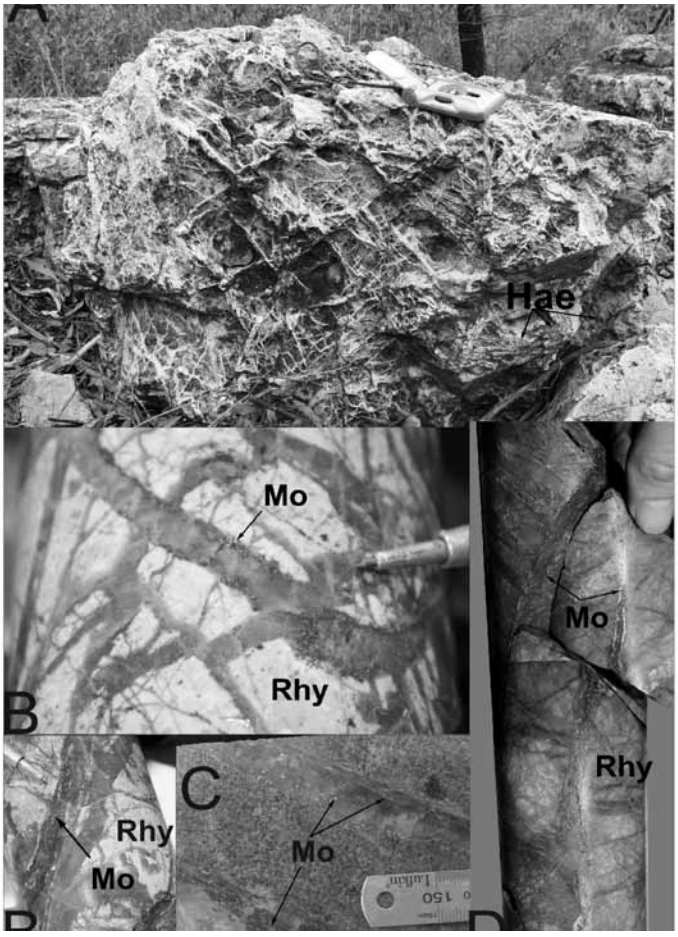

Figure 10

The Unicorn Climax-type Mo Porphyry – a Urad-Henderson Analogy

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palaeo-geographic shelf respectively. Westward they point towards major kinks in the Stavely volcanic arc, and locally they intersect major kinks in respective Kiandra and Macquarie arcs. Together these features indicate they are very deep cross terrane structures. In the Unicorn's region, east eugeocline arc elements converge, bound westerly by the Gilmore Sutures major regional kink, sweeping SSW into Victoria. This arose from the eugeocline collision against the miogeocline, suture closure against the OMB nucleus in the Ordo-Silurian assisting arc constriction locally and convergence with NW over SE thrusts providing structural splay preparation for Unicorn. Flexure of the suture about the OMB nucleus radiated cross splays in the border region that intersect, scribing polygonal elements, shown diagrammatically in regional and intermediate-camp scale in Figures 5 and 1. Saltpetre elements scribe the SSW trending Zulu corridor and WSW elements scribe the Empress Corridor. Unicorn and Mt Morgan porphyries occur in the intersection of the Zulu and Empress corridors. These structural elements form the basis of Dart's polygonal exploration model (PVM).

At local scale PVM elements control mineralisation and surface alteration shape within Unicorn's grid area, reflecting polygonal sericite and argillic alteration patterns following the Empress cross fracture polygons determined from HyChip grid spectral studies. An example for white mica alteration is shown in Figure 5. This is within scale order for fault bound sericite above Henderson (Figure 7). Henderson section also shows list to one side, due to convergence of the Precambrian faults reactivated in the Oligocene. Similarly Unicorn may list, possibly with NNW plunge based on surface geochemistry pattern, Saltpetre and other fault splay elements converging with the Gilmore Suture. In porphyry coppers, regional structures may not be apparent. In the Climax-type, regional structures are apparent in peripheral areas, seen in Unicorns collapse breccia (Figure 12), and may be obliterated by the rhyolitic host in central porphyry mineralisation, where radial and concentric structures, dykes and stockwork vein orientations predominate. At Unicorn Empress trending fractures persist in post SLC silicification mineral phase, pointing toward the Mt Morgan Porphyry some 7.5km to the WSW. This is consistent with potential for younger underplating mineralisation potential beneath Unicorn. Regionally, dextral trans-tensional torsion effecting reactivation of structures, with rotation of Unicorn's polygonal blocks during peak Late Silurian extension is the most likely emplacement mechanism of the Unicorn intrusion. A similar polygonal rotation mechanism has been proposed for emplacement at the giant Bingham porphyry, Utah, USA (Kloppenburg, 2010). An approximate Pridolian 420Ma peak thin OMB crust provides the most likely peak extension for Unicorn's emplacement, consistent with LFB wide crustal thickness age plots by Collins (2004). Significantly, similar aged deposits, commonly around 418 to 425 Ma, occur in the miogeocline, well into NSW and Qld (tear drops in Figure 1), as opposed to variable aged eugeocline volcanic arc mineralisation. Some mineralized granitic intrusive within arc show similar ages, indicting plate wide extension in the miogeocline also affected arc settings. This would indicate Unicorns formation necessarily involved a major tectonic plate wide roll back.

The central palaeogeographical-tectonic features to the Climax-type are "pull-apart" basins. Regionally the Mid-Late Silurian Tumut-Mitta basins follow the Gilmore Suture and its splays, demarcating the regional scaled kink and tensional jog (Figure 1), resembling the Rio Grande Rift basin setting in Colorado. The regional curved sialic OMB build also has parallels with the Laramide Colorado mineral belts Precambrian basement, sweeping in a wide arc between Silverton to the north and Leederville to the south. Furthermore the straight line element of the regional kink, the Zulu corridor, composed of the Saltpetre fault splays and other parallel SSW trending elements, has equivalence to the 'straight line' elements in the Rio Grande Rift, the so called "Climax Line", a relatively narrow zone along which the Urad-Henderson, Climax, Mt Emmons and Silver Creek Climax-type deposits cluster. Both the Zulu Corridor and the Climax Line are contained within regional gravity lows. Zulu corridor passes from

north through the Mt Elliott Goldfield, Mt Unicorn, Mt Morgan and Mammoth porphyry's to the south.

Conclusion

With Unicorn's maiden resource recently announced, initially from the top section to around Tea pot Creek level, this has resulted in the discovery of a newly defined Mo-Cu-Au province in NE Victoria. Genetic and domain modelling reveals Unicorns Climax-Type Mo porphyry parentage, with hybrid Cu-Ag additions attributed to near arc suture rift tectonics. Modelling continues to outline lateral and depth targets, analogues to Colorado's high palaeo level Urad deposit, with potential Henderson like giant depth target which under plated Urad. A nearby 1km diameter concealed depth cluster target near the Unicorn deposit also occurs as the eastern geochemical anomaly. Unicorn is the first Climax-type discovery in Australia and reason for its existence are discussed, including sialic build, splay radiation about an OMB nucleus and cross terrane structures within a specific blend of tectonic attributes. This features a regional jog about the Tumut-Mitta pull-apart basins with resemblance to the Rio Grande Rift jog of Colorado, USA, hosting the Climax Lines Mo porphyry clusters, and the Suture Rift environment of Quartz Hill, a supergiant Climax-type Mo metallogenic hybrids in SE Alaska. Such hybrid tectonics is discussed in relation to Unicorns Zr-Sr-Rb-Nb trace element similarity to the typical Climax-type, with some modification, also related to Unicorns higher Cu and Ag, for which temporal and spatial distribution of Cu-Ag relative to Mo is not entirely understood. In some way this may also relate to the Urad-Henderson inter-phase of the Red Mountain porphyry, which contains higher base metals centrally as opposed to typically distal shells, in that a coincident separate hydrothermal sulphurdation base metal phase appears. Of interest here, though more disconnected, is close temporal superposition of the pyrite phase with Mo disposition at Urad, compared with wide temporal separation at Henderson, given Urad deposit was closely followed by the Red Mountain porphyry pyrites, in an intrusion which venting Urad. As such, reconciliation of Unicorn hydrothermal base metals as a separate hydrothermal sulphidation phase with Mo autometasomatism will reveal insight to tectonic driven mineral domains on rifting and metal ratios, providing a direction for future research. Temporal and spatial separation of the Urad-Henderson pair was likely marked by a brief compression inter-phase then episodic rapid and overtly voluminous ejection of Urad porphyry containing weak Mo by not permitting convective cycling required for Mo autometasomatism and quenched hydrothermal deposition, followed by advent of Henderson's convective cycling, promoted by Red Mountain-Urad Porphyry pressure sealing and depth containment via continued decent in a major rifted jog. Given the marked regional rift environment in focused structures these are positive attributes for Unicorns combined Mo-Cu-Ag mineralisation. ▲▲

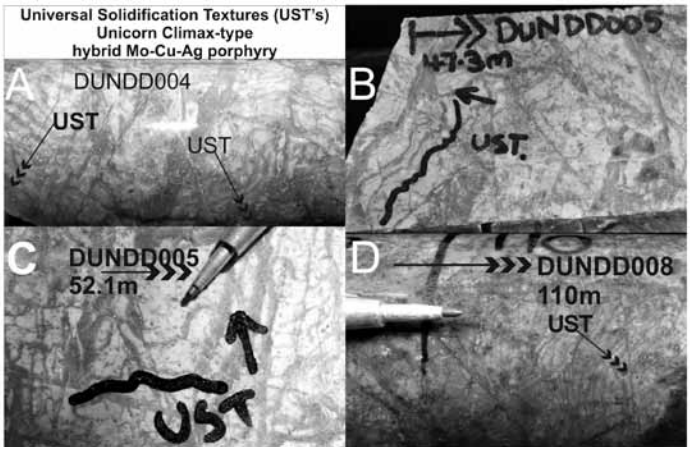

Figure 11

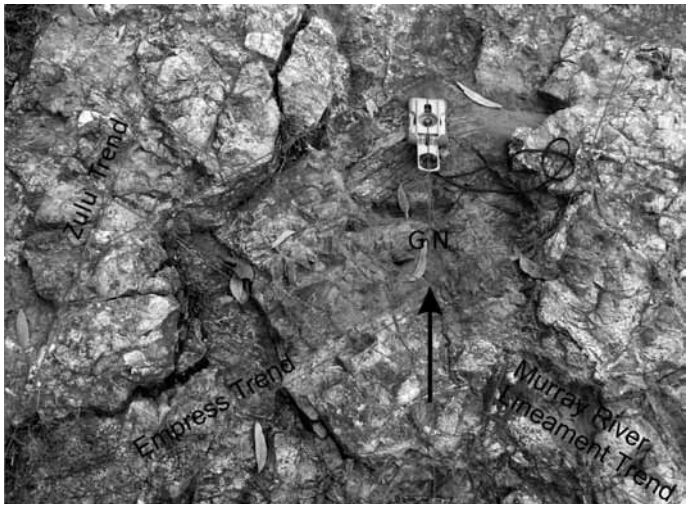

Figure 12

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The JORC Code Review: Its Scope and Future Direction?

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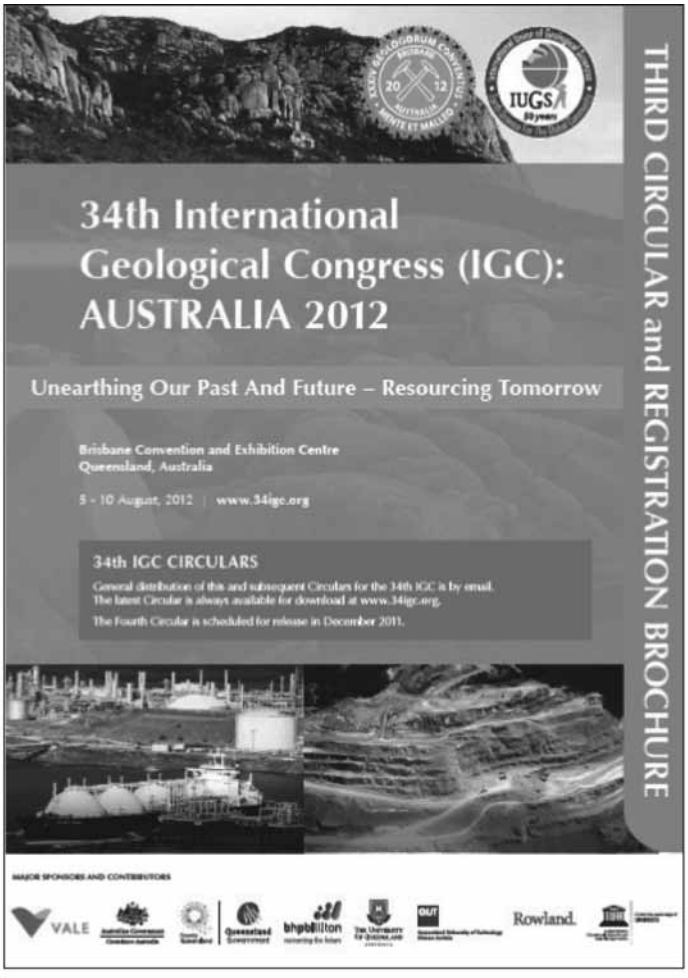
Abstract

Currently there is a debate which highlights a serious capability gap the Australian regulatory reporting system. The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (the 'JORC Code') is under review by the Joint Ore Reserve Committee ('JORC') and the Australian Securities Exchange ('ASX'), with input from the Australian Investments and Securities Commission ('ASIC'). Regular review and debate is a healthy, evolutionary activity and in this instance concern value, forward looking statements and reporting structures. While the issues raised by JORC, ASX and ASIC are valid and pertinent, some of the proposed changes appear to fall outside of the original scope and into area's more suited to The Code for the Technical Assessment and Valuation of Mineral and Petroleum Assets and Securities for Independent Expert Reports ('VALMIN Code'). This scope-creep may be a reflection of the VALMIN Code not being incorporated in the ASX Listing Rules, despite it being the more natural vehicle for issues relating to value, forward looking statements and detailed mineral reporting. The JORC Code's current evolutionary trajectory may have far-reaching implications and it raises serious questions about the scope of the JORC Code and the future role of the VALMIN Code. The author considers that the current debate focuses on individual issues without a 'big-picture' point of view, the result of which may ultimately make the structure of the Australian regulatory reporting system inferior to it international peers.



Context

This paper assumes that the reader is familiar with the recent JORC and ASX consultation papers, as well as ASIC's Submission (JORC 2011a, ASX, 2011 and Dodd, 2011a). The intent of this paper is not to discuss the various proposals or concerns, but rather presents opinion on the 'big-picture concept'. All views and opinions herein are of the author as an individual.

Background

ASX listed resource companies are subject to various legal and regulatory requirements, most notably the Corporations Act of 2001 (CommAus, 2005), ASIC Regulatory Guidelines ('RG') (which reference the JORC and VALMIN Codes) and ASX Listing Rules (which includes the JORC Code as appendix 5A).

The Corporations Act sets out the laws for Australian business entities, primarily relating to corporations (companies) but also to partnerships and managed investment schemes. At several thousand pages long, the Corporations Act is the world's largest corporate statute, dwarfing its nearest equivalent in Sweden which is a couple of hundred pages long. Needless to say, it is a complex document which effectively sets the background and framework for Australian businesses, either ASX listed or privately owned. While there is no direct reference to the JORC Code or VALMIN Code, ASIC requires that reporting be done in accordance with these so as to satisfy subsection 412(1)(a)(ii) of the Corporations Act (ASIC, 2010).

Building on from the Corporations Act, are ASIC RG's . These provide a broader base of reference for reporting across all industries and provide an overarching framework and guidance to both ASX listed and privately owned companies by:

- explaining when and how ASIC will exercise specific powers under legislation (primarily the Corporations Act)
- explaining how ASIC interprets the law
- describing the principles underlying ASIC's approach, and/or
- providing practical guidance (for example, describing the steps of a process such as applying for a licence, or giving practical examples of how regulated entities may decide to meet their obligations).

While there are numerous RG's, some of the most relevant to ASX listed resource companies are:

- **RG111 – Content of Expert Reports** (RG111), which was updated in March 2011. This RG primarily serves to provide investors with sufficient information to make informed decisions on proposed transactions by providing guidance on how Independent Experts should conduct an analysis, the methodologies they may use and the reporting requirements. Consequently, RG111 is most prominent in mergers, and acquisitions and prospectus documents, with both types of transaction being prominent in the ASX resources sector. In this guise, Experts often include accountancies or other organisations holding an Australian Financial Services Licence (a Corporations Act requirement for anyone providing a financial service). This RG contains a footnote reference to additional reporting standards and guidelines exemplified by the VALMIN Code.
- **Rg112 – Independence of Experts** (RG112), also updated in March 2011. This RG provides guidance on matters where there is a requirement for an independent opinion or analysis on such matters as professional relationships, conduct and when and how third party expertise should be used. It is under the latter point that technical (mining related) expertise becomes a requirement in the regulatory framework, mostly in the form of advice or opinion from independent mining consultancies.
- **Rg170 – Prospective financial information** (RG170) updated in April 2011; but subject to another review, possibly in 2012 (Dodd, 2011b). This document provides guidance on matters concerning prospective financial information, including expectation or prediction of future performance, benefits or costs. RG170 is designed to help the understanding of when prospective financial information can or should be disclosed, what constitutes reasonable grounds for doing so and the manner in which it is disclosed.
- **RG 228 – Prospectuses: Effective disclosure for retail investors** (RG228) last updated in November 2011. This sets out ASIC's guidance on the content of prospectus documents and how to word information in a clear, concise and effective manner. This RG makes specific reference to both the JORC Code and the VALMIN Code.

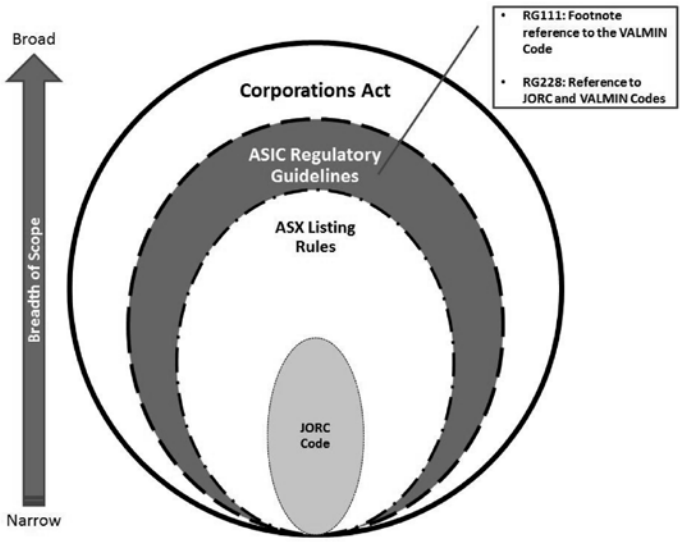


Figure 1: A simplified regulatory framework

For further information on ASIC's RGs, refer to http://www.asic.gov.au/rg.

Private companies wishing to raise capital by listing on the ASX must comply with its Listing Rules. The Listing Rules govern the admission, conduct, quotation and suspension of both the entities and constituent securities. These Listing Rules are not just contractually binding but carry the legal weight of the Corporations Act. It is under the ASX company conductlisting rule requirements that there is specific reference to the JORC Code (ASX, 2011a). For further information on the Listing Rules, refer to http://www.asxgroup.com.au/asx-listing-rules-guidance-notes-and-waivers.htm.

The formal incorporation of the JORC Code into the ASX Listing Rules is a result of the unique characteristics associated with the mining industry and which stem from unscrupulous reporting practices which previously occurred, particularly, during the 1960s nickel boom (JORC, 2011b). Since its inclusion in the ASX Listing Rules in 1989, the JORC Code was revised in 1992, 1996, 1999 and 2004, with a fifth revision scheduled for 2012.

It is reasonable to expect that most people involved with ASX listed resource companies are familiar to some extent with the JORC Code and to a lesser degree the VALMIN Code. However, the JORC Code practitioners or 'Competent Persons', may not be adequately aware of the over-arching regulatory requirements of the Corporations Act, ASIC RG's and ASX Listing Rules. Furthermore, there is a general lack of understanding of how these regulatory mechanism may impact on them if they fail contravene these requirements while meeting the minimum reporting requirements of the JORC Code (Figure 1). This has implications for the evolution of the JORC Code.

ISSUES	
ASX	**JORC Committee**
Disclosure of Exploration Results	
Disclosure of Exploration Targets	
N/A	Guidance on 'reasonable prospects for eventual economic extraction' and cut-off grade for the purpose of estimating Mineral Resources
Disclosure of key assumptions underpinning an initial, or a materially upgraded, Mineral Resource and Ore Reserve estimate	Disclosure of greater technical and modifying factor information particularly when reporting an initial, or a materially changed Mineral Resource and Ore Reserve estimate
Minimum level of study for an initial Ore Reserve estimate	Minimum level of study required to support an initial Ore Reserve estimate and reporting
Disclosure of production targets	
Annual reporting and reconciliation of Mineral Resources and Ore Reserves	
N/A	Accountability of Competent Persons

Table 1: JORC Committee and ASX issues

The 'Issues'

Currently, the JORC Committee and the ASX have issued separate industry consultation papers relating to the proposed amendments to the update of the 2004 edition of the JORC Code. The items for discussion put forth by each proponent are compared in Table 1.

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In addition to the issues outlined above, it is proposed that the 2012 Edition of the JORC Code include a number of previous 'ASX Company Updates' (stop-gap solutions between code updates), which concern:

- Metal equivalents, competent Person's Consent Forms and reporting of Inferred Resources (ASX, 2007a)
- Not reporting in ground or in-situ values (ASX, 2008)

There are also notable ASX Company Updates which have not specifically referred to in the consultation papers and address:

- Non-JORC Code compliant reporting (ASX, 2003)
- Reporting of historical estimates(ASX, 2007b)

Discussion

While the issues proposed for discussion are important and valid, the author considers that some may not fit well under the current scope of the JORC Code, in particular *in-situ* values, production targets and detailed reporting of Modifying Factors. These issues primarily concern value (in the dollars/cents sense), forward looking statements and reporting structures. The author considers these issues to be a poor fit under the JORC Code, which is meant to concern the public communication and presentation of technical items.

Value, forward looking statements and reporting structures are quite complex and interconnected with other more generic areas of regulations. The current edition of the JORC Code is largely silent (or at least vague) in its reference to these items. However, the recent public consultation about the JORC Code update suggests that it may become much more prescriptive in these areas. If some of the suggested prescriptive amendments to the JORC Code on issues outside of its traditional scope are adopted, this may create the potential for loop holes, redundancy and conflicting guidance with the over-arching laws and regulations. Such unintended consequences may result in a less efficient system, with the possible need for near-term stop-gap solutions (e.g. Company Updates). Such Company Updates promote and create further scope-creep, thereby confusing the original purpose of the JORC Code and planting the seed for future evolutionary problems with the code.

Value / in-situ values

The March 2008 Company Update details that the practice of applying commodity prices to deposit endowments is not permissible as it lacks transparency and materiality (ASX, 2008). Clearly, stating that a 100,000 ounce gold deposit has an in-situ value of $150 million using $1,500 per ounce is potentially misleading as it does not apply appropriate modifying factors.

The reporting of *in-situ* values is a misguided attempt to convey the value of a deposit. But is the JORC Code the best medium for reporting aspects of monetary value? In the author's opinion, the likely answer is 'no' as the purpose of the JORC Code is mineral centric, not value-centric. Rather, the communication of the monetary value of mineral assets falls in the mandate of the VALMIN Code, which is tailored to fit within the over-arching regulatory mechanisms such as RG111 and RG170.

The March 2008 Company Update resulted in the issue of value being addressed in ASIC's RGs, VALMIN Code and the JORC Code. Value being discussed in three regulatory documents is not efficient and may create conflict between what is supposed to be an integrated and efficient framework. Furthermore, the chances are that evolution of the JORC Code will involve added commentary on value within the JORC Code, necessitating the skill set of the JORC Committee to be expanded. This would presumably take the form of a sub-committee and raises the question of what is the purpose of the existing VALMIN Code if the JORC Code is to evolve to cover the same areas of responsibility?

In the author's opinion, formally including the March 2008 Company Update into the JORC Code will result in regulatory overlap and inefficiency as well as unnecessary evolutionary danger. It may be prudent for the custodians of the JORC Code to decide whether value is really within their current mandate and the merits/pit-falls associated with an expansion of that mandate. The author considers

it may be short-sighted for the JORC Code to include value related matters, and is of the opinion that the reporting in-situ values should be addressed in the more topic specific VALMIN Code.

Forward looking statements / production targets, Modifying Factors and reasonable basis

A number of issues within the ASX and JORC Committee consultation papers concern forward looking statements, namely:

- production targets
- reasonable prospects for eventual economic extraction
- Modifying Factors

The JORC Committee, ASX and ASIC all have differing opinions on the additional detail required in the reporting of the above issues. Each issue draws on many aspects including the confidence of a Mineral Resource/Ore Reserve estimate and modifying factors such as mining, metallurgical, economic/financial assumptions, markets, marketing, extraneous logistics, exchange rates, financing as well as legal, governmental and socio-environmental considerations. The input assumptions to these are statements upon which investors will make financial decisions and as such may be considered forward looking statements/prospective financial information. The importance and implications of this cannot be understated, as evidenced by ASIC dedicating a ~8,500 word document to the topic (RG170). As Competent Persons are largely from technical backgrounds, many may not be aware of the broader reporting requirements and may fall foul of such mechanisms. Consequently, any expansion or elaboration on the above issues, must be done so as not to unintentionally expose the users of the JORC Code to the broader regulatory requirements of the Corporations Act and ASIC's RGs and their associated enforcement.

The risk posed by an amendment to the JORC Code to elaborate into areas that may be considered to represent forward looking statements is that it may:

- not be sufficiently comprehensive, placing it at odds with or necessitate and extensive education programme about over-arching regulatory requirements
- require future elaboration (Company Updates) to address loopholes and conflicts, resulting in scope-creep of the JORC Code's original mandate

So while on face value guidance by the JORC Code on forward looking statements may appear to be a simple matter, it is potentially a complex area involving a wide range of issues for which the current structure of the JORC Code is not suited. If the custodians of the JORC Code consider that forward looking statements do need to be prescribed, thereby necessitating direct influence with the over-arching requirements, then it may:

- need to draw from a more diverse range of expertise, including becoming more versed in the requirements of the Corporations Act and ASIC's RG
- overlap with content within the existing VALMIN Code
- become an unwieldy document with an ambiguous scope

As an alternative to addressing detailed regulation and guidance on the mining specific use of forward looking statements, the author considers that the VALMIN Code is much better placed to address production targets as it:

- already covers some of the subject matter
- can easily be modified to directly address the matter
- maintains the focus of the JORC Code on the reporting of exploration results and estimates of mineral resources and ore reserves
- is referenced by ASIC RG111 (Content of Expert Reports)

Reporting Structures / Canadian NI43-101

One of the solutions proposed by the ASX to deal with the disclosure of detailed key assumptions is akin to the mandated structure of the Canadian National Instrument 43 101 ('NI43-101') (NI43-101, 2011). If this solution is pursued, is the JORC Code suited to prescribing reporting structures like the NI43-101? This does not seem to be the case. Alternatively, does the VALMIN Code already have the framework and much of the language suited to providing guidance on detailed technical reports? The answer being 'Yes', it is already in scope and referred to in the title of the document. If the JORC Code custodians elect to implement an NI43-101 like reporting requirement, then in the author's opinion the stakeholders are best served by having the:

- JORC Code concern high-level reporting of forward looking statements
- JORC Code should cross reference the VALMIN Code regarding such matters
- VALMIN Code provide the framework and guidance for in-depth, substantiated forward looking statements contained within a comprehensive NI43-101-like document that meets the requirements of ASIC's RG228.

Scope

In both the ASX and JORC Committee consultation papers, there is much discussion on international comparisons, principally relating to the South African and Canadian regulatory jurisdictions. On this basis it is worth examining how these jurisdictions regulate the technical aspects unique to the mining industry (Table 2). It is noteworthy that in each, the scope of each code is different. The most recent is the South African Minerals Codes (SAMCODE) system, in which the SAMREC and SAMVAL Codes are seamlessly integrated. The strength of this structure is that there is essentially one custodial oversight body that manages the SAMREC and SAMVAL sub-committees. In contrast, the Canadian system involves three disassociated codes/definitions that quarantine the role of each

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The JORC Code Review: Its Scope and Future Direction

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regulation, but lacks a dedicated oversight body. The proposed Australian system also lacks an oversight body to manage both the Codes, but also lacks quarantined roles as evidenced by the proposed scope of JORC Code creeping into VALMIN Code's mandate. The proposed JORC Code modifications mean that it has a direct influence on all three areas of scope, yet lacks the comprehensiveness and maturity in the newly proposed areas. In the author's opinion, this would mean that while Australia has the newest mining specific code system, it runs the risk of being structurally inferior to both the South African and Canadian systems because of its overlap and confusion of scope.

ISSUES	JURISDICTION		
	Australia	South Africa	Canada
Exploration results, resources and reserves	JORC Code	SAMREC[1]	CIM Definitions & Standards[3]
Mineral asset valuation	VALMIN Code JORC Code*	SAMVAL[2]	CIMVAL[4]
Technical report content	VALMIN Code JORC Code**	SAMREC	NI43-101[5]

Table 2: Scope of the main international reporting codes

1. SAMCODE (2009); 2. SAMVAL (2009); 3. CIM (2010); 4. CIMVAL (2003); 5. NI43-101 (2011)
* If commentary about in-situ values and production targets are incorporated
** If detailed information about modifying factors and production targets are mandated in an NI43-101 style report

The scope creep in the JORC Code is in part due to the VALMIN Code not being formally recognised in the ASX Listing Rules. Despite the VALMIN Code being mature and time tested, it is a poor cousin to the JORC Code and lacks the enforceability of the latter because of its omission from the Listing Rules. As a consequence, some of the issues raised in the ASX/JORC Committee consultation papers are the result of the lack of a formal bridge between the very technical (JORC Code) and broader (ASIC's RG) reporting requirements. This is a role which the VALMIN Code could play.

The current drawback of the VALMIN Code is that its use is largely restricted to mining industry consultants. The scope of the VALMIN code can be broader so as to facilitate more efficient and standardised communication across a wider section of the mining and investment community. Indeed, the current limited use of the VALMIN Code could easily be fixed by changing the wording of the Code to be more inclusive. This may include broadening its scope to include the non-core JORC Code issues, with particular reference to in-situ values, production targets and detailed reporting of modifying factors.

A Way Forward

Returning to the issues outlined in the recent consultation paper, the topic specific items of in-situ values, production targets and the detailed reporting of modifying factors, are more naturally suited to the VALMIN Code as it:

- frames the issues better and leverages off existing guidelines and regulations
- prevents duplication between codes
- help reduce the risk of loop holes and the requirement for future 'Company Updates'
- provides cross-reference and cohesion with ASIC RG's
- provides cross-reference and cohesion with the JORC Code
- is a seasoned and mature code

As both the JORC and VALMIN Codes are currently subject to review and update, it is an ideal time to clarify the purpose and scope of the JORC Code, incorporate some of the issues highlighted during the JORC Code review process and provide a better bridge for interaction with Corporations Act and ASIC's RG. It is in facilitating communication between these two very different worlds that the VALMIN Code could play a vital role (Figure 1).

To effect such changes, the author considers that the VALMIN Code should be incorporated in the ASX Listing Rules. Such inclusion would provide a more efficient means of addressing the grey area of

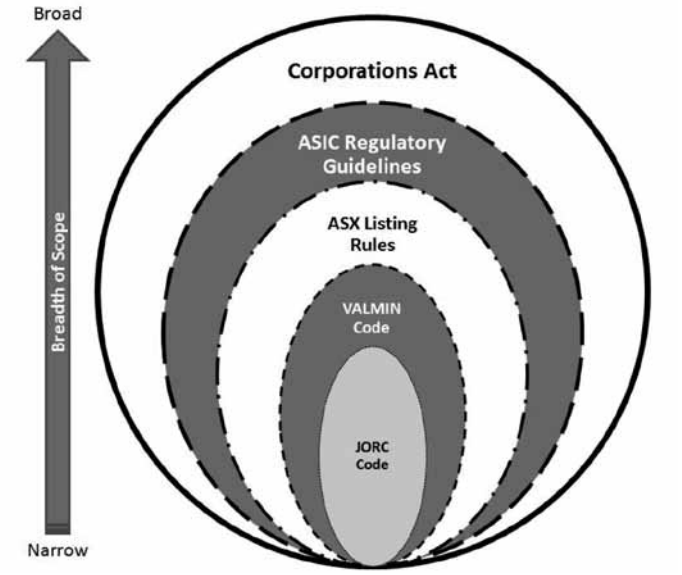

Figure 1: The VALMIN Code's potential role in the regulatory framework

interaction between the technical reporting requirements of the JORC Code and the over-arching reporting and financial requirements of the ASX and ASIC. Furthermore, it would give the VALMIN Code a greater degree of enforceability. For this to work, it may be prudent to develop an over-sight committee to ensure that the mandate of the JORC and VALMIN Codes are clearly defined and maintained, akin to SAMCODES system. The existing JORC and VALMIN Committees could form a joint oversight committee and have members common to both committees. In this way, the

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strengths of each committee are harnessed to create a more comprehensive, co-ordinated system that protects investors and ensures greater consistency with ASIC regulations and the Corporations Act. In the author's mind this would be a more efficient evolutionary path to take than what may result as the consequence of the unintended changes to the scope of the JORC Code. ▲▲

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Obituary – Hugo Hoogvliet

Hugo Hoogvliet of Sydney passed away on 7th November 2011 at the age of 55 years. Having beaten cancer in 2010, Hugo succumbed to an unexpected heart attack.

Family and friends, geology and motorcycles were cornerstones of Hugo's life. He is remembered by friends as a blend of the best of Dutch and Australian culture; combining determination and purpose with a strong sense of humour and mateship. His approach to the challenges he faced in 2010 demonstrated all these characteristics and confirmed Hugo as a man of rare courage.

Hugo grew up in the Netherlands and his love of the outdoors drew him to geology which saw him complete an MSc in Geology. Hugo started his Australian adventure in 1982 with a round-Australia motorcycle trip where he was later joined by his wife to be Helna.

From 1984 to 1993 Hugo worked for Kennecott. It was a career highlight being a key member of the exploration and feasibility team unwrapping one of the great gold mines – Lihir Island, PNG. Hugo created many formative and enduring friendships over this period. Thereafter, from 1994 to 2002, Hugo worked at the Mt Muro gold mine in Indonesia with Aurora Gold which he proudly described as a mine startup to mine closure experience.

Over the past 10 years Hugo broadened his career into a consulting role. He coined the motto 'From Start to Finish' to highlight his experience and skills which covered all aspects of the resource cycle, from early to advanced exploration, pre-feasibility, feasibility, mine start up, full production and mine closure.

Geographic experience included Australia, Brazil, Mexico, USA, Solomon Islands, Tajikistan, Malaysia, Indonesia and Vietnam. His particular passion was feasibility projects, resource modelling and grade control challenges. Hugo's most recent publication was on resource modeling of Industrial minerals.

Hugo will be deeply missed by his wife Helna, children Louise and Lars and many friends. ▲▲

Geological Data Management for the Small Explorer

Laurie Veska
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Solid foundations

It is essential for a small, recently listed or low market-cap exploration company to lay a solid foundation for the management of its geological data. The geological database a company uses provides this foundation, and is thus a key asset, with its value being increased by improving the inherent quality of the data. Improving the quality of this data, which can provide good dividends both now and in the future, is the focus of this article.

Acquisition of data

Typically, a company will have acquired its tenement holdings with an accompanying package of legacy geoscientific and spatial (GIS) data. This data represents the sum total of the previous explorers' investment in the ground that makes up the tenement holdings. It will take many forms; and is usually of widely varying quality and completeness. In its most basic form, the data will be a pile of field notes and associated maps and plans. You maybe a little luckier and find a collection of quizzically named spreadsheets, which when opened display an artistic collage of colourful cells, the exact meaning of which has been lost long ago. At least in this instance much of the data is in digital form. Yet there are many good reasons why a company should be thinking beyond spreadsheets.

Thinking beyond spreadsheets

Why do so many small companies continue to use spreadsheets when a database is the better choice? A spreadsheet has serious drawbacks when used for data storage. It is cumbersome to retrieve selective data from a spreadsheet. Spreadsheets offer little or no data validation and little or no protection against data corruption from well-meaning but poorly trained users (Read: Data sorting). So why do so many small explorers stick with spreadsheets? It is often because of familiarity and a lack of understanding of the alternatives.

Some companies will have discovered they have one or more 'desktop' databases, most commonly MS Access or the equivalent. This is a promising sign because there is a good chance at least some data will be in relational tables. However, before an existing desktop database is used, a company should consider the following questions:

1. Does the database design suit your current business requirements?
2 Does the database have a means of data viewing, entry and editing using well-designed forms?
3 Is there an inbuilt means to create presentation reports for the stored data?

If the answer to any of these questions is no, then either a commercial solution, or some in-house development should be considered. If you are already in possession of a 3D mining package, most provide some means of creating a geological database, however, these databases are often too simplistic and inflexible for other uses. Often

in a small company the expense, or indeed the need, for a fully-fledged commercial data-management solution can't be justified. However, there are other solutions available to improve or extend the design and functionality of your current database. There is also the option of creating a new solution from scratch.

There are good reasons to consider your data management needs early, so as not to compound problems over time. Ignoring the health of your geological data will mean that when it comes time for a resource calculation you may have to pay for a consultant and a significant part of their time (and your money) will be spent making sense of your poorly-organised data.

Organising data - some solutions

Drill hole and Samples Database

For the small explorer, the starting point (or scope of the undertaking) is usually a means of managing reconnaissance 'point' data e.g. soil samples, stream sediment samples, rock chip samples etc., as well as drill hole (or linear data). A practical and proven solution for the small explorer is to use a desktop database which also has some means of creating data-entry forms, a graphic user-interface (GUI) to aid in creating queries, a method to produce basic reports such as a summary drill hole listing (for exploration announcements) and a detailed drill hole report (annual reporting to the government body).

Microsoft Access is a common choice in industry for both a data entry and reporting tool, especially for those with little programming experience. This is a valid choice for the small operation; there is also a good business case for using MS Access as a front-end CRUD tool, with a separate instance for the back-end database (where only the data will reside). Some suggested back-end options are MS Access again, or for a sturdier solution; SQL Server Express 2008 R2, or Oracle XE which are both freely down-loadable tools and very capable. With respect to CRUD, I'm not talking about a 'coating or an incrustation of filth or refuse' (to which the geologist's amongst us are intimately familiar). I am referring to Create, Read, Update and Delete, basic functions of a computer database system.

The separation of front-end from back-end is a good future-proofing idea; the data tables in the back-end are linked to the front-end database containing the forms, queries and reports. This means that work can be done on the front-end without worrying about taking the database off-line or data synchronisation later.

The Database Model

For the beginning geology database modeller there are a number of common pitfalls. Whilst there are important criteria to generally follow in order to create or model a database, there is no single, correct design. Many volumes have been written regarding general database design, however I will discuss only the most problematic pitfalls as they apply to geological and drilling-related data repositories.

It is crucial to understand the importance of storing your geoscientific data in the most logically consistent and efficient manner. It is a common misconception that you store your data according to a specific end use. An example would be the modelling of a database in such a way that collar, sample and perhaps even analysis data are held in the same database table. This may have been designed to eliminate the use of joins in GIS/3D software, but this practice severely limits the flexibility and use of the stored data for other future software or purposes. I have reviewed a database from a medium sized mining company where the 'Prospect' field was duplicated in several tables, including the collar table, the geology table and the assay table. Data redundancy such as this can lead to data anomalies and corruption. As an example, if the prospect for a given collar required editing, it would have to be changed in literally thousands of records, instead of one edit in one lookup table.

This leads to the practice of separating the storage from the presentation layers. Ideally you will have one storage layer for your data, but many presentation layers. For example, a GIS presentation layer for each of your GIS software tools of choice, a 3D presentation layer for your modelling software of choice and so on, the key point

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being that you can easily add presentation layers as the business need arises with the proviso that your storage layer has been properly designed from the start. Presentation layers are commonly created through the use of database Views (saved queries).

To achieve the best protection for your valuable geological data, it is important to understand that the current generation of desktop database engines typically provide inbuilt tools and functionality to ensure the data in your database is accurate and consistent i.e. has integrity.

Whilst no amount of programming can prevent every type of error that could be introduced, it is important to learn how to utilise the provided tools to the best of your ability in order to maximise the validity and quality of your geoscientific data. You will have heard of the old adage: Garbage In – Garbage Out , well let's keep the garbage out!

Ensuring data integrity

There are four primary types of data integrity: entity, domain, referential, and user-defined. In general terms; entity integrity applies at the row level; domain integrity applies at the column (or field) level; and referential integrity applies at the table level.

1. Entity Integrity AKA: Hey, my drill hole is in there twice!

No duplicate rows. Entity Integrity ensures that the data that you store remains in the proper format as well as remaining comprehensible. Every row has a unique field that can't be null or empty.

In a typical table designed to hold collar information it is very common practice to designate the name of the drill hole or costean as the Primary Key or unique, not null field. Many drill databases generated from 3D modelling software such as Surpac do this. Text fields traditionally make poor primary keys, especially fields that the user manually enters, such as the drill hole name.

This happens both in commercial software, and more than likely in your very own database. For a small scale, simple to maintain system suited to the small explorer, this is understandable particularly given the user-friendliness it offers. Drill hole 'DDH-97 GREENFIELDS-009' is the same as 'DDH97 GREENFIELDS-009' isn't it? You and I know that, but to your database they couldn't be more different.

During the data collation stage where you may be initially loading your database tables with data, the practice of using the drill hole name as the Primary Key is going to be at its highest risk in terms of data integrity between tables.

You may find that the geology logs are not displaying for a drill hole you could swear has been logged and the data entered. The end result may be that you enter this log information again and duplication occurs - your entity integrity has been compromised.

One partial solution here is to provide the user a means of easily performing a search for existing data before new rows are created. A search performed in the background to display drill holes with similar names as you enter your new hole, for example. Another, even better solution is to use integer type fields to link tables, such as a drill-id.

2. Domain Integrity

The values in any given column fall within an accepted range. (Validation)

It is important to make sure that the data entered into a table is not only correct, but appropriate for the fields it is entered into.

Some familiar examples may include:

1. A numeric field to hold end of hole (E.O.H) depth.
2. A date field (with date picker in your entry form) for the drill start date, drill end date
3. Drill hole collar azimuth in the range (0-360 degrees)
4. Drill hole collar dip in the range (-90 - +90).
5. Multi-field validation: hole survey depths must be less than or equal to E.O.H depth.

If the range of acceptable values for a given field must conform to a list of values (e.g. a rock code or alteration type), then typically a lookup list would be employed within the application, with or without a referential integrity constraint (see next) applied at database level on a matching lookup table to enforce this referential integrity.

3. Referential Integrity

Foreign key values point to valid rows in the referenced table. In geological database terms, a consequence will be the requirement to have a drill hole collar entered first, before you can enter its geological log. Additionally you will be prevented from deleting a drill hole collar before first deleting all its associated logs, down-hole survey entries, RQD and Recovery values etc.

4. User-defined Integrity

The data complies with applicable business rules. For instance you may have a rule that states all analyses are to be entered in parts per million units rather than percent. You may require that a drill hole name be entered in the form: "DDH"+ Year + Prospect Name. It is almost certain that you will want to prevent lithology intervals for a given hole from overlapping.

Summary

Given that geologists are normal, fallible human beings a database design and its application code should be able to anticipate and prevent many types of errors, there should also be an expectation that every effort is made to enter data correctly. Some errors may be impossible to trap systematically (for example, an incorrectly typed name or rock description), but any business rules which can be defined should be enforced in your database. Avoid the temptation to rely solely on vigilance by end-users to ensure accurate data.

A database and application is ultimately worthless if the data is of poor quality and cannot be relied upon. The geological database a company uses is a key asset, with its value being increased by improving the inherent quality of the data - and improving the quality of data can provide good dividends both now and in the future. ▲▲

2011 Xmas Cruise WA













Scientific Illusions in Education

Guy Berthault

OUR EUROPEAN CIVILIZATION rests upon two pillars: Judeo-Christian revelation, its religious pillar, and Greco-Roman thought, its philosophical and political pillar.

In modern times, these foundations have been dangerously eroded by the acceptance of erroneous ideas in natural science, especially in astronomy and geology. This paper will demonstrate that modern science has now exposed these errors and opened the way for a restoration of the religious, political, and philosophical foundations of Western civilization.

During the Middle Ages, after rediscovering the ancient philosophers, especially Plato and Aristotle, thanks to the Arab philosopher Averroes and the Jewish philosopher Maïmonides, an harmonious synthesis of Judeo-Christian and Greco-Roman thought was achieved, first by St. Albert the Great and then by his pupil St. Thomas Aquinas in his *Summa Theologica.*

The University at that time was in the hands of the Church. The queen of all sciences, theology, drew from two sources of knowledge: religion from divine revelation, and natural religion, inspired by the metaphysics of Aristotle. Aristotle showed that natural movement (impetus) only resulted from an initial Mover which corresponded to the revealed God, Creator of the universe.

The universe had been described in Aristotle's work *"De Coelo"* as an unchanging sphere containing the fixed stars, with its centre being the immobile Earth around which revolved the Sun and the planets. Four centuries later, the astronomer Claude Ptolemy, in his work *"The Almagest"*, which took into account his measurements of the position of known planets, established Aristotle's philosophical theory as a scientific theory. It was this theory that was taught in the Christian Universities of the Middle Ages.

In the third century before Christ, however, Aristarchus of Samos, espousing the existence of the fixed star sphere, postulated that the Sun was its centre.

The ancient Greeks, therefore, had two philosophical schools which agreed about the existence of a sphere containing the fixed stars, but which were opposed as to whether the body at the centre of the sphere was the Sun or the Earth.

Inevitably the debate resurfaced within the Christian civilization of the Middle Ages. Copernicus, a canon and astronomer, wondered why the planets around the Earth described irregular orbits. He re-worked the calculations of the positions of the planets measured by Ptolemy and demonstrated that they revolved around the Sun. From his calculations of their approximate distance from the Sun, he assigned them a circular orbit, which Kepler demonstrated soon after to be an ellipse, with the Sun as its focus.

Copernicus reported his measurements in his book "De Revolutionibus Orbium Coelestum" published in 1543. It was sent posthumously by his friend Osiander to Pope Paul III.

In a preface addressed to the Pope, Copernicus, considering the Earth as a simple planet, asserted without proof that it circled the Sun. In this way the Sun became the centre of the whole world. Copernicus had no proof, but he quoted *Hermes Trismegistes* who referred to the Sun as a "visible god."

There was no reaction from Pope Paul III or his followers. Tycho Brahe, who was the astronomer of the King of Denmark, made a great number of measurements of the position and distance of the planets. Kepler used and added to them in his special study of Mars, from which he formulated his three laws in his works "Astronomia Nova" and "Harmonices Mundi."

So far all the study concerned the planets but not the Earth. Tycho Brahe had rightly remarked that the apparent positions of the Sun and of the planets, observed from the Earth, remained identical, whether the Sun revolved around the Earth, or vice versa. The temptation, however, to consider the Earth to be a planet like any other, was too strong, and Kepler adopted the Copernican thesis. At the beginning of the 17th century, Rome had still not adopted a position on the matter.

Then came Galileo who taught in the Padua University. Following his successes in astronomy he publicly declared himself pro-Copernican.

Finally the Church reacted in 1616 by a decree condemning two propositions: *The Sun is the centre of the world*, and *The Earth is not the centre of the world and is moving*.

In spite of this condemnation, Galileo showed himself more and more Copernican. It was his work *"Il Dialogo"* which caused him to be condemned in 1633, in similar terms to those of the 1616 decree.

Galileo's first proposition that: *The sun is the centre of the world and is absolutely without local movement* was also condemned by the Holy Office as follows: *"It is absurd and false philosophically*

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speaking and positively heretical being opposed to Holy Scripture."

His second proposition: *The earth is not the centre of the world and is moving not only in space, but also in a diurnal movement around itself*, was also judged *absurd and false philosophically speaking and (ought to be) considered theologically speaking at least as erroneous in Faith.*

This condemnation created a cleavage between theology and the natural sciences, with the latter henceforth tending towards rationalist philosophy.

Four years after the Galileo trial, the *Discours de la Méthode* by Descartes made natural science primarily subject to clear and distinct ideas. This favouring of ideas over facts was a characteristic of rationalism. Next came Newton who in 1687 formulated the laws of universal gravitation in his *Principia Mathematica*. He no longer referred to the "centre of the world," but in his first law he used the principle of inertia which asserted that in the absence of an external force, all bodies stay at rest or move in a rectilinear uniform movement. In so doing, he immediately dropped the principle of Aristotelian *impetus*. In his third law, he postulated the identity of action and reaction, and applied it to two bodies at a distance one from the other. From it he deduced the identity of reciprocal attraction, expressed by the product of the mass by the acceleration of a body. He calculated from this the mass of the sun as being equal to 330,000 times that of the Earth, and much greater than that of the great planets. He concluded that the sun was the centre of gravity of the solar system which included the planets and the Earth.

In 1727, Bradley discovered the stellar aberration which is characterized by an elliptic orbit of each star in a plane parallel to that of the ecliptic. The half great axis of the orbit is seen from the Earth to be an angle of 20.49'(min of arc). Bradley gave an explanation of the phenomenon. Assuming, as did his predecessors, that the sun was motionless, he accepted that the relative speed of the Earth in relation to the sun stayed the same (30km/s) with respect to the fixed stars. Composing this speed with that of the light, he showed, the ratio of the two speeds 30/300,000 = 1/10000, corresponded to the angle of aberration of 20.49'. His explanation seemed to prove that the Earth revolved around the sun.

As far as the public was concerned, from that moment forward heliocentricity had been proven. Catholic theology with its old-fashioned dogmatism had been wrong to condemn Galileo! This led to the almost universal acceptance of heliocentricity by the end of the 18th century.

Supported by Bradley's paper on aberration presented to the Royal Society in 1728, the *Principia Mathematica* became the "Bible" of the rationalists.

The effect upon the other sciences was significant, as will be shown in the case of geology, because rationalism reversed scientific reasoning. Instead of the latter being founded on observed and

of natural scientists became subject to principles, postulates and laws. These latter favour *a prioris* as a starting point, accepting the facts which confirm them whilst eliminating the others. In this way rationalism developed from Descartes to Kant.

In the political arena the Revolution first moved against the Church, then against the monarchies. It ended with the defeat of Napoleon and the return of Louis XVIII, but not for long because the scientific causes which led to the revolution remained. There was no going back to the revolutionary state and the Terror (apart from brief periods like the *Commune*). France became a democracy drawing upon the same principles of liberty, equality and fraternity stemming from this Revolution. The same pattern was followed by the young United States. Progressively many countries were won over to the same principles.

Let us turn to another great science, geology, whose illusions have had implications of a similar or greater magnitude. It was in 1667, that Nicolas Steno defined the fundamentals of the subject in his book *Canis Calchariae* by interpreting the superposition of rock strata as a succession of sedimentary deposits. In 1669 in *Prodromus* he deduced from the same interpretation the principles of stratigraphy upon which in 1832 Charles Lyell formulated his geological time-scale showing a succession of fossil species. Lyell attributed a total duration of 240 million years taking into account "biological revolutions". This figure was increased by radiometric dating to 560 million in the 20th century. This succession over a long period led Darwin to formulate his theory in "Origin of the Species" in 1859. It was the natural selection of the species by the struggle for existence producing evolution over time.

Two years later, Karl Marx wrote to Lassalle: *The book of Darwin is very significant. It shows that class warfare in history has its foundation in natural science. Also Engels in "Ludwig Feuerbach and the end of the German philosophy" wrote: The general demonstration made for the first time by Darwin was that all the products of nature around us now, including men, are the result of a long process of development from a small number of unicellular germs originally, and that these, in turn, stemmed from a protoplasm or from an albuminoïdal body constituted from chemicals. From this "discovery" of Darwin he deduced a law of the evolution of societies: But what is true concerning nature, recognized equally as a process of historic development, is true also for the history of society in all its branches and all sciences which concern human things (and divine)*. (Marx, Engels, Etudes *philosophiques*, Ed.Sociales, pp.213-214.)

Scientific socialism therefore proceeded from Darwin, as did national-socialism, with its advocacy of Aryan racial supremacy leading to the Bolshevik revolution, the Second World War: more than 100 million deaths for nothing, not to mention the Colonial wars. The French Revolution was defeated militarily, but was successful in imposing its ideas on the world, and this same pattern was repeated with the defeat of the Nazi and Soviet regimes. The least that can be said is that the socialist principles underlying them have survived because the scientific errors underlying the ideologies are not recognized. Worse, the errors develop like a cancer, because at present the big bang theory completes the theory of evolution, providing an agnostic view of the world, from which the idea of God the Creator is excluded. Those who believe in a transcendent Creator God are now denounced as "creationists". Scientists know to their cost this method of intellectual terrorism.

Catholic theology nowadays seems to accept evolution. The crisis in the Church is manifest as are the consequences: the tree is judged by its fruit. All of this has as its cause fundamental illusions in astronomy and historical geology. Science has become a sort of religion with its dogmas that must be believed without discussion.

Astronomy

The illusion of the Greek philosophers, according to which the celestial vault was a sphere carrying the fixed stars, started a quarrel between those who maintained that the centre of the world was either the sun or the Earth. It was not before the beginning of the 18th century that the stellar parallax proved that the stars were not the same distance from the Earth. The "illusion" of a sphere containing fixed stars therefore disappeared, as did the debate between geocentrists and heliocentrists which arose from the same illusion. The quarrel was continued between Copernicus and Galileo on the one hand, and heliocentrists and Aristotle's heirs on the other, leading to the Church's condemnation of Galileo.

The Church was certainly geocentrist. Not in a geometric sense but in the biblical sense in that the Creation is organised around the Earth where God created life and man. To have admitted that the quarrel between geocentrism and heliocentrism was based upon erroneous data would have brought it to an end. But as was not the case in Galileo's time, the persistent quarrel has produced in the minds of many philosophers and naturalists an anti-Catholic prejudice which interfered with their objectivity.

The first in line was Newton. An analysis of his reasoning for establishing his third law, moreover, shows that nothing had been demonstrated to support it. In order to show the equality of action and reaction, i.e. the reciprocal attraction forces between two bodies at a distance, he reduced the problem to one of contact. He introduced, conceptually, an intermediate body in contact with the two bodies, through which reciprocal attraction forces were exerted.

After having set aside the hypothesis that one of the bodies A attracts B more than B attracts A, as contrary to the inertia principle (first law), he added: because this system, according to that law, should continue in its state of rest or rectilinear uniform movement; consequently, the bodies will exert an equal pressure on the obstacle and will attract each other, one as much as the other. First, this hypothesis is not contrary to his first law stated previously, since each body impresses its own force of attraction on the other. Second, Newton had overlooked the fact that in this case, the acceleration of both A and B was nil. If he had realised it, he would have translated the reciprocal attraction forces as being equal: the equation would have been $M_a \times 0 = M_b \times 0$ (M_a and M_b being the masses of A and B), which obviously demonstrated nothing. In consequence his

Cont. Overleaf

Scientific Illusions in Education

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calculation of the mass of the sun and of the planets was without basis. No demonstration was, therefore, given that the sun was the centre of gravity of the solar system, that it was fixed in interstellar space, or that the Earth turned around the sun at a speed of 30km/s in absolute space.

The law of universal gravitation : $F = GM_aM_b / d^2$

(M_a and M_b being the masses which attract each other, d their distance and G a universal constant) is the consequence of the third law with regard to masses. The fact that this third law had not been demonstrated, nor the law of universal gravitation, the calculation of the masses of the sun and the planets is called into question. Now, in 1798, Cavendish performed an experiment to show the gravitational effect between two masses. Using a torsion balance, he determined the value of G, knowing the masses, their distance, and the gravitational effect measured. In doing so he referred to Newton's law!

In view of the fact that the third law, and therefore the law of universal gravitation had not been demonstrated, I decided to repeat the Cavendish experiment to measure the gravitational effect as a function of varying masses and distances, but without reference to Newton.

The Royal Observatory of Belgium (R.O.B), specialising in gravimetry, agreed to perform the experiment and made a gravitational balance for this purpose. The latter was presented to a gravimetry symposium in Saint Petersburg in June 2010. It eliminated the torsion of the suspension wire, the source of errors. In this way G is measured with great precision. In 2002, a Russian scientific team directed by Mikhaïl Gershtein had shown by experiment that G varied in a day. The R.O.B. is going to verify the results with the gravitational balance being installed in the Han grottos free from variations in pressure and temperature by varying the mass attraction and distance to the mass attracted. I signed the experimental contract which R.O.B. will complete in May 2012.

As to Bradley, he had assumed the sun was fixed (as postulated by Galileo) and consequently identified the relative speed of the Earth in relation to the sun with its absolute speed in space, in order to explain stellar aberration. Today's astronomy teaches that the sun and its planets revolve around the galactic centre at an average speed of 210 km/s.

A1so questioned are the interferometric experiments of Michelson in 1881, Michelson and Morley (1887) and Morley-Miller (1902-1905) which did not demonstrate the speed of the Earth in the presumed immobile ether as 30 km/s. These results left physicists with a dilemma and led Einstein to define the two postulates of his special theory of relativity. In fact, such a theory was not needed. The failure of the experiments implied the hypothesis of immobile ether. According to the interferometric experiments performed up until today, it had to be admitted that according to most the speed of ether on the surface of the earth was either nil, or weak according to Miller (as justified later by Maurice Allais). These hypotheses are compatible with the phenomenon of aberration.

As to the Big-Bang, it is based upon the movement to the red of the galactic spectra. This is interpreted as "proof" of their flight. It was questioned by photos taken in 2004 by the Hubble satellite which showed the yellow light of galactic masses appeared red through the gases which surrounded them: just like the sun-light through the low layers of the atmosphere at sunset. As to the spectral time-lag of specific rays referred to in Hubble's law for calculating the distance of the galaxy, the lag can be due to the galactic rays crossing the gas; with no relation to galactic distances. Once again this calls into question the Big-Bang.

Geology

Concerning historical geology, I will summarise my experiments on stratification published by the French Academy of Sciences, the Geological Society of France and the Russian Academy of Sciences (*Lithology and Mineral Resources* 2002, 2004 and 2011). The results of these experiments refute the interpretations of Steno (1667) and the principles of stratigraphy (1669). They show the evident action of the water as the agent of sedimentation from which sedimentary rocks are formed. The current in turbulent conditions, grades the sedimentary particles and produces erosion surfaces. When the sediments dry out, joints appear. The fact that the current is the agent of stratification has not been recognized.

Sedimentologists today, as a result of their sub-marine observations, and flume experiments, have established relationships between hydraulic conditions and size of sedimentary particles. This allows the minimum paleo-speeds of transport to be determined. It now remains to establish the erosion speeds which, in particular, created the conglomerates at the base of the sequences.

The "Hydraulic Institute of Russia" at my request performed an experimental programme on erosion of sedimentary rocks with currents up to ($v < 27$ m/s). Others are to follow.

We can already ascertain from existing data the time it takes for sedimentary sequences to form. This is the work of a team of Russian sedimentologists with whom I am associated directed by Alexander Lalomov of the Institute of Geology of Mineral Deposits and The Russian Academy of Sciences. He studied the mechanics of suspensions presented by Pierre Julien in *Erosion and Sedimentation* (Cambridge University Press) which refers to a number of sedimentologists who have produced methods for calculating the time of sedimentation of a sequence. The time is the quotient of the volume of the sequence by the capacity of sedimentary transport by unit of time and unit of volume. He made four successive expeditions, in Crimea, the East and West Urals, and in the St. Petersburg region. The results of the latter were published in "Lithology and Mineral Resources" in January 2011 which indicated the time of sedimentation to be 0.05% of the time allotted by the geological time-scale.

All relevant publications are included on my website www.sedimentology.fr

In consequence the geological time-scale is also called into question. Henceforward sedimentology ought to be based upon a study of the origin of transgressive and regressive sequences developing laterally in the direction of the current and vertically by accumulation and not by superposition of strata over time. The calculation of their time of deposit is shown to be very much shorter than the time indicated in the time-scale. Obviously, this is not without consequence for the interpretation of the succession of fossils over time used to justify the theory of evolution.

Moreover, the discovery of contemporary sub-marine fauna varying according to the depth of water, its latitude, and longitude, produce new ecological data, unknown when the geological time-scale was erected.

These sudden catastrophes creating vast oceanic movements have tectonic causes. Christian Marchal of ONERA, a polytechnician colleague, published in 1996 a study on the subject in *Bulletin du Museum d'Histoire Naturelle de Paris* (completed by an "erratum" in Geodiversitas – 1997). It was entitled: *Earth's polar displacements of large amplitude: a possible mechanism*, and showed that the uplift of a large mountain mass such as the Himalayas would modify by several millionths the moment of the Earth's inertia, sufficient to displace by several tens of degrees the stable equilibrium position of the poles. This published study stated specifically that large transgressions and regressions would result from the combined effect of the displacement of the poles and the Earth's rotation. Their amplitude would be much greater than ocean level variations due to glaciation or melting glaciers following cyclical variations of the orbital parameters of the Earth. In addition to the paleohydraulics data, it could explain, other than by falling meteorites, the existence of extensive flood conditions in the geological past.

I would add that the dating of rocks by radio elements is not founded because of the radioactivity existing in the magma. Being independent of pressure and temperature, this radioactivity is not affected by the change of state of magma into rock. It cannot be determined, therefore, how much of the daughter radioactive element was produced in the magma and how much in the rock. As a result, rocks cannot be dated by this method.

Conclusion

The widespread acceptance of major scientific illusions and their catastrophic consequences for mankind should prompt scientists to reflect on Bossuet's words: *Men err more often by bad reasoning from true principles, than by good reasoning from false principles or inexact judgements.* He challenges natural scientists to analyse objectively the sciences they teach in conjunction with experimentally observed facts, and to test the theories which, in and through their teaching, become dogmas. ▲▲

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Education Report

Kaylene Camuti
(Chair, AIG Education Committee)

AIG Bursary Program

In 2011 the AIG awarded 17 AIG bursaries to third year, honours and postgraduate geoscience students. Student reports and honours thesis abstracts from last year's winners will be gradually uploaded to the AIG web site. Reports and abstracts from bursary winners in previous years can be found by going to the education section of the AIG web site at http://aig.org.au/index.php?option=com_content&view=article&id=134&Itemid=81, and selecting from the left hand menu for each year.

The application form for 2012 AIG bursary applications will be available in March. The form will be distributed to students and academics throughout Australia and will also be available on the AIG web site and from the AIG Secretariat.

New Diamond Bursary Sponsor

The AIG wishes to welcome Geoff Davis as a new Diamond Sponsor of the AIG Bursary Program. Geoff is the chairman of Medusa Mining Limited and a graduate of both UWA and JCU. Geoff's very generous contribution to the bursary program will allow the AIG to offer bursaries to students enrolled at UWA and JCU who are involved in projects with a field work component. The Davis – AIG bursaries will help students cover the costs associated with their field projects.

TESEP Update – a continuing success story and now an award-winning program

(The following TESEP update mainly comprises material summarised from a review published in the PESA newsletter in November 2011.)

How It All Started

The Teacher Earth Science Education Programme (TESEP) began as an idea in 2007, and developed with the help of seed funding from the Petroleum Exploration Society of Australia (PESA) and under the guidance of ExxonMobil geologist, Jill Stevens. By 2008 the idea had blossomed into a major educational initiative, with the aim of raising the capacity of middle school (Years 7–10) teachers to teach the Earth Science components of the curriculum through the development and delivery of teacher-orientated professional development workshops.

When TESEP was first proposed in 2007, Earth Science WA (ESWA) was already underway and running classroom Earth Science workshops for primary and secondary students and teachers. These workshops informed and enabled teachers and resulted in increased Earth and Environmental Science student numbers. As the ESWA program runs only in WA there was a need for teacher education in the other states, and it was with this need in mind that TESEP was created, albeit using a different model to ESWA.

By 2008 TESEP had gathered a team of teacher-educators, surveyed teachers to identify high priority workshop needs, commenced workshop development and by mid-2008 was in a position to deliver the first of eight workshops in the "Challenging

Earth" series. TESEP had also assembled an advisory board comprising key personnel from all sectors of the Earth Science community, and had attracted several industry, university and government partners to assist with funding and logistics (including the AIG). The final key to the initial success of the program was the inclusion of the Australian Science Teachers Association (ASTA), to provide administrative and financial management of TESEP, and to provide the quality endorsement and accreditation that teachers look for when choosing professional development workshops.

Since 2008 TESEP has developed eight workshops on earth science topics, and has also had input into the development of the new Australian Curriculum for Science. TESEP is now considered a key stakeholder in discussions about Earth Science education in Australia. TESEP has also delivered over 77 workshops to more than 945 teachers in 23 locations across all states and territories other than Western Australia. Teachers report very high levels of satisfaction with the entire workshop delivery program, and it is estimated that each satisfied teacher shares their learning, the support materials and the enthusiasm for teaching the subject, with at least 2 or 3 other teachers.

TESEP's Success Recognised

In recognition of her outstanding efforts in initiating, nurturing and promoting TESEP, Jill Stevens, the founder and chairperson of TESEP, has been awarded the prestigious American Association of Petroleum Geologists (AAPG) Harrison Schmitt Award, further adding to the recognition she received for TESEP with the PESA Meritorious Service Award 2008. The AAPG citation states it is in recognition of outstanding accomplishment in Teacher Education outreach work.

Following her nomination for the award Jill advised AAPG that the founding members of the TESEP team were a talented, dedicated group of educators/geologists, who had developed and presented the material at face-to-face workshops and were collectively the reason for the success of the workshop series. In response to Jill's representations the AAPG awards committee have re-conferred the award to "Jill Stevens and TESEP".

The Harrison Schmitt Award will be presented to Jill at the AAPG Awards Ceremony during the AAPG Conference in Los Angeles in April this year.

The Program Continues

In 2012 TESEP continues to progress, delivering workshops across many more locations, developing the ASTA online webinar portal, and compiling additional case study examples and new classroom support materials. The continuing success of TESEP is, however, dependent on the financial and logistical support of its partner organisations. To find out more about TESEP and how to be a partner visit: www.tesep.org.au. ▲▲

Missing Members

We are having difficulty in contacting the following members directly. Could you please contact the AIG as soon as possible to update your details? Additionally, as a Member, if you know how to contact anyone on this list, please contact Stephanie Adams (Membership Administrator) on aig@aig.org.au. It would be appreciated if all information could be sent to the AIG office by Friday, March 9th.

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New Members and Upgrades at the February Council Meeting 2012

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GOH	Hilary	
HARRIS	Sarah	
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MACKLIN	Daniel	Timothy
MCINTOSH	Sarah	Patricia
QUINN	Jane	Elizabeth
THOM	James	David
THOMAS	Wendy	Jane
TURNBULL	Ryan	James
VERMAAK	Kevin	Harry
WILKINSON	Lindsey	Joanne

STUDENTS

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BOATA	Sorin	
BOYCE	Robert	
CUNNINGHAM	Hamish	Thomas
DIBBEN	Alexandra	Claire
HUME	Kristie	
MCMAHON	Brendan	
MILBURN	Max	Thomas
ORMESHER	Yvonne	Marie
PETELIN	Anna	Delma
SEHIC	Aida	
SHAY	Maura	
SU	Sonia	
SUBRAMANIAM	Romei	
VAN RENSBURG	Mathew	
WILSON	Ian	

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For the latest in Geoscientist news, views, codes, events, employment and education visit the AIG website:
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AIG FEDERAL COUNCIL FOR 2011-12

AIG NEWS

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AIG News is published quarterly as per the following table. Avoid disappointment by contacting the Editor at least several days beforehand to advise submission of items for the newsletter.

ISSUE DATE	CONTRIBUTION DEADLINE
February	January 31st
May	April 30th
August	July 31st
November	October 31st

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

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