MINING FISCAL REFORM: AN UPDATE

Analysis of the MRRT impact on a small DSO iron ore mine in Western Australia

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The Centre for Exploration Targeting is an unincorporated joint venture between the University of Western Australia, Curtin University and the mineral exploration industry

INTRODUCTION

Times of rapid fiscal policy changes

Just as we were going to print with an article analysing the impact of the proposed Resource Super Profit Tax (RSPT) on a small gold mine in Western Australia, this concept was abandoned by the Federal Government. Having reached agreement with the major mining companies in Australia, the Federal Government announced on July 2, 2010 the introduction of a Mineral Resource Rent Tax (MRRT). This new tax is to apply as of 1 July 2012 at the rate of 30% exclusively to iron ore mines, and to no other commodity, when their annual profit exceeds $50 million. As a consequence the number of projects to which this tax will apply falls down to around 320 from an original total of about 2500 which would have been subjected to a possible RSPT.

A modified form of Petroleum Resource Rent Tax (PRRT) will apply to all coal mining and oil and gas projects both on-shore and off-shore.

The purpose of this paper is to interpret the July 2 MRRT government press release, assess its difference from the RSPT proposal, and to analyse its impact on a small direct shipping ore (DSO) iron mine in Western Australia.

For more exhaustive background on current mining taxation reform, readers are referred to the article on the RSPT which appears lower down in this newsletter.

Revisiting the rational for the introduction of a profit-based mineral fiscal regime

The rationale for the introduction of a profit-based form of mineral taxation boils down to two considerations:

• Economic efficiency and

• 'A fair return to the nation' from the exploitation of its non-renewable mineral resources.

Arguments relating to the economic inefficiency of the current royalty regime have been discussed to some degree in my previous article and need not be repeated other than to stress, once again, that no resource rent tax is currently levied in the mineral context anywhere in the world. This is in spite of resource rent being recognised in academic circles as considerably more efficient and as having potentially less distorting effects on investment decisions than the current fiscal regime. The reason for its lack of adoption is primarily its administrative complexity and high compliance cost, which make it of impractical application other than to a handful of very large and profitable projects, which explains why its application to date has been limited to the petroleum industry.

Questions of fair distribution of the value of mineral resources between government (on

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behalf of the community) and the shareholders of mining companies have no theoretical base in economics, as they revolve, as recent events clearly demonstrate, on arguments about balancing market forces with political imperatives. The need for government to raise revenue is tempered by what the market will bear and by policy considerations as to where government would like to place the nation in the global pecking order in terms of its investment attractiveness to mobile exploration and mine development capital.

In a theoretical global market which is efficient, frictionless, where information is perfect and instantaneously disseminated to all investors, who have similar preferences and where, therefore, there is no opportunity for arbitrage profits, government could theoretically take 100% of the economic rent above an appropriate level of 'normal' profit. The level of normal profit needs to be adequate to attract and retain investment in the industry, i.e. to compensate investors not just for the timing and risk of future project cash flows, but also for the cost and risks associated with the previous, unsuccessful exploration programs that culminated in the initial discovery of the deposit being developed. The real world is clearly not such a place.

There is no analytical basis, for instance, why an PRRT and an RSPT rate of 40% were initially presented by government as 'fair', as the first was essentially determined in light of the political need not to appear too greedy and the second grew off a misguided desire to have common rates even though the two systems to which they would have applied were essentially very different. Neither is there

any logical economic reason why a rate of 30% (down to 22.5% after consideration of the extraction allowance) should now be fair, as it is merely the result of a political compromise following a power struggle cast against the background of an impending election.

Difference between the MRRT and the RSPT

The essential differences between the MRRT announced by the Federal Government on July 2, 2010 and the RSPT are summarised in Table 1. The main difference between the two fiscal regimes has to do with differences in their:

- tax rates (i.e. from 40% to 30% (or 22.5% when the new 25% extraction allowance is taken into consideration),

- up-lift rates (up from the long-term government bond (LTGB) rate (currently 5.1%) to LTGB plus a 7% premium) and

- capital deduction rules (from the depreciation deductions allowed for the purpose of assessing corporate income tax to immediate deduction for new investments and a choice between two transitional deduction rules for established mines, as discussed below).

It is important to bear in mind that the MRRT is intended to be applied to both new iron ore mine developments but also retrospectively to existing iron ore mines.

As already mentioned, the main difference in policy between new and established projects has to do primarily with the capital deduction rules that would apply to them.

ITEM	RSPT May 2,2010 announcement	MRRT July 2, 2010 announcement
Commodities	All minerals and petroleum	Only iron ore Coal and petroleum to be subject to a modified PRRT
Tax headline rate as % of economic rent	40% of RSPT annual above-'normal' resource profit including revenue realised through downstream processing to concentrate or metal	30% of MRRT annual above-'normal' resource profit exceeding $ 50M and based on the value of the resources, i.e. excluding value added by the miner 40% for PRRT
Extraction allowance	Nil	25% of MRRT taxable profit
Normal profit and up-lift rate	Long-term government bond rate (LTGB) currently 5.1%	LTGB plus a 7% premium, currently 12.1%
Capital and losses up-lift rate	As above	As above
Terminal accumulated losses in case of project closure	Rebated at a rate of 40%	Business to bear them
State and territory royalties	Rebated to company but capped to current rates/levels	Credit provided for royalties only when annual resource profit greater than $ 50M Consultation committee to clarify methodology
Resources exploration rebate	30% of exploration expenditure in the year in which is incurred	No rebate
Capital investment deductions	In line with depreciation charges for corporate income tax	New project investments: Immediate write-off Existing projects: Choice of depreciation of written down value over 5 years or of market value over up to 25 years. Requires clarification.
Corporate income tax rate	Decrease from 30% to 29% in 2013/14 and 28% in 2014/15	Decrease from 30% to 29% in 2013/14

Table 1: Differences between the MRRT and the previously proposed RSPT

From Your President

AT THE PRESENT TIME it's the beginning of August, we're in the middle of a Federal Election (who would have guessed?) and we wait with interest to see what support geoscience receives from the incoming government.

Regardless of which party wins the election, however, it is incumbent on Council to continue to represent the interests and views of our members specifically, and the sustainability of geoscience, in general. Article 2(f) of the AIG's Memorandum of Association specifies that one of the objects for which the Institute was established is to "represent geoscientists in the matters affecting, relating, or pertaining to the profession or to the practice, teaching or study of geological science or related subjects and for this purpose to issue or make statements, comments and submissions to the public, government or any institution or authority."

There is more than a semantic difference, however, between "representing" and "lobbying," and it is a distinction Council is sensitive about. Council does not lobby – it does not press for political action. It represents the interests and views of its members irrespective of politics. One such example is a flow through share scheme (FTS) for which, over the past year, the AIG has been making representations to Government. The AIG's stance is based on its concerns for a sustainable mining industry, on an election promise unfulfilled, and indeed the AIG would make the same representations, for the same reasons and in the same way, to any Government of any political persuasion.

The AIG is continuing to actively seek opportunities to join with kindred organisations to present technical seminars and workshops. To this end the AIG was involved in the Geological Society of Australia's highly successful Australian Earth Sciences Convention which was held in Canberra in early July. During the Convention the NSW Branch of the AIG held a symposium which showcased the broad multi-disciplinary character of the AIG, with presentations on traditional geology, industrial minerals, hydrogeology, engineering geoscience, environmental geoscience and mineral exploration, not to forget forensic geology and a geological hero (the first geologist to climb Mt Everest).

Additionally, the Victorian Branch of the AIG recently hosted a seminar with the Victorian Chapter of the International Association of Hydrogeologists, which highlighted the physical linkages between coal seam gas (CSG) extraction and groundwater; specifically that the liberation of CSG requires the pumping of groundwater, which in-turn has the potential to result in groundwater draw-downs that affect local residents, the farming industry, local business, groundwater-dependent ecosystems (where groundwater and surface water are hydraulically connected) and issues such as ground stability and subsidence. Indeed, the identified potential groundwater issues relate equally to CSG extraction, mine site dewatering and geothermal developments.

The above are just two of a number of AIG events that have been held over past months and which collectively present the impressive technical breadth of our membership. Moreover they hint at what the AIG, singularly or in association with kindred organisations, could accomplish at the 34th International Geological Convention (IGC), which will be held in Brisbane from 2nd – 10th August 2012 and which undoubtedly will be one of the greatest opportunities this decade for us to locally showcase our Institute to a broad group of national and international geoscientists.

The IGC is the pre-eminent international gathering for geoscientists. It is only held every four years and there is always strong competition from across the world to host the event, which covers all aspects of geoscience. The AIG is a co-organiser of the IGC and is already actively involved in its management through the leadership of Mark Berry, President of the Queensland Branch. A draft list of themes has been developed (http://www.34igc.org/scientific-program.php) and Mark is in the process of coordinating the AIG's input. We are looking for AIG members to help Mark over the next 18 months with pulling together the AIG's components of the IGC. Anyone wishing to be involved in the IGC should contact Mark at mberry@amcconsultants.com.au.

We are continuing to monitor the employment status of geoscientists through our online employment survey. Although the number of respondents in the most recent assessment was down on previous surveys the results are encouraging, with geoscientist employment in Australia continuing to improve during the second quarter of 2010. The improvement in employment is good sign and indeed the lower response rate could simply indicate that many geoscientists are once again employed and no longer see the value of the survey. The information from the survey continues, however, to be immensely valuable to both the AIG and to kindred organisations with which the AIG shares the employment data, and I encourage you to continue to take part in the survey, which only takes a few minutes to complete. You will be notified when the next survey is available for your input. For more details on the most recent survey, please read Andrew Waltho's report in this edition.

Council is currently in the process of updating the "look and feel" of the AIG's website. While the backroom functionality of the site is excellent, key considerations that Council has for the new face of the AIG website are that it:

- Looks more modern

- Can be easily navigated

- Maintains the existing content and provides for additional content such as forums and comments on articles

- Has an ability to deliver secure members only content via a Members Area

- Has a members directory in which all members can, if they choose, contribute listings and self employed members can publicise their capabilities and services

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In the case of a new mine development capital investments can be deducted immediately for the purpose of determining the profit base on which the MRRT will be levied. The value of as yet undeducted capital expenses will be up-lifted each year at a rate equal to the long-term government bond (LTGB) (currently 5.1%) plus a 7% premium, i.e. by 12.1%. This approach is much more generous than that proposed for the RSPT which envisaged capital deductions similar to the depreciation charges use in determining the taxable income for corporate income tax.

In the case of retrospective application to existing mines, companies have a choice between deducting the current written down value of their tangible investment over a period of 5 years or depreciating the market value of the project, that's to say including the intangible value of its 'mineral rights' over a period of up to 25 years. The latter approach will require significant clarifications as to the methodology to be applied to establish the market value of a project.

To highlight the complexity of this valuation process one need only consider the case of a major Australian coal mine currently the subject of a takeover offer. Its book value is just under $200 million, but it was capitalised by the market prior to the takeover announcement at just over $2 billion and now, following the announcement is capitalised at over $4 billion.

Some of these valuation issues arise from the fact that conservative financial accounting principles define an asset as (1) something of material value, the value of which can be estimated with an acceptable degree of confidence, (2) which will generate benefits beyond the current period and (3) which is owned or controlled by the entity. To the extent that mining reserves and resources do not satisfy criteria (1) and (3), their value is not recorded in the Balance Sheet of the company that discovers them, while the market takes them into considerable account when determining the value of the company. The discoverer's Balance Sheet will only record as a tangible asset the amounts actually expended on the project. If, however the project is subsequently sold for a price exceeding its written down value, the Balance Sheet of the acquirer will record both the original tangible asset with the difference in price recorded as an intangible asset, generally referred to as 'mining rights'. Any future extensions of resources or further discoveries by the acquiring party will not increase the value of its 'mining rights'.

Another area of some uncertainty requiring clarification is the treatment of state royalties. Under the RSPT regime royalties would have been rebated to the company capped to their current rates. Under the MRRT regime a 'credit' will be provided to the company for their state royalties. The word credit probably implies that the relevant benefit will be lagged to the following year and defrayed against an MRRT profit. Government has indicated that royalty credits may be carried forward and that no credit applies when annual profit is below $ 50 million as the company would not pay MRRT and would in effect be taxed under the current royalty regime, except for the fact that its corporate income tax will presumably be levied at the lower new rate of 29%.

Thus the mining fiscal regime in Australia will change from one based on various state royalties plus 30% corporate income tax to one based on 30% MRRT and 25% extraction allowance plus 29% income tax, with the MRRT being a legitimate deduction for the purpose of assessing taxable income.

Not surprisingly with the increase in up-lift rate from LTGB to LTGB plus 7% government also decided to remove the previous RSPT rebating of accumulated losses in case of a project closing down. In effect government no longer shares any of the project risk with the company.

The original RSPT provision for the rebating of exploration expenditure was also removed from the package very much to the chagrin of junior exploration companies.

The rest of the conditions at this stage appear broadly similar.

Purpose and scope of the present study

The purpose of this paper is to present the financial impact of the application of the MRRT on the decision to invest in a new, small direct shipping ore (DSO) iron ore mine typical of many currently being considered in Western Australia. The analysis is based on a realistic Discounted Cash Flow (DCF) model of a fictitious mine called "Rusty Iron", constructed in a fashion similar to that normally used to value mining projects at the conceptual or pre-feasibility stages.

A "base case" model is first constructed to provide a measure of total taxation under current fiscal conditions (i.e. 5.625% and 7.5% ad-valorem state royalties for fines and lump respectively plus 30% income tax, but excluding other local, state and federal government taxes). This is then modified to generate the corresponding total taxation under the 40% RSPT plus 28% income tax and the 30% (22.5%) MRRT plus 29% income tax variants.

A comparison of the three variants provides a measure of the relative transfer of value and return from the shareholders to government under current buoyant iron ore price conditions. It also displays significant differences in annual and total tax paid, and in aggregate effective rate of taxation.

A sensitivity analysis is then carried out to determine how the differential between the current royalty and the MRRT regimes would vary if the profitability of the project were to increase or decrease due, for instance, to changes in the real rates of price and cost escalation.

This exercise is representative of the type of analysis that mineral exploration and development companies will need to become proficient at if the MRRT is eventually introduced, as they will need to estimate their income tax liability at the consolidated company level but work out their MRRT for each individual project in their portfolio to do so. Highly profitable projects will pay large amounts of MRRT, while less profitable ones will pay less and, if their rate of return falls below 12.1% will not pay any MRRT.

THE "RUSTY IRON" DSO IRON ORE MINE CASE STUDY

Project description and main assumptions

The "Rusty Iron" DSO iron ore mine is an open pit mine and crushing and screening development typical of many in Western Australia. Rusty Iron Mining N.L. holds 100% equity in the project, which represents its main asset. The company is making the transition from explorer to producer and as a consequence it currently has neither taxable income or resources rent tax liabilities against which to offset possible losses, which will need to be

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carried forward. In this respect the company is at a distinct disadvantage compared to an integrated company which could offset both income tax and MRRT losses against taxable income and MRRT liabilities of an associated company respectively thus accelerating the related benefits and cash flows.

Diluted mining reserves amount to 28 million tonnes (Mt) of ore with a grade of 61.5% Fe of acceptable quality other than for slightly high silica imposing a price penalty of around 3%. The average waste to ore ratio (W:O) is 0.5. These reserves are estimated to support an optimal production life of 10 years, hence will be exploited at a rate of 2.8 Mt of ore and 1.4 Mt of waste per annum. The ore is split 60% lump and 40% fines and for the purpose of simplicity it is assumed that the grade remains constant for the two components during crushing and screening.

The mine is located 225 km from the export harbour. The loading and trucking cost is $ 0.1/tkm, while port storage and ship loading costs are $5/t.

The development requires a capital investment estimated at $150 million in real (year 0) dollars spread over two years, with production and asset depreciation commencing in year 3. Both capital and operating costs are expected to escalate at a real rate of 2% per annum above the rate of inflation, which is expected to average about 3% per annum. To approximate the current fiscal

- Has an ability to make large files available for download by members, for example audio and video files / podcasts

- Has a strong emphasis on member involvement, including State Branch activities, prominence of the latest news, events and publications

- Has an ability to encapsulate content delivered by our current streaming video service provider

- Includes an events calendar of conferences, seminars and meetings for both AIG and kindred society events

- Has e-commerce facilities for membership subscriptions and publication sales

- Has more regularly used areas posted prominently on the site

I'm excited about the new site and think it will be a big step towards enhancing the way AIG delivers services to its members.

As always, we are listening for your contributions on any relevant matters.

Martin Robinson

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depreciation rules for the purpose of assessing income tax, capital assets have been categorised into:

- Immediately expendable, e.g. exploration, feasibility study, overburden stripping, environmental measures etc. representing 20% of total,

- Normal depreciable assets, e.g. all plant and equipment and other assets not exclusively used in mining for which the Australian Tax Office (ATO) provides indicative useful lives, representing 1/3 of the remainder of the capital cost. The straight-line method was used to depreciate these assets using an estimated weighted average useful life of 12 years.

- Pooled project assets, i.e. assets unique to the mining project representing the balance of the capital investment. The declining-balance depreciation method was used for these assets over the life of the mine. Depreciation was accelerated by the 200% mark-up in depreciable value allowed by the ATO as an incentive to investment in new assets. Pooled project assets include:

  - Mining Expenditure (mine construction and development, accommodation and mess facilities, water and power generation facilities, roadwork, airstrip and other on or near-lease capital investments)

  - Transportation expenditure (off-lease roads, railways, loading and port facilities etc.)

  - Infrastructure expenditure (up-grades to public infrastructure affected by the project, e.g. schools, hospitals, public roads up-grades etc.)

  - Sustaining capital used to replace assets with useful lives shorter than that of the mine or to update obsolete ones thus sustaining the project productive capacity.

Given the importance of correctly estimating depreciation expenses the DCF model was constructed in nominal dollars.

Assets are expected to be salvaged in year 13, following closure of the mine, at a price 10% higher than their written down value.

Other costs estimated in real (year 0) dollars include an initial injection of $15 million in working capital before the start of production, site rehabilitation costs of $6 million in year 13, fixed annual cost of $5 million and a range of variable operating costs as detailed below:

- Mining $3.5/t for waste and $4.50/t plus $1.20/t for ore and grade control respectively,

- Processing and administration costs of $11 and $3.5/t of ore respectively.

Other modelling considerations

Discount rates

A nominal cost of equity funds (RE) of 11.24% (i.e. 8% real) was considered an appropriate discount rate for the model portraying

the current fiscal regime and the MRRT variant if constructed under assumptions of 100% equity funding, given that the company would bear the whole risk of the project. This cost of equity of 11.24% could be viewed, following the Capital Asset Pricing Model (CAPM), as including a risk-free component (RF) at 5.1% to compensate investors for the timing of future cash flows and a risk premium of 6.14%.

A discount rate of 11.24%, however, would not be appropriate in the case of the RSPT variant of the DCF model. This is because government would make good in cash any accumulated losses which may have been brought forward till the end of the project to the tune of 40%. Hence, to the extent that the RSPT rules were not expected to change during the life of the project, government would have been bearing some of the risk justifying a 40% reduction in the risk premium, i.e. from 6.14% down to 3.68%, resulting in a nominal discount rate of 8.78%.

Refund of state and territory royalties

The Federal Government has indicated that it will 'credit' to project owners the amount of royalty paid to state governments, thus counter-acting the effect of state royalties. The model has been constructed on the assumption that the Federal's credit will be on the basis of royalty rates which were current or foreshadowed at the time of the July 2 MRRT announcement. As a consequence the amount of royalty refunded is assumed to rise and fall in line with changing commodity prices. In other words it is assumed that the royalty rates will be capped not the actual amount of royalty paid. Furthermore the word 'credit' implies that the benefit to the company will be lagged (in the model by one year) and not payable if annual MRRT profit falls below $50 million. Furthermore it is assumed that the new corporate income tax rate of 29% will apply to a project irrespective of whether its annual profit exceeds $50 million or not. This means that cash flows under the MRRT regime will be marginally higher than those under the current royalty regime even for projects with annual profits less than $50 million.

The exact mechanics of how the state royalty credit will be administered are, however, still uncertain and are to be considered by an appropriate consultation committee.

Finally, for the sake of simplicity, the model assumes that the state royalties, MRRT, RSPT and corporate income tax are actually paid in the year in which they are assessed. In reality in most cases there will be a three months lag between assessment and payment of these imposts, but its impact on the analysis is considered insignificant.

Base case DCF modelling results

Main model outputs

As already mentioned three variants of the base case were constructed and compared. The first DCF model values the "Rusty Iron" project under the current state royalty plus corporate income tax regime and the second under the MRRT and extraction allowance plus income tax regime and the third under the RSPT plus income tax regime.

A number of model outputs were generated including:

• The project net present value (NPV), its internal rate of return (IRR), discounted payback period and cumulative present value under each regime,

• The amount of state royalty levied in each year and in total over the life of the project,

• The amount of MRRT levied each year and in total over the life of the project,

• The amount of RSPT levied in each year and in total over the life of the project,

• The amount of corporate income tax levied in each year and in total over the life of the project under all three fiscal regimes and the

• Annual and average 'effective tax rate' (excluding other local, state and federal imposts) under all three regimes expressed as a ratio:

  - For the current fiscal regime between the sum of the state royalty and the corporate income tax divided by the net operating cash flows before royalty and income tax,

  - For the MRRT variant between the sum of the MRRT and the corporate income tax divided by the net operating cash flows before MRRT and income tax

  - For the RSPT variant between the sum of the RSPT and the corporate income tax divided by the net operating cash flows before RSPT and income tax

The above ratios were selected as a measure of 'effective tax rate' as they provide a higher degree of direct comparability between the three fiscal regime variants then ratios using different measures of taxable income in their denominators.

Base case modelling under buoyant iron ore prices

The base case revenue was estimated using the current iron ore

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price for fines (i.e. US$1.67/dmu) and assuming that lump demands a 30% price premium and that the price will escalate in real terms at a rate of 1% per annum above the average rate of inflation over the life of the mine. It was also assumed that the price will be subject to a 3% discount on account of the relatively high silica content of the ore. These factors, paired to an exchange rate averaging A$1 = US$0.85, arguably make the base case a rather profitable scenario, thus resulting in a significant difference between the combined amounts of annual and total taxation paid under the royalty, MRRT and RSPT variants respectively as shown in Table 2. Interestingly the new policies result in significant falls in corporate income tax but these are more than made up by the magnitude of the MRRT and RSPT compared to the state royalties and, as a result, total taxation in the MRRT regime variant increases by $306 million,

from $1169.7 to $1475.8 million over the life of the mine.

Significant differences also arise between the corresponding 'effective tax rates' and between the related NPVs and IRRs as shown in Table 3 and Table 4 respectively.

YEAR	3	4	5	6	7	8	9	10	11	12	13	TOTAL
Royalty	30.2	31.4	32.7	34.0	35.4	36.8	38.3	39.9	41.5	43.1	0.0	363.4
Income tax	56.8	70.1	73.4	76.7	79.9	83.1	86.2	89.4	92.6	95.8	2.3	806.3
TOTAL	87.0	101.5	106.1	110.7	115.3	119.9	124.6	129.3	134.1	139.0	2.3	1169.7
MRRT	20.9	66.0	68.2	70.6	73.0	75.5	78.1	80.7	83.5	86.3	18.8	721.6
Income tax	54.9	63.9	67.2	70.4	73.6	76.7	79.8	82.9	86.0	89.2	9.6	754.1
TOTAL	75.8	129.9	135.5	141.0	146.6	152.2	157.8	163.6	169.5	175.5	28.4	1475.8
DIFFERENCE	11.2	-28.4	-29.3	-30.3	-31.3	-32.3	-33.3	-34.4	-35.4	-36.6	-26.1	-306.0
RSPT	43.7	117.3	121.3	125.5	129.8	134.2	138.8	143.5	148.4	153.4	33.4	1289.5
Income tax	57.1	48.9	51.7	54.3	56.9	59.5	62.0	64.5	67.0	69.6	0.0	591.5
TOTAL	100.9	166.2	173.0	179.8	186.7	193.7	200.8	208.0	215.4	223.0	33.4	1881.0
DIFFERENCE	-13.8	-64.7	-66.9	-69.1	-71.4	-73.8	-76.3	-78.8	-81.4	-84.1	-31.1	-711.3

Table 2: Comparison of taxes levied under the state royalty, the MRRT and the RSPT regimes (All figures in $ million).

As already discussed, a measure of the 'effective tax rates' under the two fiscal variants was calculated using a ratio of total taxation as a percentage of the net operating cash flows after adding back these imposts. These ratios provide more comparable figures than those obtained using the respective taxable incomes under the different fiscal regimes as denominators, which are not directly comparable.

From Table 4 it would be noted that under the assumptions adopted the RSPT regime would have resulted in a very significant shift of value ($ 109.7 million) from the shareholders to the Commonwealth Government and a reduction of 10.2% in their rate of return. These effects are roughly halved in the case of the MRRT regime with a $58.1 million decrease in NPV and 3.1% in IRR. This is no great surprise given that the project is relatively profitable at current historically high iron ore prices.

Figure 1 compares the pattern of cumulative NPVs under the three fiscal regime variants.

Modelling the MRRT impact under a continuous range of scenarios from optimistic to pessimistic

To map a comprehensive picture of the effect on the project NPVs under the royalty and MRRT fiscal regimes a scenario matrix was built displaying the effect of possible combination of different real rates of escalation for both revenue and costs, which in the base case had been set at 1% and 2% respectively. In the scenario matrix of Figure 2 revenue real escalation rates were made to range

YEAR	3	4	5	6	7	8	9	10	11	12	13	Weighted average over mine life
Royalty regime effective tax	28.9%	36.5%	37.0%	37.3%	37.6%	37.8%	38.0%	38.2%	38.4%	38.5%	2.3%	37.9%
MRRT regime effective tax	26.5%	44.5%	44.9%	45.1%	45.4%	45.5%	45.7%	45.8%	45.9%	46.0%	19.7%	45.2%
RSPT regime effective tax	31.9%	56.7%	57.0%	57.3%	57.5%	57.7%	57.9%	58.0%	58.1%	58.1%	33.2%	57.6%

NOTE - Effective tax is calculated as total taxes (excluding other state, local and federal imposts) as a percentage of net operating cash flows before total taxes.

Table 3: 'Effective tax rates' as a ratio of royalty plus income tax or MRRT plus income tax or RSPT plus income tax as a percentage of net cash flows excluding taxes under the state royalty, the MRRT and RSPT regimes. Note these percentages do not include other local, state and federal taxes.

	Current royalty regime		Proposed MRRT regime		DIFFERENCE	Abandoned PSPT regime		DIFFERENCE
NPV $M	802.7	Disc. 11.24%	744.6	Disc. 11.24%	-58.1	693.0	Disc. 8.78%	-109.7
IRR %	84.1%		81.0%		-3.10%	73.9%		-10.20%

Table 4: Comparison of NPV and IRR under the state royalty, MRRT and RSPT regimes. Note that the discount rate for the RSPT model has been reduced from 11.24% to 8.78% to compensate for the lower risk due to the loss rebate provisions of the RSPT.
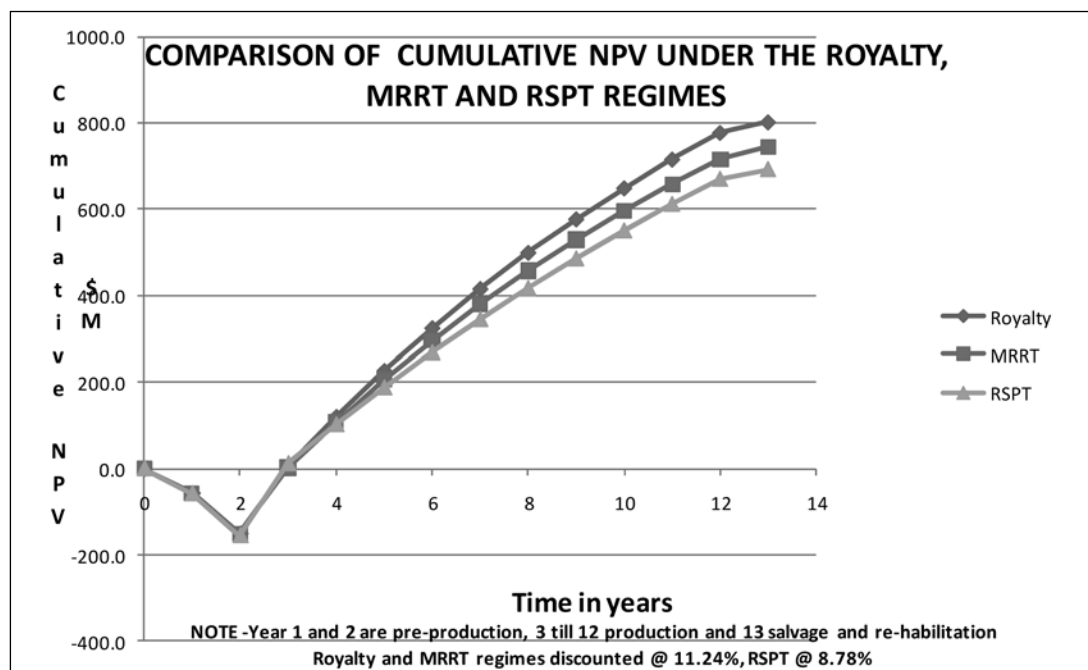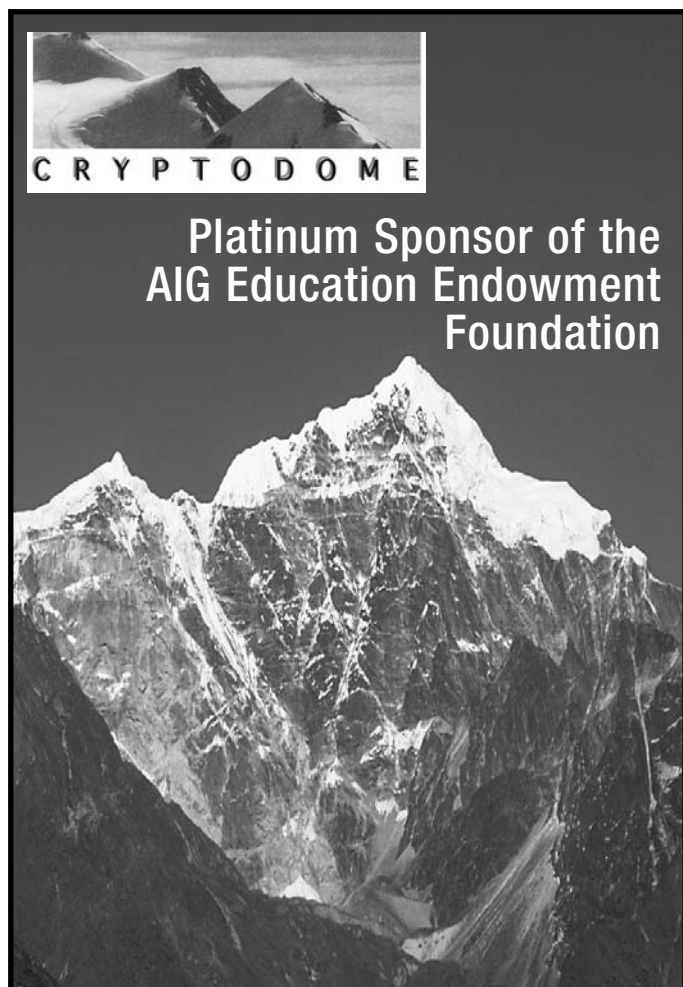

Figure 1: Comparison of cumulative NPVs and related loss of value in the hand of the shareholders under the three fiscal regimes.

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between 5% and -8%, while cost escalation rates ranged between 0% and 8%. The result of this analysis is displayed in Figure 2 which shows the NPV matrix for the royalty regime in top and that for the MRRT at the bottom. A comparison of these two matrices displays how the NPVs under the MRRT fiscal regime are more robust than those under the royalty regime for increasingly pessimistic scenarios. The area highlighted in yellow in the bottom part of Figure 2, for instance, displays a number of scenarios where the NPV under the MRRT fiscal regime is positive, while that under the royalty regime is negative.

Thus a shift from the current royalty regime to the MRRT would generate, in the case of the "Rusty Iron" mine, on the one hand significant loss of value to the shareholders under optimistic conditions, but on the other also a buffer in case of adverse trading and operational circumstances.

Figure 3 shows the difference between the NPVs under the MRRT and those under the royalty regime as shown at the bottom and top of Figure 2 respectively. In effect Figure 3 displays the matrix of transfers of values from the shareholders to government (in pink) and from government to the shareholders (in green) for any scenario leading to a positive NPV under the MRRT regime. The transfer of value is heavily biased in favour of government in the positive scenarios, which is not surprising given that the MRRT is a profit-based revenue rising measure.

Figure 4 displays the undiscounted cumulative cash flows for the "Rusty Iron" mine under the same combinations of possible scenarios as used in Figures 2 and 3 in the context of the project NPV.

Once again it will be noted that the cumulative cash flows under the royalty regime are higher than those under the MRRT regime for relatively optimistic scenarios, but that they pivot in favour of the MRRT regime under more pessimistic conditions. Of particular interest is the area highlighted in yellow in the bottom part of Figure 4, which displays scenarios under which the cumulative cash flow under the MRRT are positive, while those for the corresponding scenarios under the royalty regime would have been negative. Under progressively deteriorating circumstances the point at which annual profits fall below $ 50 million, would be reached first under the royalty regime and later under the MRRT one. Below this point at which no MRRT and state royalties refund would apply, the project would still generate cash flows marginally higher than those under the royalty regime on account of the new, lower 29%

Figure 2: Comparison of the NPVs generated for various scenarios of real escalation in revenue and costs under the royalty and MRRT fiscal regimes. The yellow areas represent pessimistic scenarios where the NPV under the MRRT regime would be positive in combinations of revenue and cost escalation rates which otherwise would have been negative under the royalty regime.

NPV UNDER THE ROYALTY REGIME
Real rate of revenue escalation (%)

802.66	5.0%	4.0%	3.0%	2.0%	1.0%	0.0%	-1.0%	-2.0%	-3.0%	-4.0%	-5.0%	-6.0%	-7.0%	-8.0%
0.0%	1473.2	1310.1	1159.4	1020.2	891.5	772.5	662.6	561.0	467.1	380.4	300.2	226.1	158.9	90.7
0.5%	1452.1	1289.0	1138.4	999.1	870.4	751.4	641.5	539.9	446.0	359.3	279.1	205.0	136.1	66.6
1.0%	1430.3	1267.2	1116.5	977.3	848.6	729.6	619.7	518.1	424.2	337.4	257.3	184.8	111.9	40.5
1.5%	1407.7	1244.7	1094.0	954.7	826.0	707.0	597.1	495.5	401.6	314.9	234.7	161.0	86.0	13.5
2.0%	1384.4	1221.3	1070.6	931.4	802.7	683.7	573.8	472.2	378.3	291.5	211.8	135.2	58.5	-15.5
2.5%	1360.2	1197.2	1046.5	907.2	778.5	659.6	549.6	448.0	354.2	267.4	188.3	107.6	29.5	-45.6
3.0%	1335.2	1172.2	1021.5	882.3	753.5	634.6	524.7	423.1	329.2	242.4	160.9	78.7	-1.0	-77.0
3.5%	1309.4	1146.4	995.7	856.4	727.7	608.8	498.8	397.2	303.4	218.2	131.8	47.5	-33.4	-110.5
4.0%	1282.7	1119.7	969.0	829.7	701.0	582.0	472.1	370.5	276.6	189.4	100.8	15.2	-67.0	-145.2
4.5%	1255.0	1092.0	941.3	802.0	673.3	554.4	444.5	342.9	250.8	158.6	67.9	-19.3	-102.3	-181.1
5.0%	1226.4	1063.4	912.7	773.4	644.7	525.8	415.9	314.3	220.9	125.4	33.1	-55.4	-139.6	-218.9
5.5%	1196.8	1033.8	883.1	743.8	615.1	496.2	386.3	284.8	187.9	90.8	-3.1	-92.8	-178.2	-258.6
6.0%	1166.2	1003.2	852.5	713.2	584.5	465.6	355.6	255.3	153.0	53.5	-41.9	-132.6	-218.3	-299.8
6.5%	1134.5	971.5	820.8	681.5	552.8	433.9	324.0	220.5	115.8	14.7	-82.1	-174.1	-260.6	-342.4
7.0%	1101.8	938.7	788.0	648.8	520.1	401.1	293.2	183.7	76.5	-26.4	-124.1	-217.1	-304.7	-386.5
7.5%	1067.9	904.8	754.1	614.9	486.1	367.2	256.6	143.8	34.8	-69.6	-168.6	-261.7	-350.5	-432.7
8.0%	1032.8	869.7	719.0	579.8	451.1	334.2	217.2	102.3	-8.5	-114.4	-214.8	-309.0	-397.9	-481.1

Real rate of cost escalation (%)

NPV UNDER THE MRRT REGIME
Real rate of revenue escalation (%)

755.50	5.0%	4.0%	3.0%	2.0%	1.0%	0.0%	-1.0%	-2.0%	-3.0%	-4.0%	-5.0%	-6.0%	-7.0%	-8.0%
0.0%	1287.3	1152.8	1028.6	913.7	807.6	709.5	618.8	535.0	457.6	386.1	320.0	247.1	190.2	135.1
0.5%	1272.3	1137.9	1013.6	898.8	792.6	694.5	603.9	520.1	442.7	371.1	305.0	231.7	175.2	114.9
1.0%	1256.9	1122.4	998.2	883.3	777.2	679.1	588.4	504.6	427.2	355.7	289.5	215.8	156.8	97.7
1.5%	1240.9	1106.4	982.2	867.3	761.2	663.1	572.4	488.6	411.2	339.7	273.6	199.7	139.1	75.7
2.0%	1224.4	1089.9	965.6	850.8	744.6	646.5	555.9	472.1	394.7	323.1	244.7	183.2	116.5	57.2
2.5%	1207.3	1072.8	948.5	833.7	727.5	629.5	538.8	455.0	377.6	306.0	227.1	161.7	98.1	30.1
3.0%	1189.6	1055.1	930.9	816.0	709.9	611.8	521.1	437.3	359.9	288.4	209.0	137.4	73.0	5.3
3.5%	1171.3	1036.8	912.6	797.7	691.6	593.5	502.8	419.1	341.6	270.1	186.8	116.9	51.2	-20.5
4.0%	1152.4	1017.9	893.7	778.8	672.7	574.6	483.9	400.1	322.7	238.2	166.2	90.6	18.6	-54.9
4.5%	1132.8	998.4	874.1	759.2	653.1	555.0	464.4	380.6	303.2	215.0	138.5	68.2	-9.2	-84.4
5.0%	1112.6	978.1	853.9	739.0	632.9	534.8	444.1	360.3	282.9	191.8	110.2	33.9	-38.0	-115.1
5.5%	1091.7	957.2	832.9	718.1	611.9	513.8	423.2	339.4	248.9	162.4	86.6	3.9	-77.1	-147.1
6.0%	1070.0	935.6	811.3	696.4	590.3	492.2	401.5	317.8	221.6	138.5	58.3	-27.2	-110.2	-189.7
6.5%	1047.6	913.2	788.9	674.0	567.9	469.8	379.1	295.4	189.4	106.6	18.9	-68.3	-144.5	-225.7
7.0%	1024.4	890.0	765.7	650.9	544.7	446.6	356.0	267.8	162.7	77.5	-14.6	-103.9	-189.3	-263.2
7.5%	1000.5	866.0	741.8	626.9	520.8	422.7	332.0	227.4	128.9	36.0	-49.4	-140.8	-228.1	-311.1
8.0%	975.7	841.3	717.0	602.1	496.0	397.9	303.9	191.1	99.2	-0.1	-96.2	-179.2	-268.4	-352.9

Real rate of cost escalation (%)

▢ Scenarios under which the NPV becomes negative

▢ Scenarios generating positive NPVs under the MRRT regime but not under the royalty regime

▢ 744.6 Base case scenario

corporate income tax rate. To the degree that more free cash would be accumulated and that the marginal cost of production will be slightly lower under the MRRT regime, a buffer would be created for the project to better withstand a protracted recession and presumably slightly delay mine closure, even though the project may be incurring accounting losses, as long as cash flows remain positive.

On the negative side it must be kept in mind is that mining developments make significant use of elevated levels (up to 75-80%) of non-recourse project finance, which is normally to be repaid during the first 2 to 3 years of the life of a project. The lower cash flows under the MRRT will decrease the capacity of projects to service this type of debt and as a consequence reduce its availability as a source of development funds which must be made up by increasing levels of more expensive and, at times hard to secure, equity.

Consideration of the fact that the MRRT regime produces comparatively higher cash flows under more pessimistic scenarios means that a project, while less

DIFFERENCE IN PROJECT NPV BETWEEN THE ROYALTY AND MRRT REGIMES
Real Rate of revenue escalation (%)

	5.0%	4.0%	3.0%	2.0%	1.0%	0.0%	-1.0%	-2.0%	-3.0%	-4.0%	-5.0%	-6.0%	-7.0%	-8.0%
0.0%	-185.88	-157.29	-130.87	-106.45	-83.89	-63.03	-43.76	-25.95	-9.49	5.72	19.78	20.99	31.30	44.43
0.5%	-179.74	-151.15	-124.73	-100.32	-77.75	-56.89	-37.62	-19.81	-3.35	11.86	25.92	26.70	39.11	48.35
1.0%	-173.38	-144.80	-118.38	-93.96	-71.40	-50.54	-31.27	-13.46	3.00	18.22	32.27	31.03	44.93	57.18
1.5%	-166.81	-138.22	-111.80	-87.39	-64.82	-43.96	-24.69	-6.88	9.58	24.79	38.85	38.77	53.17	62.25
2.0%	-160.00	-131.42	-105.00	-80.58	-58.01	-37.16	-17.89	-0.07	16.39	31.60	32.86	47.95	57.99	
2.5%	-152.96	-124.37	-97.95	-73.54	-50.97	-30.11	-10.84	6.97	23.43	38.64	38.82	54.11	68.64	
3.0%	-145.67	-117.08	-90.66	-66.25	-43.68	-22.82	-3.55	14.26	30.72	45.93	48.12	58.65		
3.5%	-138.12	-109.54	-83.12	-58.70	-36.13	-15.28	4.00	21.81	38.27	51.87	55.01	69.35		
4.0%	-130.31	-101.72	-75.30	-50.89	-28.32	-7.46	11.81	29.62	46.08	48.86	65.47			
4.5%	-122.22	-93.64	-67.22	-42.80	-20.23	0.62	19.90	37.71	52.31	56.39	70.55			
5.0%	-113.85	-85.27	-58.85	-34.43	-11.86	8.99	28.27	46.08	61.98	66.35	77.03			
5.5%	-105.18	-76.60	-50.18	-25.76	-3.20	17.66	36.93	54.61	60.97	71.62				
6.0%	-96.21	-67.63	-41.21	-16.79	5.77	26.63	45.90	62.47	68.64	85.01				
6.5%	-86.93	-58.34	-31.92	-7.51	15.06	35.92	55.19	74.89	73.65	91.90				
7.0%	-77.32	-48.73	-22.31	2.11	24.67	45.53	62.81	84.08	86.29					
7.5%	-67.36	-38.78	-12.36	12.06	34.62	55.48	75.40	83.66	94.10					
8.0%	-57.06	-28.48	-2.06	22.36	44.93	63.70	86.73	88.78						

Real rate of cost escalation (%)

▢ Transfer of value from shareholders to government under optimic scenarios

▢ 88888 Transfer of value from government to shareholders under pessimistic scenarios

▢ Scenarios generating negative NPVs under the MRRT regime hence irrelevant

Figure 3: Difference between the project NPVs under the MRRT regime and those under the royalty regime for a range of revenue and cost escalation scenarios. The pink areas show the amount of value transferred from shareholders to government under each scenario. The green areas show transfers of value from government to shareholders relative to the total tax they would have otherwise paid under the royalty regime.
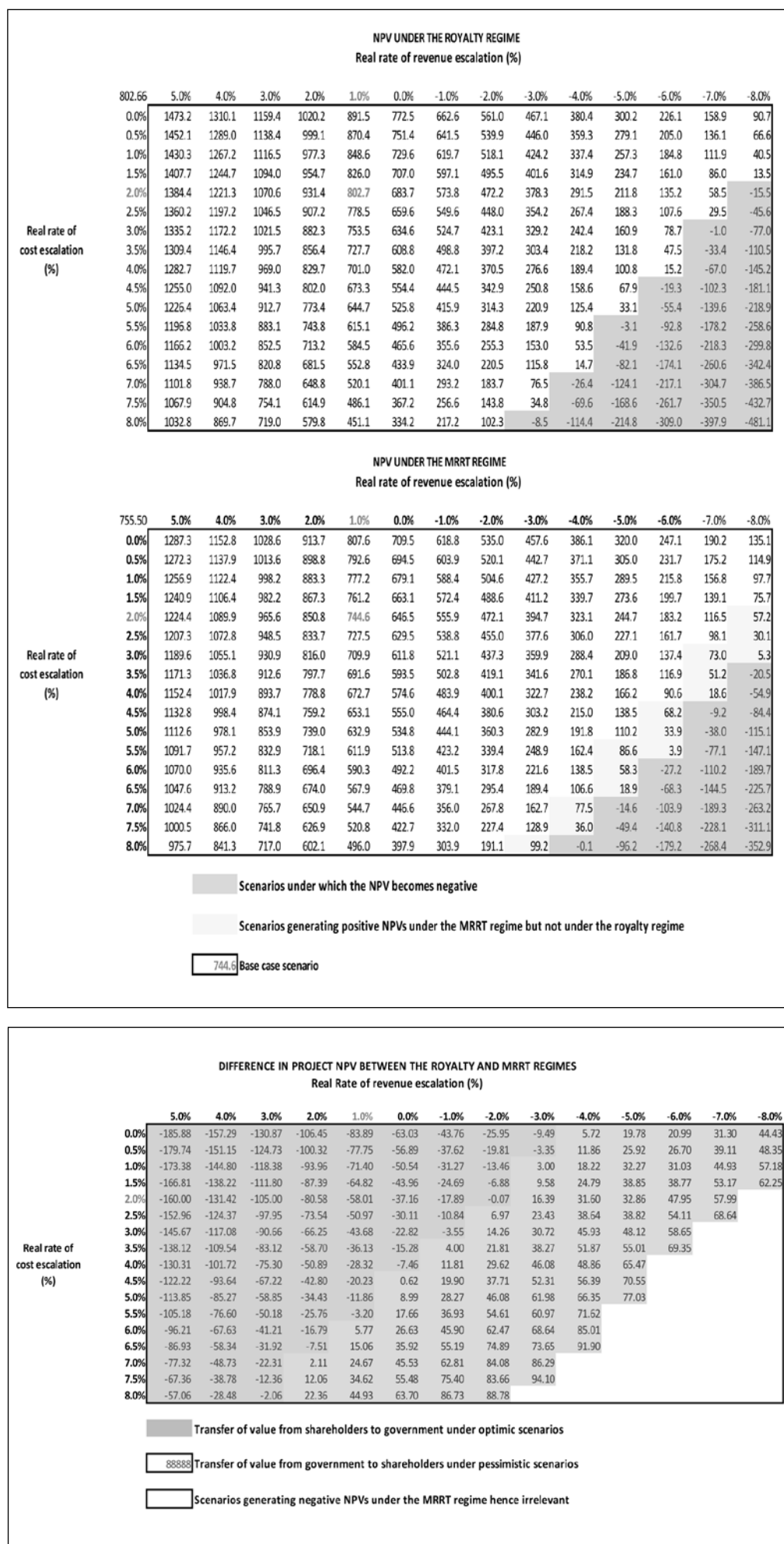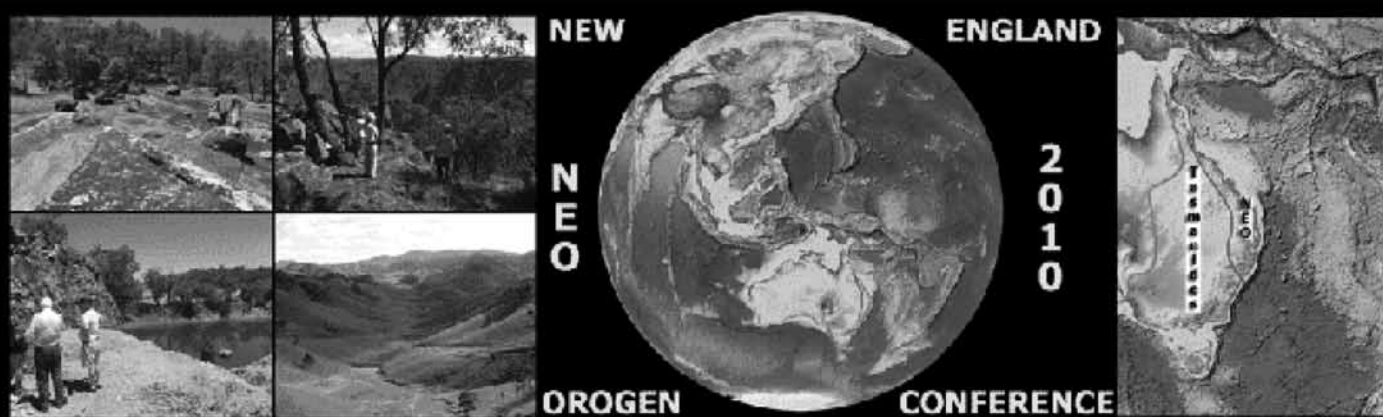
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Day 2 - Fieldtrip Armidale-Bingara
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Full late	$450 - four day conf. including inter-symposia fieldtrip
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Students	$50 - four day conf. including inter-symposia fieldtrip and conf. dinner
Daily	$200 per day
Conf. Dinner	$75 Includes meal and drinks

Fieldtrips (see website for details and updates)
13-15 Nov.	Pre-symposia tectonics fieldtrip – Scone-Barry-Nundle-Tamworth-Armidale
17 Nov.	Intersymposia fieldtrip – 1) New England Transect – Armidale to Bingara, 2) Hillgrove-Halls Creek mine site visits; or 3) Wongwibinda metamorphics
20-22 Nov.	Post-symposia granites fieldtrip – Armidale-Tingha-Emmaville-Tenterfield-Brisbane

For further information and expressions of interest in submitting a paper please contact a member of the organising committee:

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profitable and valuable in terms of its base case assumptions, is in fact more financially robust. This may justify embarking into more sophisticated analysis to determine whether a rationale may also have been created for lowering the cut-off grade at the design stage, thus increasing the diluted mining reserves and lowering the average grade, leading to a larger optimal ore throughput and/or extension of the life of the mine. This type of analysis, of course, will need to be carried out to optimise every individual project and the degree to which it may prove to be advantageous to lower the cut-off grade will depend on the presence of tonnage-grade trade-offs inherent in the type of mineralisation under consideration.

The timing and the degree to which these considerations will be taken on board by the mining industry will depend on how long it will take for the industry, after the MRRT has been enforced and settled down administratively, to develop a perception that the Australian fiscal system is once again stable and predictable. This may take a little while.

Some, somewhat cynical commentators pointed out that the RSPT would have been punishing profit and rewarding loss and that for this reason could have created dysfunctional fiscal incentives. This line of reasoning is less acceptable under the MRRT regime.

CONCLUSIONS

1. The MRRT would be more economically efficient than the current royalty regime, but would impose possibly considerable compliance costs.

2. The political events leading to the MRRT announcement of July 2 confirmed that the process which determined the MRRT rate and related package had no relationship to any economic concept of 'fair return to the nation' but was rather the result of a power struggle between market and political imperatives under the pressure of a looming election. The outcome is a repositioning of Australia in the global pecking order in terms of its competitiveness in attracting mobile exploration and development capital, which hopefully, over time, will redress some of the damage done by the

foreshadowing of a possible introduction of the RSPT and following fiscal uncertainty.

3. Whether MRRT is a tax grab or not depends entirely on future iron ore price movements.

4. The analysis conducted in this paper, designed to quantify the potential impact of the implementation of the MRRT fiscal regime in the context of a typical small but relatively profitable DSO iron ore mine in Western Australia and to compare it to those of the current royalty and of the previously proposed RSPT regimes, indicates that the MRRT regime:

   a. Still results in significant increases in the total rate of taxation (up to 45.2%) relative to the royalty regime (37.9%) but significantly lower than the previously proposed RSPT regime (57.6%).

   b. As expected still transfers significant value (NPV) and returns (IRR) from the shareholders to government for optimistic scenarios but the rate of transfer is approximately half of that that would have occurred under the RSPT regime.

   c. Would result in higher total rates of taxation in optimistic scenarios, for instance if costs were to keep pace with general inflation total taxes would be higher down to negative real price growth trends as low as -3.0% p.a. Conversely if iron ore prices were to maintain their real value over the life of the

UNDISCOUNTED CUMULATIVE NET CASH FLOWS UNDER THE ROYALTY REGIME

Real rate of cost escalation (%)	Real rate of revenue escalation (%)													
	5.0%	4.0%	3.0%	2.0%	1.0%	0.0%	-1.0%	-2.0%	-3.0%	-4.0%	-5.0%	-6.0%	-7.0%	-8.0%
0.0%	3565.3	3157.3	2782.8	2439.4	2124.3	1835.5	1570.6	1327.8	1105.3	901.4	714.5	543.3	392.0	232.0
0.5%	3515.8	3107.7	2733.3	2389.8	2074.8	1785.9	1521.1	1278.3	1055.8	851.9	665.0	493.8	336.7	172.6
1.0%	3464.4	3056.3	2681.9	2338.4	2023.4	1734.5	1469.7	1226.9	1004.3	800.4	613.5	448.9	277.3	108.1
1.5%	3410.9	3002.9	2628.4	2285.0	1969.9	1681.1	1416.2	1173.4	950.9	747.0	560.1	391.2	212.9	40.9
2.0%	3355.4	2947.3	2572.9	2229.4	1914.4	1625.5	1360.7	1117.9	895.4	691.4	506.4	327.6	144.5	-31.2
2.5%	3297.7	2889.7	2515.2	2171.8	1856.7	1567.9	1303.0	1060.2	837.7	633.8	451.8	258.6	71.6	-106.6
3.0%	3237.8	2829.7	2455.3	2111.8	1796.8	1507.9	1243.1	1000.3	777.8	573.9	383.6	186.0	-4.9	-185.3
3.5%	3175.6	2767.5	2393.1	2049.6	1734.6	1445.7	1180.9	938.1	715.5	518.5	310.6	107.2	-86.6	-269.3
4.0%	3110.9	2702.8	2328.4	1984.9	1669.9	1381.1	1116.2	873.4	650.9	446.5	231.9	25.1	-171.5	-356.6
4.5%	3043.8	2635.7	2261.3	1917.8	1602.8	1313.9	1049.0	806.3	591.4	368.8	148.3	-62.4	-261.0	-447.4
5.0%	2974.0	2565.9	2191.5	1848.0	1533.0	1244.1	979.3	736.5	517.2	284.1	59.4	-154.4	-355.5	-542.8
5.5%	2901.6	2493.5	2119.1	1775.6	1460.6	1171.7	906.8	664.6	433.1	195.5	-33.6	-250.0	-453.7	-643.0
6.0%	2826.3	2418.2	2043.8	1700.3	1385.3	1096.4	831.6	594.5	343.5	99.3	-133.1	-351.7	-555.9	-747.3
6.5%	2748.1	2340.1	1965.6	1622.2	1307.1	1018.3	753.4	505.6	247.5	-0.9	-236.6	-458.0	-663.6	-855.6
7.0%	2667.0	2258.9	1884.5	1541.0	1226.0	937.1	680.8	411.0	145.6	-107.1	-344.8	-568.4	-776.3	-968.3
7.5%	2582.7	2174.6	1800.2	1456.7	1141.7	852.8	587.2	307.0	37.2	-219.1	-459.6	-683.3	-893.4	-1086.1
8.0%	2495.1	2087.0	1712.6	1369.1	1054.1	773.9	484.8	198.9	-75.7	-335.6	-579.1	-804.9	-1015.1	-1209.5

Scenarios under which the mine would close under the royalty fiscal regime

UNDISCOUNTED CUMULATIVE NET CASH FLOWS UNDER THE MRRT REGIME

Real rate of cost escalation (%)	Real rate of revenue escalation (%)													
	5.0%	4.0%	3.0%	2.0%	1.0%	0.0%	-1.0%	-2.0%	-3.0%	-4.0%	-5.0%	-6.0%	-7.0%	-8.0%
0.0%	3139.0	2799.4	2487.9	2202.1	1939.9	1699.5	1479.2	1277.1	1092.0	922.3	766.8	608.1	477.1	346.9
0.5%	3104.3	2764.7	2453.1	2167.3	1905.2	1664.8	1444.4	1242.4	1057.2	887.5	732.0	572.7	442.4	295.0
1.0%	3068.2	2728.6	2417.0	2131.2	1869.1	1628.7	1408.3	1206.3	1021.1	851.4	695.9	536.1	396.5	253.8
1.5%	3030.7	2691.1	2379.6	2093.7	1831.6	1591.2	1370.8	1168.8	983.6	813.9	658.4	498.5	352.9	200.4
2.0%	2991.8	2652.2	2340.6	2054.8	1792.7	1552.3	1331.9	1129.9	944.7	775.0	602.6	459.6	294.9	157.5
2.5%	2951.3	2611.7	2300.2	2014.4	1752.2	1511.8	1291.5	1089.4	904.3	734.6	561.5	404.4	251.5	89.7
3.0%	2909.3	2569.7	2258.2	1972.3	1710.2	1469.8	1249.5	1047.4	862.3	692.6	518.8	341.0	189.9	25.7
3.5%	2865.7	2526.1	2214.5	1928.7	1666.6	1426.2	1205.8	1003.8	818.6	648.9	462.3	291.1	136.8	-40.9
4.0%	2820.4	2480.8	2169.2	1883.4	1621.3	1380.9	1160.5	958.5	773.3	585.8	411.3	226.5	52.2	-128.2
4.5%	2773.3	2433.7	2122.2	1836.3	1574.2	1333.8	1113.4	911.4	726.3	527.8	338.6	172.9	-20.1	-204.7
5.0%	2724.4	2384.8	2073.3	1787.5	1525.3	1285.0	1064.6	862.5	677.4	469.1	267.7	83.3	-95.5	-284.3
5.5%	2673.7	2334.1	2022.5	1736.7	1474.6	1234.2	1013.8	811.8	608.6	392.0	211.7	4.8	-195.5	-367.7
6.0%	2621.0	2281.4	1969.8	1684.0	1421.9	1181.5	961.1	759.1	538.1	333.2	138.3	-77.0	-281.9	-474.0
6.5%	2566.2	2226.6	1915.1	1629.3	1367.1	1126.8	906.4	704.3	452.6	253.6	34.5	-183.0	-371.8	-567.8
7.0%	2509.4	2169.8	1858.2	1572.4	1310.3	1069.9	849.5	633.6	386.2	179.4	-54.3	-276.6	-484.9	-665.3
7.5%	2450.4	2110.8	1799.2	1513.4	1251.3	1010.9	790.5	546.1	300.9	69.5	-146.7	-374.0	-586.4	-780.7
8.0%	2389.1	2049.5	1738.0	1452.1	1190.0	949.6	719.4	449.5	226.9	-26.8	-268.0	-475.1	-692.0	-888.8

Scenarios under which the mine would have closed under the royalty fiscal regime but would remain open under the MRRT regime

Figure 4: Undiscounted cumulative operational cash flows under the royalty (top table) and MRRT regimes. The cumulative cash flows are higher for relatively optimistic scenarios under the royalty regime, but become comparatively lower than those under the MRRT regime for more pessimistic scenarios leading to mining operation under this regime closing at a later, more adverse stage.

Mining Fiscal Reform: An Update

mine, total taxation under the MRRT regime would still be higher up to real cost escalation trends of 4% p.a.,

d. Below the above boundary, which includes many scenarios which were realised in the past when the iron ore industry was in the doldrums, however, total taxes under the MRRT regime become comparatively and progressively lower than those applicable under the royalty regime,

e. At the limit brings about a situation where net operating cash flows remain positive well beyond revenue and cost combinations for which they would have been negative under the royalty regime.

f. When conditions deteriorate to a point where the annual project profit drops below $ 50 M and the MRRT and the state royalty refund no longer apply, the cash flows under the MRRT are only slightly higher than those under the royalty regime due to the lower 29% corporate income tax rate. On balance, under progressively deteriorating circumstances the point at which annual profits fall below $ 50 million, would be reached first under the royalty regime and later under the MRRT one. Below this point at which no MRRT and state royalties refund would apply, the project would still generate cash flows marginally higher than those under the royalty regime on account of the new, lower 29% corporate income tax rate. To the degree that more free cash would be accumulated and that the marginal cost of production will be slightly lower under the MRRT regime, a buffer would be created for the project to better withstand a protracted recession and presumably slightly delay mine closure, even though the project may be incurring accounting losses, as long as cash flows remain positive.

g. Consideration of the fact that the MRRT regime produces comparatively higher cash flows and slightly lower marginal costs of production under more pessimistic scenarios means that a project, while less profitable and valuable in terms of its base case assumptions, is in fact more financially robust. This may justify embarking into more sophisticated analysis to determine whether a rationale may also have been created for lowering the cut-off grade at the design stage, thus increasing the diluted mining reserves and lowering the average grade, leading to a larger optimal ore throughput and/or extension of the life of the mine. These behavioural changes, however, will lag well behind the implementation of the MRRT until mine developers develop a perception that the Australian fiscal regime has once again become stable and predictable.

h. This would vindicate claims that the resource rent model is more economically efficient, albeit at severe pain to the current shareholders of mining companies.   ▲▲

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Quantifying the Value of Mineral Estimate Confidence

J A Bell[1], P Guj[2], S R Havlin[3], I M Glacken[4],

THE VALUE ASSOCIATED with the confidence level of gold deposit estimates can be gauged by spatially distributing their sales prices of as a function of their sizes, grades and resources confidence index.

Using a variation of the block-model method discussed in the November 2009 edition of this Newsletter (http://aig.org.au/newsletters), the sale prices of 300 gold deposits in Australia, Canada and the United States were used in a 3D block-model to predict prices for future transactions in these safe, mature mining jurisdictions given any size, grade and estimate confidence combination. While the study confirmed that transaction unit values generally rise with increases in size and grade, the main finding was that an increase in confidence does not necessarily always translate into an increase in value if the deposit is perceived to be 'small'. Block-model methods have the potential to inject some comparability and objectivity in the otherwise arbitrary application of 'rule-of-thumb' in determining transaction prices for in-situ resources. By being able to gain a better understanding of how mineral estimate confidence influences value project managers may be able to optimise exploration expenditure to meet corporate objectives.

Despite being one of the fundamental aspects of a projects value, the market premium relating to the confidence of a mineral resource estimate is poorly described in the asset valuation literature. Invariably the revenue function has a greater impact on the economic viability of a mining project than its cost function. For gold deposits, revenue is, asides from pricing considerations, most sensitive to the uncertain quantity (size) and quality (grade) of in situ mineralisation. Even though there is significant value at stake, there appears to be little research into quantifying the value added by reducing the size and grade uncertainty of a deposit. This article presents an overview of a new study into identifying the likely market premia for increased confidence levels in a mineral resource estimate.

Market-based valuations have significant potential but, until recently, have not evolved significantly compared to the income and cost-based approaches. Traditional linear analysis of comparable transactions has helped develop an intuitive 'feel' for the likely market price of various, uncertain deposit size-grade combinations at a particular point in time. However normal human intellectual capacity is inadequate to consistently and robustly take into account the multiple variables affecting market value ('value drivers'). This cognitive weakness can be to some degree overcome by using the market block-model methodology which was previously reported as being effectively used to model sovereign risk discounts. Whilst the magnitude of each data point is a function of a number of other value drivers, the

geostatistical estimation process accounts for the fact that the sample point may be under or over representative of the market (much like the drill intersection of a deposit where a sample may be overly rich or adversely poor in gold). On this basis, the block-model method has the potential to reduce the influence of arbitrary opinion in mineral asset valuations.

In the study, a subset of Alexander Research's transactions database was used, comprising 300 transactions announced during the period September 11, 2001 and August 15, 2009 where gold accounts for more than 75% of the total value. To minimise sovereign risk influence, only transactions which occurred in Australia, Canada and the United States were used. By and large, these are mature mining jurisdictions with comparably stable regulatory and fiscal regimes, allowing for some variations at a State or Provincial level.

The three dimensions of the block-model are size (Moz Au), grade (g/t Au) and a confidence index based on simple equal and somewhat arbitrary weighting of the following categories:

- Proved Reserve = 6;
- Probable Reserve = 5;
- Measured Resource (exclusive of Ore Reserves) = 4;
- Indicated Resource (exclusive of Ore Reserves) = 3;
- Inferred Resource = 2; and
- 'other' estimates = 1.

Where historical estimates with close analogies to the but not complying with the current JORC Code classifications were reported (e.g. historical 'measured resource' reported in 2001), a value of one was deducted

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from the index score to reflect the potential cost required to bring it to current reporting standards. Use of an alternative index based on the Sherman-Kent subjectivity scale was attempted with limited success. Due to limitations in the scope of this paper a lengthy discussion of the alternative results is omitted from the subsequent discussion.

Having defined the X,Y and Z axis, the relationship and continuity between each of the spatially distributed data-points was determined in order to interpolate and extrapolate the data in the 3D space (Figure 1).

Whilst the absolute values in the block model provide an interesting snap-shot in time, their commercial and academic relevance date rapidly. A more resilient measure may be the proportional relationship between each of the block values (Table 1).

The patterns in Table 1, which uses the entire unfiltered dataset, suggest that:

* Small projects in each grade category incur a discount relative to other sizes with increased confidence. This may be explained by a market perception that increased confidence decreases the exploration potential, a key value driver.

The confirmation (high-confidence) that a deposit is small limits its economic potential and therefore market value. On this basis, a project manager of a small deposit may create more market value by diverting exploration funds to increasing the deposit size rather than increasing confidence in the mineral estimate.

* Small, medium-grade and high-grade deposits incur greater market

Figure 1

discounts than lower-grade equivalents of the same size (ie. 50%-45%-70% or 78%-68%-113%). This suggests that small, low-grade deposits may not yet have been adequately delineated, resulting in an expectation that at some stage in the future, deposits with relatively low metal content may be expanded to more economically favorable size-grade proportions.

- Increasing the confidence of medium and large deposits should attract substantial market premia. This reflects the higher probability of a return on investment; reduced time to potential production; ability to attract additional project finance; and the project having greater promotional value.

Of course there are many value drivers to a transaction. One such driver is the macro-economic cycle ('boom' or 'bust'). A sub-analysis of the economic conditions suggested that the relationships (e.g. increased confidence of small deposits erodes value etc.) remain the same, albeit with differences in magnitude to those observed using the entire dataset. However:

- Small, low-grade deposits appear to be relatively unaffected by changing market conditions irrespective of the confidence category. The relative resilience of small, low-grade deposits may be due to the larger pool of market participants seeking such assets.

- In medium and high-confidence domains, medium and large low-grade deposits attracted a substantial discount in the order of 50% to 60% of the pre-June 2007 values. The aversion to low-grade may be due to the market making a connection between low-grade and low-margins; or the need for higher capital expenditure in a capital constrained market. For high-grade deposits the inverse may have also been true.

- In low-confidence domains, the market again behaves in a markedly different way compared to the higher-confidence domains. In the low-confidence domain, the market appears to apply a discount to medium to large, medium to high-grade deposits relative to pre-June 2007 prices. This counter-intuitive result may be an artifact of most low-confidence deposits being held by small to medium-capitalisation companies with no income and constrained capital. This market may also be discounting due to the significant expenditure required to increase the deposits confidence during a period when venture capital was difficult to obtain.

Grade (g/t Au)		Low-confidence <2.5			Medium-confidence 2.5-3.5			High-confidence >3.5		
High	>6				50%	132%	184%	78%	156%	403%
Medium	3-6		100%		45%	147%	183%	68%	320%	522%
Low	<3				70%	177%	242%	113%	238%	575%
Size (Moz Au)		<0.25	0.25-1.00	>1.00	<0.25	0.25-1.00	>1.00	<0.25	0.25-1.00	>1.00
		Small	Medium	Large	Small	Medium	Large	Small	Medium	Large

Table 1

- The newer market had an apparently strong preference for deposits that are either low-grade or small, although the absolute values remain less than the larger or higher grade comparables. This relative price improvement for small or low-grade assets in the post-June 2007, dataset may be due to a large number of small companies seeking these assets for the purpose of upgrading their status from early-stage explorers or switching commodities (eg uranium, phosphate or iron explorers wanting to re-badge themselves as gold companies). Perceived exploration potential may also be a factor in explaining the relative performance of small and low-grade deposits.

Whilst there are differences between the two models covering the two intervals of time, the authors regarded that the overall trends within the models are reasonably correlated given the smaller sub-sets of data used and the complex interaction of exploration potential and market appetite. It is considered that the use of a dataset encompassing all phases of a single market cycle is justified if a 'rule-of-thumb' is sought.

On a technical level, the possible mining techniques influence value with the observations about the difference between open pit and underground deposits including:

- In most cases the underground deposits traded at higher values than those nearer to the surface. Due to the cost and difficulty of defining Ore Reserves and Mineral Resources at considerable

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depths below surface, the market may be adding a premium to the price to reflect the perception that there is a likelihood of defining additional mineralisation at depth or along strike. This exploration potential may be offsetting the higher operating costs associated with underground deposits.

- The highest increase in value relative to the open pit equivalents was mostly associated with low-confidence estimates. This may be explained by lower confidence deposits being perceived as having higher exploration potential than their higher confidence comparables.

- The absolute block value patterns for open pit and underground deposits remained the same for those observed in the entire dataset.

In application, if values for an open pit/underground deposit are sought, then if enough data is available, dedicated block-models should be created for this purpose. However, if the likely premia are sought, then both underground and open pit deposit transactions may be used as an enlarged dataset promotes a more representative block-model.

The main finding of the study was that for medium and large deposits, an increase in confidence generally results in an increase in value, however for small deposits (<0.25 Moz Au) an increase in confidence may decrease the implied value of the asset. Coupled with the observation that small low-confidence deposits trade at premia above their larger low-confidence comparables, the study suggested that the market views an increase in confidence for a small deposit as a direct decrease in its potential to discover the additional ounces required to

give it a higher chance of economic viability. These observations were consistent in all of the subset block-models generated, including depth to mineralisation, specific time intervals capturing different stock market sentiment, gold price adjustments and domain boundary models.

The ability to gauge the market premia associated with the level of mineral estimate confidence may enable a project manager to be better informed when deciding whether to allocate funds to increasing the potential size of a known deposit, or raising its level of confidence. As project managers may have an intuitive grasp of the probability of discovering additional mineralisation and the associated costs and payoffs they may be able to undertake a cost-benefit analysis to optimise their exploration program. By using the expected value method, which takes into account cost, probability and pay-offs, project managers can use the block-model method to help decide whether to drill for additional mineralisation or raise the confidence of known resources. In this manner, the results of a block-model can be used by exploration managers, in addition to those in the consulting, finance and legal sectors.

A more detailed paper discussing the above concept, entitled "Mineral Estimate Confidence Premia: A Transaction Based Statistical Analysis", was published in the August 2010 edition of the AusIMM Bulleting. Alternatively, a presentation on this paper was presented at the AIG MARV Seminar in October last year, a web cast of which can be viewed at http://aig.org.au/conferences-and-seminars/marv09. ▲▲

New Publication:

Advanced Methodologies for Mineral Project Valuation

by Dr Eric Lilford

AIG'S LATEST PUBLICATION, Advanced Methodologies for Mineral Project Valuation, will be released in the next few weeks.

Dr Eric Lilford has more than 23 years operational, investment and merchant banking experience across the global resources sector, focusing on identifying, securing and managing investment opportunities, facilitating the development of mineral projects and managing corporate finance mandates. He has extensive technical and economic expertise and experience in the mining sector. His focus on the delivery of innovative, qualitative and quantitative techno-economic solutions, often driven by the impacts arising from economic and legislative impositions within the resources industry, has provided a foundation for his interest in mineral economics.

The publication is a much needed contribution to the field of mineral asset valuation.

Despite the immense value involved in mineral asset transactions, there are few publications which address the topic directly. This publication reviews a number of valuation methods, new developments and important value drivers, making it is a useful reference for valuers, mining professionals and anyone with an interest in mineral economics.

The AIG Council, at its July 2010 meeting, resolved that all future AIG publications will be released in digital form (searchable pdf) only. Publications will, in the future, be available to members for download from the AIG web site, free of charge. Non-members will be able to purchase publications through the web site or on disc from the Secretariat office.

Dr Eric Lilford

A DVD containing all AIG publications will continue to be available for purchase by members, through both the web site and the Secretariat office. ▲▲

NASA's Lunar Reconnaissance Orbiter Reveals 'Incredible Shrinking Moon'

Science Daily, August 20, 2010, reports that 'Newly discovered cliffs in the lunar crust indicate the moon shrank globally in the geologically recent past and might still be shrinking today, according to a team analyzing new images from NASA's Lunar Reconnaissance Orbiter (LRO) spacecraft. The results provide important clues to the moon's recent geologic and tectonic evolution.

The moon formed in a chaotic environment of intense bombardment by asteroids and meteors. These collisions, along with the decay of radioactive elements, made the moon hot. The moon cooled off as it aged, and scientists have long thought the moon shrank over time as it cooled, especially in its early history. The new research reveals relatively recent tectonic activity connected to the long-lived cooling and associated contraction of the lunar interior.

"We estimate these cliffs, called lobate scarps, formed less than a billion years ago, and they could be as young as a hundred million years," said Dr. Thomas Watters of the Center for Earth and Planetary Studies at the Smithsonian's National Air and Space Museum, Washington. While ancient in human terms, it is less than 25 percent of the moon's current age of more than four billion years. "Based on the size of the scarps, we estimate the distance between the moon's

center and its surface shrank by about 300 feet," said Watters, lead author of a paper on this research appearing in Science August 20.

"These exciting results highlight the importance of global observations for understanding global processes," said Dr. John Keller, Deputy Project Scientist for LRO at NASA's Goddard Space Flight Center, Greenbelt, Md. "As the LRO mission continues in to a new phase, with emphasis on science measurements, our ability to create inventories of lunar geologic features will be a powerful tool for understanding the history of the moon and the solar system."

The scarps are relatively small; the largest is about 300 feet high and extends for several miles or so, but typical lengths are shorter and heights are more in the tens of yards (meters) range. The team believes they are among the freshest features on the moon, in part because they cut across small craters. Since the moon is constantly bombarded by meteors, features like small craters (those less than about 1,200 feet across) are likely to be young because they are quickly destroyed by other impacts and don't last long. So, if a small crater has been disrupted by a scarp, the scarp formed after the crater and is even younger. Even more compelling evidence is that large craters, which are likely to be old, don't appear on top any of the scarps, and the scarps look crisp and relatively undegraded.

Lobate scarps on the moon were discovered during the Apollo missions with analysis of pictures from the high-resolution Panoramic

Camera installed on Apollo 15, 16, and 17. However, these missions orbited over regions near the lunar equator, and were only able to photograph some 20 percent of the lunar surface, so researchers couldn't be sure the scarps were not just the result of local activity around the equator. The team found 14 previously undetected scarps in the LRO images, seven of which are at high latitudes (more than 60 degrees). This confirms that the scarps are a global phenomenon, making a shrinking moon the most likely explanation for their wide distribution, according to the team.

As the moon contracted, the mantle and surface crust were forced to respond, forming thrust faults where a section of the crust cracks and juts out over another. Many of the resulting cliffs, or scarps, have a semi-circular or lobe-shaped appearance, giving rise to the term "lobate scarps." Scientists aren't sure why they look this way; perhaps it's the way the lunar soil (regolith) expresses thrust faults, according to Watters.

Lobate scarps are found on other worlds in our solar system, including Mercury, where they are much larger. "Lobate scarps on Mercury can be over a mile high and run for hundreds of miles," said Watters. Massive scarps like these lead scientists to believe that Mercury was completely molten as it formed. If so, Mercury would be expected to shrink more as it cooled, and thus form larger scarps, than a world that may have been only partially molten with a relatively small core. Our moon has more than a third of the volume of Mercury, but since the moon's scarps are typically much smaller, the team believes the moon shrank less.

Because the scarps are so young, the moon could have been cooling and shrinking very recently, according to the team. Seismometers emplaced by the Apollo missions have recorded moonquakes. While most can be attributed to things like meteorite strikes, the Earth's

gravitational tides, and day/night temperature changes, it's remotely possible that some moonquakes might be associated with ongoing scarp formation, according to Watters. The team plans to compare photographs of scarps by the Apollo Panoramic Cameras to new images from LRO to see if any have changed over the decades, possibly indicating recent activity.

While Earth's tides are most likely not strong enough to create the scarps, they could contribute to their appearance, perhaps influencing their orientation, according to Watters. During the next few years, the team hopes to use LRO's high-resolution Narrow Angle Cameras (NACs) to build up a global, highly detailed map of the moon. This could identify additional scarps and allow the team to see if some have a preferred orientation or other features that might be associated with Earth's gravitational pull.

"The ultrahigh resolution images from the NACs are changing our view of the moon," said Dr. Mark Robinson of the School of Earth and Space Exploration at Arizona State University, Tempe, Ariz., a coauthor and Principal Investigator of the Lunar Reconnaissance Orbiter Camera. "We've not only detected many previously unknown lunar scarps; we're also seeing much greater detail on the scarps identified in the Apollo photographs."

The research was funded by NASA's Exploration Systems Mission Directorate at NASA Headquarters, Washington. The team includes researchers from the Smithsonian, Arizona State, the SETI Institute, Mountain View, Calif., NASA Ames Research Center, Moffett Field, Calif., Cornell University, Ithaca, N.Y., Institut für Planetologie, Westfälische Wilhelms-Universität, Münster, Germany, Brown University, Providence, R.I., and the Johns Hopkins University Applied Physics Laboratory, Laurel, Md. ▲▲
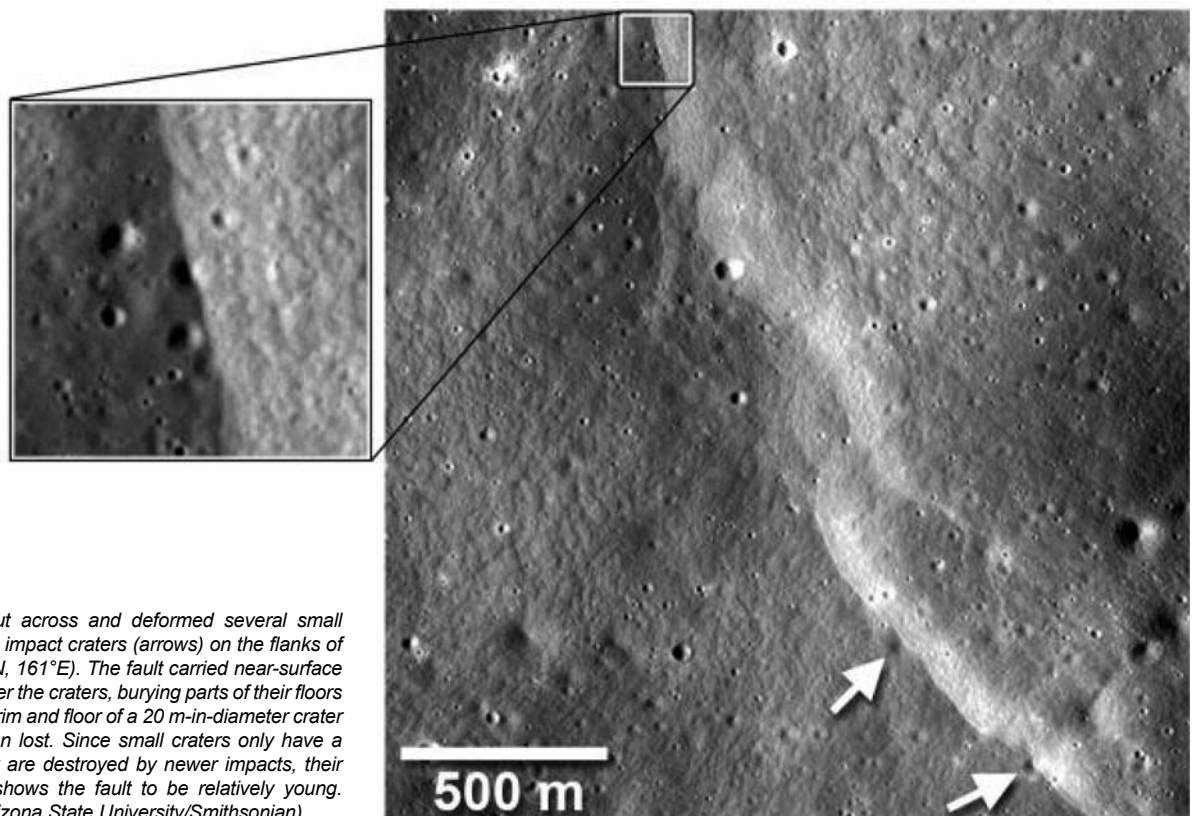
Figure 1: Another fault cut across and deformed several small diameter (~40-m diameter) impact craters (arrows) on the flanks of Mandel'shtam crater (6.5°N, 161°E). The fault carried near-surface crustal materials up and over the craters, burying parts of their floors and rims. About half of the rim and floor of a 20 m-in-diameter crater shown in the box has been lost. Since small craters only have a limited lifetime before they are destroyed by newer impacts, their deformation by the fault shows the fault to be relatively young. (Credit: NASA/Goddard/Arizona State University/Smithsonian)

500 m

Are We Running Out of Oil?
The Mystery of Eugene Island 330

EUGENE ISLAND IS A SUBMERGED mountain in the Gulf of Mexico about 80 miles off the Louisiana coast. The landscape of Eugene Island is riven with deep fissures and faults from which spew spontaneous belches of gas and oil.

Up on the surface, a platform designated Eugene Island 330 began producing about 15,000 barrels of oil per day in the early 1970s. By 1989, the flow had dwindled to 4,000 barrels per day. Then, suddenly, production zoomed to 13,000 barrels. In addition, estimated reserves rocketed from 60 to 400 million barrels. Even more anomalous is the discovery that the geological age of today's oil is quite different from that recovered 10 years ago. What's going on under the Gulf of Mexico?

It is difficult to avoid the conclusion that the oil reservoir at Eugene Island is rapidly refilling itself from "some continuous source miles below the earth's surface." In support of this surmise, analysis of seismic records revealed a deep fault which "was gushing oil like a garden hose."

The deep-seated oil source at Eugene Island strongly supports T. Gold's theory about The Deep Hot Biosphere. Gold holds:

"that oil is actually a renewable, primordial syrup continually manufactured by the earth under ultrahot conditions and tremendous pressures. As this substance migrates toward the surface, it is attacked by bacteria, making it appear to have an organic origin dating back to the dinosaurs."

The apparent deep-seated oil source at Eugene Island and Gold's ideas make petroleum engineers wonder about a similar situation at the seemingly inexhaustible oil fields of the Middle East.

"The Middle East has more than doubled its reserves in the past 20 years, despite half a century of intense exploitation and relatively few new discoveries. It would take a pretty big pile of dead dinosaurs and prehistoric plants to account for the estimated 660 billion barrels of oil in the region, notes Norman Hyne, a professor at the University of Tulsa in Oklahoma. "Off-the-wall theories often turn out to be right," he says."   ▲▲

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An Ancient Earth Like Ours: Geologists Reconstruct Earth's Climate Belts Between 460 and 445 Million Years Ago

SCIENCEDAILY (AUG. 12, 2010) reports that an international team of scientists including Mark Williams and Jan Zalasiewicz of the Geology Department of the University of Leicester, and led by Dr. Thijs Vandenbroucke, formerly of Leicester and now at the University of Lille 1 (France), has reconstructed the Earth's climate belts of the late Ordovician Period, between 460 and 445 million years ago.

They further note: The findings have been published online in the Proceedings of the National Academy of Sciences – and show that these ancient climate belts were surprisingly like those of the present.

The researchers state: "The world of the ancient past had been thought by scientists to differ from ours in many respects, including having carbon dioxide levels much higher – over twenty times as high – than those of the present. However, it is very hard to deduce carbon dioxide levels with any accuracy from such ancient rocks, and it was known that there was a paradox, for the late Ordovician was known to include a brief, intense glaciation – something difficult to envisage in a world with high levels of greenhouse gases. "

The team of scientists looked at the global distribution of common, but mysterious fossils called chitinozoans – probably the egg-cases of extinct planktonic animals – before and during this Ordovician glaciation. They found a pattern that revealed the position of ancient climate belts, including such features as the polar front, which separates cold polar waters from more temperate ones at lower latitudes. The position of these climate belts changed as the Earth entered the Ordovician glaciation – but in a pattern very similar to that which happened in oceans much more recently, as they adjusted to the glacial and interglacial phases of our current (and ongoing) Ice Age.

This 'modern-looking' pattern suggests that those ancient carbon dioxide levels could not have been as high as previously thought, but were more modest, at about five times current levels (they would have had to be somewhat higher than today's, because the sun in those far-off times shone less brightly).

"These ancient, but modern-looking oceans emphasise the stability of Earth's atmosphere and climate through deep time – and show the current man-made rise in greenhouse gas levels to be an even more striking phenomenon than was thought," the researchers conclude. ▲▲
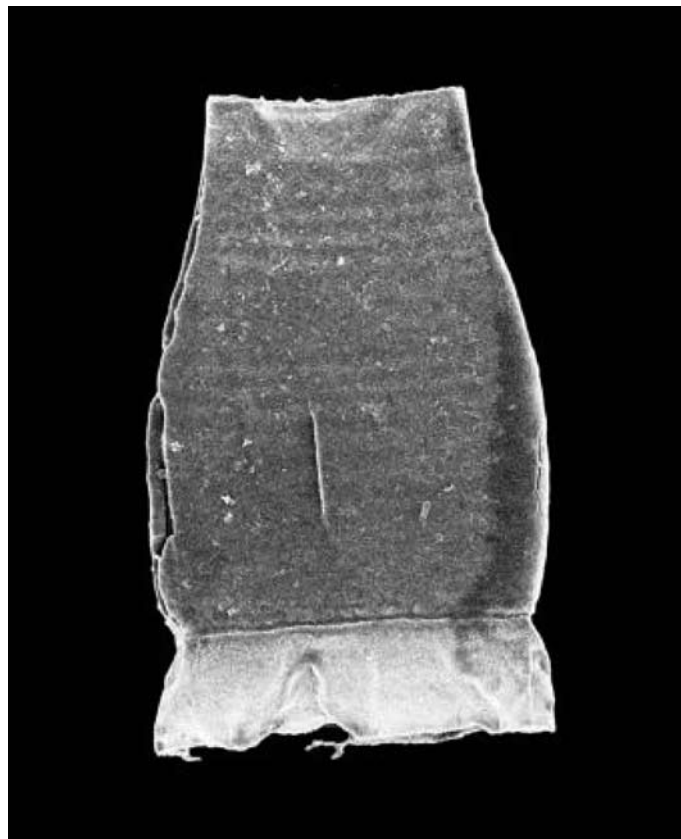
Figure 1: This is a specimen of the chitinozoan species *Armoricochitina nigerica* (length = c. 0.3mm). Chitinozoans are microfossils of marine zooplankton in the Ordovician. Their distribution allows to track climate belts in deep time, much in a way that zooplankton has been used for climate modeling in the Cenozoic. *A. nigerica* is an important component of the Polar Fauna during the late Ordovician Hirnantian glaciation. (Credit: University of Leicester)

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The Science Debate Redux

By James Isanhart

WE CERTAINLY ARE LIVING in interesting times. We have heated debates about the cause(s) and repairs of the Global Financial Crisis, with one side advocating the public spending advocated by the noted economist John Maynard Keynes, and the other side arguing their case for a free market solution based upon the famous economist Milton Friedman. When you think of it, economists and weathermen get to keep their jobs even when they are proven wrong.

The debate over Climate change is another very heated debate which has captured the views of billions across the globe; on one side we have a multitude of cataclysmic claims and another emerging group claiming – "It is a natural cycle". Could it be the so called consensus of Climate science maybe wrong?

What are we to make of this when so much seems to be at stake? After all it's not like we are talking about a simple thing like the GFC, we are talking about the possible destruction of our planet. Is the prudent thing to do to immediately enact a Carbon Trading Scheme just to be on the safe side? You know, use precaution, because the Earth and our children are counting on us to do what is imperative and nobly right. If the Earth may be in peril should we not implement a price on carbon even if energy prices rise and cause economic uncertainty?

On the other hand, we have the Climate Sceptics (there is even a new political party called, the Climate Sceptics) also known as Climate Deniers (in a pejorative way). Their main argument goes something like this: "The climate is always changing and the recent, albeit miniscule uptick in global temperatures is nothing to be alarmed about". This reasoning does not give me the warm and fuzzies; after all the Earth cannot wait for us to take action. Can it?

In this debate we have to rely upon scientists for our information. That is all well and good, but what are we to make of scientific findings, which seemingly are more and more linked with politics? More people are starting to speak out and believe that the science behind the ever increasing climate scare stories is losing its credibility because it has adopted an authoritarian tone, and has let itself be co-opted by politics.

Can it be so many expert scientists could be wrong and maybe, just maybe, the so called Climate Change Deniers could be right? No, it cannot be so. A consensus of Climatologists throughout the world could not be wrong!

The history of science is not one without famous blunders having taken place throughout our past. Galileo spent more than twenty years under house arrest for having the temerity to question the noted experts (Priests) of his era about whether the Sun or the Earth was the centre of the solar system.

Climate scientists of today are all learned experts with a special depth of knowledge which surpasses the knowledge of other scientific disciplines. Or are they?

In the early 70's a young geologist named Walter Alvarez noticed a pronounced layer of reddish clay which was between two layers of limestone. He took a sample of this clay and asked a nuclear chemist friend of his, Frank Asaro, to analyse it in an effort to better understand its composition.

Frank Asaro the nuclear chemist, and Walter Alvarez the geologist determined the clay contained a high concentration of a very rare element called iridium, an element only found in space objects, like meteorites, comets, or asteroids. They immediately came to the conclusion that a large object collided with the Earth approximately 65 million years ago causing the mass extinctions of the dinosaurs in a short period of time. It was conclusive, was it not?

However, the paleontological community of scientists thought this information was an outrageous heresy as all real palaeontologists knew the dinosaurs died out over millions of years, not in a quick extinction. The consensus of the paleontological community was united in questioning this meddling in their area of expertise.

It was around 1990 when a geologist, named Gene Shoemaker, discovered an impact crater near the Yucatan coast of Mexico which had high levels of iridium. When confronted with the crater discovery palaeontologists still had a hard time accepting that they were wrong. Gene Shoemaker noted, "It was like our findings were against their religion."

Twenty years elapsed between the discovery of the iridium clay layer and the locating of the impact crater before a majority of the paleontological community gave their blessing to this new science. Even today there are holdouts in the paleontological community who still do not support the impact theory to explain the mass extinction of the dinosaurs.

What is to be learned about climate science from this story? Sometimes the experts get it wrong and sometimes the non-experts get it right. I do not feel for one minute the paleontological community had any nefarious intent by questioning the new science. That is how science works, by questioning and defending a position based upon the science each party knows. In a similar way, I do not feel the climatology community is wrong to strongly defend their scientific consensus, especially as it relates to the environment.

However, maybe – just maybe – the climate sceptics, many of whom are established scientists in their own fields, have judged the climate change story correctly.

World renowned scientific leaders including Freeman Dyson, Ivar Giaever (Nobel Prize), Robert Laughlin (Nobel Prize), Edward Teller, Frederick Seitz, Robert Jastrow and William Nierenberg have each come forward with their respective doubts about man-made global warming claims authored by the now discredited consensus of United Nations sponsored climatologists.

I for one do not believe we should institute a carbon tax of any kind at this time as the history of scientific consensus is not one to hang our whole economic future on. ▲▲

Mr. Isanhart lives in Rhodes, NSW and has been involved in environmental matters for over 30 years, starting with legally disposing of hazardous and toxic materials. For the past few years his focus has been in championing waste minimization efforts throughout the world. Jim can be contacted by: Mobile 040 598 6255 or Email jisanhart@gmail.com

Know Your Councillor – Greg Corbett

GREG BEGAN HIS TIME as an AIG Councillor (and AIG member) about 1989 when he was chair of SMEDG and the AIG embarked on a period of closer co-operation with that less structured group. It seems the excuse "I'm not a member" didn't work.

The presence of AIG founders Ken Glasson and Lindsay Ingall on AIG Council provided valuable guidance as to 'what the AIG was about' which influenced Greg's attitude towards the recent possible merger with the GSA. Greg served as AIG President in 2000-2 during a recession in the exploration industry and also greater co operation between the different Institutes when Ian Goddard was President of the AusIMM. Because Greg does so little work in Australia he launched the Presidents lecture tour to meet the members and find out firsthand what was going on prior meeting with the Federal Minister. The lecture tour of about 20 centres, where a talk on epithermal Au and free beer brought the troops in, proved to be one of the most rewarding aspects of the presidency. As is the custom Greg was put out to pasture after the post-president period as vice president but has returned to Council as he and Sam Lees take turn about in the grumpy old man position. He also represents NSW, chairs the Ethics and Standards committee and helps Jillian with memberships ... particularly the increased overseas memberships.

Greg works as a field based consultant economic geologist specialising in Pacific rim epithermal Au-Ag and porphyry Cu-Au. Consequently, not much of Greg's work is in Australia and he stopped counting at 30 countries. The Pacific rim adventure began in 1980 when he ventured to Porgera in Papua New Guinea and Kidston for Placer, after a PhD at Broken Hill and a short time with the Geological Survey of NSW. The Broken Hill experience provided valuable mentoring from Barney Stevens and Ian Plimer, the latter also during undergraduate at Macquarie University. Having been taught to question, Greg discovered early the rocks at Porgera didn't fit with the published literature on ore deposits and so embarked on a quest for understanding the science based on the premise of working on many examples. Two weeks is a long job for Greg in a career based on a nightmare schedule of multiclient trips to remote locations. During the 1990s petrologist Terry Leach and Greg pooled their energies and experiences to develop new geological models based upon their fieldwork at many exploration projects and mines and unwittingly found themselves presenting a

Photo: Fiona Karaut

Not to outdo Wendy Corbett's know your councillor photo
... red pencil for scale.

series of short courses (stopped counting at 20 presentations in 12 countries), the notes for which were published by Economic Geology as the 238 page Special Publication 6. He also recently wrote the 'Geology and mineral potential of Papua New Guinea' for the PNG Govt. from his experiences in that country which he returns to on a regular basis. These days most of his field work is in South America, although this note is being written in a Russian freight plane in Siberia. He finds it most productive with a group of young geologists to whip out the powerpoints and show them other examples of whatever deposit type they are working on and inflict some Leach and Corbett science upon them.

Greg's interest outside geology include bush walking (commonly with others getting a geology lesson whether they need it or not) and gardening where he specialises in the "plant and piss-off technique" leaving the long suffering wife Denese Oates to look after and possibly eat the vegetable plantings. Denese, a sculptor and Greg live in Sydney in a 19th century warehouse and shop have been married 22 years ... or 11.5 if you base it on Greg's level of attendance.   ▲▲

From the Editor
– Louis Hissink

This issue of AIG News has been hijacked by our fiscally oriented members due to the dreaded mining resource rent tax problem and other issues concerning mining and valuation problems members face. (In this case the editor is involved with some interesting "feedback" from the ASX concerning company announcements, leading to the slowly dawning realisation that the ASX, now part of the ASIC in a regulatory sense, doesn't fully understand the basis for the difference between reporting base metal and precious metal assays on one hand, and bulk commodity assays on the other. The JORC never had to deal with corporate shenanigans over iron or manganese deposits as those tend to be high tonnage, low value deposits more aptly described as "quarrying-operations" by one of the editor's scabrous mates. But now that iron and manganese are the objects of share market activity, it's time AIG members extended the reach of our codes to these commodities as well. And if we are going to do that, we may as well include coal.

Climate Change problems seem to have dropped off the radar screen though I received an email expressing support for the balanced reporting of climate change issues by AIG News,   and balanced by another, expressed during AESC in Sydney recently, that we weren't. As I am still upright during daylight hours, and therefore in balance (have no idea when I am asleep), I can only assume that any perceived climatic imbalance is politically, rather than scientifically, driven, and confirmed by our latest publication on climate problems in this issue.

AIG News further reports on some geological oddities ranging from a shrinking moon and other peculiar geological phenomena in the Gulf of Mexico concerning oil seeps, and interesting 'balanced' opinion on climate change belief. Members are also reminded we are running a photo competition and as noted to the right, we need someone to review Roger Marjoribanks new text, the prize being a free copy but you have to work for it.

Reviewer Wanted
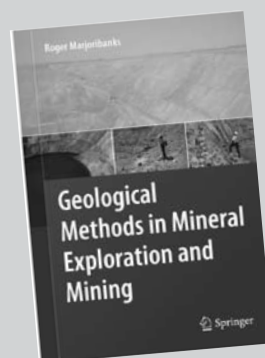
Geological Methods in Mineral Exploration and Mining

R. Marjoribanks, Industry Consultant, Perth, Australia

Roger Marjoribanks has written a new book, Geological methods in mineral exploration and mining" published by Springer and AIG News is looking for a book review for publication in the next issue. Interested members should contact the editor direct who can then arrange to have a copy of the book sent to the reviewer from the author.

This practical step-by-step guide describes the key geological field techniques needed by today's exploration geologists involved in the search for metallic deposits. The techniques described are fundamental to the collection, storage and presentation of geological data and their use to locate ore. This book explains the various tasks which the exploration geologist is asked to perform in the sequence in which they might be employed in an actual exploration project. Hints and tips are give. The steps are illustrated with numerous examples drawn from real projects on which the author has worked. The book emphasizes traditional skills and shows how they can be combined effectively with modern technological approaches....

more on http://springer.com/978-3-540-74370-5

AIG Symposium at Australian Earth Sciences Convention (AESC) 2010

THE AIG NSW BRANCH conducted a very well attended resources symposium within the Australian Earth Science Convention (AESC) 2010 held in Canberra by the GSA during the week of the 5th to 9th July. The AIG symposium entitled 'Geology in Action' was held on Wednesday 7th July.

The speakers and session chairs were coordinated by NSW committee members Greg Corbett and Wendy Corbett. The sessions were chaired by NSW committee members Greg Kotze, Mike Smith, Greg Corbett and Michael Edwards.

The AIG was well represented with speakers of the day Mike Smith, Greg Kotze, Steve Collins and Graeme Teale. The day was a great success with the following program of speakers and diverse topics:

- **Graham Teale**: 'Why geological mapping is important'

- **Stephen Collins**: Application of IP geophysics to practical geology from Mineral Exploration'

- **David Cooke**: 'Architectural controls on Paleozoic porphyry gold copper mineralization in the Cadia Valley NSW'

- **Peter Stoker**: 'The importance of good geological control in resource estimation with several examples'

- **Alan Moon**: 'Geological mapping in civil engineering'

- **Greg Kotze**: 'Geohazards – their identification and management'

- **B. Jane Barron**: 'Forensic Petrology'

- **Jonathan Fawsett**: 'Groundwater dependent ecosystems'

- **Mike Smith**: 'Professionalism in the geosciences through the Australian Institute of Geosciences'

- **Andrew Kohlrusch (Keynote)**: Geoscientists – our relevance in the age of technology'

- **Catherine Stafford**: The Australian geothermal industry – An overview'

- **Ted Ambler**: Industrial minerals – big but not sexy!!

- **Ian Warland**: 'Iluka Resources heavy mineral exploration in the Eastern Eucla Basin, SA'

- **Greg Mortimer**: 'The joys of having rocks in your head'

The keynote address for the symposium was undertaken by Andrew Kohlrusch, an EPA NSW accredited Site Auditor and current president of ACLCA (Aust. Contaminated Lands Consultants Association). Andrew presented a very inspiring talk on geoscience and geoscientists sometimes 'unsung' contribution to society.

Other talks of note included Dave Cooke's discussion of several years of research in the Cadia Valley by CODES (Uni. of Tasmania) which amongst other things demonstrates the Cadia system is structurally controlled and emplaced into a shelf volcanosedimentary sequence rather that the traditional stratovolcano setting, commonly considered for porphyry Cu-Cu mineralisation.

As much of the audience was expected to be young geologists and students early in their careers several talks were designed to inspire and inform on the importance of basic principles of geology and geological mapping, in mineral exploration and resource development. These included the talks by Graham Teale, Peter Stoker, Catherine Stafford, Ted Ambler, Greg Kotze and Alan Moon.

The day was wrapped up by a very well attended talk by adventurer and mountaineer Greg Mortimer, (and originally a geologist) who spoke on the influence of his geological background on aspects of his career such as (with Tim Macartney-Snape) to the first Australian ascent of Mt Everest in 1984 and some of his amazing experiences. One could hear the gasps from the audience when some of the slides came up.   ▲▲

'The Three Gregs' at the Australian Earth Sciences Convention (AESC) 2010 – AIG (NSW) Symposium
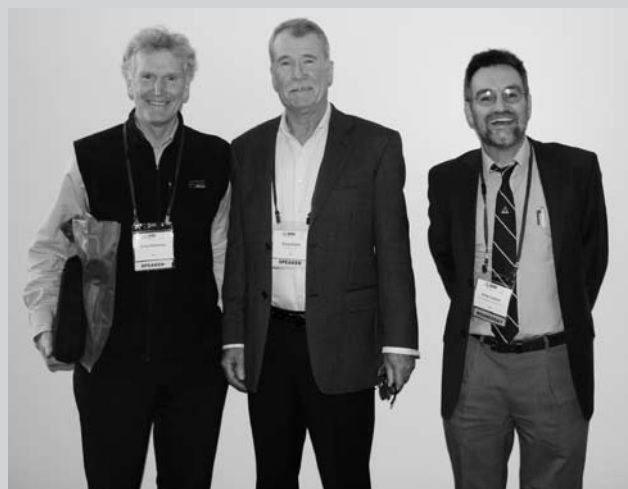
The AIG (NSW Branch) symposium entitled "Geology in Action" at the Australian Earth Sciences Convention (AESC) 2010, saw the reunion of three Macquarie University (MU) "old boys" who graduated in Geology from the MU School of Earth Sciences in 1974.

From left to right in the photograph, Greg Mortimer, Greg Kotze and Greg Corbett, all featured in the AIG symposium.

Greg Corbett, who manages his own consultancy Corbett Geological Services, was a conference organiser and a session chairman. Greg Kotze, who is the Chief Engineering Geologist with GHD Pty Ltd, was also a session chairman and a presenter on the subject "Geohazards – Their Identification and Management". Greg Mortimer, the renowned adventurer and mountaineer, concluded the seminar proceedings with an inspiring presentati¬on on his first Australian ascent of Mt Everest and his subsequent travels to the Antarctic.

Second Quarter 2010 Employment Survey Results

Geoscientist Employment Continues to Improve

Geoscientist employment in Australia continued to improve during the second quarter of 2010 according to the results of the latest Australian Institute of Geoscientists (AIG) employment survey.

The proportion of survey respondents reporting that they were unemployed or underemployed fell from 11.9% to 5.3% between the first and second quarter of 2010. The unemployment rate fell from 4.4% to 2.6%.

Geoscience Employment

Legend: Geoscience un- & underemp.; Exploration un- & underemp; Australian unemployment; Geoscience unempoyment; Exploration unemployment

Unemployment and underemployment in the mineral exploration sector fell from 10.6% to 6.0% in the corresponding period. The unemployment rate for the exploration sector declined slightly from 4.4% to 3.3%. No respondent indicated that they were seeking employment outside their profession. Both the overall and exploration unemployment rates were below the unemployment rate for the Australian workforce for the first time since quarterly surveys by AIG commenced. More than 40% of geoscientists currently underemployed or unemployed felt confident that they would egain full employment within 3 months.
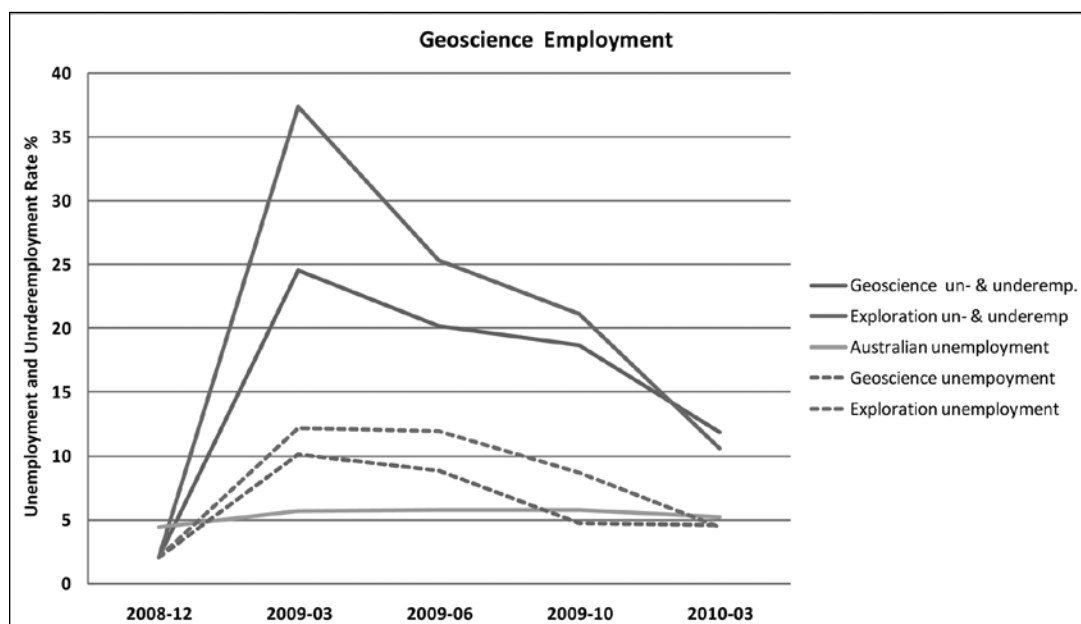
Most responses were collected prior to the announcement of the proposed Resources Super Profits Tax by the current federal government.

"The continued improvement in geoscientist employment since the peak experienced in March 2009 will be welcomed by geoscience professionals throughout Australia" said AIG Vice President Andrew Waltho.

"Despite the continued improvement in geoscientist employment, AIG continues to promote the need for measures to reduce volatility in resource exploration investment, designed particularly to help lessen the severity of cycles in exploration activity and minimise disruption to resource discovery and project development required to sustain Australia's resource industries".

Andrew Waltho

Education Report

Kaylene Camuti
(Chair, AIG Education Committee)

AIG Student Bursary Program

Applications for the 2010 student bursary program closed in early August and the bursary committee has started to review the applications. We have received applications from 45 third year, honours and postgraduate students – a record number.

This year your membership invoice included the option of making a tax deductible donation to the AIG Education Foundation, which is the fund that supports the bursary program. Many members chose to make a contribution and we thank them for their support.

State Branch Education Activities – scholarships, career nights, training courses

Several state branches regularly hold student career nights. The Queensland Branch held a successful student night in July, when about 70 students from UQ and QUT gathered at QUT to hear presentations from several professional geologists working in a range of geological specialties. The NSW branch also ran a very successful student careers night at Sydney University, attended by around 50 students, and will be running a similar event at Macquarie University in August. In WA a geosciences career night for high school and tertiary students will be held in Perth in late August. This event is being organised by the ASEG, the AIG WA branch, PESA, the GSA and Curtin University.

The state branches also actively promote education and training opportunities for students and graduate geoscientists. This year the NSW branch awarded $2000 to Will Abbott, an Honours student at Macquarie University, to help fund his attendance at an SEG student field trip to Salt Lake City in September. In Queensland, over the next year, the AIG state branch is planning to increase its program of training courses and run several short courses and/or workshops suitable for graduate geoscientists and students. The courses will also be suitable for experienced geoscientists wishing to refresh their skills. Courses being considered include drilling for geologists, recognition of alteration, breccias and ore textures, and a course on porphyry-related mineralisation.

The AIG Qld branch is also collaborating with the Qld branch of the GSA to host an Earth Science booth at the National Science Pavilion at the EKKA (the Brisbane show), from the 5 to 14 August. For the last two years over 50,000 people have visited the National Science Pavilion and many have stopped at the Earth Science booth to find out more about how the earth sciences impact their day-to-day lives, and career opportunities in earth science.

Please contact your state branch if you would like to take part in the various education activities happening around the country, or if you would like to put your hand up to help with state branch functions. ▲▲

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

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Honours Abstract:
A Magnetic and Geochemical Perspective of Charters Towers

The Ravenswood Batholith is situated southwest of Townsville, Australia, covering over 6000 km2 in area and is host to the world class Charters Towers goldfield. The heterogeneous nature of the Ravenswood Batholith is well recognised by a diversity of the igneous rock types, including granodiorites, tonalites, quartz-diorites, and mafic dykes. Samples were petrographically examined and then analysed for major and trace elements by XRF and laser ablation (LA) ICP-MS. Several key samples were processed for U/Pb zircon geochronology. Field mapping and a ground magnetic survey were also performed. The aims of this study were to: (1) evaluate different petrogenetic models for Silurian/Devonian granitoids, (2) distinguish the difference in tectonic environments between the Cambrian-Ordovician and Silurian-Devonian eras, and (3) contribute to further exploration of the Ravenswood Batholith area.

Combined field, petrographic, geochronological and chemical observations of rock types in the field and from a deep drill hole (2000m) were conducted. Diffuse contacts, together with mafic igneous inclusions and end-members, were found in the field. Mixing textures were observed in thin section including mafic clots. Geochemistry presented as Harker diagrams and multi-elements plots illustrate linear trends and suggest a crustal-mantle signature. These findings fit a magma mixing model.

Two distinct suites of mafic dykes are represented by different ages, chemical compositions and orientations. Using multi-element diagrams group 1 is a Silurian-Devonian parent magma which shows a variable arc signature with a 'spiked' pattern similar to Basin and Range and the TaupoVolcanics. This fits a late stage extension arc signature. Group 2 is a Cambrian primary magma with a 'spiked' pattern closer to MORB similar to the Western Lau Basin. Group 2 fits volcanic back-arc basalt models. Silurian-Devonian dykes can be further separated into sub-groups based on high and low titanium coupled with NW or NNW-SSE orientations.

Clustering U/Pb ages ~465 and ~430 Ma of Charters Towers granites suggests punctuated magmatic activity due to the onset of extension. The Middle Ordovician age of the Towers Hill Granodiorite suggests a contraction event may have occurred pre-Silurian.

A two-stage mixing model is developed. Mafic magmas intruded the lower crust during extension causing it to melt. Chemical and/or crystal exchange allowed the separate melts to mix. Mixing occurred in the lower to middle crust and was intense enough to create a homogenised magma. Mixed magma intruded as separate sheet bodies causing the variety of rock types. Hybrid magmas were later intruded by a series of mafic dykes.

A ground magnetic survey shows several magnetic domains, a sharp contact between tonalite and metamorphic rocks and structural linears. Diffuse contacts between intrusions may be due to shallow dipping bodies. Mineralisation is a possibility for the study area with young linears that run parallel to mineralised veins. These structures are thought to be active at the time of mineralisation.

Michael Pocock, James Cook University
2009 Terra Search-AIG Honours Bursary Winner

Membership Update

New Members and Upgrades at the June Council Meeting 2010

FELLOWS

COHEN	David	Ronald
DOMINY	Simon	Charlesr

MEMBERS

BUTERA	Kristin	Michael
CASTANEDA	Julio	Felix
CHAMBERS	Christopher	David
GARAY	Enrique	
HANTLER	Aaron	Grant
HUMPHRIES	Michael	Bernard
JOHNSON	David	Michael
MCCALLUM	Wayne	Stuart
ROESTENBURG	Jon	Willlem
WHITTY	Michael	Edward

GRADUATES

GUTTERREZ OTI	Juan	
LE BHERZ	Max	Anthony
PETERS	Nicola	Anne

STUDENTS

BOYCE	Julie	Ann
BURTON-BRADLEY	Elodie	
COCKERTON	Amy	Beth Donovan
ESPANON	Venera	Ruth
HOLCROFT	Emily	Frances
MILLS	Stephanie	
REYNOLDS	Lisa	
SMITH	Paul	David
STEEL	Michael	Alan
WARD	Josephine	
WEISS	Amy	
ZAHIROVIC	Sabin	

New Members and Upgrades at the July Council Meeting 2010

MEMBERS

HALL	Benjamin
HILL	Peter
KARAUT	Fiona
KOMAR	Vasily
LITVINOV	Pavel
LUTHER	Graeme
MORRELL	Anne
SAID	Hassan
SHAW	Nicholas
WOOD	David

GRADUATES

BRIGHT	Sian
CONNER	Graham
CORTES-MANZO	Omar

STUDENTS

CARR	Patrick
FRANKS	Jesse
HODGSON	Jack
ILETT	Rachael
MCLEAN	Kenneth
POINTON	Vair
POSKUS	Danielle
REA	Amy
SEGUI	David

RETIRED

CROUCH	Antony

We welcome all new members to the AIG.

Registered Professional Geoscientist Approvals & Applications

CANDIDATES APPROVED BY AIG COUNCIL IN JULY 2010

Dr. Lange Jorstad of NSW in the single field of Hydrogeology

Dr. Andy Wilde of Victoria in the single field of Mineral Exploration

Mr. Michael Edwards of NSW in the single field of Environmental Geoscience

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

Mr. Simon Dominy of Surrey, England, is applying in the field of Mining

Mr. Dragos Gavriliu of Beldon, WA, is applying in the field of Geophysics

Mr. Graeme Luther of Windsor, Victoria, is applying in the fields of Geotechnical & Engineering plus Environmental Geoscience

VALMIN Committee

The AIG is pleased to announce that in concert with the AusIMM, the new VALMIN Committee has been appointed.

The AIG representatives are

Jeames McKibben, Deborah Lord and Jonathan Bell;

and the AusIMM representatives being Louis Rozman (Chair), Victor Rudenno, Darren Herdman and Steve Gemell.

AIG FEDERAL COUNCIL FOR 2010-11

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SECRETARY
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