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Australia Mining

Commodities are king in the current boom, but an emerging global reputation for innovative technology and exploration expertise may be the industry's ultimate money-maker

A REPORT BY GBR FOR E&MJ

JAN/FEB 2006

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Australia's Mining Industry Rides High on Asia's Economic Wave

Exuberance characterizes a good deal of current thinking within Australia's prosperous mining sector. The long-term benefits of the boom will be in the expertise being accumulated, not in what's being extracted underground.

The global resource industry is renowned for its pronounced cyclicality. Yet what is unique about the current surge in metals and minerals demand is the fact that it is broadly based across commodities and is drawing upon rapid economic development in Asia that resource-rich Australia is geographically well-placed to exploit. Open, durable but remote, the local mining industry is now ratcheting up the country's overall international economic profile to levels not previously seen—and there's little sign of a slowdown.

It is a profile that deserves some publicity. According to the International Monetary Fund, Australia's economic growth averaged 3.1% per year between 2000 and 2005 (incorporating a Fund estimate for 2005), better than any other major industrialized country including the 2.8% seen in the U.S. While not large—Australia ranks 16th in the world terms of size based on an estimated purchasing power parity-adjusted GDP of US$638 billion in 2005 and its population of 20 million is a little smaller than that of Texas—the economy has proved highly resilient over the past decade, registering a hugely impressive average growth rate of 4.5% between 1997-99 when the Asian financial crisis was in full-swing. Meanwhile, unemployment fell to an estimated 5.1% in 2005, a rate only bettered by the U.S., the UK and Japan in the developed world, and inflation has stayed low.

Perhaps surprisingly, the local mining industry represents a relatively small part of the Australian economy, though its volatility tends to give it greater significance for the overall growth numbers than other, larger sectors. Mining production activities account for around 3.7% of the country's Gross Value Added with a further 0.4% attributable to mining-related services, meaning that even 10% annual growth in the mining industry would add just 0.4% to GDP growth directly. It makes a positive contribution to productivity, however, with that 4.1% of GDP produced by less than 1% of the employed workforce.

Mineral resources also have a huge role in the country's international trade, with mineral exports being worth some A$67.6 billion (US$50.8 billion) in 2004/05 (A$11 billion of which was from petroleum products) and equivalent to 53% of all merchandise exports and 41% of all exports of goods and services. The value of the mineral sector's exports leapt 29% in 2004/05 on a year earlier as demand from Asia surged, with the most significant increases seen in coal (especially coking coal), copper and iron ore.

Equally unambiguous is the massive resource base that remains. According to the Australian government's Geoscience Australia organization, at the end of 2004, Australia contained the world's largest demonstrated reserves of zinc (18% of the world's economic demonstrated resources), lead (33%), nickel (37%), rutile (39%), zircon (41%), tantalum (95%) and uranium (40%), while bauxite (25%), black coal (5%), brown coal (24%), copper (9%), gold (13%), iron ore (9%), ilmenite (20%), manganese ore (11%), silver (15%) and industrial diamonds (10%) rank in the top six worldwide.

Australia's Major Mineral Resources (End of 2004)

Commodity		Unit	Australia's EDR*	World EDR	Australia's Percent of World Total
Bauxite		Gt	5.7	23	25
Black coal	in situ	Gt	57.4	-	-
	recoverable	Gt	40.4	743	5
Brown coal	in situ	Gt	41.7	-	-
	recoverable	Gt	37.5	156	24
Cadmium		kt Cd	65.5	569	12
Cobalt		kt Co	1253	6798	18
Copper		Mt Cu	42.1	490	9
Diamond	gem & near gem	Mc	53.4	-	-
	industrial	Mc	55.6	580	10
Gold		t Au	5589	42000	13
Iron ore		Gt	14.6	160	9
Lead		Mt Pb	22.9	70	33
Manganese ore		Mt	133	1175	11
Mineral sands	ilmenite	Mt	217.2	1088	20
	rutile	Mt	20.2	52	39
	zircon	Mt	30	74	41
Nickel		Mt Ni	22.6	61.8	37
Silver		kt Ag	41.4	280	15
Tantalum		kt Ta	53	56	95
Tin		kt Sn	163	6100	3
Uranium		kt U	701	1743	40
Zinc		Mt Zn	41	222	18

Source: Australia's Identified Mineral Resources 2005, Geoscience Australia
** EDR=Economic Demonstrated Resources*

Historically, mining has always been at the center of Australia's industrial activity and the latest boom is hardly the first that the country has witnessed. The gold rush in New South Wales in 1851 that saw mass migration by mining hopefuls was said by some to have left Melbourne in neighboring Victoria resembling a ghost town, something that finds an echo in the acute shortages of skills that are proving the industry's Achilles heel today. (See Worker and Material Shortages Threaten Project Viability, p. xx.)

Of more modern relevance could be the failed "Poseidon" nickel boom of the 1970s, an event that today threatens to find resonance in the latest huge jump in nickel prices from an average of US$4,631/mt in 1998 to a peak of US$16,904/mt in May last year—which some observers see as unsustainable. The beneficiaries have been not only the

multi-billion dollar revenue Anglo-Australian giants BHP Billiton and rival Rio Tinto, but also a gang of thriving emerging nickel producers such as Sally Malay, Jubilee Mines, Independence Group, Western Areas and Lion Ore, all housed in Western Australia—home to more than half of the country's mineral resources—and championing a forward-looking, pioneering spirit. "We have the most exciting exploration future of any company in this country," says Kerry Harmanis, managing director of Jubilee Mines who won the coveted local Digger of the Year award for the second time in 2005.

The recent success of these firms and others is a reminder of the potential for history to repeat itself in a sharp downturn. But they simultaneously provide the most rewarding potential for Australia to capitalize on a step-change in demands for raw materials used in steel production, driven by current rapid rates of economic growth in large Asian markets.

The sense of optimism is becoming increasingly pervasive. Some companies are aggressively developing strategies based on what they see as changing patterns of global consumption. "Our company got to where it is today through growth in steel consumption in China and we see our future growth and earnings being directly related to the development of China's growing middle class and urbanization—that's nickel and copper," says Michael Kiernan, managing director of Consolidated Minerals, whose business took off with the rapid development of its high-grade manganese deposit, but has since diversified through a spate of acquisitions. "Urbanization is taking place because 350-400 million people are moving from the rural areas to the city areas. Young people want a western lifestyle: they love mum and dad, but mum and dad don't have sewerage, water or power. Also, people are moving to the cities for better job opportunities."

Yet the real winners might be found beyond the boom, in the skills and expertise that the local mining industry's expanded workforce is acquiring. Some of these come in the areas of software, mineral processing or niche equipment. (See Australian Technology Firms Find New Markets in Niche Applications p. 49.) But increasingly, some say, they could come from the business of the mining houses themselves. "From an exploration point of view, over the last quarter of a century, our exploration skills have increased substantially," says Kiernan. "We are now world leaders with regard to some technology, such as airborne magnetic and data." That bodes well not only for the opening up of new domestic frontiers for exploration, but also for the country's ability to grow its global influence by exporting services, as well as commodities, overseas.

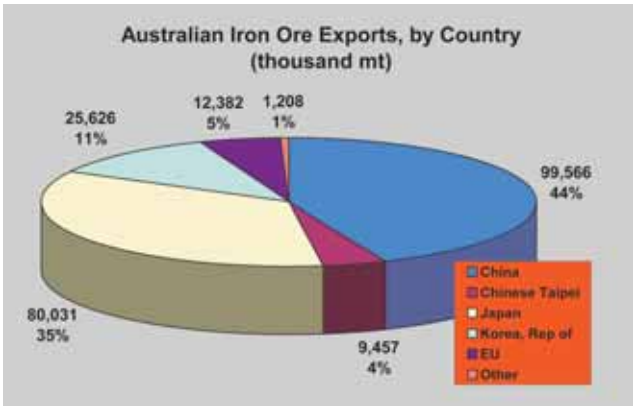
That process looks to be under way already. "We will probably expand our presence in Eastern Europe over the next couple of years," says Steve Coughlan, managing director of specialist underground contractor Byrnecut Mining, which employs some 1,200 staff around Australia. "The market is competitive here, so exporting overseas can be very attractive and our productivity and skills are first rate. We'll go anywhere, but look for first world clients." Rival contractors Barminco say something similar. "We'll be looking to take a 'can-do' attitude abroad over the next two years—to Chile and South Africa, for example," says Peter Bartlett, the company's managing director. Local resource-driven engineering, EPC and consultancy outfits such as Thiess, Sinclair Knight Merz and Roche Mining are doing the same.

Should they be successful in carving out new or niche markets, the end of the current resource cycle might possess a less gloomy finale. Some of the local mining industry's significant resource projects, the challenges faced and the technological developments being made are explored on the following pages.

Iron Ore and Coal: Pricing and Volume up for These Key Export Commodities

Australia's huge coal and iron ore industries are booming. Up until now, the majors have benefited handsomely, but smaller players are beginning to muscle in.

Nowhere is the recent surge in commodity demand more visible than in Australia's vast coal and iron ore industries—important components in supporting global power generation and, in particular, Asia's ballooning steel production. The two are already Australia's most important commodity exports, worth a combined A$25 billion (US$18.8 billion) in 2004/05 and representing 20% of the country's visible exports. Official figures show that their importance is expected to increase. The Australian Bureau of Agricultural and Resource Economics (ABARE) forecast export volumes to rise 3% and 17% to 238 million mt and 267 million mt for coal and iron ore respectively, in 2005/06. And on top of stronger volumes, they say, big price rises seen during 2005 will push coal export values up 45% to A$24.8 billion (US$18.7 billion) in 2005/06 and iron ore export values up an astonishing 72% to A$14 billion (US$10.5 billion). All that on top of beefy increases a year earlier, too.



Irrespective of current growth, Australia already has a world-class ranking in the two goods, thanks both to the scale of its output and the proven stability of its supplies. It produced 300 million mt of saleable black coal in 2004/05. In terms of a world comparison, its 285 million mt in 2004 made it the world's fourth largest producer of hard coal, after China (1,956 million mt/y) the U.S. (933 million mt/y) and India (373 million mt/y), but it is comfortably the world's largest exporter, selling more than double the amount of its nearest rival, Indonesia (107 million mt in 2004) and accounting for an estimated 30% of world exports in 2005. Just under half of those exports have gone to Japan in recent years. Its standing in iron ore is even more impressive. Australia produced 241 million mt in 2005—ranked in the world's top three behind Brazil and China, although exact estimates for the latter are often viewed as inaccurate—and accounted for an estimated 40% of world exports. In 2004/05, 44% of Australian iron ore exports went to China and a further 35% to Japan.

Domestically, the resource bases are geographically lopsided. Most of Australia's known iron ore lies in Western Australia, which accounted for 98% of the country's iron ore production in 2004/05. Black coal deposits, on the other hand, are largely found on the eastern side of the country, in New South Wales and Queensland—home to the famous Bowen Basin—which combined accounted for 97% of the country's black coal production in 2004/05. Some 54% of Australia's black coal exports were from coking coal in 2004/05 and 46% from thermal coal. The southern state of Victoria also produced 68 million mt of brown coal in 2004/05.

Cast Iron Rewards for the Majors

The exploitation of the local iron ore industry—and the recent consequences of surging Asian demand—has been overwhelmingly tackled by the two Anglo-Australian majors who dominate in their own backyards. Some 225 million mt (or more than 90%) of the iron ore produced in Australia in 2005 was estimated to have been produced by either BHP Billiton or Rio Tinto or their subsidiaries, which are now undergoing massive expansion plans at the industry's center of gravity, the historic Pilbara region in north western Australia. BHP Billiton is currently in the middle of Rapid Growth Project (RPG) II, a US$575-million plan to boost overall production from 110 million mt/y to 117 million mt/y due for completion by the second half of 2006. In October 2005, it formally announced RPG III, a US$1.6-billion plan that includes a US$496-million investment to double production at its Mining Area C to 42 million mt/y, US$744 million to expand port capacity at Port Hedland to 129 million mt and US$232 million on rail lines and rolling stock. Production under the plan is slated to start in late 2007. The company is also currently formulating RPG IV which could be just as large as RPGIII, though its exact scope and shape remain undecided.

Train loading at BHP Billiton's iron ore operations at Mine Area C in the Pilbara.

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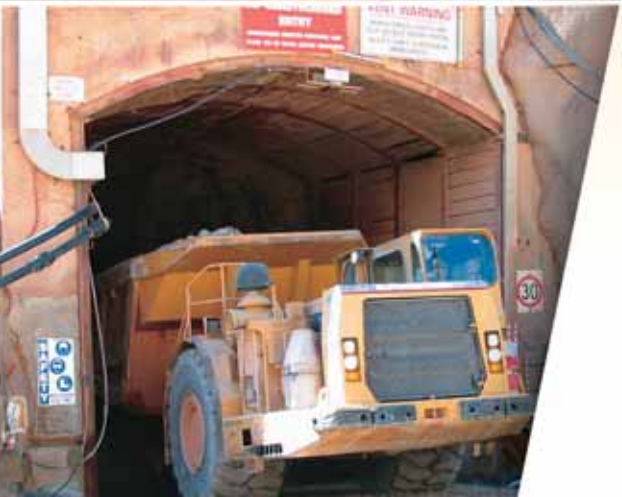

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Rival Rio Tinto's Australian iron ore operations are owned by its 100% subsidiary Hamersley Iron and through its 53% shareholding of Robe River, a joint venture between itself and Japanese partners Mitsui, Sumitomo Metal Industries and Nippon Steel Corp. but operated by Pilbara Iron, formed in 2004 with a view to coordinating and streamlining Rio's Pilbara-based operations. Hamersley and Robe together produced some 130 million mt in 2004 and Rio Tinto has just finished a major expansion to its Pilbara operations. It recently announced further expansions totaling US$1.4 billion and comprising US$530 million allocated to a 44% expansion at its Yandicoogina mine to 52 million mt/y and US$690 million to upgrading the Dampier port's capacity from 116 million mt/y to 140 million mt/y. The balance will be spent on rolling stock and other infrastructure. The plan is expected to be commissioned at the end of 2007 and go into production in 2008 and takes the total committed to expanding the Pilbara operations in the last three years to almost US$3 billion.

Clearly, with demand at unprecedented levels, the current round of investments is seen as more than a punt. "When you spend the amounts of money that we are in our expansion plans, you have to have a fair bit of confidence about the prospects for your market," says David Smith, Pilbara Iron's managing director. Indeed, the possibility of a significant and immediate drop-off in demand from emerging Asia is now largely sniffed at by the major resource companies. "There will be bumps in the iron ore market, partly because of domestic things in China but also because additional supply will come on in large tranches. But the overall view is very positive for continued very strong growth in the iron ore market." That growth, argues Smith, is made more secure by the fact that it reflects changes of a structural nature, rather than a transient boost to demand. "If you look at where China is on any steel intensity curve, it's still down near the bottom. If you assume that it will follow a Japan, a Korea or a Taiwan, the growth potential there is still enormous." BHP Billiton's CEO Chip Goodyear is known to hold a similar view.

Having seen the Pilbara region's emergence as a world-class source of iron ore closely associated with the post-war industrialization of Japan in the 1960s, the local depiction of how the market might evolve contains added authority. "Growth will flatten off at some point," says Smith. "Generally what industrializing and urbanizing nations do is go through a very strong period of almost exponential growth in steel consumption. Then recycling processes come in and you get a replacement effect, which sees steel demand flatten off or even decline slightly. But I think growth in China will go on for a very, very long time before we start to see that flattening off. It's not easy to say how long it will be, but it will take the whole iron ore market on to a completely different platform—a substantially bigger one."

Yet despite that broad optimism, the outlook is not without its flashpoints. Even if demand remains buoyant, relationships with buyers could be jeopardized by future rounds of price negotiations. BHP Billiton, Rio Tinto and Companhia Vale do Rio Doce (CVRD) of Brazil—who together supply over three-quarters of the world's seaborne iron ore trade—last year hiked the price for high grade fines by 71.5% for 2005/06 to

An ore train en route from West Angelas in Western Australia. Rail upgrades are part of Rio Tinto's US$1.4-billion expansion plan for its Pilbara-based iron ore operations.

$US0.6172 per dry mt unit, claiming that the price increase reflects the investment spending needed to satisfy clients' future demand. BHP Billiton also argues that its buyers still get a good deal since freight rates to China, for example, are less than half those from Brazil, something that is likely to see them asking for a further premium of up to 20% in future rounds of iron ore price negotiations.

The consequences of the price increases are not so much in the prospects of piqued buyers reducing their purchases of iron ore, but that higher prices today might mean a more volatile market in the future. Moreover, China might look to consolidate the number of importers involved in price negotiations in order to boost its buying power—a move that could prove powerful if market conditions were to change.

New Entrants

A further threat could emerge from the cluster of newer local players responding to improved market conditions by looking to develop alternative sources of supply. Many have projects at advanced stages. One is Murchison Metals, which owns the Jack Hill deposit outside the Pilbara, in the Murchison region of Western Australia. "The region was drilled back in the 1960s and 1970s by Anglo American, but because of the relatively low iron ore prices and the abundance of supply from the Pilbara, it wasn't developed," says the company's Managing Director, Robert Vagnoni. The deposit contains a measured and inferred resource of 67 million mt of premium grade direct shipping ore, and is expected to go into production in the first quarter of 2006 at a starter rate of 1.2 million mt/y. Initial studies suggest that the resource has a potential mineralization of 380 million mt at a 62% iron grade, which the company is looking to develop in two stages.

"Cost is the major advantage in our case," says Vagnoni. "It's only mining, crushing and screening and minimal processing. It's also environmentally friendly because there's no cyanide." Ore will initially be trucked 540 km to the Geraldton port, but there are plans further down the line for Murchison to build its own rail line to Geraldton.

In September 2005, Korean steel giant Posco took a 5% stake in the company—seen as a precursor to a 19.9% holding when the company completes further feasibility studies on and development of the project—as well as an option to purchase 10 million mt/y of iron ore over 25 years as hoped-for production comes on stream. Murchison aims to reach production of 25 million mt/y—a rate that would start to make the majors notice—by 2010 and the Posco involvement is seen as a vote of confidence in the quality of Murchison's assets.

Other projects include Portman's 8 million mt/y Koolyanobbing project (previously 4-6 million mt/y but ramping up from this year) and Fortescue Metal Group's huge proposed 40-45 million mt/y Chichester Range project (expected to start in 2008 and reaching full production by 2011). Fortescue's stated aim is to break the international majors' oligopoly and become "the new force" in iron ore.

Shipping times from Australia to Asia give local companies a cost advantage over iron ore suppliers from Brazil.

They face some skepticism—though much of it stems from inside the very majors whose stranglehold on world supply they are looking to break. "The new entrants will find that this is an expensive, capital intensive game," says Pilbara Iron's Smith. "You have to spend billions of dollars getting into it so you'd better be serious and patient." Other critics argue that the small companies lack the balance sheets to deal with problems should demand conditions turn, or if new capacity twists the market into a position of oversupply in a few years

BHP Billiton's Autralian coal operations include a 50-50 joint venture with Japanese trading company Mitsubishi.

time. But the juniors appear confident enough. "This is the start of the history of the midwest," says Vagnoni. And given that their potential customers have an interest in diversifying their sources, so they might be.

Mid-Tier Coal Producers Gain Visibility

Australia's coal industry is slightly less concentrated, but is nevertheless still dominated by a clutch of four international majors: BHP Billiton, Rio Tinto, Anglo Coal Australia (a division of Anglo American) and Xstrata, who together account for up to three-quarters of Australia's production of saleable black coal. Most of BHP Billiton's activities are operated in a 50:50 joint venture with general trading giant Mitsubishi of Japan (the BHP Billiton Mitsubishi Alliance, or BMA), which produced some 56 million mt/y in 2004-05 and is Australia's single largest coal producer.

There is, however, a reasonably strong and increasingly assertive small-to-mid-cap presence, reflecting an evolution that is yet to take place in the iron ore industry. That new mid-tier includes Centennial Coal, Felix Resources, Excel Coal and Macarthur Coal. "The majors have got bigger and bigger over the years through acquisition and the mid-sector has been taken out. Now there are a few of us who were yesterday's juniors," says Ken Talbot, managing director of the Brisbane-based Macarthur Coal, which produces 5 million mt/y from their Coppabella and Moorvale operations in the Bowen Basin and supplies 38% of the world's low volatile coal for Pulverized Coal Injection (PCI) use to steel mills in Asia, Europe and Brazil. "I see more value in growing the company over the next 10 years than taking a small premium and selling," says Talbot. "The majors must grow and the only option they will have is through acquisition, so they'll be offering premiums. But they'll run out of targets eventually. Any independents left in another 10 years will be in very strong demand."

Tony Haggarty, managing director at Excel Coal, recognizes that the mid-cap sector is of benefit to the customers, too. "Unlike some other commodities, coal is an industrial market and the big customers like competition amongst suppliers." The mid-tier is also, he argues, able to carry through projects that the majors would disregard on the grounds of a lack of financial upside which gives the sector more mobility.

Eye-catching coal expansion projects are somewhat less common than in the iron ore sector, partly reflecting China's ability to draw on its own large indigenous reserves of thermal coal for its mushrooming power needs. Nevertheless, some companies believe that opportunities could yet arise. "There is no real alternative to thermal coal over the next 30 years," says Jon Parker, managing director of Felix Resources, which expects to produce close to 6 million mt/y of a mixture of PCI, thermal and coking coal from its Queensland and New South Wales operations in 2006. "China produces around 1.9 billion tons per year of coal at the moment. But if just 10% of that is diverted to the export market, it's a huge number. There is a significant chance for them to be a net importer of coal going forward." China lacks, however, the relatively hard coking coal more commonly found in Australia and that area is perceived as offering a major growth opportunity. "Hard coking coal is not in huge supply around the world but steel demand is growing strongly, so I see a very good long run future for it," says Parker. "Australia can benefit from that."

But perhaps the critical factors that have assisted the emergence of the mid-tier firms is a widely available resource base combined with fairly straightforward mining conditions, which has kept capital costs relatively low. "Mining is a pretty simple business here, but to do it efficiently requires very good applications of skills and resources," says Parker. "We developed our Minerva operation into an operating mine in less than 12 months. There's an advantage of being a small company in that the decision making process can be quite prompt."

Indeed, the consensus view is that, unlike in other commodities, the technical challenges facing local coal miners are unlikely to increase dramatically over the next few years. "For the brown coal deposits in Victoria and in metalliferous mining generally, companies are starting to go down into deeper areas that they have never reached before," says Garry Ash, managing director of underground coal contracting specialists Walter Mining. "But there's no real need for black coal mining to become much more challenging here in Australia because, by and large, there's still so much black coal near to the surface."

A bigger constraint looks to be the infrastructure system, a legacy of Australia's long and distinguished mining history but now in

urgent need of an upgrade as demand expands. "Improvements in the port infrastructure are critical for the coal industry," says Talbot. Australia has some nine coal terminals, the largest of which are Dalrymple Bay and Gladstone in Queensland and Newcastle in New South Wales, with capacities of 56 million mt/y, 45 million mt/y and 89 million mt/y, respectively. The nine terminals share a total capacity of around 250 million mt/y, but exporters are feeling the squeeze. "When it comes to looking to ship more coking coal, the ports are now full and there's a lead time of maybe three years before we can materially change that position," says Talbot. The first half of 2005 saw a reported queue of over 40 vessels stranded on approach to Dalrymple Bay, a bottleneck cleverly circumvented by Macarthur which arranged a diesel locomotive to take some of its supplies 200 km north to the next terminal at a cost of an extra A$12-14 per mt.

Not only has the unexpected surge in demand caught most producers and the government-run port authorities by surprise, but the privately operated Dalrymple terminal is locked in dispute with the state government over the charges it will pass on to its users in the light of a proposed expansion. While all this is an issue for both large and small coal producers, the latter say privately that while the ports are common user, it is not in the interests of the majors to lobby for capacity expansions that might undermine their market clout. Moreover, delays for the small producers are often extremely costly, with each ship costing producers over US$50,000 per day while waiting to dock.

The problem is now beginning to filter down to the local service industry. "The infrastructure shortage puts a natural constraint on a potential explosion of new coking coal projects," says Peter Hay, managing director of the Australian arm of Sedgman, the world's largest coal preparation and materials handling engineering design and construction management firm. "Our continued growth will probably come from international markets, such as South Africa. Medium-term, given that Sedgman US is already doing a number of projects in China, our growth will also focus on India. We've had early discussions with potential partners in India—that's the strategy we're pursuing in the current market."

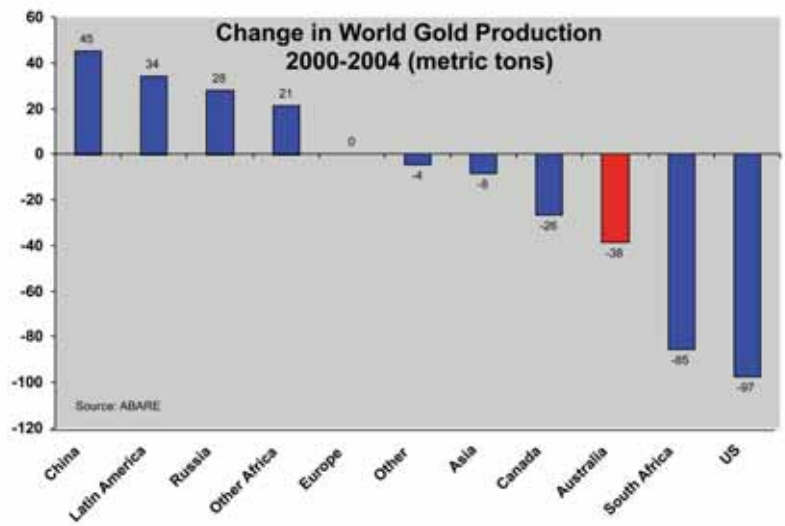
That hardly means that the local market is being neglected. But it is typical of the determination that small-to-mid-sized Australian companies are prepared to show to establish their growth credentials both at home and abroad. The bulk of the iron ore and coal industries are likely to remain dictated by the existing major companies over the coming years. Meanwhile, the smaller players will go on searching for a paradigm shift in supply equal to the one currently taking place to global demand.

Gold Mining Loses its Luster from Lack of Domestic Exploration

A hole in the middle-ground of Australia's corporate gold sector has left it lacking clout. The response should include building on Australian companies' intriguing positions overseas

As the attraction of gold both as a commodity and an investment asset increases, so does attention on the ambitions and virility of its prospectors in Australia—a country that was not only the scene of the second gold rush in 1851 (three years after the Californian gold rush), but that's also still the world's second largest gold producer behind South Africa.

Lately, however, darlings of the industry have been difficult to come by. In common with some of the world's other leading gold producing countries, Australia's production figures have flagged in recent years as large, older mines such as Newmont's Kalgoorlie and Tanami operations (gold sales down around 27% and 32% respectively, in Q3 2005 compared with a year earlier) have matured, produced lower ore grades and failed to be replaced by newer projects of comparable significance. As the following chart shows, Australian gold production fell from 296 mt to 258 mt, or 13%, between 2000 and 2004, though even bigger declines were seen in both South Africa and the U.S.



While production was expected to have broadly stabilized in 2005–and smaller volumes have been cushioned by higher gold prices—two other forces are now shaping the underlying dynamics of the industry: one related to changes in its own structure and the other to the perception that there are easier pickings to be had overseas.

"There's been a lot of consolidation over the past 10 years," says Chris Fraser, executive director of the Victoria branch of the Minerals Council of Australia. "It looks different now." That round of consolidation–including Newmont's 2002 acquisition of Normandy and Placer Dome's takeover of Auriongold in the same year—has stripped Australia of some of its most energetic mid-level gold miners, leaving the industry stratified across two camps: a number of juniors such as Bendigo Mining, Ballarat Goldfields and Perseverance Corporation in the burgeoning Golden Triangle in Victoria, earnestly developing projects on a scale unlikely to quickly reverse declining production rates elsewhere, and the international majors, who have shown little interest in aggressive exploration efforts of late. Indeed, private exploration expenditure on gold has plunged 46% in nominal terms from its peak of A$728 mil-

lion (US$543 million) in 1996/97 to A$392 million (US$292 million) in 2004/05. That compares to an equivalent 4% increase for mineral exploration expenditure overall and a whopping 26% increase for base metals.

To some extent, say industry participants, the sector is naturally inclined to divisions based upon company size. "Consolidation is the gold industry," says Tony Palmer, managing director of Newcrest Mining, now the only remaining Australian gold miner producing in the mid-tier range of over 700,000 oz per year and with a stock market capitalization of A$6.5 billion (US$4.8 billion). "The characteristics of gold mines are that they tend to be small and short life in comparison to the big coal or iron ore deposits, for example. In the 1980s there were 40 or 50 listed companies with gold producing operations in Australia. Now they're all gone."

"Yet," says Palmer, whose company has been the subject of recent takeover speculation itself, "more of the blame for the weak outlook for meaningful exploration probably lies at the other end of the mining spectrum. The major gold companies were taken over in the 1990s by Americans and South Africans who decided not to explore. But somebody's got to do the work." Palmer's interest in greenfield projects emphasizes what he believes the Australian gold sector is lacking. "Exploration is fundamental to us," he says. "Finding something is the way to seriously add value. Look back at the history of BHP (Billiton) for example. They get real boosts when they find something. But you can't expect a junior explorer who has raised a few million dollars to find a big ore body – it just isn't going to happen."

Gold-copper ore at Telfer being dumped into primary crusher.

That type of aggressive thinking was central to the expansion of the company's huge Telfer operations, whose mineral resource was upgraded to 26 million oz of gold in 2002 after a massive exploration effort that included 140 km of drilling and 150,000 mt of bulk sampling. Now the Western Australia-based mine is expected to average production of 800,000 oz per year of gold over a 24-year period from 2006, as well as 30,000 mt /y of copper, making it potentially Australia's biggest gold mine. That in itself will provide support for Australia's gold industry going forward, though not enough to offset bigger declines elsewhere. And

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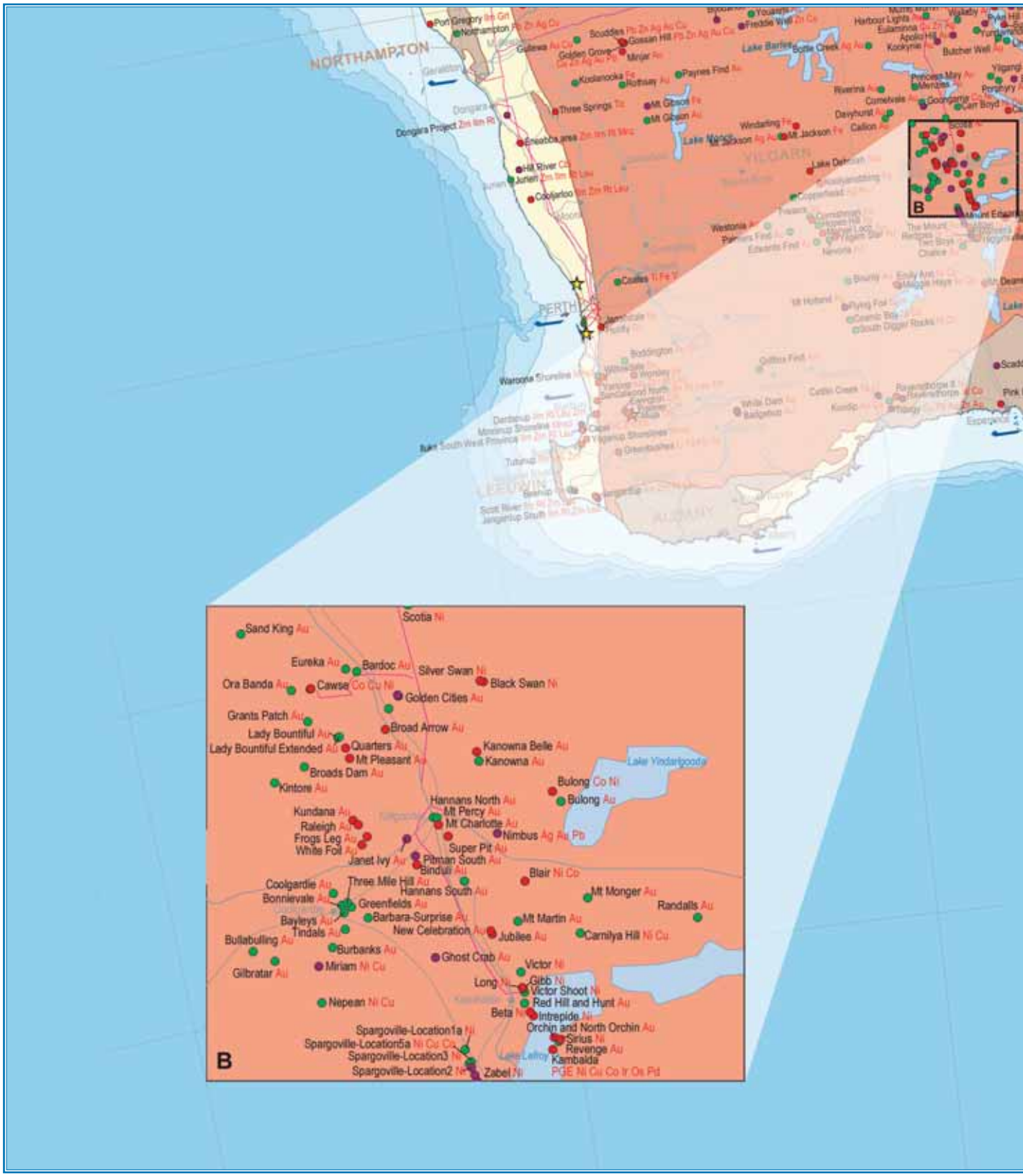

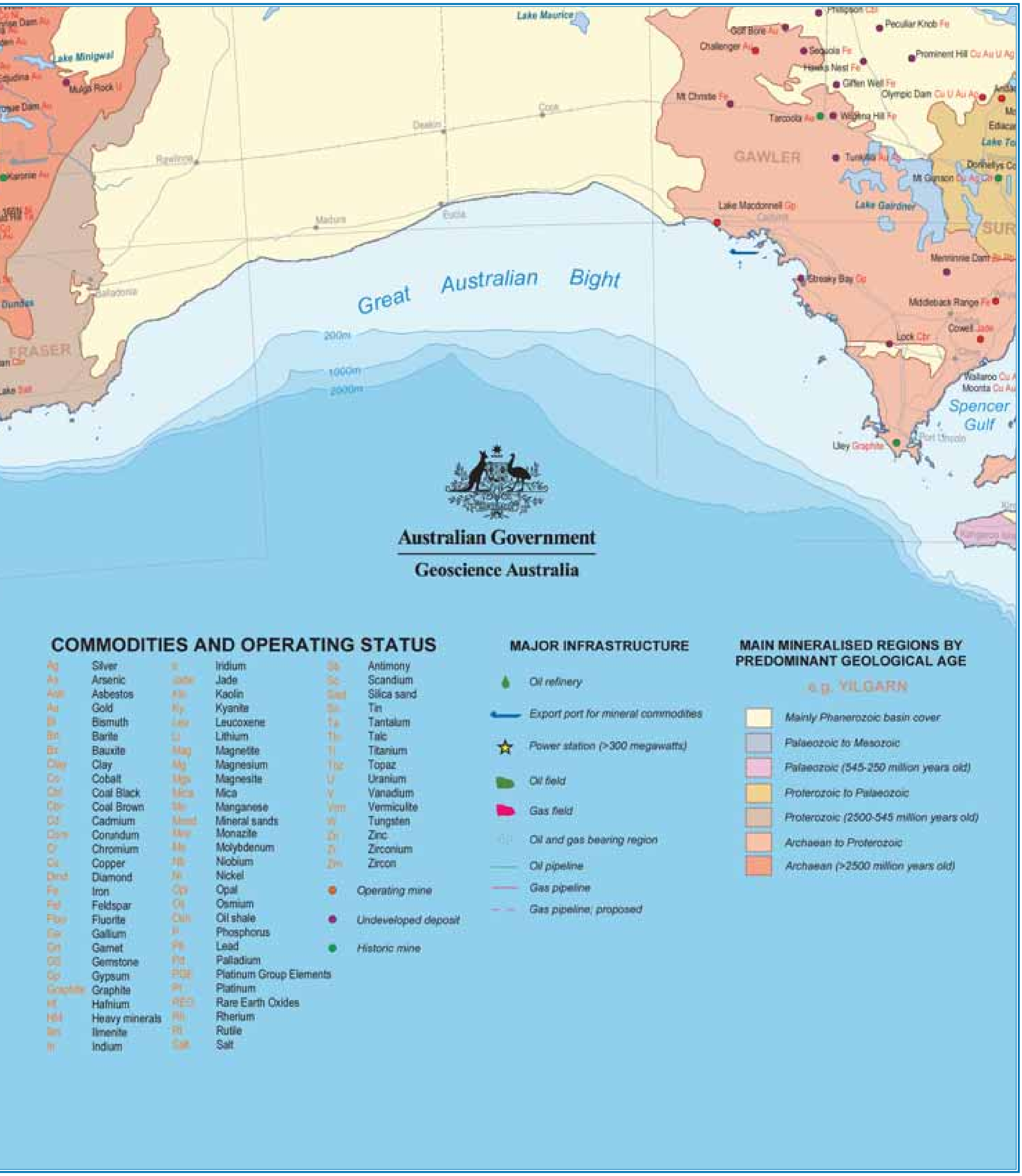
Great Australian Bight
Lake Minigwal
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COMMODITIES AND OPERATING STATUS
Silver
Arsenic
Asbestos
Gold
Bismuth
Barite
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Clay
Cobalt
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Operating mine
Undeveloped deposit
Historic mine
MAJOR INFRASTRUCTURE
Oil refinery
Export port for mineral commodities
Power station (>300 megawatts)
Oil field
Gas field
Oil and gas bearing region
Oil pipeline
Gas pipeline
Gas pipeline; proposed
MAIN MINERALISED REGIONS BY PREDOMINANT GEOLOGICAL AGE
e.g. YILGARN
Mainly Phanerozoic basin cover
Palaeozoic to Mesozoic
Palaeozoic (545-250 million years old)
Proterozoic to Palaeozoic
Proterozoic (2500-545 million years old)
Archaean to Proterozoic
Archaean (>2500 million years old)

Kingsgate's Chatree mine, 280 km north east of Bangkok in Thailand.

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there was bad news at Telfer recently, with the original mine's performance hampered by relatively high arsenic content of its high grade gold, which saw its cash costs rise to A$212/oz in Q3 2005 from A$126/oz in Q2.

Palmer concedes, however, that over the medium-term, Newcrest faces the same challenges in growing its Australian operations as other larger operators: a perceived lack of prospectivity at home, as well as limited tenement availability. "Australia is unlikely to remain the heart of Newcrest's operations," he says. "When we announced Telfer three years ago, we decided that we needed to double our exploration effort at the same time. Our geological team said we can't spend all of that in Australia. The ground's too tightly held here. If you're trying to produce 2 million ounces per year—which we are— a small block doesn't do it for you. So right now we're looking in the Americas and in Indonesia."

Senior figures in other companies agree that future consolidation amongst gold players—driven by the need for higher production volumes—is likely. "I suspect that there will be further consolidation in the industry. Companies aren't replacing their reserves here in Australia, so potential for organic growth is limited. They will be forced to go offshore or acquire," says Gavin Thomas, CEO of Sydney-based Kingsgate Consolidated, one of Australia's leading overseas gold producers through its Chatree mine 280 km north of Bangkok in Thailand. "We are Thailand's only modern gold miner," says Thomas, who was named one of the Legends of Australian Mining & Exploration at the annual Mining & Exploration Excellence 2005 conference in Sydney in October 2005. "We've produced around 150,000 ounces of gold per year for the past four years from Chatree and we're finding resources to replace our current annual production every one to two months." There is no circumspection when it comes to prospectivity, either. "We are confident that this central Thailand gold belt is a truly world class gold province. We have resources of over 3.2 million oz and reserves of over 1.8 million oz and have traditionally had a conversion rate from resources to reserves of around 70%. The gap is there simply because we can't drill fast enough."

That positive outlook, Thomas says, is part of a clutch of factors that have made the venture a success, despite some administrative difficulties. "Mining is not part of the mainstream in Thailand, so there can be a long processing or administrative period. But at the same time, the fiscal terms are very favorable and the infrastructure is fantastic: there are lots of bitumen roads and we have hydroelectric power from a Laotian power line that runs down to Bangkok. The line is 1 km from our operations, so we get power on site at about US$5.7–5.9c per kilowatt hour."

Just as well-positioned is Sydney-based Sinogold, with operations in China. "We are the first and only foreign operator of a gold mine in China," says Jake Klein, the company's CEO. "We have our small-scale Jianchaling mine in the Shaanxi province of central China, but it is due to run out of ore in early 2006. Our real resource is the 3.5 million oz Jinfeng deposit in Southern China. It has the capacity to produce at least 300,000 oz per year in its first phase, which will make it the second largest gold mine in the country and potentially the largest in phase 2." Intial production of 180,000 oz per year is slated to start from mid-2006, ramping up to 300,000 oz in 2007.

Klein explains that it is not just the prospectivity of the region —which neighbors other major gold provinces such as Russia, Kazakhstan and Mongolia— that makes the opportunity exciting, but the very real prospects for inorganic growth. "The industry is at present very fractured and under-capitalized. There are thousands of small scale operations and the average size of production from a mine is 16,000 oz per year. It's an industry desperate for modernization and consolidation. Within five to 10 years there will emerge five or six well-capitalized growth-oriented companies that act as consolidators to the sector. Each might have one million ounce production bases, and not all of them will be Chinese." The company's strategy, says Klein, is to position itself to exploit that shift in market structure, initially through development of its Jinfeng deposit. "For us, getting to large-scale production is critically important. Once we are producing 300,000 oz of gold per year, suddenly you are a natural consolidator."

Other Australian companies with less prospective overseas opportunities have nevertheless been nimble enough to enjoy short, but profitable ventures. Perth-based Troy Resources produced 69,580 oz from its short-life, high grade Sertão operations 380 km west of Brasilia in 2004/05, in which it has a 70% share with its local partner, Amazônia Mineração. "Brazil has been marvelous for us," says Troy's Managing Director Ken Nilsson. "It is one of the lowest cost operations anywhere in the world and produced gold at an average cash cost of US$44 per oz in 2003/04." The low cost, he says, was partly attributable to flat operating structures, including training up locals rather than using expatriate labor, as well as the speed with which the operation was up and running. "We plowed through the permitting, imported a second-hand Australian processing plant that had been sitting for 12 years in a wharf in Adelaide and got the mine operating in the fastest time ever recorded in Brazil according to the Mines Department."

As initial mine life has matured, costs have drifted up—though not before the company built up a substantial cash position of around A$35 million (US$26 million). The next step, says Nilsson, includes actively seeking additional ventures offshore. "While we want to be quite aggressive in terms of acquisitions, our approach is quite conservative. We'll look for infrastructure," says Nilsson.

Industry insiders are now questioning the long-term viability of Australia's gold industry, pointing to the fact that its share of world exploration dollars has slipped from nearly 20% in 1999 to just over 12% in 2005, according to numbers from the Australian Gold Council. That's hardly encouraging. But it also reflects stronger overseas competition for funds and the opening up of new geographical exploration frontiers, opportunities that Australian companies themselves are actively exploiting. An extended run of overseas mining successes might in fact be the best way to go about rebuilding the mid-tier of Australia's gold industry—and even kick-start the business of beefing up exploration at home in a few years time.

Uranium: Overcoming Speculative Risks, Fighting Through Regulatory Roadblocks

Surging stock prices are fueling skepticism about the local uranium sector. But if legislative issues can be overcome, the long-term fundamentals look promising.

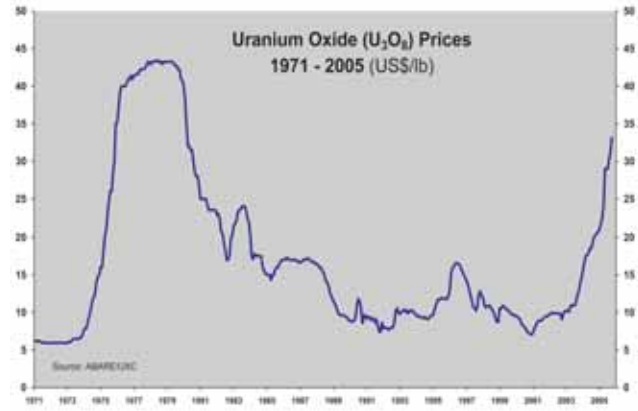
Few Australian resource sectors have been more fashionable over the past two years than the uranium industry. As fears over supply shortages from conventional energy sources have risen and world prices for uranium oxide (U_3O_8)—the main feedstock for the global nuclear power industry—have increased nearly 200% since mid-2003, many of Australia's uranium-focused companies have been transformed, and activity in the country's already vibrant IPO sector has been frenzied.

According to the Australian Uranium Organization, there are some 57 publicly listed Australian companies with interests in uranium exploration and development—and more are coming to market each month. Yet, in fact, local production of U_3O_8 remains tightly held by only three firms: BHP Billiton, Rio Tinto and Heathgate Resources. And these apart, no more than a small handful are anywhere close to production. Critics increasingly argue that excited investors are failing to distinguish more solid ventures from the highly speculative ones, making a bust almost inevitable. That would leave companies with good projects picking up the pieces of the sector's shattered reputation—something that could put development proposals in a burgeoning industry back several years.

The cracks are starting to show; even industry fund managers are beginning to question the quality of the assets underpinning current stock market valuations. Deep Yellow, a revamped junior gold explorer whose share price climbed from A$0.01 to A$0.19 less than a year after it switched focus to uranium exploration in November 2004, saw its shares suspended in November 2005 after new drilling results from its Napperby uranium tenement in the Northern Territory revealed deposits "orders of magnitudes less" than originally stated. The true nature of the deposits may turn out to be as optimistic as initially hoped. But the episode has begun to inject more cynicism into the local uranium debate.

"There are lots of poor quality deposits out there and many of the junior companies now emerging will burn themselves out," says Mark Chalmers, general manager of Heathgate Resources, which owns and operates the Beverley uranium mine in South Australia. Unlike its contemporaries, Heathgate is unique in having remained in private hands, owned by U.S. firm General Atomics. "The disadvantage, of course, is that it is comparatively difficult for us to raise money at times when stock markets are buoyant," says Chalmers. "But the advantages are that we are not subject to the same swings in financial sentiment. Moreover, we can derive a competitive advantage through being able to avoid public disclosure rules, as well as sidestep the administrative burden."

What the start-up companies are aiming for is certainly a huge prize. Australia has the world's largest reserves of uranium—



some 1,074,000 mt U, or 30% of the world's known recoverable resources. That compares to 622,000 mt in Kazakhstan and 439,000 mt in Canada. Three producing mines yielded 10,591 mt U_3O_8 (8,982 t U) in 2004, leaving Australia ranked second in terms of world production behind Canada. Aside from the 1,084 mt U_3O_8 from Heathgate's in-situ leach Beverley mine, 5,137 mt U_3O_8 came from Rio Tinto's Ranger operation in the Northern Territory, while 4,370 mt came from BHP Billiton's giant Olympic Dam mine in South Australia—which contains the world's largest uranium deposit at an estimated 500,000 mt U recoverable at costs of under US$40/kg U. Under expansion plans outlined by Olympic Dam's previous owner, WMC Resources, U_3O_8 production at the site could jump to 15,000 mt/y by 2013.

Some argue that there is in fact a good deal more to the current interest in Australia's uranium opportunities than heightened cyclical pressures—and that the nature of the boom is very different from others that have been witnessed over the past 30 years. "The boom in the 1970s was an expectation boom partly as a result of the oil shocks, but caused an over-production inventory which rolled over until 2004," says John Borshoff, managing director of Perth-based Paladin Resources and one of the industry's leading proponents. "Meanwhile there was Kyoto in 1996, which generated interest in uranium from a greenhouse gas perspective. Since 2003, for the first time it is a supply-demand issue: there are now 440 reactors burning fuel incredibly well, producing electricity and they need more uranium. The supply-demand imbalance may take 10-20 years to resolve."

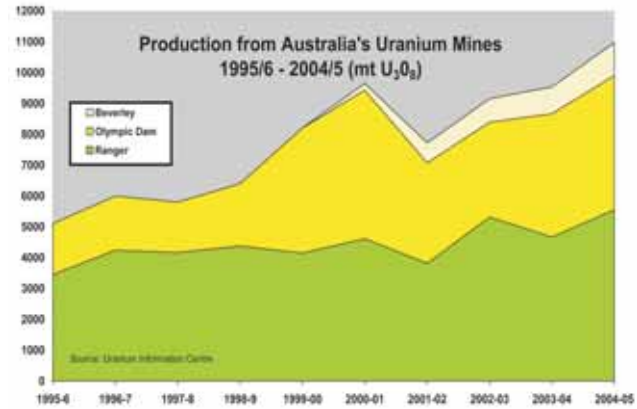
While that might underpin prices, it doesn't make the task of mining uranium much easier. Unlike nearly all of its contemporaries, Paladin plans to begin production from its important Langer Heinrich project in September 2006, with production of an estimated 1,180 mt/y U_3O_8 over 11 years. Its ability to get production on-stream quickly is a result of one factor: the mine is located not in Australia, but in Namibia.

Although the Liberal party-led Federal government adopts a pro-mining policy, the Australian Labor Party—which dominates

Australia's state governments—maintains support for the 22-year old "three mines policy" that bars the approval of further mining licenses. In August 2005, the Federal government announced that it was taking control of mining permits in the Northern Territory—which contains an estimated A$12 billion (USD$8.7 billion) of uranium deposits—effectively giving uranium explorers a green light. The legislatively more autonomous state governments in Western Australia and Queensland are now under continuous pressure to yield to the pro-mining lobby. While some polls suggest that most Australians support a continued ban, huge share price gains from popular uranium stocks and escalating alarm over rising conventional energy costs have seen public opinion become more supportive in recent years.

"There's a major shift in government policy on the cards—possibly within the next 12 months," says Alan Eggers of Perth-based Summit Resources, operator of one of Australia's most advanced prospective uranium plays 40 km from the city of Mount Isa in northwest Queensland. While a drilling program is now under way, future development of the site will be on hold until the government decides on a change in policy. "Our deposit contains an attributable resource of 76 million lb U_3O_8 [over 34,000 mt] across three deposits. The pre-capital operating costs are around US$8/lb, so at uranium prices upwards of US$30/lb we're looking at huge profit margins. These deposits will be mined."

One irony for the Queensland government is that it must consider how to promote uranium interests without threatening investment in the local coal industry—regarded as a far larger polluter.



And ultimately, it's not just junior explorers banking on the successful evolution of Australia's huge uranium reserves. After governmental talks last year regarding a nuclear safeguard agreement that would permit the export of Australian uranium to China, there is anticipation that Chinese companies—irked at having previously being forced to swallow large increases in prices for some other commodities—will soon start to take a stake in uranium exploration in Australia with a view to feeding the reported 40 new nuclear reactors it plans to construct between now and 2020 to meet its burgeoning energy demand. That might help the boom continue should local investors lose their appetite—and could even mark the beginning of a new phase of shareholder interest in the metal.

Worker and Material Shortages Threaten Project Viability

Shortages of labor and equipment are threatening massive cost blowouts on some of Australia's major projects.

In the midst of buoyant demand conditions, booming commodity prices and escalating share values, it's unsurprisingly difficult to spot pessimists inside the Australian mining industry right now. Yet despite this, profitability is becoming an ever more urgent issue for some. The unprecedented pull on Australia's mining resource base is raising the daunting prospect that the industry might bring itself down from within—through a shortage of skilled labor and equipment which are now approaching crisis levels.

"There's now an across-the-board labor shortage," says John Davidson of one of Australia's leading mining recruitment companies, John Davidson Associates. "There are things happening that we've never seen. Even surveyors and civil engineers are now working in roles traditionally filled by mining engineers. And two years ago, 60 year olds wouldn't even get a look-in. Now, no one looks at age."

The chart below illustrates how dramatic the surge in labor demand has been. Since sinking to a low of 74,000 in May 2000, employment in the mining industry (mining and mining-related services) had almost doubled to 134,000 by November 2005. That's easily the highest level on record and even more remarkable given the advances in productivity made by the industry over the past two decades.

The shortage of skilled labor is now a critical concern for both larger companies like BHP Billiton and smaller ones.

The labor shortage is not just in mining, A recent report by the Australian Department of Employment and Workplace Relations (DEWR) forecast that, on top of an already tight labor market, population aging by itself will cut the number of available workers by 195,000 by 2010. The government is trying to do things such as encourage immigration of skilled personnel, 78,000 of whom arrived in the country in 2004/05. But in the past, the average age of migrants has been only marginally lower than that of the existing population. Moreover, since some of the countries Australia has typically drawn on for migrants are facing the same problems, the battle for workers could intensify. With mining operations often located in remote and sparsely populated areas, the massive increase in demand has left the industry especially vulnerable.

Within the overall search, says Davidson, companies looking to recruit face varying degrees of difficulty. "At the top end—mine management and senior technical people—it's absolutely given that you immediately look overseas. But these aren't the jobs that are hardest to fill, because it's a matter of someone stepping up to the mark and taking a promotion." In other areas, he says, the situation looks more intractable. "You have a real shortage of metallurgists, mining and geo-technical engineers. And when you get to the top-level trades

people, the shortages can be diabolical. Special class electricians and diesel fitters, for example, are really difficult to find. As for foreman, the degree of shortage can depend on where the mine is located. If it's somewhere remote like Kalgoorlie or Mount Isa, it's a big problem."

The subsequent upward pressure on wages hasn't just been a problem for the smaller companies with less spending power. "The larger companies have to have more of a salary structure—you can't have a foreman earning more than a supervisor," says Davidson. "But they are probably missing out on quality people because elsewhere they're getting A$15,000-$20,000 (US$11,000-$15,000) more than the pay range of a major. A third-tier mining engineer with five years experience might be looking at A$110,000 (US$81,000) if they are based in suburbia and A$140,000 (US$103,000) if based in a remote location. But contract mining houses are paying them A$160,000 (US$117,000)."

Squeals from companies about the effect of these escalating costs on their bottom lines have become extremely common. Mid-cap gold producer Newcrest announced last year that development costs at its huge Telfer mine had risen 18% from A$1.2 billion to A$1.4 billion, (USD$873 million to USD$1.02 billion) partly as a result of rising labor costs at the desert-edge, fly-in-fly-out operation. In September, BHP Billiton revealed that costs at its Ravensthorpe and Yabulu nickel projects had surged A$528 million (USD$384 million) or 30% from previous estimates partly as a result of a shortage of engineering skills as well as a paucity of construction labor in Western Australia.

Worse still, in some cases, projects have even been mothballed completely. In March 2005, junior explorer View Resources announced that development of its Bronzewing gold mine in Western Australia—slated to produce some 100,000-120,000 oz/y which would make it Australia's fourth largest gold producer—had been shelved owing to what the company described as "chronic" shortages of skilled mining labor and contractor costs 30% higher than previously estimated, worth an extra A$50 million (US$37 million) over four years.

But there are more than just costs at stake in the shortage of personnel—there's a health and safety dimension, too. "The technical people are not staying technical for long enough," says Davidson. "To be a

fully-fledged mining executive, you've got to do a lot of things in your career: you do your underground time as a driller, become proficient in planning software and acquire various other technical tools that are used in the industry. But people are now very quick through that first stage. At the age of 31, someone could be in charge of safety at a medium-sized underground mine."

If the job market problem seems intractable, there is a mirror image in the shortage of mining-related equipment, especially excavation and other heavy machinery. One gauge of the shortage has been in the remarkable success of companies dealing in both new and used equipment. "We finished the Olympic games in 2000 with a turnover of around A$200 million (US$146 million) and will finish the Melbourne 2006 Commonwealth games with turnover of around A$700 million (US$511 million)," says Malcolm Jackman, CEO of Australia's largest mining, construction and industrial equipment rental hire firm Coates.

Part of that growth, explains Jackman, has come through Coates' A$128-million (US$94-million) acquisition of local mining and large earthmoving equipment supplier Allied Equipment in July 2005. "It has put us right at the heart of the mining industry," says Jackman, "which is a great place to be." Coates' product range varies from small hand drills up to 300-mt haul trucks. "About 15% of the equipment used in mine production activities is hired. Quite apart from the broader pressures on the overall demand for mining equipment, there's a good chance that the demand for hired equipment will increase over time as part of the broader industry trend towards outsourcing."

In common with many, Jackman sees little short-term scope to alleviate existing supply pressures. "There is no silver bullet to the current shortage. Everyone is scouring the world for fleet as it becomes available." But in a capital-intensive industry specializing in projects with long time horizons, how has such a shortage been allowed to arise? "The main issue revolves around the manufacturers, not the mining houses. Mining is a boom-bust activity. The Caterpillars of the world don't want to build a manufacturing facility, only to see the market turn and be left with a white elephant. We face the same issue. It's better to say 'no' to a proportion of our customers at the peak of the cycle than to be left with overcapacity."

Coates' biggest local rival in the mining industry, Perth-based heavy fleet sale and hire firm Emeco, has enjoyed similar success. "In the last four years, we've averaged 35% revenue growth per year and our turnover in 2004/05 was A$300 million (US$219 million)," says Laurie Freedman, Emeco's managing director. "We're looking to take the business global now. We might also be relatively insulated from the cycle. Our key business driver is the amount of dirt moved. If prices fall, mining houses will probably want to mine greater volumes to protect profits."

Perhaps. But at the same time, it'll be difficult to protect profits if the marginal cost of mining continues to rise. If manufacturers have been unwilling to commit to production increases for fear of being caught at the peak of a cycle, it seems difficult to imagine any significant short-term easing of supply shortages. The time lags required to bring new skills and people into the industry will be even longer. A drop in commodity demand seems the more likely way to bring the mining industry's input imbalance back into symmetry.

Australian Technology Firms Find New Markets in Niche Applications

In many areas, technological innovations by Australian companies are putting the country at the forefront of reducing costs and improving productivity in the global mining industry. Here are three of them:

Maptek's new I-SiTE product is capable of combining detailed laser imaging with real panoramic photography.

Software Success Stories

A clutch of private software houses are taking advantage of the need to improve mine planning and mine efficiency both locally and abroad. In fact, Australian companies are now said to supply 60% of the world's mining software. "Our Vulcan product really established us around the world and has a dominant position among the world's leading miners such as Rio, BHP and CVRD," says Steve Sullivan, CEO of Adelaide-based mining software developer Maptek. "Vulcan is basically a 3-D modeling and mine planning design tool which can also be used for conventional surveying. It's an integrated product with different functionalities such as for geotechnical, groundwater and seismic analysis." With 210 staff working in 11 countries around the globe, Maptek has recently launched an office in Cancún, Mexico, as part of a plan to strengthen its presence in the booming Latin American mining industry.

Aside from version 7 of the Vulcan software planned for 2006, the company is adding new products to its portfolio. "We've now developed the I-SiTE 4400 laser imaging product. It collects 4,400 three-dimensional points per second, so you end up with a 3-D world on your computer screen within a minute. We also have a panoramic camera in that device and you overlay a picture on that 3-D world, so it's very good for mining reconciliations." The product was recently used to map structural and geotechnical damage caused in New Orleans by Hurricane Katrina.

Meanwhile, software specialist Surpac Minex is now marketing Sirovision, a new 3-D modeling product developed by the Commonwealth Science and Industrial Research Organization (CSIRO), an Australian government research organization. "You take two photographs using a high resolution digital camera, then Sirovision merges them into a very accurate 3-D model

of what you've just photographed," says Tony Hampton, the company's CEO. "It enables you to stand back 600 meters from a pit wall, take photos and reproduce that wall with very high precision within just a few centimeters of accuracy. It gets an incredible level of detail."

"It has huge safety and productivity implications for the industry, because of the speed at which you can collect data," Hampton says. "Information on a 1-km mining face can be collected in a morning, rather than in days. And the amount of information you are getting is 100 times what you would get from someone surveying just the precise location of a few points on the surface. Moreover, it's applicable to every mine in the world, both open cut and underground."

Surpac also has had success selling their own products into China, now seen as the new frontier for established software developers as its mining industry seeks to upgrade its technological infrastructure and improve mine safety. "Early on, we invested in writing our mine planning and optimization software in Chinese, which is not easy for something with several thousand functions. But it has paid off."

"When we first went to China two-and-a-half-years ago to do a presentation, the first question they asked us was 'what does your software do?'. They really had no idea at all. It took us two years to get them to really accept the technology and the advantages it can offer. Now they really want it and we are flat out with inquiries." The company had 51 licenses for its software in China in 2004-2005 and expects its business to have doubled by the end of 2005-2006. "But the technical support requirements are high," says Hampton. "There is a tendency for them to want to install the software and think they are now a modern, well-run mining company, when that's clearly not the case."

Competitor Micromine has had even greater success in burgeoning markets overseas. "We have around 300 users in both Russia and China, simply because our software is so well engineered and easy to translate," says Graeme Tuder, Micromine's managing director. "China accounts for 10% to 15% of all our business now, through our exploration and mine design packages. It was hard going at first—we went for two years without a real breakthrough. But we got a break with a contract from the Ministry of Land and Resources in Beijing, who also gave us advice on how to tidy up some of the Chinese expressions in the dialogue boxes."

Tuder is upbeat about Micromine's prospects in China. "They have huge resources, but have never really explored the country properly," he says. "There may be a certain ideological awkwardness in the country about allowing foreign ownership of local assets, but there's no problem with using western software to improve their mining efforts."

Tire Management Gains Corporate Attention

Two Australian companies lead the world in this important, but still relatively unrecognized area. One is Perth-based Otraco. "One thing driving the significance of this business has been the inexorable rise in the size of mining equipment, which has had the effect that the cost of tires now consumes a far greater proportion of total haulage costs than when equipment was smaller," says Otraco's Managing Director, Basil Winterbourn.

"In the 1960s, tires on 75-mt-capacity, rigid-frame, rear dump trucks consumed perhaps 10% of haulage costs. But if you want to double capacity, it would cost you four to five times as much for the tires. Now, with the latest 400-mt trucks, tires can consume up to 40% of total operating costs, so it starts to become much more important." Moreover, in large mines, huge expenditures make savings especially valuable. "Now we are dealing with single pits that are spending US$40 million a year on tires," he says.

So what is the secret to good tire management? "It's a multi-faceted approach to tire costs, including the design of the mine, the road surfacing, actual mining techniques, training, as well as selection of the tires and maintenance," says Winterbourn.

Otraco's local rival, Klinge, has taken a further step. "We've developed our own Total Tire Control software, which we not only sell to our clients, but use ourselves," says Tom Klinge, the company's managing director. "We have over 350 of our systems out there. We know where the tire has worked, what fleet of trucks it has worked in, what sort of work it was doing. We even know how many tons it has carried and over what sort of distances. We know the wear rate and we actually depreciate the asset as it wears out. You periodically measure the tread remaining on the tire and from that you can accurately measure the consumption of the rubber against the effort and life to-date."

For the mining houses themselves, the service has yielded significant benefits. "We've had some amazing successes," says Klinge. "One company in Indonesia started off with around 2,500 hours of tire life. Now they run over 11,000 hours." Otraco's Winterbourn says his clients have also seen large gains. "We charge a premium, but for large operations, we will guarantee reductions in your tire bill which will be many times that premium. Our most successful contracts have been those where we have taken a proportion of the reduction in a company's earthmover tire bill. We've never failed to reduce costs by at least 20% and often by as much as 50%."

Both companies report that industry awareness of tire management is now being forced to improve rapidly due to the current crisis in earthmoving tire supply. "Part of the problem stems from the fact that there are effectively only three tire manufacturers globally (Bridgestone, Michelin and Goodyear)—and worse still, there are only five factories," says Winterbourn. "We're on a knife edge now. If one of those factories were to go down, the mining industry would be in serious trouble."

To some extent, suggests Winterbourn, the mining houses only have themselves to blame for being in that perilous position. "15 years ago, the mining industry started to wake up to cost issues and revise their purchasing activities as they went global. They were very successful in getting together and reducing costs from suppliers—cutting them by perhaps 20%. The tire industry is a US$70 billion a year industry, but the very large tire market used in the mining industry is just US$3 billion. The end result was that the segment went from being a small, profitable industry for the manufacturers, to being small, but less profitable. So the incentive to expand production has been removed."

And, he says, there's little immediate sign that the shortage is about to ease. "Right now, in the critical sizes, none of the three tire companies can guarantee to deliver you a tire before the end of 2007. They're all operating to full production from pre-orders."

In fact, tire management companies now worry about what mining houses might be doing to deal with the problem. "I think there's now a risk from over-use of tires," says Klinge. "At the moment there are second-hand, half-worn tires being purchased for double the going rate for a new one. That gives you an idea of the risk of being short in this area."

Nevertheless, he says, companies may be learning a valuable lesson. "It's an ill wind that doesn't blow well. The shortage will effectively force mining houses to become much more effective in using tires in the future."

Innovations in Mineral Processing Methods and Equipment

Ballarat-based Gekko Systems has enjoyed rapid growth in a short time with their adaptation of gravity separation methods used in mineral processing—so far applied primarily in the gold, diamond, tin and tantalum sectors. "After we raised A$1 million in venture capital back in 1998, the company went ballistic," says Gekko's Managing Director, Elizabeth Lewis-Gray.

Gekko's Inline Pressure Jig (IPJ) involves a variation of some very traditional processing methods. "Gravity separation—gold panning, for example—was one of the first forms of separation that ever occurred. But when chemical separation came along, everyone dropped those old techniques. In fact, there's been very lit-

tle new technology developed in the sector over the past 100 years."

"Traditionally, a shaking technology would be done through a rectangular form, pulsing water through the bed, shaking the bed up and down with the heavy particles coming to the bottom and the lighter particles being forced across. But when you pulse water in, you are increasing the water velocity. And the higher the water velocity, the less opportunity you have for the heavier particles to settle. So you capture the large coarse particles, but you don't get the heavier fine ones because they get caught up in the crossfire."

A subtle, yet important shift in the engineering, explains Lewis-Gray, made the difference. "What we did was change the rectangular bed to a circular, flat one fed from the middle. As it starts pulsing across the bed, the velocity is actually slowing because the surface area is rising. The other thing is that instead of pulsing water through the bed which adds water to the bed, it is lifting the spring up and dropping it, in what is effectively a volume of contained, encapsulated water. So while it's an old concept, it's quite a different mechanism for doing it."

"The upshot is that we are much more efficient than most other methods and can do higher volumes. Typical power consumption is 20% less than through a traditional jig. And where we really make a difference is with the finer mineral particles: anything from a millimeter down to 50 microns would get much better separation—perhaps about 30% better—than through other jigs."

Lewis-Gray feels that while the IPJ is largely for use in niche markets, other markets remain unexplored. "We do concentrate at the smaller end of the market place and on more complex orebodies. The larger companies are typically at the slower end of the buying cycle and want to see the technology established before trying it. But we have had more than 300 sales to date and 70% of those have been overseas, so it's been well market-tested. There are also exciting opportunities for us in the diamond industry, which is under pressure from higher power costs."

The company won Australia's Southern Region Entrepreneur of the Year award last September partly in recognition of their rapid success on the international stage, which could provide the platform for the next phase of Gekko's development. "We now have offices in South Africa and Canada. The next stage will include developing markets in South America and Russia."

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