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Show me the antimony, Australia

Antimony might be a mere silvery spec on the Australian resource map, but as the mineral's market metrics become increasingly inviting, the nation's post-boom mining industry is beginning to pay this niche metalloid close attention, *Laura Syrett, Assistant Editor*, discovers.

U p until last year, it seemed as though Australia's mining industry might buck the unwritten fiscal truth that any student of economics knows: booms can't last forever.

Then, sure enough, former Australian Prime Minister, Labour's Kevin Rudd, announced shortly before his ousting from government in September that the good times for the nation's resource industry were well and truly over.

"The truth is that we face new economic challenges with the end of the mining boom and that means that we have got to ensure in the future we have a new way of not having all our eggs in one basket," Rudd said during a press conference in August before going on to suffer the party's worst electoral defeat since 1934.

While the mining crash was not the only reason voters turned against Rudd, it seems likely that an angry anti-Labour campaign by Australia's powerful mining lobby weighed heavily against him.

It therefore came as no surprise when Australia's newly-elected leader, Tony Abbott, pledged on his first day in power to resurrect the mining industry's prosperity by putting an end to a perceived excess of red tape and punitive taxation policies.

Abbott's mission statement notwithstanding, the picture still looks pretty bleak for Australia's flagship mineral commodities of iron ore and coal. As a result, an increasing number of smaller miners are diversifying their portfolios to include more specialist minerals, such as antimony.

Australian antimony

Although Australia is a relatively small producer of antimony (Sb), its rich mineral reserves, sophisticated mining industry and geographical position at the southern gateway to Asia make it one to watch on the supply side.

The price projections for antimony trioxide and antimony metal have spurred the development of what have previously been considered economically unattractive deposits, and the country has seen a spate of exploration activity in the last 18 months.

However, although the prospect of renewing Australia's antimony industry may be attractive for would-be miners, a legacy of pollution and poor community relations by some mining companies have made residents in development areas wary of new projects.



In the red: the end of Australia's mining boom has led some prospectors to look at supply-risk minerals such as antimony.

Community opposition

The attempted restart of operations at the mothballed Hillgrove gold-antimony mine in New South Wales has been repeatedly scuppered by obstacles including residents' objections.

Although the mine now looks set to reopen under a new owner, Bracken Resources, earlier plans to revive Hillgrove failed partly because local councils highlighted the risk of antimony-run off into the Macleay River catchment, which includes national parks and agricultural land.

Other concerns have centred on the disruptive impact mining has had on the local community of Armidale.

Past operators of Hillgrove brought staff in on a short-term basis to work the mine in FIFO (fly in, fly out) arrangements, rather than creating jobs locally.

Having purchased Hillgrove earlier this year from Straits Resources, Bracken has sought to allay fears on both environmental and social fronts. Its CEO, Roger Jackson, has made a personal promise to operate the mine responsibly.

"We're cleaning up the site to ensure there are none of the older [environmental] legacies that caused problems in the past," said Jackson, addressing concerns about the mine's history of pollution.

"We are not looking at a fly-in, fly-out operation. This means some people will move to Armidale, while we'll locally source other positions".

Nearby, antimony mining proposals put forward by another local operator, Precious Metal Resources, in Nambucca Valley have also faced hostility.

Residents' group, "Lock the Nambucca Valley", have voiced fears that the valley's entire catchment could be at risk if antimony

Antimony prices

A steady decline in antimony output from China contributed to a formidable price increase over the past decade.

In 2002, the metal was being sold for \$2,000/tonne, but by 2011 it had risen 700%, to around \$15,000/tonne.

The last twelve months has been characterised by significant volatility and the price has dropped from its 2011 highs, but antimony metal still selling at a considerable premium compared to a decade ago, with values currently sitting at around \$10,000/tonne.

mining went ahead. "The extreme instability of the geological formations in our valleys is evidenced by the many landslips recently," group president, Rudy Van Drie said.

Under current laws, Australian landowners may "lock the gate" to stop companies from accessing their property and force them to negotiate an agreement, however there is no legal way to completely stop access.

Mining firms and residents' groups have continued to meet throughout the year to discuss environmental safeguards and land access agreements.

Developing projects

While few mining projects are entirely free of controversy, two less-encumbered operators in Australia include local operator, Artemis Resources, which is developing the greenfield Eastern Hills project in Western Australia and

TSX-listed Mandalay Resources, which is looking to develop Costerfield site in Victoria.

Artemis Resources

In September, Artemis Resources commenced a 15-hole, 3,000 metre drilling programme at its Eastern Hills antimony project, which confirmed the presence of antimony in sulphide mineralisation intersected in the project's southern conductor zones.

The project is being supported by the Western Australian government, which has pledged to provide up to Australian dollar (A\$) 140,000 (\$131,000*) towards the development of Eastern Hills, a sum which Artemis estimates will cover around half of the planned direct drilling costs.

Surface rock chip sampling by Artemis in 2013 returned assay results of up to 7.5%

antimony, and the company is targeting a maiden JORC resource by October.

Mandalay Resources

TSX-listed Mandalay Resources is one of the most advanced antimony miners in Australia, having recently completed its preliminary economic analysis of the Costerfield project in Victoria.

The company restarted capital development at the end of December 2009, and discovered the Cuffley Lode antimony deposit in 2011.

The Costerfield tenements currently total approximately 7,541 ha (75.41km²), of which 1,219 ha (12.2km²) are held as the main mining licence and the balance in two exploration licenses. The mine is fully permitted and operates year round

**Conversion made September 2013*

Artemis Resources' Eastern Hills antimony project

Geology

The Eastern Hills project is located within the Ashburton Basin, a belt of Proterozoic meta-sedimentary and meta-volcanic rocks that flank the southern and western margins of the Hamersley Basin.

Rocks of the Wyloo Group outcrop as mudstones, siltstones, and subordinate sandstones of the deep-marine Ashburton formation, and Sb-Pb mineralisation is hosted by quartz-massive sulphide veining within silicified and foliated siltstone and sandstone.

Massive sulphides in quartz vein bounded by a broader zone, up to 15 metres-wide, of disseminated sulphides. The vein represented at surface by an outcropping gossanous zone.

Preliminary metallurgy with rougher flotation using potassium amyl xanthate (PAX) and two recognised activators yielded high Sb and Pb recoveries – greater than 98%.

Access

Sealed roads run to within 20km of the project and farm tracks provide access to the remainder of the property.

The nearest commercial port is Onslow (225km away) with a larger port at Dampier (370km away).

Development schedule

The Eastern Hills project is in the early stages of exploration. Planned progress anticipates:

- Phase 1 drilling completion in October 2013
- Final assay results by the end of November 2013
- Maiden JORC resource estimate by the end of 2013
- Initial scoping study in Q1 2014

- Phase 2 drilling program and resource expansion in H1 2014
- Possible prefeasibility study in 2014

Drilling is underway with the objective of converting the current exploration target of 0.4-1.25m tonnes at 1.5-1.9% Sb into a JORC compliant resource.

Financing

A recent capital-raising by Artemis raised A\$1.5m, which will fund activities into 2014. Discussions are commencing with potential strategic partners for possible subsequent funding.

Market comment

According to Artemis Resources' geological consultant, Trevor Woolfe, miners can bank on antimony prices remaining close to current levels for the next few years, with a possible uptick in values in the more distant future if Chinese supply becomes more restricted.

"In my view, antimony prices averaging above \$10,000/tonne are achievable over the short to medium term. Forecast stable economic growth in China and improved economic conditions in Europe and the USA, should support the predicted increases in demand," he says.

"This combined with any supply limitations could see the antimony price head back towards \$12,000/tonne and above in the medium to longer term."

Woolfe also notes that antimony consumers in Europe, North America and Japan, which he believes could be potential offtakers for Artemis' antimony products, could opt for non-Chinese supplies in the interests of raw material security.

Antimony: uses and supply

Uses

Occurring naturally as the sulphide, stibnite (Sb₂S₃), antimony is a minor metal with a wide variety of industrial uses.

Around 80% of antimony mine production is converted to antimony trioxide, which is used principally in flame retardants for textiles, plastics and rubber and building materials, and in catalysts for production of polyethylene terephthalate (PET) bottles.

The principal use of antimony metal is as an ingredient in alloys where it imparts hardness, strength, anticorrosion and other properties. Antimonial lead is used chiefly for automotive and stand-by batteries. Other uses are in solders, ammunition, corrosion resistant pipes and cable sheathing.

Supply

The US Geological Survey estimates there are about 1.83m tonnes of global antimony reserves, with total production in 2012 of 180,000 tonnes, of which China produced 150,000 tonnes.

The remainder was produced by Russia, South Africa, Tajikistan, Bolivia and a handful of other countries, including Australia and Mexico.

This supply concentration, combined with the mineral's geological rareness – antimony has a crustal abundance value of just 200 ppb – prompted the British Geological Survey in 2012 to name antimony as being the mineral at the most at risk of supply disruption.

China has nearly exhausted its supply of high-grade antimony ore, and between 15-20% of all antimony supply is sourced from small, illegal, polluting Chinese mines that are gradually being identified and shut down.

Mandalay Resources' Costerfield project

Geology

Host rocks are weakly metamorphosed early Paleozoic fine-grained sedimentary rocks. These rocks are thrust and folded. The veins are principally moderately to steeply-dipping, north-trending structures typically 0.5-1 metre-wide.

The veins are offset by and locally guided by the thrust faults, suggesting mineralisation occurred during deformation.

Typically, there is an early quartz vein fill event, with a subsequent stibnite (antimony) gold event.

Access

Access to the Costerfield project is via the sealed Heathcote-Nagamie Road, which is accessed off the Northern Highway linking Bendigo (50km to the east of Costerfield) with Melbourne (100km to the south).

The Cuffley Lode is located beneath unrestricted Crown land, consisting of sparse woodland, with numerous abandoned shafts and workings.

Development schedule

Mandalay expects to mine about 4000 tonnes of development ore in 2013, which should provide information on the continuity of mineralisation and support the conversion of all the Cuffley indicated resources to probable reserves.

Resource extension and infill drilling is also continuing in order to grow mineral resources and reserves as quickly as possible toward an expanded resource and reserve estimate and mine life by the end of the year, and justification of a power upgrade and mill expansion opportunity by mid-2014.

The mine is slated to produce 2,800-3,000 tonnes saleable antimony in 2013, along with 20,000-25,000 oz saleable gold. The PEA demonstrates that this rate can be maintained to Q1 2017.

The site has proven and probable reserves of 178,150 tonnes, grading at 4.1% Sb for 7,212 tonnes Sb.

Finances

Mandalay does not need any additional fundraising to accomplish the project, since the volume and cost performance of the mine to date has rendered the project almost self-funding.

The difference has been made up from the approximately \$23.6m in cash and equivalents the company had at the end of the second quarter, 2013.

Market comment

Mandalay's President, Mark Sander thinks that Chinese buying activity, as well as its restrictions on supply, will determine future antimony prices and believes that values will remain strong.

"Given that China recently began buying antimony metal at \$9,500/tonne, we believe that this is the lower limit, and that this price is likely to be maintained for a significant period of time - in fact, it has already recovered to slightly over \$10,000/tonne," he notes.

"Antimony, at this point, is a 'GDP-mineral' with demand growing about at the rate of GDP growth. Currently, the principal use of antimony is as a fire retardant, in addition to some lesser uses in lead alloys, electronics and semiconductors. One potential large-scale new use we are watching is as a key ingredient in grid-scale, liquid antimony-magnesium electrical power storage batteries," Sander says.

Other Australian antimony projects

Company	Project name and location	Geology	Resource size	Notes
Anchor Resources Ltd	Bielsdown, New South Wales	The deposit is hosted by a sub-vertical fault breccia within a sequence of metasediments. The antimony-rich core of the structure is contained within a cemented (silicified) stibnite rich breccia.	Total inferred and indicated resource of 1.59m tonnes Sb, grading at 1.29% Sb at a 0.2% cut-off (20,500 tonnes Sb - 2010 estimate).	The Bielsdown Project, located 12km north of Dorrigo in north-eastern NSW includes the Wild Cattle Creek antimony mine which was discovered in the late 1800's and mined intermittently on a small scale until the most recent mining in the 1970's.
Bracken Resources Pty Ltd	Hillgrove, New South Wales	Mineral occurrences hosted in late Palaeozoic polydeformed, hornfelsed metasediments and Permo-Carboniferous granitoids of the New England Orogen. Mineralisation is developed in veins, vein breccias, sheeted veins, network stockworks and as alteration sulphide haloes.	N/A	Bracken entered an agreement to acquire Hillgrove from Straits Resources in 2012 for A\$27m, subject to satisfactory due diligence. The mine is scheduled to re-open early 2014, having been mothballed by Straits in 2009 owing to technical issues. Bracken intends to mine around 250,000 tonnes of ore in the initial stages.
Northwest Resources Ltd	Blue Spec, Western Australia	The deposit is characterised at surface by wide zones of deformation, increased veining and sericite-chlorite-limonite alteration. Mineralisation is associated with quartz-carbonate-pyrite veining.	Mineral resource of 646,000 tonnes at 1.2% Sb (7,900 Sb)	Originally discovered in 1906, Anglo American acquired Blue Spec in 1973 and operated the mine for 22 months between 1976 and 1978 before closing the site due to poor metal recoveries. Northwest is targeting 2013 to restart mining at Blue Spec.
Precious Metal Resources Ltd	Halls Peak, New South Wales	Halls Peak is an inferred centre for volcanic massive sulphide deposits rich in copper, lead, zinc, silver antimony and gold. The area hosts breccias floaters and small pods of quartz.	N/A	Resampling and re-assaying of approximately 4,000 metres of existing core from 39 holes drilled between 1969 and 1974 is underway. After listing on the ASX, Precious Metal plans to begin exploration with the aim of bringing them to proven resource stage.