

A little tin solder

Perhaps it is the abundance of other minerals across the island, but for some reason, certain metals fail to light the enthusiasm of Australian investors and explorers.

While commodities as wide ranging as iron ore, gold, nickel, copper, uranium, phosphate and diamonds have all had their moment in the sun in recent years, others have received barely a cursory glance. Tin is one such metal.

Despite travelling on an upward trajectory as steep as any other during the boom years of the mid-2000s, Australian explorers have largely turned a blind eye to tin. The country can offer less than 20 projects with existing JORC-compliant tin resources, a fact all the more surprising considering the rush which surrounded Australia's early tin finds and the presence in Tasmania of one of the world's largest tin deposits, the Renison mine.

Tin was first discovered in Australia in the 1870s and the country became an important worldwide producer on the back of the Mt Bischoff mine, also in Tasmania. Tin rushes followed in Tasmania, New South Wales and Western Australia but by the 1930s, tin production in Australia had slowed to little more than a trickle.

Following the war, world production and supply was dominated by the International Tin Council, a cartel acting on behalf of the large tin producers of Cornwall in Britain and Malaysia. The ITC's role was to maintain, and inflate, the tin price. It bought tin when the market was over-stocked and released it when supplies were lower but as recycling grew more sophisticated, aluminium became favoured in the food packaging industry and the new produc-

tion centres of Indonesia, China, Bolivia and particularly Brazil began flooding the market, it could no longer maintain its grip on supply.

In October 1985 the cartel collapsed, immediately sending the tin price into freefall. The 1980s saw the tin price at historic lows as unchecked supply from the new producers poured into a market already flooded by the ITC's stockpiles.

So, it is unsurprising that Australian companies have been reluctant to search for a metal which seemed to be of another age.

However, the metal has been given a new lease of life in recent years, largely thanks to applications in new technologies. No longer is tin use confined to cans and food packaging. Its major use now is in electronics. In 2000 the US EPA outlawed the use of lead solders in electronics, sending tin solder use up almost overnight. Today, 51% of tin use is in tin solder.

Although this new application placed pressure on demand, it wasn't until tin supply ran into issues that prices increased. The LME tin price reached historic lows of below \$US4,000/t in the period 2001-2002 as the ITC stockpiles continued to inflate supply. As those stockpiles dwindled in the latter part of 2003 and 2004, the price eventually gained traction. Coupled with this, supply side constraints continued due to shrinking reserves, political problems in Indonesia and China's change of stance from net importer of tin to net exporter.

Like most commodities, the future demand of tin is intrinsically linked to China. The country is both the world's largest consumer and

producer of tin but actions in the last two years have indicated the Chinese Government is moving to secure future supply.

In 2008 it imposed a 10% tax on exports of primary refined tin and in November 2009 announced it was reducing its 2010 tin export quotas for Chinese companies to 21,000t, a 9.87% drop on 2009 quotas.

This withdrawal from Chinese tin producers has coincided with production problems in the traditional tin producing nations of Malaysia, Thailand and Indonesia. While Malaysia and Thailand have been hindered by decreasing reserves, Indonesia's problems have been more politically driven.

In March, Reuters reported Indonesian tin production could fall 50% below the Government's annual production target of 105,000t, largely due to the effects of the new Indonesian Mining Act.

The new Act, passed in December 2008 has put severe pressure on small miners.

Indonesia supplies nearly 30% of the world's tin consumption, most of it from the Bangka-Belitung islands.

"Refined tin output from small smelters will decline if their areas are getting smaller because of the new mining law," said Johan Murod, director of PT Bangka-Belitung Timah Sejahtera, a consortium of seven smelters.

"Tin production from Bangka-Belitung may only reach 50,000t this year because of it," Murod said.

Over the past four years, the industry in the Bangka-Belitung islands, has been hit by weaker tin prices, a police crackdown on illegal mining, and the depletion of easily mined



There are currently 20 companies in Australia that can lay claim to JORC-compliant tin resources. Below is a list of those companies with tin projects which are currently active and their reported resources

Company	Projects
Metals X Ltd (80,649t)	Renison tin mine, Tasmania (131,673t) Rentails tin-copper tailings, Tasmania
Xtreme Resources Ltd Stonehenge Metals Ltd	Mt Bischoff mine, Tasmania (12,193t) Collingwood mine, Queensland (7,685t) Summer Hill project, Queensland (75,000t) Granville project, Tasmania (60,000t) Federation project, Tasmania (2,886t)
Stellar Resources Ltd Consolidated Tin Mines Ltd Cluff Resources Pacific NL Venture Minerals Ltd Goldminco Corporation Minemakers Ltd Outback Metals Ltd North Queensland Metals Ltd	Heemksirk project, Tasmania (50,240t) Mt Garnet project, Queensland (46,084t) Ardlethan mine, New South Wales (45,829t) Mt Lindsay project, Tasmania (29,820t) Doradilla project, NSW (22,259t) Great Pyramid tin-silver project (15,572t) Mt Wells tin-copper-tungsten project (11,771t) Baal Gammon tin-copper project, QLD (10,504t)
YTC Resources Ltd Central West Gold NL	Pound Flat tin project, NSW (8,860t) Ottery project, NSW (1,930t)

onshore reserves.

Refined tin production from the Bangka-Belitung islands fell to 88,146t in 2008, compared with 123,009t in 2005 after the government launched a crackdown on illegal mining and smelting in 2006, prompting dozens of small smelters to shut operations.

The tin industry itself is also working to clean up supply in the industry. Artisanal mining accounts for more than 50% of the world's tin production and, industry lobby group ITRI is keen to increase the traceability of such production.

In July, the international tin association, ITRI, established a comprehensive due diligence plan for tin aimed at improving the transparency of tin supply, putting further pressure on the industry.

All of which has caused a new rush of interest in tin from Australia's junior exploration community. Companies such as Venture Minerals Ltd, Consolidated Tin Mines Ltd, Kasbah Resources Ltd and Stonehenge Metals Ltd have all identified tin projects as leading assets in their portfolios and more exploration spending is expected to follow.

The deal struck between Metals X Ltd and Yunnan Tin Group over the Renison mine – Australia's largest tin resource – in Tasmania also indicates that, as with most other commodities, international parties will be willing to invest in any Australian junior that proves able to produce a viable tin project.

Over the next 10 pages, **Paydirt** takes a closer look at some of those companies and the opportunities they hold for a new era of tin mining in Australia and overseas.

– Dominic Piper

Mining

The main method of mining large placer tin deposits is by bucket-line dredging. The alluvium containing the tin is excavated and transported by a continuous chain of buckets to the interior of the dredge where it is washed and roughly concentrated. In South-East Asia particularly, smaller deposits, or those unsuitable for dredging (e.g. because the bedrock is very rough) are worked by gravel pumping. The impure cassiterite concentrate is further concentrated by gravity methods which involve passing the concentrate in a stream of water over equipment such as jigs, spirals, or shaking tables. This separates the heavy cassiterite from the lighter minerals such as quartz. Magnetic or electrostatic separation removes the heavy mineral impurities. The end product is a cassiterite concentrate containing about 70% tin.

Vein and disseminated tin deposits are mined by the same methods used in hard-rock mining of other non-ferrous ores. The concentrate is usually of a lower grade (about 50% tin) than placer concentrate because of the fine grain size of the cassiterite and the difficulty of removing all the associated sulphide minerals. Although flotation is not as efficient for tin ores as it is for sulphide ores, it is used increasingly to improve the amount of tin recovered and to recover tin from the residues of earlier treatment.

Smelting

Cassiterite is reduced to tin by heating with carbon at 1,200°C to 1,300°C. Reverberatory furnaces are used to smelt tin concentrate and, for additional tin recovery, to re-smelt slag,

which is left after the ore has been smelted. The molten tin from the bottom of the settler is cast into slabs or pigs (of about 34kg) for refining, and the cooled slag, which contains 10-25% tin, is crushed and re-smelted.

Refining

Refining may be by heat treatment or by electrolytic processes. Heat treatment is the more widely used method and involves heating the tin from smelters on an inclined hearth to a temperature just above the melting point of pure tin, but below that of the melting point of the impurities. The relatively pure molten tin flows into a kettle and impurities remain behind in a residue which is re-treated to recover more tin. As there is not a great demand for tin of extremely high-purity, the more costly electrolytic method is rarely used.

Top ten world tin producers (2009 figures)

Yunnan Tin (China)	55,898t
PT Timah (Indonesia)	45,800t
Malaysia Smelting (Malaysia)	36,407t
Minsur (Peru)	33,920t
Thaisarco (Thailand)	19,300t
Yunnan Chengfeng (China)	14,947t
EM Vinto (Bolivia)	11,805t
Liuzhou China Tin (China)	10,500t
Metallo Chimique (Belgium)	8,690t
PT Koba Tin (Indonesia)	7,455t
Gejiu Zi-Li (China)	5,600t
Gold Bell Group (China)	4,650t
OMSA (Bolivia)	3,205t
Taboca/Paranapanema (Brazil)	2,745t