EDISON

Cradle Resources

Initiation of coverage

Tantalising...

Metals & mining

In Panda Hill, Cradle has a 50% interest in a unique niobium asset in Tanzania. Not only its geology, but also the majority of its metallurgy is entirely conventional. As such, it is poised to become only the fourth mine in the world to produce a metal so unique that its price did not fall during the 2008/09 global financial crisis. Niobium is deemed 'strategic' by the US and 'critical' by the EU. Moreover, it is almost the only metal in the world in which China's consumption is below trend for its GDP per head.

Year end	Revenue (A$m)	PBT* (A$m)	EPS* (c)	DPS (c)	P/E (x)	Yield (%)
06/14	0.0	(3.3)	(3.7)	0.0	N/A	N/A
06/15	0.0	(4.0)	(3.1)	0.0	N/A	N/A
06/16e	0.0	(9.9)	(5.4)	0.0	N/A	N/A
06/17e	0.0	(1.1)	(0.4)	0.0	N/A	N/A

Note: *PBT and EPS are normalised, excluding amortisation of acquired intangibles and exceptional items.

Infrastructure excellent; FID imminent

The Panda Hill project has excellent nearby infrastructure. It is 5km from the main Dar es Salaam-Tunduma highway, 2km from the TAZARA (aka Tanzam) railway line and 8km from Songwe airport. There is major power infrastructure 26km away in Mbeya and three potential sources of water for the plant, both above and below ground. Cradle has now advanced the project to DFS stage. In the meantime, its partner, Tremont, has been conducting off-take and financing talks, with a view to making a final investment decision (FID) in Q416.

Ready appetite for risk diversification

Official supply of niobium to the world market is currently restricted to just three mines in Brazil and Canada. As such, there is ready appetite for diversification of risk among consumers. The growing recognition of niobium as a vital new-age metal with limited supply was reflected in Anglo American's recent sale of its Catalão niobium mine. The auction process was keenly competitive and resulted in Anglo selling Catalão for US$1.5bn, a 50% premium to prior market forecasts.

Valuation: A$0.70/share (post-assumed dilution)

At the project level, Edison calculates a value for the project of US$365m, based on the net present value of potential cash-flows, discounted at 10% per year (vs US$404m in the DFS – the difference probably being attributable to pricing assumptions). On this basis therefore, Cradle's 50% share of Edison's Panda Hill valuation equates to US$1.11/share (before potential dilution). Assuming dilution at Cradle's current share price in order to fund its share of joint venture capex however, this valuation declines to A$0.70/share (post-dilution), albeit still a 169% premium to the current share price. Depending on Cradle's funding mix of its equity obligations in Panda Hill, however, it has the option to gear this up to A$1.42/share, at its discretion (albeit with increased financial risk).

11 August 2016

Price	**A$0.26**
Market cap	**A$43m**
	A$1.2965/US$
Net cash (A$m) at 31 March 2016	2.9
Shares in issue	164.7m
Free float	42%
Code	CXX
Primary exchange	ASX
Secondary exchange	N/A

Share price performance

%	1m	3m	12m
Abs	(1.9)	(16.1)	4.0
Rel (local)	(7.3)	(19.5)	1.7
52-week high/low	A$0.34		A$0.16

Business description

Cradle Resources has a 50% interest in the Panda Hill niobium project in Tanzania. This interest makes Cradle one of the few niobium explorers/developers; 90% of the world's metal supply originates from one country (Brazil) and just three companies.

Next events

Decision to mine	Q416

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Edison profile page

Cradle Resources is a research client of Edison Investment Research Limited

Poised to become the world's fourth niobium mine

Company description: A unique niobium (columbium) explorer

Cradle Resources has a 50% interest in the Panda Hill niobium project in a known mining jurisdiction. Unlike other projects, its geology and metallurgy are almost entirely conventional and, as such, it is poised to become only the world's fourth producing niobium mine.

Valuation: A$0.70/share (post-assumed dilution)

At the project level, Edison calculates a value for the project of US$365m, based on the net present value of cash-flows, discounted at 10% per year. This compares with the DFS valuation of US$404m (the difference probably being attributable to pricing assumptions). On this basis therefore, Cradle's 50% share of Edison's Panda Hill valuation equates to US$1.11/share (before potential dilution). Assuming dilution at Cradle's current share price in order to fund its share of joint venture capex however, this valuation declines to A$0.70/share (post-dilution).

Sensitivities: Technical risks significantly mitigated

In quantitative terms, Cradle's sensitivity to a number of key parameters may be summarised as follows:

Exhibit 1: Cradle valuation sensitivity to external parameters (%)

	Change (%)		
Parameter	-10.0	0.0	+10.0
Niobium price	-21.4	u/c	+21.4
Operating costs	+14.3	u/c	-14.3
Forex rate (A$/US$)	-4.3	u/c	+4.3

Source: Edison Investment Research

Edison's base case scenario valuation of A$0.70/share assumes that Cradle will meet its equity funding obligations exclusively via the issue of its own equity. To the extent that it is able to fund its equity funding obligations via its own debt however, the value of its effective interest in the project may be geared as follows (albeit attended by increased financial risk):

Exhibit 2: Cradle discounted dividend NPV with varying funding structures

Percent of Panda Hill equity funded with Cradle equity	0	25	50	75	100
NPV (A$/share)	1.42	1.09	0.90	0.78	0.70
Percent change in NPV (%)	+102.9	+55.7	+28.6	+11.4	u/c
Maximum (debt) funding requirement (A$m)	76.4	56.9	37.4	17.9	0.0
Maximum Cradle leverage (%)	85.4	63.3	41.2	19.1	N/A

Source: Edison Investment Research

In qualitative terms, the principal risk to which the Panda Hill project is immediately exposed may be described as execution risk. Once in production, however, this risk will abate and other risks (eg commercial, commodity price, foreign exchange and global economic) will become relatively more significant. In the meantime, a number of circumstances mitigate the immediate technical risks. In geological terms, the ore body is almost entirely conventional, while its near-vertical orientation means that it is amenable to low-cost, bulk mining techniques. In the meantime, the grade is comparable to an underground mine. Finally, geological risk mitigation also exists in the form of the relatively close-spaced 50m × 50m drilling. Metallurgical risk is mitigated by the fact that the majority of the Panda Hill niobium mineralisation is in the form of pyrochlore and lesser columbite within fresh to moderately weathered carbonatite lithologies. As a result, the process flow sheet is also almost entirely conventional.

Cradle Resources

The Panda Hill project is located on three mining licences, which were granted to Panda Hill Mines in November 2006 and cover a total area of approximately 22.1km^2. Cradle became involved in early 2012 (in its incarnation as Verona Capital). After a corporate reorganisation, which involved transferring the mining licences from Panda Hill Mines to a company called RECB and finally Panda Hill Tanzania, Cradle became 100% owner of the project via its Panda Hill Mining Pty subsidiary in November 2015. In the meantime, in June 2014, Cradle concluded an agreement with Tremont Investments (backed by Denham Capital), whereby Tremont would fund the project to definitive feasibility study via a US$20m investment in return for a 50% interest in the project. The title to these licences (which allow the owner to search for, mine, dig, mill, process, transport, use and/or market niobium or other minerals found to occur in association with that mineral) has since been extended for a further 10 years to November 2026.

The niobium market

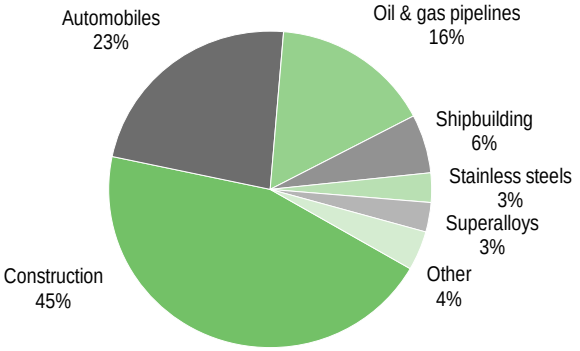
For a fuller background note on niobium, please see Niobium – The envy of the gods. The growing recognition of niobium as a vital new-age metal with limited supply was reflected in Anglo American's recent sale of Catalão. The auction process was keenly competitive and resulted in Anglo selling Catalão for US$1.5bn, approximately 50% more than prior market forecasts. Two years earlier, in 2014, Magris Resources (50% owned by Cheung Kong and 50% by the Canadian Imperial Bank of Commerce) and Temasek acquired Niobec from IAMGOLD for c US$500m. In 2011, Posco and Nippon jointly invested c US$2.0bn for a 15% interest in CBMM (Companhia Brasileira de Metalurgia e Mineração), followed by a Chinese consortium comprising CITIC, Baosteel and Shougang on similar terms.

Niobium, formerly columbium, is a transition metal in the vanadium family (Group 5, according to the new IUPAC system of classifying elements) with symbol Nb, located between vanadium (above) and tantalum (below). Niobium metal is produced by the aluminothermic reduction of high purity niobium oxide with aluminium, lime and fluorspar. Ferro-niobium is produced from pyrochlore/columbite concentrates to which hematite (iron oxide) and aluminium are added to produce a 66% ferro-niobium matte.

Niobium's first use was as filaments in incandescent lamps, although it was quickly rendered obsolete by tungsten, which has a higher melting point. In the 1920s, however, it was discovered that niobium improves the strength of steel, and this application remains its predominant use, with c 89% of the market for niobium accounted for by ferro-niobium.

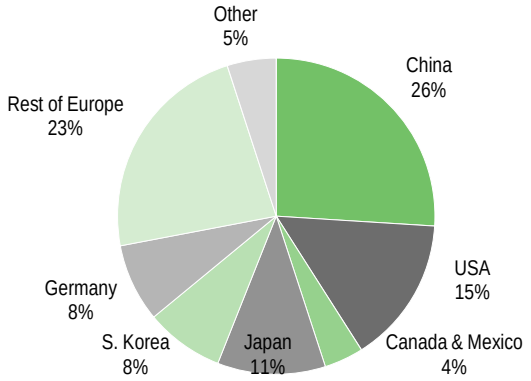
As with most other metals, the major industrial nations represent the largest market for ferro-niobium (and therefore, by extension, niobium), with the exception China, which is the world's largest consumer.

Exhibit 3: Niobium use, by application (%)



Source: pallisadeglobal.com, palisade-research.com, NioCorp

Exhibit 4: Global ferro-niobium consumption, by country



Source: Cradle Resources, Roskill, Edison Investment Research

Supply and demand

Supply: over 93% of official, global niobium resources occur in Brazil, with the balance being in Canada. Numerous other carbonatite-hosted niobium deposits are known across the world, the most significant being the Tomtor deposit in Siberia and the Morro dos Seis Lagos deposit in Brazil. Other countries with unquantified niobium resources include Egypt, Malawi and Greenland.

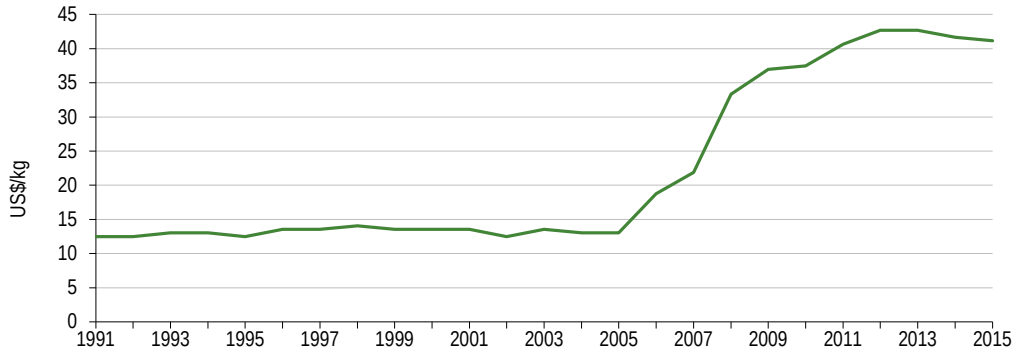
As with its resources, niobium production is concentrated in Brazil, which accounts for 92% of the world's supply, the majority of which (c 85%) is controlled by one private company, CBMM. The balance of the world's supply is almost exclusively produced in Canada (8%). As a result, Brazil is also the world's leading producer of ferro-niobium. From 1995 until 2011, the USGS estimates that global output of ferro-niobium increased at an average compound growth rate of 8.2% per year, before stabilising in 2012.

Demand: since 2001, global apparent ferro-niobium demand has increased at a compound average growth rate of 6.9% per year, notwithstanding a material contraction at the time of the global financial crisis in 2009. While, currently, about 10% of the steel produced globally contains niobium, that share is expected to rise to as much as 20% in future.

Pricing

Niobium materials are not openly traded on any metal exchange. Key characteristics of the niobium market therefore are the important role played by bilateral, long-term contracts between buyers and sellers, which now cover about 95% of total sales. Under these, FeNb is sold directly to steelmakers, which has led to a highly stable pricing environment.

Exhibit 5: Ferro-niobium price, 1991-2015 (US$/kg)



Source: Cradle Resources, Global Trade Atlas

Our (conservative) view is that niobium prices (and particularly ferro-niobium prices), are expected to remain at approximately the same level as in late 2008 and early 2009 (c US$35.16/kg) and will display little volatility in coming years, primarily due to CBMM's dominance over supply (cf an average import price in excess of US$41/kg in the years 2010-15).

History of the Panda Hill niobium project

The Panda Hill carbonatite intrusion has been the subject of multiple phases of exploration work over the past 65 years, initially for phosphates, but latterly (and in the majority) for niobium:

- Between 1953 and 1965, the Geological Survey of Tanzania undertook mapping and trenching and drilled 17 diamond holes over 1,405m (average 83m per hole).
- Between 1954 and 1963, a joint venture between Billiton Maatschappij and the CDC drilled 66 diamond holes over 3,708m (average 56m per hole), sunk two shafts, undertook trial mining and constructed a gravity and flotation plant. Positive early metallurgical test work results were noted, but no actual results appear to have been reported.
- Between 1978 and 1982, a Yugoslavian state enterprise conducted a joint study predominantly on the phosphate endowment of the carbonatite in collaboration with the Tanzanian Mining Industrial Association and the State Mining Corporation. Included in the study were mapping, pitting and an additional 13 diamond drill holes over 1,306m (average 100m per hole).

Until 1982, a total of 96 diamond drill holes were completed over 6,419m (average 67m per hole). Cradle began work on the project in 2013, drilling a further 137 holes (both diamond and reverse circulation) over 20,724m (average 151m per hole), as well as undertaking an extensive geological mapping campaign and regional magnetic and radiometric surveys. The majority of the drilling was conducted on a 50m x 50m grid, although some spacing was broadened to 100m x 100m.

An initial scoping study was undertaken at Panda Hill in 2013. In addition to Class 5 capex and opex estimates, this included metallurgical test-work, pit optimisations, mining schedules and plant and infrastructure designs. The scoping study was followed a year later by a pre-feasibility study (PFS). This envisaged a 2Mtpa open pit operation to produce an average 6,800tpa ferro-niobium (FeNb) over a 30-year life for an initial capital expenditure of US$158m. In addition to a process plant including a pyrometallurgical converter, the PFS also included an on-site, heavy fuel oil (HFO) power plant.

In June 2014, Cradle concluded an agreement with Tremont Investments (backed by Denham Capital), whereby Tremont would fund the project to definitive feasibility study via a US$20m investment in return for a 50% interest in the project. Initially, a review of the PFS was carried out to consider the consequences of the discovery of the high grade Angel zone and to take into account the effect of production from Panda Hill on the global market. As a result of this review, the decision

was made to proceed with a detailed feasibility study at an ore feed rate reduced from 2.0Mtpa to 1.3Mtpa in the first four years of the project, but then doubling to 2.6Mtpa in year five with a coincidental conversion from HFO power to grid power.

Panda Hill DFS April 2016

On 20 April 2016, Cradle announced the results of the Cradle DFS on the Panda Hill niobium project. Compiled by MDM in collaboration with Coffey, SRK, SGS, SLR and Roskill (among others), the DFS envisaged a 1.3Mtpa open pit operation, expanding by 100% in year five, mining an average 0.68% Nb_2O_5 grade in years 1-10 (and 0.54% over the 30-year life of mine) to produce an average 8,200t of ferro-niobium per year at an average stripping ratio of 1.5:1 and metallurgical recovery of 61%. Initial capex was estimated to be US$196m, with a further US$93m (to be funded from project cash flows) in year four. Average life-of-mine EBITDA is estimated to be US$112m pa (US$0.83/share undiluted at that time) and the payback period to be 4.75 years. Ultimately, the DFS calculated a pre-tax project IRR of 32% and a post-tax NPV_{10} of US$404m (equating to US$1.50/share, undiluted, at that time, for Cradle's 50% share of the project) at an initial product price of US$37.65/kg Nb and average unit operating costs of US$48.04/t ore processed or US$21.34/kg Nb produced.

Geography

The Panda Hill niobium project is located near the town of Songwe in the southwestern corner of Tanzania, approximately 70km (47 miles) from the Zambian border at Tunduma. It is 5km from the main Dar es Salaam-Tunduma road (the A104), 2km from the TAZARA (aka Tanzam) railway line and 8km from Songwe airport (usually referred to in flight schedules as Mbeya), which is serviced twice daily from Dar es Salaam by Fastjet. Mbeya itself is 26km away and is the site of major power infrastructure. The TAZARA rail line is designed with a 1,067 mm gauge that permits through-traffic operations with the contiguous railway of Southern Africa and has a design capacity of 5Mtpa.

Primary access to the mine will nevertheless be via an 8km laterite road connecting with the southern side of the A104.

Geology

The Panda Hill carbonatite is a mid-Cretaceous volcanic intrusion into gneisses and amphibolites of a northeast-southwest trending mobile belt. It forms a steeply dipping, near-vertical plug of approximately 1.5km (about one mile) in diameter and is partly covered by a fenitised cap, which is, in its turn, overlain by residual and transported soils. Volcanic ash over part of the complex suggests a later stage of volcanic activity.

Evidence suggests three stages of carbonatite activity, with an early-stage (Sovite) calcite carbonatite forming the core, surrounded by late-stage carbonatites composed of more magnesium- and iron-rich carbonatites. Later-stage apatite-magnetite rich rocks and ferro-carbonatite dykes are also found in the complex.

Mineralisation

The majority of the Panda Hill niobium mineralisation is in the form of pyrochlore and lesser columbite and is found within primary (ie, fresh to moderately weathered) carbonatite lithologies. Higher-grade material up to 3% Nb_2O_5 is related to magnetite rich bands and flow-banding (schlieren) within the carbonatite. However, the weathered carbonatite lithologies can also contain up to 3% Nb_2O_5 as well.

Reserves and resources

Cradle's updated mineral resource at Panda Hill is based predominantly on new drilling undertaken in 2013 and 2014 and is estimated using multiple indicator Kriging on 2m composites with a 25m x 25m x 5m panel to generate a recoverable estimate simulating a selective mining unit (SMU) including mining dilution of 6.25m x 12.5m x 5m. Dated as at April 2015, the mineral resource is summarised in the table below by weathering type (at a cut-off grade of 0.3% Nb_2O_5).

Exhibit 6: Panda Hill resource statement (April 2015)

	Tonnes (Mt)	Grade (% Nb_2O_5)	Nb_2O_5 content (kt)	Percent (%)
Primary carbonatite				
Measured	14	0.62	84	10.1
Indicated	50	0.49	247	29.9
Measured & Indicated	64	0.52	331	40.0
Inferred	103	0.48	496	60.0
Total	167	0.50	827	100.0
Weathered carbonatite				
Measured	2	0.67	15	24.6
Indicated	3	0.53	15	23.8
Measured & Indicated	5	0.61	30	48.5
Inferred	6	0.52	32	51.5
Total	11	0.57	63	100.0
Total				
Measured	16	0.63	99	11.1
Indicated	53	0.50	263	29.5
Measured & Indicated	69	0.52	362	40.7
Inferred	109	0.48	528	59.2
Grand total	178	0.50	891	100.0

Source: Cradle Resources. Note: 0.3% Nb_2O_5 cut-off grade.

Assaying for Nb_2O_5 was by Borate fusion XRF carried out by SGS in Johannesburg.

To date, only approximately 40% of the area of the carbonatite has been properly drill tested with the result that the operators have an ongoing exploration target of 200-400Mt of mineralised material at Panda Hill at a grade of 0.4-0.6% Nb_2O_5.

In the meantime, a reserve of 20.6Mt at 0.68% Nb_2O_5 has been delineated, which is sufficient to support operations for the first 10 years of the mine's operational life:

Exhibit 7: Panda Hill reserves (June 2016)

Reserves	Tonnes (Mt)	Grade (% Nb_2O_5)	Nb_2O_5 content (kt)	Percent (%)
Oxide				
Proved	0.84	0.77	6	4.6
Probable	0.83	0.68	6	4.0
Proven & Probable	1.67	0.73	12	8.7
Transition				
Proved	3.46	0.77	27	19.1
Probable	3.84	0.68	26	18.7
Proven & Probable	7.3	0.72	53	37.7
Fresh				
Proved	3.02	0.66	20	14.3
Probable	8.57	0.63	54	38.6
Proven & Probable	11.59	0.64	74	52.9
Total				
Proved	7.32	0.73	53	37.9
Probable	13.25	0.65	86	61.3
Proven & Probable	20.57	0.69	140	100.0

Source: Cradle Resources, Coffey Mining (Perth), Edison Investment Research

Ore reserves were estimated only on the measured and indicated portion of the resources. The average cut-off applied was 0.46% Nb_2O_5, although the actual cut-off grade varied from year to year. The ore reserve was achieved by creating a MineSight model from the Multiple Indicator Kriging (MIK) resource model and was driven by the Whittle Optimisation work and the detailed mine design and scheduling. The mining schedule includes a 5% mining loss, with the mine dilution incorporated through the MIK model.

Mining and processing

Mining

The mining study relating to Panda Hill was conducted by SRK based on conventional open cut mining based on drill, blast, load and haul using a typical medium fleet arrangement of two 120 tonne excavators and 6-18 ninety tonne haul trucks (eg CAT 777). The pit design incorporates six pushbacks – the first three occurring in the first 10 years of operations and the second three occurring in the subsequent 20 years. For the first 10 years of operations, run-of-mine material will be sourced exclusively from the measured and indicated categories of resources, with inferred resources and low-grade material being stockpiled together for potential subsequent processing. In addition, sub-optimal metallurgical material will be stockpiled along with waste material, albeit in a dedicated area, so as to be separately accessible if required. The effect of this strategy is to ensure the earlier mining and processing of higher-grade material, although it does so at the cost of a higher initial stripping ratio. After the first 10 years of operations, inferred material is also assumed to be directed towards the processing plant.

Processing

Initial crushing is effected by a primary crusher and two-stage SAG-ball mill combination. The milled product is then de-slimed and subjected to magnetic separation to remove magnetite before entering the staged flotation circuits. These comprise a pyrite float, a calcite float (with cleaning and de-watering) and then the niobium float to produce a c 40-45% concentrate. Impurities are removed by a two-stage leach process that removes phosphates and sulphur. The final leach residue is then dried and fed to a DC furnace for standard grade ferro-niobium production using aluminium as a reductant.

Significantly, the flotation process is similar to Niobec in Canada, which has a similar geology and mineralogy to Panda Hill primary material, while the leach process is based on Catalão and the converter process on some of the principles from the final stage of the CBMM pyrometallurgical circuit.

Infrastructure

The project has excellent infrastructure. Apart from the TAZARA rail line, the Tunduma Highway and the airport, there is also a dry port and a major fuel depot, both located at Mbeya.

Electricity

Currently, two power lines run from Mbeya to Songwe. One provides power to the town of Songwe; the other is a dedicated power line to Lafarge's cement factory (6km away). Initially, the plant was designed to operate on power supplied by heavy fuel oil (HFO) generators (which will be leased). However, TANESCO is planning to build a new 400kV power line that will run past the licence area. As a result, management expects to connect to the national grid in the fifth year of operations, with the result that energy costs should decline from 18.8c (US) per kWh (based on current fuel prices) to 8.5c once the connection to the grid occurs. A capital amount of US$15m has been included in the capex schedules under Infrastructure (see below) to account for this contingency in the form of a sub-station and dedicated plant line.

Water

Water demand for the project is anticipated to average 0.8Mm^3 in the first four years of operations, rising to 1.3Mm^3 from year 5 onwards, with the plant expansion to 2.6Mtpa. The project has three potential sources of water: water harvesting & storage, the Songwe River and boreholes. Surface water studies have indicated that the initial stage of operation will be self-sufficient in water if enough storage is provided to collect water during the wet season to feed into the process during the dry season. Once the expansion occurs, the balance is most likely to be supplied by the Songwe River (for which Cradle has a modest extraction permit). Any additional requirement will be supplied by a potentially large aquifer to the southeast of the tailings storage facility.

Logistics

Notwithstanding the proximity of the TAZARA rail line, Cradle's preferred logistics route is via road from Johannesburg and Botswana (for equipment and steel for construction) and via road to Dar es Salaam (for imported consumables and finished product). Panda Hill's average output of 8,200t of FeNb per year equates to c 683t per month or c 23t per day, which will be transported in shipping containers on 20t trucks. By contrast, the volume of incoming and imported consumables will be much larger. Nevertheless, Cradle estimates this should be able to be accommodated by no more than 20-25 twenty tonne trucks running on a continuous basis per month, adding no more than 1-2% to the total number of trucks already using the road.

Security of the finished product is not perceived to be a significant risk given the absence of a ready local market for ferro-niobium.

Assumptions

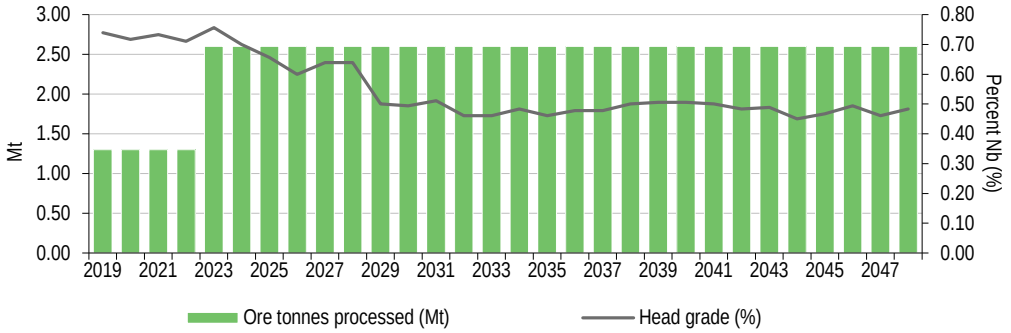
Pricing

As per our separate niobium report (also summarised on pages 3-4 of this note), the long-term ferro-niobium price is assumed to be US$35.15/kg (cf Roskill's estimate of US$40-45/kg, depending on region).

Operational

Operational assumptions are based on the definitive feasibility study. Ore delivered to the mill for processing is assumed to start at a rate of 1.3Mtpa in CY18/FY19, rising to 2.6Mtpa in CY22/FY23. The head grade varies, but generally declines and averages 0.54% Nb over the 30-year life of the mine:

Exhibit 8: Panda Hill forecast plant processing rate (Mtpa) and head grade (%), FY19-FY48



Source: Cradle Resources, Edison Investment Research. Note: FY19 corresponds to June CY18-June CY19.

Metallurgical recovery is forecast to be 61%.

Capex

Capital costs estimates were prepared by MDM Engineering with input from SLR Consulting (for the tailings and water facilities) and SRK Consulting for mining. The plant is to start up on power supplied by heavy fuel oil (HFO) generators, which will be leased, with a capital amount included in the year-four expansion estimate of US$15m (included within Infrastructure) for connection to the national grid. The estimates were finalised in Q116 to an accuracy of -10% to +15%, as follows:

Exhibit 9: Panda Hill capital cost estimates (excluding working capital)

		Phase 1 (years 1 to 4)		Phase II expansion		Total	
Stage	Item	US$m	Capital intensity (US$/t*)	US$m	Capital intensity (US$/t*)	US$m	Capital intensity (US$/t*)
Pre-production	First fills	2.7	2.08		0.00	2.7	1.04
	Spares	1.9	1.46		0.00	1.9	0.73
	Owner's costs	4.7	3.62		0.00	4.7	1.81
	Pre-production	15	11.54		0.00	15.0	5.77
	Prison relocation	6.2	4.77		0.00	6.2	2.38
	Total pre-production	30.5	23.46		0.00	30.5	11.73
Production	Mining	3.1	2.38	0.0	0.00	3.1	1.19
	Plant	75.4	58.00	59.9	46.08	135.3	52.04
	Infrastructure	7.8	6.00	15.3	11.77	23.1	8.88
	Tailings and water	42.5	32.69	0.0	0.00	42.5	16.35
	Indirect costs	4.2	3.23	0.0	0.00	4.2	1.62
	Management costs	14.3	11.00	8.8	6.77	23.1	8.88
	Subtotal	147.3	113.31	84.0	64.62	231.3	88.96
	Project contingency	17.8	13.69	8.9	6.85	26.7	10.27
	Project escalation	0	0.00	0.0	0.00	0.0	0.00
	Subtotal	17.8	13.69	8.9	6.85	26.7	10.27
	Total production	165.1	127.00	92.9	71.46	258.0	99.23
Grand total		195.6	150.46	92.9	71.46	288.5	110.96

Source: Cradle Resources, MDM Engineering, SLR Consulting, SRK Consulting, Edison. Note: *US$/t annual throughput.

Initial capital expenditure was assumed to be phased over three years in the proportion one third, one half, one sixth. Expansion capital expenditure is all assumed to be expended in year four. Sustaining capital expenditure is estimated to be US$4.1m per year; the majority relates to tailings dam lifts.

In addition to the above, US$60m of closure costs related to the plant, tailings storage facility, waste rock dump and stockpiles has also been assumed.

Opex

Operating cost estimates were similarly prepared by MDM Engineering with input from SLR Consulting (for the tailings and water facilities) and SRK Consulting for mining. They were also finalised in Q116 to an accuracy of -10% to +15% (although without the inclusion of any contingency):

Exhibit 10: Panda Hill operating cost estimates

		Phase 1 (years 1-4, 1.3Mtpa)		Phase 2 (years 5-30, 2.6Mtpa)		Life of mine (years 1-30)	
		US$m pa	US$/t*	US$m pa	US$/t*	US$m pa	US$/t*
Production	Mining	21.5	17.18	28.2	10.84	27.3	11.29
	Processing & maintenance	44.8	35.76	66.0	25.40	63.2	26.15
	General & administrative	9.1	7.23	9.1	3.50	9.1	3.76
	Total mine site cash costs	75.4	60.16	103.3	39.74	99.5	41.20
	Product transport	1.3	1.05	2.2	0.86	2.1	0.86
	Marketing & Insurance	4.1	3.28	7.3	2.82	6.9	2.87
	Royalty	4.5	3.58	8.0	3.06	7.5	3.11
	Total cash cost	85.3	68.08	120.8	46.48	116.1	48.04

Source: Cradle Resources, MDM Engineering, SLR Consulting, SRK Consulting, Edison Investment Research. Note: *US$/t annual throughput.

Financial

Initially (ie for Phase 1), the Panda Hill project is assumed to be funded 50:50 debt:equity, implying total equity funding of US$102.2m (including funding working capital), split equally between its two partners, Cradle and Tremont. Phase 2 is then presumed to be funded internally via project cash-flows.

Our base-case scenario assumes that Cradle will meet its equity funding obligations exclusively via the issue of its own equity to the same extent. Inasmuch as it is able to fund its obligations via its own debt, however, it may be able to increase its effective financial gearing to the project (this is considered in the Sensitivities section, below).

Miscellaneous

Additional assumptions include a 30% Tanzanian mining tax rate and a 3% government royalty and a 0.3% local government levy on gross revenues. Capital is depreciated over five years (in line with Tanzanian legislation) and peak working capital is assumed to be US$8.7m (which equates to approximately 24 days of initial turnover).

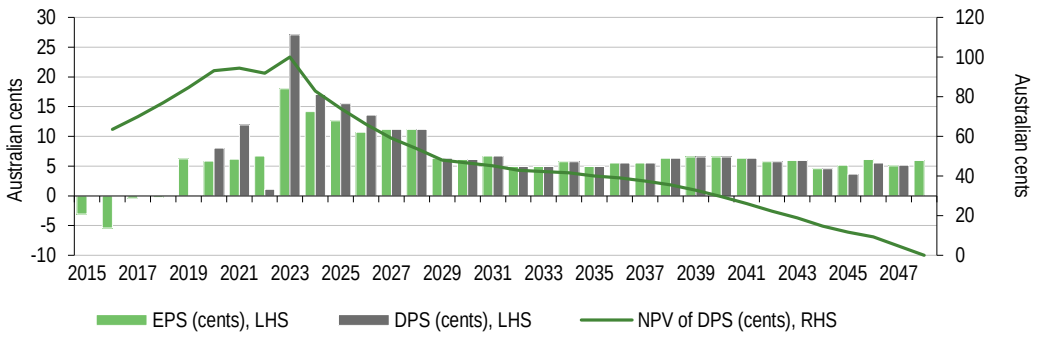
Valuation

Cradle accounts for its 50% interest in the joint venture using the equity method of accounting. As such, Panda Hill will be reflected in just a single line in Cradle's accounts in the income statement and balance sheet with three further lines in the cash flow statement (predominantly related to funding).

In the meantime, we calculate a value for the project of US$365m based on the net present value of cash-flows, discounted at 10% per year. This compares with the DFS valuation of US$404m – the difference in the valuations probably being attributable to different pricing assumptions (the DFS using pricing assumptions being provided by Roskill, which were not disclosed for reasons of commercial sensitivity). Note that at a flat, real niobium price of US$36.58/kg, Edison's financial model dovetails with the DFS financial model such that both yield a project NPV_{10} of US$404m. This price compares with a known starting price (derived from Roskill) of US$37.56/kg used in the DFS – possibly implying that Roskill calculated a declining flat, real niobium price over time.

On this basis, therefore, Cradle's 50% share of Edison's Panda Hill valuation equates to US$1.11/share (before potential dilution) vs US$1.50 based on the DFS valuation at the time of Cradle's DFS results' announcement on 20 April. However, assuming dilution at Cradle's current share price to fund its share of joint venture capex (ie via the issue of 254.7m shares at A$0.26 to raise A$66.2m, US$51.1m, or 1.5x the company's existing market capitalisation), this valuation declines to A$0.70/sh (post-assumed dilution), as shown below:

Exhibit 11: Cradle Resources EPS and maximum potential DPS (Australian cents), FY15-FY38



Source: Edison Investment Research

Note that in the maximum case (when the highest grade ores are mined) EPS and maximum potential DPS projections approximate the current share price.

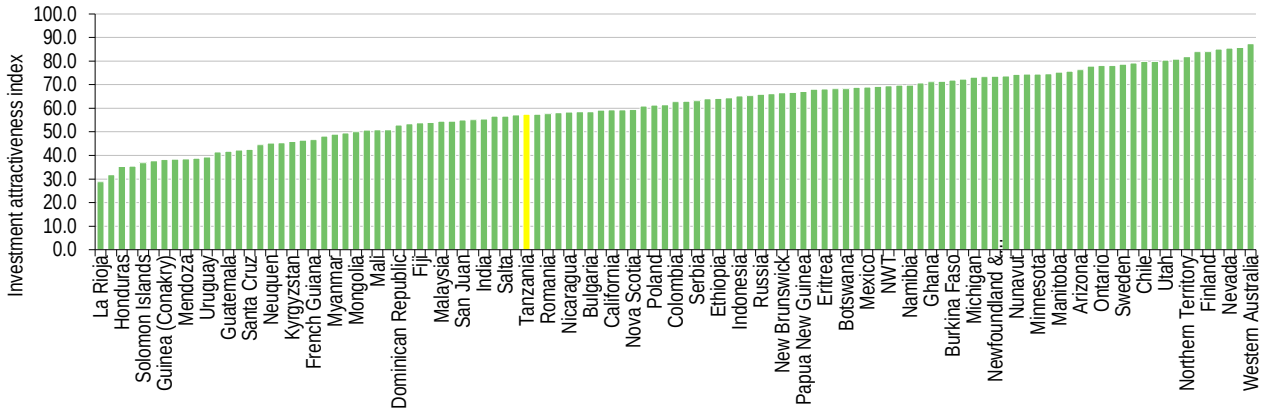
Sensitivities

In qualitative terms, the Panda Hill project is immediately exposed to geographical/sovereign, geological, metallurgical, engineering, financing and management risks. In general terms, these may be summarised as execution risk – ie management's ability to bring the project to account within its geographical jurisdiction and the required technical parameters. Once in production however, these risks will be perceived to have reduced and others, such as commercial, commodity price, foreign exchange and global economic risks will become relatively more significant. In the meantime, however, a number of circumstances mitigate the initial risks identified.

- In geological terms, the ore body is almost entirely conventional, as it is composed of a carbonatite plug. The near-vertical orientation of the deposit means it is amenable to low cost, bulk mining techniques. Note that this also mitigates engineering risk to some extent. In addition, the grade of the deposit is comparable to an underground mine (eg Niobec in Canada). Finally, geological risk mitigation also exists in the form of the relatively close-spaced drilling, which is as close as 50m x 50m in some areas.
- Metallurgical risk is mitigated by the fact that the majority of the Panda Hill niobium mineralisation is in the form of pyrochlore and lesser columbite and is found within primary (fresh to moderately weathered) carbonatite lithologies. Detailed metallurgical testwork, undertaken within the scoping study, PFS and DFS demonstrated that a high grade concentrate can be cleaned and upgraded through a leach circuit to produce a material suitable for conversion to FeNb in a conventional single stage converter. A subsequent pilot plant campaign confirmed niobium recoveries consistent with the previous bench-scale results. Recoveries averaged 61%. Importantly, the flotation circuit was shown to be stable and repeatable and to yield predictable and consistent recoveries. Subsequent benchscale tests (by ANSTO) have also confirmed that the resulting concentrate will produce high grade (eg 69% Nb) ferro-niobium buttons – in line with the specifications required by the global steel industry. As a result, the process flow-sheet is once again entirely conventional in its constituent parts. The flotation process, for example, is similar to Niobec in Canada, which has a similar geology and mineralogy to Panda Hill primary material, while the leach process is based upon Catalão and the converter process on some of the principles from the final stage of the CBMM pyrometallurgical circuit.

- In terms of sovereign/geographical risk, Tanzania ranks 69 out of 109 in the Fraser Institute's 2015 survey and ranking of investment attractiveness – similar to jurisdictions such as Zambia, South Africa, Victoria (Australia) and California (USA). While not without its challenges, Tanzania hosts a recognisable mining industry, including Acacia Mining's (formerly African Barrick Gold's) three operational gold mines, the Williamson-Mwadui diamond mine and TanzaniteOne's tanzanite mine. All told, it employs approximately one million people and contributes 2-3% of Tanzania's GDP. It is the fourth largest gold producer in Africa (after South Africa, Mali and Ghana).

Exhibit 12: Fraser Institute 2015 survey of Investment Attractiveness (Tanzania highlighted)



Source: Fraser Institute

From a quantitative perspective, variations in Cradle's discounted dividend net present valuation with metals prices, costs, the discount rate and foreign exchange rates, respectively, are shown in the tables below.

Exhibit 13: Cradle discounted dividend NPV sensitivity to metals prices (A$/share)

Metals prices change	-10%	Base case	+10%
NPV (A$/share)	0.55	0.70	0.85
Percent change in NPV (%)	-21.4	u/c	+21.4

Source: Edison Investment Research

Exhibit 14: Cradle discounted dividend NPV sensitivity to unit costs (A$/share)

Unit costs change	+10%	Base case	-10%
NPV (A$/share)	0.60	0.70	0.80
Percent change in NPV (%)	-14.3	u/c	+14.3

Source: Edison Investment Research

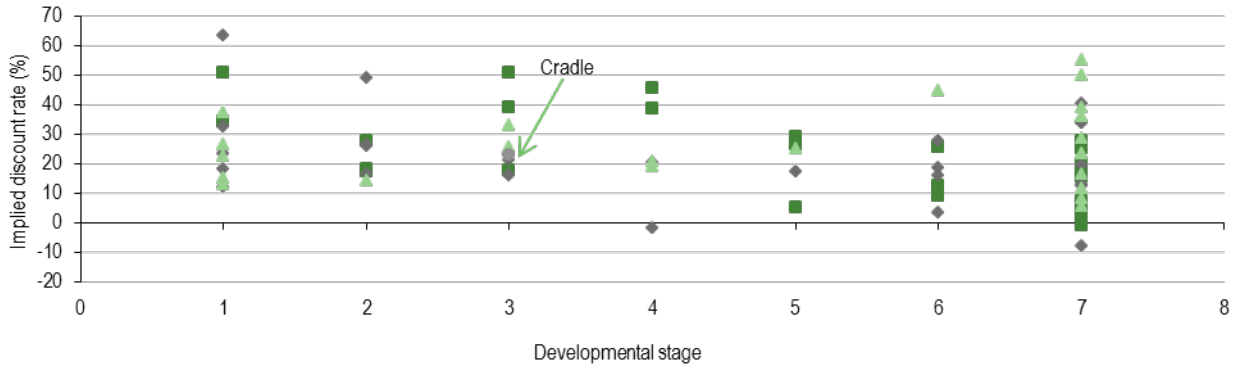
Exhibit 15: Cradle discounted dividend NPV at varying discount rates (A$/share)

Discount rate (%)	0%	10%	20%	23.0%	30%
NPV (A$/share)	2.24	0.70	0.32	0.26	0.17

Source: Edison Investment Research

The 23.0% discount rate implied by the current share price compares to the universe of mining companies followed by Edison over time, analysed by stage of development, as follows:

Exhibit 16: Implied Cradle discount rate (cost of equity) within universe of Edison coverage over time (%)



Source: Edison Investment Research

Note that for the purposes of this analysis, 1 denotes companies at scoping study stage, 2 denotes companies at PFS stage, 3 denotes companies at BFS stage, 4 denotes companies that are financed, 5 denotes companies that are in development, 6 denotes companies which are in production via a subsidiary asset and 7 denotes companies that are in production via their main asset.

With respect to foreign exchange rates, the relationship between the Australian and US dollar is one of conversion between (effectively) US dollar-denominated earnings and an Australian dollar-denominated share price.

Exhibit 17: Cradle discounted dividend NPV at varying A$/US$ rates (A$/share)

A$/US$ rate	1.1669	1.2965	1.4262
Change (%)	-10.0	0.0	+10.0
NPV (A$/share)	0.67	0.70	0.73
Percent change in NPV (%)	-4.3	u/c	+4.3

Source: Edison Investment Research

Finally, as noted above, Edison's base-case scenario assumes that Cradle will meet its equity funding obligations exclusively via the issue of its own equity to the same extent. To the extent that it is able to fund its equity funding obligations via its own debt however, the value of its effective interest in the project may be geared as follows (albeit attended by increased financial risk):

Exhibit 18: Cradle discounted dividend NPV with varying funding structures

Percent of Panda Hill equity funded with Cradle equity	0	25	50	75	100
NPV (A$/share)	1.42	1.09	0.90	0.78	0.70
Percent change in NPV (%)	+102.9	+55.7	+28.6	+11.4	u/c
Maximum (debt) funding requirement (A$m)	76.4	56.9	37.4	17.9	0.0
Maximum Cradle leverage (%)	85.4	63.3	41.2	19.1	N/A

Source: Edison Investment Research

The same analysis, performed with a sensitivity related to the share price at which new funds are raised is then as follows:

Exhibit 19: Cradle valuation sensitivity with respect to funding structure and price (A$)

Percent of Panda Hill equity funded with Cradle equity	0	25	50	75	100
Equity price at which funds raised (A$)					
0.50	1.42	1.26	1.14	1.06	0.99
0.40	1.42	1.21	1.07	0.97	0.89
0.30	1.42	1.13	0.96	0.85	0.76
0.26	1.42	1.09	0.90	0.78	0.70
0.20	1.42	1.01	0.8	0.68	0.59

Source: Edison Investment Research

Financials

Cradle had A$2.865m in cash as at 31 March 2016. Since then it has raised an additional A$2.76m (before expenses), which should provide ample funds to advance it to a final investment decision in H117 (the second half of CY16), subject to the conclusion of offtake agreements and financing arrangements. In the meantime, Cradle intends to undertake a number of critical tasks for relatively minor costs, which could then reduce the execution schedule to c 18 months (vs 21 months) to around March 2018.

Exhibit 20: Financial summary

A$'000s	2014	2015	2016e	2017e
Year-end 30 June	IFRS	IFRS	IFRS	IFRS
PROFIT & LOSS				
Revenue	0	0	0	0
Cost of Sales	0	0	0	0
Gross Profit	0	0	0	0
EBITDA	(3,296)	(3,975)	(9,937)	(1,149)
Operating Profit (before amort. and except.)	(3,296)	(3,975)	(9,937)	(1,149)
Intangible Amortisation	0	0	0	0
Exceptionals	0	0	0	0
Other	0	0	0	0
Operating Profit	(3,296)	(3,975)	(9,937)	(1,149)
Net Interest	13	11	12	34
Profit Before Tax (norm)	(3,283)	(3,964)	(9,926)	(1,115)
Profit Before Tax (FRS 3)	(3,283)	(3,964)	(9,926)	(1,115)
Tax	0	0	0	0
Profit After Tax (norm)	(3,283)	(3,964)	(9,926)	(1,115)
Profit After Tax (FRS 3)	(3,283)	(3,964)	(9,926)	(1,115)
Average Number of Shares Outstanding (m)	88.5	128.7	146.7	292.1
EPS - normalised (c)	(3.7)	(3.1)	(5.4)	(0.4)
EPS - normalised and fully diluted (c)	(1.9)	(1.5)	(2.6)	(0.2)
EPS - (IFRS) (c)	(3.7)	(3.1)	(5.4)	(0.4)
Dividend per share (c)	0.0	0.0	0.0	0.0
Gross Margin (%)	N/A	N/A	N/A	N/A
EBITDA Margin (%)	N/A	N/A	N/A	N/A
Operating Margin (before GW and except.) (%)	N/A	N/A	N/A	N/A
BALANCE SHEET				
Fixed Assets	20,209	26,180	17,336	83,379
Intangible Assets	20,209	26,180	17,336	83,379
Tangible Assets	0	0	0	0
Investments	0	0	0	0
Current Assets	2,719	3,439	6,841	3,022
Stocks	0	0	0	0
Debtors	657	1,087	14	0
Cash	2,054	2,351	6,827	3,022
Other	7	0	0	0
Current Liabilities	(3,241)	(3,423)	(3,615)	(3,582)
Creditors	(3,241)	(3,423)	(3,615)	(3,582)
Short term borrowings	0	0	0	0
Long Term Liabilities	0	0	0	0
Long term borrowings	0	0	0	0
Other long term liabilities	0	0	0	0
Net Assets	19,687	26,196	20,562	82,818
CASH FLOW				
Operating Cash Flow	(1,456)	(1,566)	188	(992)
Net Interest	13	11	12	34
Tax	0	0	0	0
Capex	(2,509)	1,153	318	(66,219)
Acquisitions/disposals	92	19	0	0
Financing	5,502	679	3,957	63,371
Dividends	0	0	0	0
Net Cash Flow	1,642	297	4,476	(3,805)
Opening net debt/(cash)	(412)	(2,054)	(2,351)	(6,827)
HP finance leases initiated	0	0	0	0
Other	0	0	0	0
Closing net debt/(cash)	(2,054)	(2,351)	(6,827)	(3,022)

Source: Company sources, Edison Investment Research

Contact details	Revenue by geography
Level 7 1008 Hay Street Perth WA 6000 Australia +61 8 9389 2000 www.cradleresources.com.au	N/A

Management team

Chairman: Craig Burton	Project director: Keith Bowes
Mr Burton has over 25 years of experience in financing, developing and managing resource projects and mining service businesses in Canada and the UK, comprising diamonds, nickel, copper, gold and oil & gas. He co-founded Mirabela Nickel and Panoramic Resources and is a non-executive director of Capital Drilling.	Mr Bowes has 20 years of metallurgical experience in flotation, leaching and the pyro-metallurgical treatment of base metals and gold, especially in Africa.
Executive director: James Kelly	**Geology manager: Neil Inwood**
Mr Kelly is a metals and mining executive with over 15 years of experience in corporate finance, general finance, banking and principal investing. During his time at Xstrata, he was a senior member of the business development team whose remit included strategy, M&A and capital allocation and worked on numerous transactions, of which over US$10bn were successfully executed, prior to the merger with Glencore. He had additional extensive involvement in investor relations as well as financial management of the underlying business units, including a secondment to Xstrata Coal. Recently, he has co-founded two natural resources private equity funds, namely Greenstone Resources LP and Buckthorn Partners LLP. He is a fellow of the Institute of Chartered Accountants of England & Wales.	Mr Inwood has 20 years of multi-commodity project and consulting experience in Australia, Africa, the US, Europe, South America and Central Asia. He has been the Qualified Person (TSX) or Competent Person (ASX) for a variety of international uranium, gold, nickel, base metal and iron ore projects. Previously he was principal resources consultant at a major international mining consultancy. He is a fellow of the Australian Institute of Mining & Metallurgy and holds a master's degree in geology (UWA), a BSc in geology (Curtin University) and a graduate certificate in geostatistics (ECU).

Principal shareholders	(%)
Verona Capital	17.65
Edwards Family Holdings	10.41
Arredo	9.56
Aviemore Capital	8.39
Pershing Australia Nominees (Argonaut account)	7.30
HSBC Custody Nominees (Australia)	5.16
Mr Brett Mitchell & Mrs Michelle Mitchell (Mitchell Spring Family a/c)	3.36

Companies named in this report

Companhia Brasileira de Metalurgia e Mineração (CBMM), Mineração Catalão, China Molybdenum, Anglo American, Magris Resources, IAMGOLD

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