EDISON

Cradle Resources

A point of principle

Investment decision imminent

Metals & mining

Cradle Resources has a 50% interest in the Panda Hill niobium project in Tanzania. Unlike other niobium projects, its geology and metallurgy are almost entirely conventional. The flotation process at Panda Hill is similar to Niobec, for example, while the leach process is based on Catalão and the converter process on some of the principles from the final stage of the CBMM pyro-metallurgical circuit. On 20 April 2016, Cradle announced the results of a definitive feasibility study (DFS) on the project compiled by MDM, Coffey, SRK, SGS, SLR and Roskill (among others). Cradle is currently optimising the DFS before making a final investment decision in Q217. Assuming that it is affirmative, Panda Hill will then be poised to become only the world's fourth producing niobium mine.

Year end	Revenue (A$m)	PBT* (A$m)	EPS* (c)	DPS (c)	P/E (x)	Yield (%)
06/15	0.0	(4.0)	(3.1)	0.0	N/A	N/A
06/16	0.0	(11.2)	(6.7)	0.0	N/A	N/A
06/17e	0.0	(1.2)	(0.4)	0.0	N/A	N/A
06/18e	0.0	(1.4)	(0.3)	0.0	N/A	N/A

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

Cradle's niobium unfairly discounted vs price/rarity

One of the disadvantages that besets Cradle is that it has effectively no peer group and hence there is no sample of niobium explorers from which an average in-situ value of niobium resources may be derived. Despite the fact that only c 40% of the Panda Hill carbonatite has been properly drill tested, Cradle's current enterprise value equates to just US$91.49 per tonne of attributable contained niobium metal at Panda Hill – or 0.26% of the price of niobium. Given its rarity in the earth's crust (just 20ppm) and its consequently relatively high price (US$35.16/kg long-term Edison estimate), we would expect a rating in the range 0.51-0.93%, based on our statistical analysis. Applying a 'worst case' 0.5145% in-situ value relative to price ratio to Cradle's 50% interest in the niobium metal content of Panda Hill instead implies a fair value attributable to the company of at least US$56.3m, or US$0.34 (A$0.46) per Cradle share. Applying the average 0.8057% ratio implies a value of US$88.2m, or US$0.54 (A$0.71) per Cradle share.

Valuation: A$0.69/share, but could be A$0.96/share

At the project level, Edison's valuation of Panda Hill remains ostensibly unchanged at US$369m, based on the net present value of potential cash flows, discounted at 10% per year (vs US$404m in the DFS). On this basis, Cradle's 50% share of Panda Hill is worth US$1.12/share. This dilutes to A$0.69/share, assuming future dilution at Cradle's current share price sufficient to fund its share of joint venture capex via equity financing. If Cradle's shares are afforded a re-rating by the market that is consistent with niobium's rarity and price, however (ie at least A$0.46/share based on our regression analysis), then the reduced subsequent equity dilution would be such as to increase its valuation by 39.1% to A$0.96/share (note: Cradle also has the opportunity to gear its valuation up further, to A$1.42/share, by debt funding, rather than equity funding, its joint venture capital commitments).

31 January 2017

Price	**A$0.25**
Market cap	**A$41m**
	A$1.3326/US$
Net cash (A$m) at 30 September 2016	3.1
Shares in issue	164.7m
Free float	42%
Code	CXX
Primary exchange	ASX
Secondary exchange	N/A

Share price performance

%	1m	3m	12m
Abs	6.3	0.0	34.2
Rel (local)	6.3	(6.0)	18.8
52-week high/low		A$0.3	A$0.2

Business description

Approximately 90% of the world's supply of niobium comes from one country (Brazil) and just three companies. Cradle's 50% interest in the Panda Hill niobium project in Tanzania therefore makes it a member of a very exclusive club of mining juniors.

Next events

BFS optimisation	Q117
Investment decision	Q217

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Edison profile page

Cradle Resources is a research client of Edison Investment Research Limited

A unique niobium 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.

Panda Hill DFS April 2016

On 20 April 2016, Cradle announced the results of a definitive feasibility study (DFS), performed 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 for the expansion. Average life-of-mine EBITDA was estimated to be US$112m pa (US$0.83 per undiluted share at that time) and the payback period at 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.

The mining study relating to Panda Hill envisaged conventional open-cut mining based on drill, blast, load and haul using a typical medium fleet arrangement of two 120-tonne excavators and six to 18 90-tonne haul trucks (eg CAT 777). The pit design incorporated 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 is to 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 also 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, albeit at the cost of a higher initial stripping ratio. After the first 10 years of operations, inferred material is also included in the mining and processing schedule.

Processing

In summary, initial crushing will be 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. Phosphate, silicate and sulphur impurities are removed by a two-stage leach process. 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 at Panda Hill is similar to Niobec in Canada, which has a similar geology and mineralogy, while the leach process is based on Catalão and the converter process on some of the principles from the final stage of the CBMM pyro-metallurgical circuit.

Edison's August 2016 discounted dividend flow valuation of Cradle

On the basis of the DFS, in August, Edison calculated a value for the project of US$365m based on the net present value of cash flows, discounted at 10% per year. This compared with the DFS valuation of US$404m – the difference in the valuations probably being attributable to different pricing assumptions (the DFS uses pricing assumptions provided by Roskill, which were not disclosed for reasons of commercial sensitivity). As such, Edison's valuation of Cradle's 50% share of Panda Hill valuation equated to US$1.11/share (before potential dilution) vs US$1.50 based on the DFS valuation. Assuming equity financing at Cradle's prevailing 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, or US$51.1m), however, this valuation then diluted to A$0.70/share.

Recent progress

In the two quarters since Edison's initiation note, Cradle has continued to progress the project via a number of initiatives relating to product offtake, financing and front-end engineering & design (FEED) as well as technical mining and engineering activities.

Significantly, Panda Hill Tanzania (PHT) is continuing its discussions with three separate potential counterparties in various regions regarding marketing and offtake agreements. Currently, it is awaiting feedback from the primary offtake party on a final set of comments in the offtake agreement, following which it will be circulated to all parties. Thereafter, it is anticipated that an agreement "will be finalized in the next few months following approval by the PHT and Cradle Boards".

Similarly, PHT and the project debt arranger are targeting credit committee approval for the project finance facility early this year (subject to the usual conditions precedent). To this end, in the past few months:

- An independent engineer has been engaged by the project debt arranger and has substantially completed its review of the project (including site visit) with no material issues identified; and
- A debt financing draft term sheet has been received by Cradle.

Key matters to be concluded include finalisation of the independent engineer's report, execution of the legal due diligence and an opinion from Roskill on conditions in the niobium market.

Front End Engineering & Design (FEED)

At the same time, the Panda Hill FEED has now been completed ostensibly on time and within budget, the main outcomes from the programme being:

- Mine and infrastructure design have been significantly de-risked.
- The completion of the mining pit and haul road optimisation work and production schedules.
- Issue of the mining tender information pack to potential mining contractors.
- Issue of the bulk earthworks enquiry (including tailings) to approved tenderers for pricing purposes.
- Completion of construction camp requirements and tender issue.
- Selection of preferred contractors for project construction services.
- Receipt of all mechanical equipment tender packages and submissions.
- Receipt and assessment of three EPCM bids from consultants.
- Completion of the southern tailings storage facility (TSF) design, including related bill of quantities, infrastructure modelling and wall and tailings deposition phasing.
- Revision of the storm water management strategy (based on new layouts and the phasing of those layouts).
- Finalisation of the business risk register.
- Completion of the hazard and operability study (HAZOP 3).

- Completion of water bore drilling (note: with 'significant' water seen in four holes).

Technical activity

Technical activity during the period focused on the progress of the activities defined in the FEED scope, including the following:

Engineering

- Updating of bulk earthwork enquiries, with revised civils, tailings storage quantities and mine access road requirements.
- Finalisation, receipt and review of mechanical tenders and tender submissions from the appropriate OEM equipment suppliers.
- Review of the leach section.
- Updating, completion and review of all the process flow diagrams and piping and instrumentation drawings.
- Updating of the total mine power load schedule.
- Appointment of a furnace consultant and the completion and issue of the furnace tender document to all suppliers.
- Receipt of furnace bids from two suppliers.
- Receipt of bids and award for preferred bidder status for a) bulk earthworks, b) TSF construction, c) road construction, d) civils construction, e) mining drill and blast, and f) mining load and haul.

Within the context of the above, the initial capex estimate for the project has been lowered by US$10m to US$186m, after significant savings were made in the TSF construction, mine haul road and access road budgets. At the same time, life-of-mine opex was reduced from US$61.63/t to US$61.15/t and the construction schedule from 21 to 18 months.

Tailings

- Completion of the TSF basin walls and reclaim dam.
- Completion of the permit approval submission document for the extraction water from the Songwe River for the Lake Rukwa Basin office.
- Completion of water balance scenario planning.
- Revision of the site-wide water balance.
- Revision of the storm water management strategy, based on new layouts and the phasing of those layouts.
- Generation of the application letter to the National Environmental Management Council of Tanzania (NEMC) and the Commissioner of Mines for the approval of the phasing of the TSF.

Mining

- Completion of the pit design work for phase 1 and completion of the strategic mining schedule for the life of the mine, using net present value (NPV) scheduler software.
- Completion of a cut-off grade optimisation process designed to maximise NPV.
- Provision of a block model demonstrating the block-by-block mining sequence to be used for the run-of-mine stockpile and plant simulation studies.
- Receipt and evaluation of mining tenders.

Mine site activities

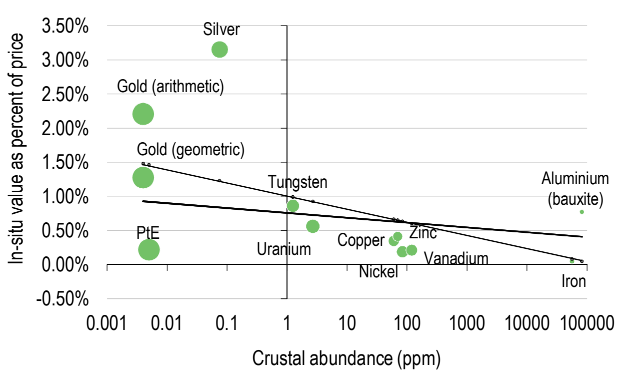
- Finalisation and submission of the prison relocation agreement to the minister for sign-off.
- Completion of the study relating to the re-routing of the overhead prison power lines and the receipt of various contractor tender documents.
- Completion of six water borehole sites by the wellfield drilling contractor.
- Submission of water extraction permits for the yielding boreholes to the Lake Rukwa Water Board with finalisation and approval anticipated in Q117.
- Receipt of approval from Tanesco for power offtake from its existing power line for the early works (eg construction camp, etc). Note: the line will be upgraded at a later juncture.
- Tazara (aka Tanzam) approval for the construction of the access road running parallel to its existing rail tracks.

Note that the above activities follow the conclusion of a major community initiative in July 2016. Since then, PHT has continued with the various community stakeholder liaison meetings. It is also in the process of conducting bi-weekly water flow sampling of the Songwe River for the environmental baseline assessment.

In-situ resource valuation

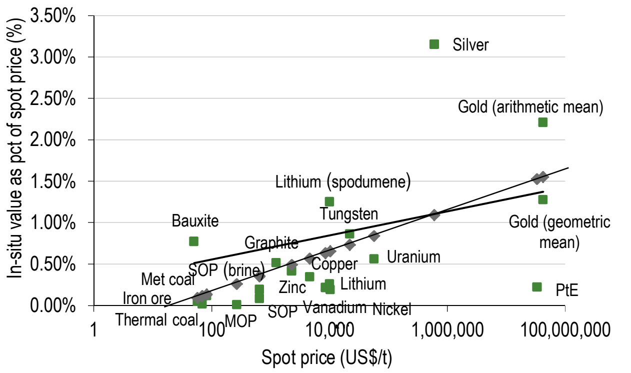
In October 2016, Edison published its annual mining overview, entitled Normalisation augurs well for exploration. Among other things, this report considered the relationship between the crustal abundance of a metal or mineral and its average in-situ value as a percent of the spot price as well as the relationship between the price of a metal or mineral and its average in-situ value as a percent of the spot price. In chart form, the results were as follows:

Exhibit 1: In-situ resource values as a percentage of spot price vs crustal abundance, selected metals



Source: Edison Investment Research

Exhibit 2: In-situ resource values as a percentage of spot price vs spot prices, selected metals & minerals



Source: Edison Investment Research

The x-axis of each graph is presented on a logarithmic scale in order to accommodate the range of data points. Nevertheless, within this context, it is possible to apply a 'best fit' line to the data displayed. As such, two 'best fit' lines are shown on each graph. One depicts the conventional linear 'best fit' trend line (ie as if the scale on the x-axis were linear, rather than logarithmic). The other depicts the linear 'best fit' trend line to the data as displayed on the logarithmic scale shown.

Owing to the paucity of listed explorers in the sector, it was not considered practical to include niobium in the analysis at the time. Nevertheless, given its price and crustal abundance, it is possible to use the 'best fit' lines shown to estimate where niobium should appear in the above graphs, all other things being equal. A summary, considering each of the two 'best fit' lines for two variables (crustal abundance and price) is as follows:

Exhibit 3: Implied niobium in-situ value as a percentage of price

Variable	Relationship applied	Implied in-situ value as a percentage of spot price (%)
Price (US$35.16/kg)*	Conventional linear relationship	0.5145%
	'Best fit' line relative to logarithmic scale	0.7827%
Crustal abundance (20ppm)**	Conventional linear relationship	0.9274%
	'Best fit' line relative to logarithmic scale	0.7564%
Average		**0.8057%**

Source: Edison Investment Research. Note: *See Edison's Outlook note, published 11 August 2016; **Wikipedia citing 'It's Elemental — The Periodic Table of Elements' (Jefferson Lab), archived from the original on 29 April 2007.

Dated April 2015, Cradle's actual niobium resource at Panda Hill is summarised in the table below (at a cut-off grade of 0.3% Nb_2O_5):

Exhibit 4: Panda Hill resource statement (April 2015)

	Tonnes (Mt)	Grade (% Nb_2O_5)	Nb_2O_5 content (kt)	Estimated Nb metal content* (kt)
Measured	16	0.63	99	69
Indicated	53	0.50	263	184
Measured & indicated	69	0.52	362	253
Inferred	109	0.48	528	369
Grand total	**178**	**0.50**	**891**	**623**

Source: Cradle Resources, Edison Investment Research. 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; *69.9% conversion factor used from Nb_2O_5 to Nb (metal).

Note that Cradle's current enterprise value of US$28.5m (using end-September cash) equates to US$91.49 per tonne of attributable contained niobium metal in its resource at Panda Hill – or 0.26% of the price of niobium contained within ferro-niobium. Applying the lowest derived 0.5145% in-situ value relative to price ratio (see Exhibit 3) to Cradle's 50% interest in the niobium metal content of Panda Hill implies a value attributable to Cradle Resources of US$56.3m, or US$0.34 (A$0.46) per existing Cradle share. Applying the average 0.8057% in-situ value relative to price ratio implies a value attributable to Cradle of US$88.2m, or US$0.54 (A$0.71) per Cradle share. At the same time, expansion potential exists to the extent that only approximately 40% of the area of the Panda Hill carbonatite has been properly drill tested with the result that the operators have an ongoing exploration target of 200-400Mt of mineralised material at a grade of 0.4-0.6% Nb_2O_5.

Valuation

Our valuation of Cradle has always been (and continues to be) conducted as at the start of FY17 (ie 1 July 2016). Since the publication of our Outlook note last August, Cradle has reported its FY16 financial results, as a result of which we have made minor adjustments to our cash burn forecasts. We have also incorporated updated capex and opex estimates – albeit these changes are relatively small (see above). As a result, our fundamental value for the Panda Hill project therefore remains ostensibly unchanged at US$369m (cf US$365m previously) 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 used by Edison and Roskill (Roskill's pricing assumptions were not disclosed in the DFS for reasons of commercial sensitivity). On this basis, Cradle's 50% share of our Panda Hill valuation equates to US$1.12/share (before potential dilution) vs US$1.50 based on the DFS valuation at the time of Cradle's DFS results announcement on 20 April 2016. Assuming equity financing at Cradle's current share price (and the prevailing A$/US$ exchange rate) to fund its share of joint venture capex commitments, however (ie via the issue of 263.4m shares at A$0.25 to raise A$64.7m, or US$48.6m), this valuation now dilutes to A$0.69/share.

In-situ valuation implications

In the event that it were to re-rate to something approaching a sector-appropriate valuation given the size of its in-situ niobium resource and the price and rarity of niobium, Cradle's share price could be expected to rise to in excess of A$0.46 per share. That being the case, the dilution associated with Cradle's equity funding of its joint venture capex commitments would reduce to 143.2m shares at A$0.46, in which case its valuation dilutes to only A$0.96/share, rather than the A$0.69/share.

Edison's base-case scenario assumes that Cradle will meet its equity funding obligations ostensibly via the issue of its own equity. To the extent that it is able to finance 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 as measured by financial leverage):

Exhibit 5: Cradle discounted dividend NPV with varying funding structures

Percent of Panda Hill equity funded with Cradle equity	0	25	50	75	100
NPV (A$/share)	1.40	1.08	0.89	0.77	0.69
Percent change in NPV (%)	+102.9	+56.5	+29.0	+11.6	u/c
Maximum (debt) funding requirement (A$m)	80.7	61.6	42.6	23.5	4.4
Maximum Cradle leverage (%)*	70.5	53.9	37.2	20.5	3.8

Source: Edison Investment Research. Note: *Defined as (net debt/[net debt+equity]).

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

Exhibit 6: 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	1.15	1.06	1.00
0.46	**1.42**	**1.24**	**1.12**	**1.03**	**0.96**
0.40	1.41	1.21	1.07	0.97	0.90
0.30	1.41	1.13	0.96	0.85	0.77
0.25	**1.40**	**1.08**	**0.89**	**0.77**	**0.69**
0.20	1.39	1.00	0.80	0.68	0.60

Source: Edison Investment Research

Exhibit 7: Financial summary

A$'000s	2014	2015	2016	2017e	2018e
June	IFRS	IFRS	IFRS	IFRS	IFRS
PROFIT & LOSS					
Revenue	0	0	0	0	0
Cost of Sales	0	0	0	0	0
Gross Profit	0	0	0	0	0
EBITDA	(3,296)	(3,975)	(11,206)	(1,272)	(1,272)
Operating Profit (before amort. and except.)	(3,296)	(3,975)	(11,206)	(1,272)	(1,272)
Intangible Amortisation	0	0	0	0	0
Exceptionals	0	0	0	0	0
Other	0	0	0	0	0
Operating Profit	(3,296)	(3,975)	(11,206)	(1,272)	(1,272)
Net Interest	13	11	10	28	(158)
Profit Before Tax (norm)	(3,283)	(3,964)	(11,197)	(1,244)	(1,429)
Profit Before Tax (FRS 3)	(3,283)	(3,964)	(11,197)	(1,244)	(1,429)
Tax	0	0	0	0	0
Profit After Tax (norm)	(3,283)	(3,964)	(11,197)	(1,244)	(1,429)
Profit After Tax (FRS 3)	(3,283)	(3,964)	(11,197)	(1,244)	(1,429)
Average Number of Shares Outstanding (m)	88.5	128.7	137.0	296.5	428.2
EPS - normalised (c)	(3.7)	(3.1)	(6.7)	(0.4)	(0.3)
EPS - normalised and fully diluted (c)	(3.7)	(3.1)	(6.7)	(0.4)	(0.3)
EPS - (IFRS) (c)	(3.7)	(3.1)	(6.7)	(0.4)	(0.3)
Dividend per share (c)	0.0	0.0	0.0	0.0	0.0
Gross Margin (%)	N/A	N/A	N/A	N/A	N/A
EBITDA Margin (%)	N/A	N/A	N/A	N/A	N/A
Operating Margin (before GW and except.) (%)	N/A	N/A	N/A	N/A	N/A
BALANCE SHEET					
Fixed Assets	20,209	26,180	18,210	86,915	86,890
Intangible Assets	20,209	26,180	18,210	86,915	86,890
Tangible Assets	0	0	0	0	0
Investments	0	0	0	0	0
Current Assets	2,719	3,439	5,604	(1,433)	(2,837)
Stocks	0	0	0	0	0
Debtors	657	1,087	33	0	0
Cash	2,054	2,351	5,571	(1,433)	(2,837)
Other	7	0	0	0	0
Current Liabilities	(3,241)	(3,423)	(245)	(127)	(127)
Creditors	(3,241)	(3,423)	(245)	(127)	(127)
Short term borrowings	0	0	0	0	0
Long Term Liabilities	0	0	0	0	0
Long term borrowings	0	0	0	0	0
Other long term liabilities	0	0	0	0	0
Net Assets	19,687	26,196	23,569	85,355	83,926
CASH FLOW					
Operating Cash Flow	(1,456)	(1,566)	(986)	(1,331)	(1,246)
Net Interest	13	11	10	28	(158)
Tax	0	0	0	0	0
Capex	(2,509)	1,153	1,879	(68,731)	0
Acquisitions/disposals	92	19	(1)	0	0
Financing	5,502	679	2,320	63,030	0
Dividends	0	0	0	0	0
Net Cash Flow	1,642	297	3,220	(7,004)	(1,404)
Opening net debt/(cash)	(412)	(2,054)	(2,351)	(5,571)	1,433
HP finance leases initiated	0	0	0	0	0
Other	0	0	0	0	0
Closing net debt/(cash)	(2,054)	(2,351)	(5,571)	1,433	2,837

Source: Cradle Resources accounts, Edison Investment Research

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