Cradle Resources

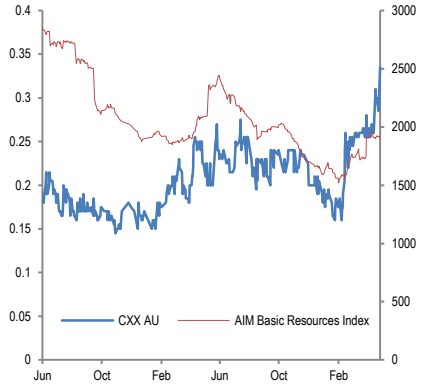
MIRABAUD 1819

Mining Research

23 May 2016

Speculative Buy

Ticker	CXX AU
Share Price (A$)	0.34
Target Price (A$)	0.59
Upside (%)	74%
12mth high/low (A$)	0.35/0.16
Shares out (m)	154.7
Market Cap (A$m)	51.0
Enterprise Value (A$m)	48.1



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Production getting closer

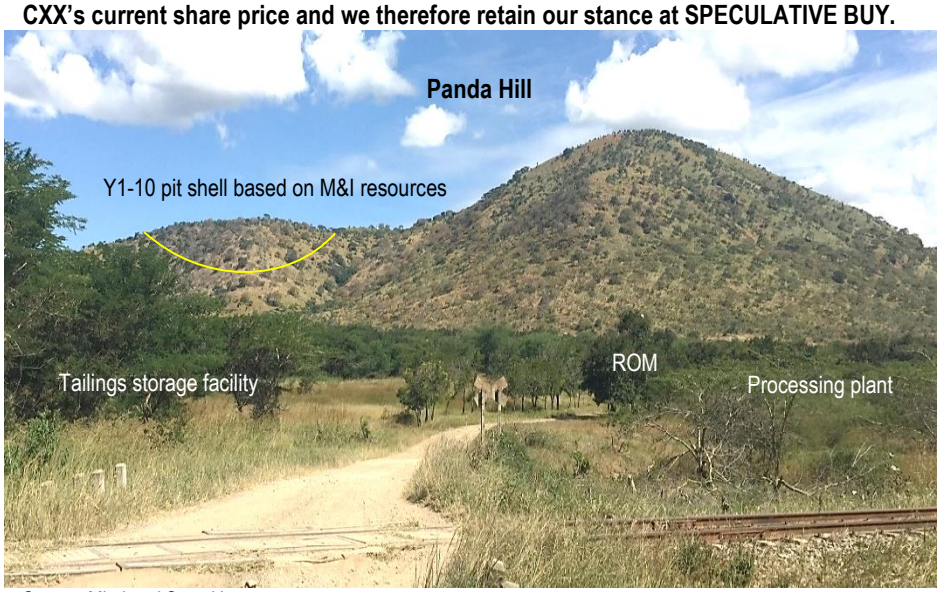
On 20 April Cradle announced positive results from its definitive feasibility study (DFS) for its 50% owned Panda Hill niobium project in Tanzania. This was followed by the appointment of three key people to the company's board. James Kelly was promoted to an executive role while Ian Middlemas and Robert Behets joined Cradle as non-executive directors (see p8).

Cradle's DFS, which supersedes the prefeasibility study (PFS - 31 March 2015), is based on the company's revised development concept which considers a plant throughput of 1.3Mtpa from an open-pit operation with the option to expand to 2.6Mtpa after the 4th year of production. That is based on a mineable resource of 72.4Mt at 0.54% of Nb_2O_5 for ~390kt of Nb_2O_5, for a ~30-year life-of-mine (LoM) and calculates an unfunded NPV_8 of US$542m and IRR of 27% at an average niobium (Nb) price of US$42/kg. In our view the staged approach is the preferable option mainly due to the benefits of a gradual entry into the highly concentrated niobium market.

The DFS, which shows a quick route to production, more than justifies our faith in the robust nature of the project and enhances our confidence that Cradle will be capable of securing funding (~US$100m) to develop Panda Hill thus becoming the first primary niobium producer to come on stream since 1976, in a market dominated by only three players (CBMM, Niobec and Catalao). Global demand for niobium is expected to grow at a minimum annual rate of 3% over the next 5 years, as a result of both a growth in niobium's intensity and of increasing demand for steel from emerging nations, niobium's market main driver (see p11).

We calculate that Panda Hill has approximately the same value as an equivalent 14.2Moz open-pittable gold deposit graded at 2.8g/t (or a 2.8Mt copper deposit at ~1.7% Cu), with a very low LoM strip-ratio of 1.5:1 which in turn results in a cash cost (also expressed as an equivalent gold project) of ~US$600/oz and an attractive AISC of ~US$720/oz (see p7).

We value Cradle on a sum-of-the-parts basis, incorporating a risk-adjusted NPV estimate of Panda Hill, using the operating and cost parameters from the project's DFS. **Our revised valuation of A$0.59/share (from A$0.56/share previously), now offers 74% upside to CXX's current share price and we therefore retain our stance at SPECULATIVE BUY.**



Source: Mirabaud Securities

Upcoming catalysts

IFC complaint environmental & social impact assessment (ESIA) report issuance	Q2 CY2016
Off-take and debt financing	Q3 CY2016
The project company's (PHT's) definitive feasibility study	Q3 CY2016
Project funding	Q3 CY2016
PHT pays US$3m to RECB (to be met 50:50 by CXX and Tremont)	30 September 2016
Front-end engineering and design (FEED) work completion	Q4 CY2016
Construction starts	Q4 CY2016
Stage I first production expected	H2 CY2018
Stage I fully commissioned (1.3Mtpa)	Q1 CY2019
Stage II construction	2022
Connection to the national grid replaces HFO	2023
Stage II fully commissioned (2.6Mtpa)	2023

Source: Mirabaud Securities

DFS confirms Panda Hill's strong economics

The recently announced Panda Hill DFS, which supersedes the prefeasibility study (PFS - 31 March 2015), is based on Cradle's revised development concept which considers a plant throughput of 1.3Mtpa from an open-pit operation with the option to expand to 2.6Mtpa after the 4th year of production (vs. the PFS's stable throughput assumption of 2Mtpa). That is based on Panda Hill's mineable resource base estimate of 72.4Mt (comprising 35.3Mt of M&I resources and 37.1Mt of inferred resources) at 0.54% of Nb_2O_5 for ~390kt of Nb_2O_5, for a 30-year LoM with the first 10 years being based on M&I resources alone.

The DFS assumes FeNb production of ~6ktpa for the first 4 years, after which it is planned to rise to ~8.5ktpa for a LoM average of 8.2ktpa of FeNb (or 5.4ktpa of contained Nb), vs. 6.8ktpa in the PFS (see table p3). The above results in a DFS post-tax IRR and NPV_{10} of 27% and US$404m respectively (vs. IRR of ~56% and NPV_{10} of US$470m in the PFS).

Cradle is targeting a ~6% of world FeNb production when fully expanded

The new approach is designed to maintain an early life FeNb production profile at ~3.5% (and a LoM average FeNb production at ~6%) of world's production (currently estimated at 138ktpa of FeNb). In our view, this smoother entry into the niobium market compares favourably with the company's more aggressive entry strategy in the PFS, since the Nb market is a highly concentrated one.

The company's updated average Nb price assumption of US$42/kg (vs. US$44/kg in the PFS) now commences at US$37.6/kg (comprising 60% Roskill's US$ and 40% Roskill's Euro price deck). The above allows for a strong cash margin of ~45% which, according to the company, would yield a LoM average annual EBITDA of US$112m (vs. US$103m in the 2Mtpa PFS scenario).

In anticipation of the maiden ore reserve, we are conservatively modelling Panda Hill based on a recoverable reserves basis of 50Mt at ~0.56% of Nb_2O_5 for 278kt of Nb_2O_5 (~22-year LoM), down from 60Mt previously (see table in p3). That is based on the project's M&I resources of ~69Mt (at 0.53% Nb_2O_5 for 362kt of Nb_2O_5) and a resource-to-reserve conversion rate of ~75% (which we believe is reasonable for the nature of the deposit). We have also updated our model's throughput assumption in-line with the company's DFS of 1.3Mtpa expanding to 2.6Mtpa after the 4th year of production.

In that base case we estimate an unfunded project NPV_8 of US$360m and IRR of 23.3% for Panda Hill (on a 100% basis), based on our unchanged in-house long-

term niobium price assumption of US$40/kg (in-line with the last five years' average niobium price of ~US$40/kg Nb). That allows for wide cash operating margins (~45% representing ~US$100m LoM average) and the potential for the upfront capex to be repaid within the first ~5 years from first production.

Mine design boosts project's economics by increasing Nb grade in the early year.

We are expecting a frontloaded cash flow profile as the mine design boosts the project's economics by increasing the Nb grade (and thus production) in the early years (see graph in p4) by targeting only the M&I material. We note that any lower grade (<0.5% of Nb_2O_5) or lower recovery material as well as the inferred material will be stockpiled for later use (after the first ten years).

Staged II expansion and HFO-to-grid power replacement will be funded from the project's cash flow

Thus we believe that the project could internally fund both the Stage II expansion to 2.6Mtpa (~US$80m including contingencies) and the cost for the conversion from HFO to grid power (~US$15m capital expenditure for a unit cost reduction of ~50% to US$0.115/kWh from US$0.213/kWh previously), while serving its more-than-halved annual sustaining capex (of US$4.1m vs. US$8.6m in the PFS).

See below tabulated our current model assumptions and outputs compared with the company's DFS and PFS estimates. For comparison purposes we are also including our previous' model assumptions.

Summary of Mirabaud and Cradle cash-flow modelling assumptions and outputs

Item	Unit	Mirabaud - based on DFS (new)	Cradle - DFS (base-case)	Mirabaud - based on PFS (old)	Cradle - PFS (old)
Scenario (staged – throughput increase after year 4)	-	1.3-2.6Mt	1.3-2.6Mt	1.0-2.0Mtpa	2Mtpa stable
Mineable resource	Mt	50	72	60	60
Life-of-mine	Years	22	30	32	30
Annual mill throughput (first 4 years)	Mt	1.3	1.3	1.0	2.0
Annual mill throughput LoM	Mt	2.3	2.4	1.8	2.0
Strip-ratio (years 1-10)	X	2.5:1	2.5:1	2.2:1	2.6:1
Strip-ratio (years LoM average)	X	1.8:1	1.5:1	2.3:1	2.3:1
Average Nb_2O_5 head grade (years 1-10)	%	0.67	0.68	0.69	0.68
Average Nb_2O_5 head grade (LoM average)	%	0.54	0.54	0.54	0.54
Nb recovery to concentrate (years 1-10)	%	62	61	63	63
Nb recovery to concentrate (LoM average)	%	61	61	62	62
Nb-in-concentrate production (years 1-10)	Kt	5.7	-	5.4	5.5
Nb-in-concentrate production (LoM average)	Kt	5.4	5.4	4.2	4.5
FeNb converter recovery (LoM average)	%	96	97	97	97
FeNb matte (66% Nb grade) product (years 1-10)	Kt	8.6	-	8.2	8.4
FeNb matte (66% Nb grade) product (LoM average)	kt	8.1	8.2	6.3	6.8
Long-term real Nb price	US$/kg	40	42	40	44
Royalties	%	3	3	3	3
On-site cash operating costs	US$/kg	19	18	20	19
Total cash costs (incl transport, marketing and royalties)	US$/kg	22	21	22	22
All-in sustaining cost	US$/kg	23	22	-	-
Annual EBITDA (LoM average)	US$m	96	112	85	103
Tax rate	%	30	30	30	30
Initial capex (incl contingency – in today's money)	US$m	200	196	144	195
Peak working capital needs	US$m	10	9	-	-
Stage II expansion capex (incl contingency)	US$m	95	93	81	-
LoM cumulative sustaining capital cost	US$m	88	122	260	258
LoM capex (incl sustaining capex)	US$m	393	420	485	453
Post-tax NPV_8 (*at 10% discount rate)	US$m	360	542	371*	470*
Post-tax IRR	-	23%	27%	32%	56%
Payback period	years	4.9	4.7	3.0	1.5

Source: Mirabaud Securities estimates

Although plant throughput in the DFS has been reduced vs. the PFS by 35% to 1.3Mtpa, initial capital needs remained almost unchanged at US$195.6m (that contains contingency of US$17.8m as well as the prison relocation cost of US$6.2m) compared with ~US$197m in the PFS for the 2Mtpa throughput scenario (prison relocation cost included). That is in-line with our previous assumption of US$150m for the 1Mtpa initial throughput assumption.

Despite the relative capex increase, we note that the DFS offers Cradle a much better understanding of the project both in terms of the cost structure (with a level of opex and capex accuracy of -10% +15% vs. -15% +25% in the PFS), as well as in the level of detail of geological and engineering studies, as the project advances from preliminary (PFS) to full feasibility phase (DFS).

We estimate the project's initial capital expenditure needs at ~US$210m

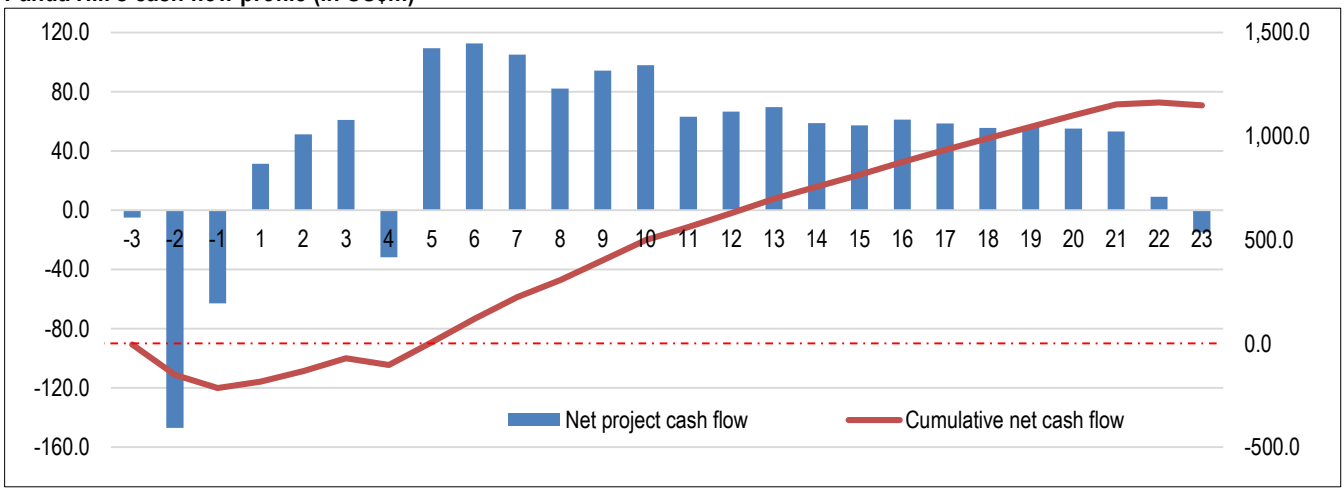
Our updated model assumes initial capex of ~US$200m which along with our peak working capital assumption of ~US$10m, results in an initial funding need for Panda Hill of ~US$210m (or ~US$105m for Cradle's part). The difference between Cradle's and our initial capex assumption of ~US$4m is due to our higher contingency assumption of 15% of the capital cost (in-line with DFS's capex accuracy of +15%) compared with Cradle's assumption of 12%.

Although the DFS's early life strip ratio is unchanged at 2.5:1, the average LoM strip ratio falls to 1.5:1 vs. 2.3:1 in the PFS. Even in the early years, the project's stripping remains low compared with other open-pit mines, due to the project's deposit geometry and favourable geomorphology (see picture on cover page).

We are maintaining our strip ratio assumption of ~2.6:1 in the early years, during which the uneconomic-to-treat (due its relatively low metallurgical recoveries) weathered cover (which comprises the upper part of the deposit and thus must be mined first) should be removed (strongly oxidised zone). However, we reduce our LoM average stripping to 1.8:1 from 2.3:1 previously (vs. 1.5:1 in the DFS).

Mine site cash costs (mining & processing) remain almost unchanged at US$18.3/kg (vs. US$18.9/kg in the PFS). That rises to a total cash cost of US$21.34/kg (vs. the PFS's US$21.78/kg) when including royalties, transport and marketing costs. The mining cost reduction, which was driven by the lower LoM strip-ratio, was partly offset by the more complicated processing flow sheet which has increased processing costs mainly by introducing a two-stage flotation circuit.

Panda Hill's cash flow profile (in US$m)



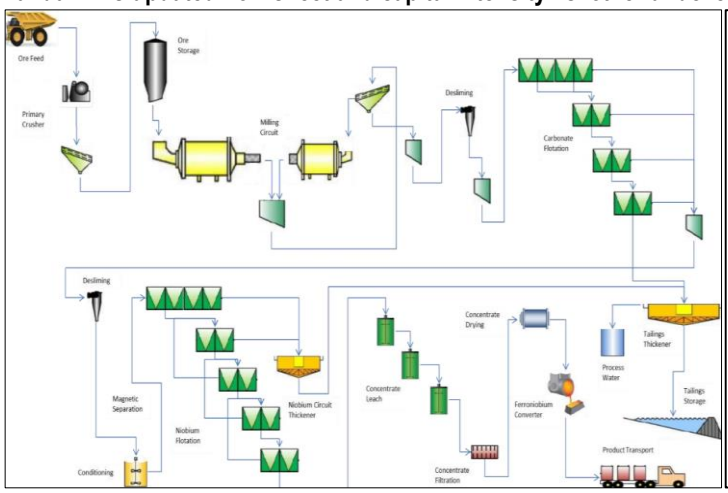
Source: Mirabaud Securities estimates

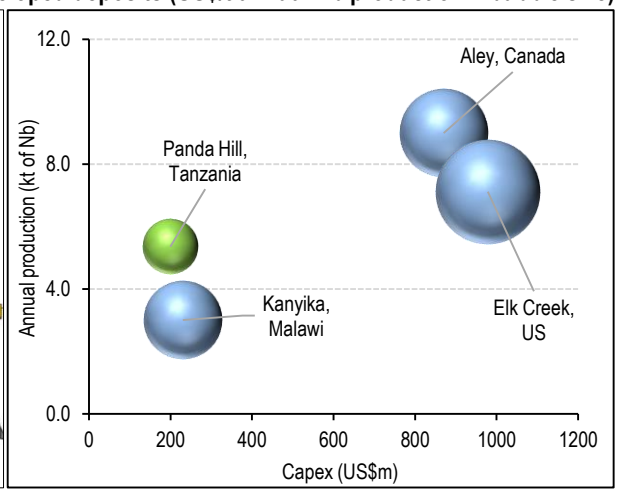
Two-stage flotation increases processing costs

Having similar mineralogy with Magris Resources' Niobec mine in Canada, Cradle has designed a similar two-stage flotation process (see graph below). That, along with the concentrate leaching circuit (similar to that of Catalao – the Brazilian operation recently sold by Anglo American), which removes some impurities (mainly phosphates and sulphur) while reducing the final silicate grade, results in an average LoM metallurgical recovery of ~61% (vs. 62% in the PFS).

The company reiterates its pyro-metallurgical converter recovery assumption of 97% which is based purely on the experience of specialist consultants. In our view this assumption contains a level of risk considering that the pyro-metallurgical recovery is a key sensitivity of the project (see p10). Thus we have adopted a more conservative Nb pyro-metallurgical recovery assumption of 96% in anticipation of the pyro-metallurgical test work results, currently underway which we understand will be incorporated in the project company's (PHT's) own DFS.

Panda Hill's updated flow sheet and capital intensity vs. other undeveloped deposits (US$/t annual Nb production – bubble size)





Source: Cradle Resources

Next steps

Panda Hill is one step closer towards unlocking the value of a world-class niobium resource

Cradle's DFS more than justifies our faith in the robust nature of the project and enhances our confidence that Cradle will be capable of securing funding to develop Panda Hill thus becoming the first primary Nb producer to come on stream since 1976, in a market dominated by only three players (CBMM, Niobec and Catalao). We also believe that Cradle will have viable funding options that are not solely reliant on equity markets for its 50% project share which, based on the DFS, we now estimate at ~US$105m.

As this DFS has been prepared by Cradle it is not intended to support an immediate decision to mine and thus we are expecting PHT to complete its own DFS after the finalisation of the off-take agreement (critical for the debt funding) and debt financing procedures later this year (Q3 2016). In the meantime the lag will be covered by a programme of front-end engineering and design work (FEED- a budget for which will be announced soon) overlapping the debt financing period.

On this schedule we believe project funding should be completed by end-Q3 2016 and thus construction of the project could commence by year-end, facilitating first production in H2 2018 (assuming a 21-month construction period). That, followed by a 3 month ramp-up period, will result in steady-state production in early 2019 (see chart on p6).

Panda Hill targeted development timetable

Activities	Target End Date	Q4 2016	Q1 2017	Q2 2017	Q3 2017	Q4 2017	Q1 2018	Q2 2018	Q3 2018
Project Schedule	June 2018								
Mining	March 2018								
Mobilisation / Training	May 2017								
Haul Road	March 2018								
WRD/ISP/ROM pad	March 2018								
Tailings Storage Facility	June 2018								
Design & Engineering	June 2017								
TSF Construction	June 2018								
Storm Water Management	April 2018								
Processing Plant	May 2018								
Detailed Engineering	August 2017								
Procurement	September 2017								
Detailing/Fabrication	November 2017								
Delivery Phase	January 2018								
Construction Phase	May 2018								
Initial Site Establishment	January 2017								
Bulk Earthworks	July 2017								
Plant Buildings	April 2018								
External Infrastructure	September 2017								
Prison	August 2017								
Housing	September 2017								
Other Infrastructure	July 2017								
Access Roads	August 2017								
Commissioning	June 2018								
C3 Mill/Float	June 2018								
C3 Converter	June 2018								

Source: Cradle Resources

Further upside potential

The updated (JORC-compliant) resource published in April 2015 almost doubled Panda Hill's resource base to 178Mt at 0.50% of Nb_2O_5 for 891kt of Nb_2O_5 (from 96Mt at 0.52% of Nb_2O_5 for 504kt of Nb_2O_5 in January 2015). The increase came mainly via a 90% increase in tonnage of the primary carbonatite material (~94% of total resources with the lower-recovery weathered material contributing only ~6%) to 167Mt at 0.50% of Nb_2O_5 (vs. 88Mt at 0.52% of Nb_2O_5 previously). The new resource incorporates depth extensions (in the core resource area of Angel Zone – initial starter pit) along with strike extensions to the north and south of the deposit.

Updated April 2015 Panda Hill JORC* mineral resources

above 0.3% Nb_2O_5 cut-off	Mt	% Nb_2O_5	Nb_2O_5 (kt)
Weathered carbonatite	5	0.59	30
Primary carbonatite	64	0.52	332
Sub-total measured & indicated	**69**	**0.53**	**362**
Weathered carbonatite	6	0.52	32
Primary carbonatite	103	0.48	496
Sub-total inferred	**109**	**0.48**	**528**
Total weathered carbonatite	11	0.55	63
Total primary carbonatite	167	0.50	828
Total resources	**178**	**0.50**	**891**

Source: Cradle Resources *The JORC Code 2012 edition

Drill hole (left) and core sample of fresh carbonatite material (right)

Source: Mirabaud Securities

Our model assumes a relatively conservative resource-to-reserve conversion rate of 72% from the deposit's 69Mt of M&I resources (mineable in situ resources) to form a potential recoverable resource base of 50Mt (22y LoM). That compares with our previous assumption of 60Mt (30y LoM) and CXX's aggregate throughput estimate of 72.4Mt (30y LoM, includes some inferred resources). The difference has a relatively small impact on the project's NPV and almost none on the project's IRR (see tables below).

Panda Hill offers significant exploration potential upside

However, we feel confident that the company will extend the project's life to >30 years by upgrading some inferred material to the M&I category and thus to reserves, though at a lower grade towards the end of the project's life. The deposit has been sporadically drilled with ~40% of the carbonatite outcrop tested to date. Cradle has also reported an exploration target of 200-400Mt, which lies outside the current mineral resource. The target grade is between 0.4-0.6% of Nb_2O_5.

Sensitivity analysis of project's NPV8 (US$m) to LoM throughput (Mt)/resource-to-reserve conversion rate and Nb price (US$/kg)

US$/kg	35Mt (51%)	40Mt (58%)	45Mt (65%)	**50Mt** (72%)	55Mt (79%)	60Mt (86%)	65Mt (93%)	70Mt (100%)
44	400	432	459	481	501	519	535	549
42	347	376	400	420	438	455	470	483
40	294	320	342	**360**	375	390	404	416
38	241	264	283	299	313	326	338	349
36	187	207	224	238	250	262	272	282

Source: Mirabaud Securities estimates

Sensitivity analysis of Panda Hill's IRR (%) to aggregate throughput (kt) and Nb price (US$/kg)

US$/kg	35Mt (51%)	40Mt (58%)	45Mt (65%)	**50Mt** (72%)	55Mt (79%)	60Mt (86%)	65Mt (93%)	70Mt (100%)
44	26.9%	27.1%	27.3%	27.3%	27.4%	27.4%	27.4%	27.4%
42	24.9%	25.1%	25.3%	25.3%	25.4%	25.4%	25.5%	25.5%
40	22.7%	23.0%	23.1%	**23.3%**	23.3%	23.4%	23.4%	23.4%
38	20.4%	20.7%	20.9%	21.1%	21.2%	21.2%	21.3%	21.3%
36	18.0%	18.4%	18.6%	18.8%	18.9%	19.0%	19.0%	19.1%

Source: Mirabaud Securities estimates

Niobium: a semi-precious metal

Niobium, assuming an average long-term price of US$40/kg, is ~3x and ~7x more valuable than nickel and copper respectively (based on our own long-term price assumption of US$40/kg). According to the table below, Nb in terms of value is ranked between precious and base metals.

Niobium (and Panda Hill project) vs. other metals

				US$/kg	Metal/Nb (times)
Precious Metals	Pt	US$/oz	1,400	43,546	1,089
	Au	US$/oz	1,200	37,325	933
	Ag	US$/oz	17	529	13
	Nb	**US$/kg**	**40**	**40**	**1.00**
Base Metals	Ni	US$/t	15,000	15	0.38
	Cu	US$/t	6,000	6	0.15
	Zn	US$/t	2,000	2	0.05
	Al	US$/t	2,000	2	0.05
Minor Metals	Mg	US$/t	2,000	2	0.05
	Mo	US$/t	25,000	25	0.63

Source: Mirabaud Securities

Panda Hill has the same value as an 14.2Moz open-pittable gold deposit graded at 2.6g/t

To put the project into a broader context, Panda Hill has the same value as an equivalent open-pittable gold deposit with 14.2Moz of resources graded at 2.6g/t (or a 2.8Mt copper deposit at ~1.6%), a low LoM strip-ratio of 1.5:1. If it were a gold project, Panda Hill would have a cash cost of ~US$600/oz and a very attractive all-in sustaining cost of ~US$720/oz (using our LT price assumptions).

Cradle strengthens its board

Following the appointment of James Kelly (recently moved to an executive role), on May 9 Cradle announced two more significant additions into the company's board, that of Ian Middlemas and Robert Behets, who both joined the company as non-executive directors.

James Kelly – non-executive director

Mr Kelly was a senior member of the Xstrata group business development team and, following the merger with Glencore, was part of the team which founded Greenstone Resources, a mining private equity fund focused on post exploration development assets.

Mr Kelly has worked for over 15 years in the mining and natural resource industry and has extensive experience in corporate finance, strategy and capital allocation.

Ian Middlemas – non-executive director

Mr Middlemas is a chartered account by profession with extensive corporate and management experience. He has had several successes in the resources sector over the years as a mining executive, with most recent being the West African gold discoverer Papillion Resources.

Mr Middlemas has also had extensive experience of Tanzania, having served as chairman of Mantra Resources, a Tanzania-focused uranium exploration and development company which was transformed into a billion-dollar acquisition for Russian uranium producer ARMZ. We note that Mr Middlemas is already on Cradle's register owning ~10% of Cradle's shares.

Robert Behets – non-executive director

Mr Behets is a geologist with over 25 years' experience. Along with Mr Middlemas, he was part of the founding team that developed Mantra Resources. Mr Behets has strong technical, commercial and managerial skills in addition to operating experience in Tanzania.

Valuation

We value Cradle on a sum-of-parts basis, incorporating a risk-adjusted NPV estimate of Panda Hill (at an 8% nominal discount rate, down from 10% previously) and on a 50% Cradle-attributable basis.

Our target price is now based on a 50% risk adjustment (vs. 55% previously) to Cradle's 50% attributable share

In arriving at our sum-of-parts valuation of A$0.59/sh, we apply a 50% risk adjustment (in recognition of the risks to first production, ie financing Cradle's share of the capex and potential associated equity dilution if funded all, or in part, by equity). This adjustment is down from 55% previously (owing to the better understanding of the project and improvement in the accuracy levels to +15% vs. +25% in the PFS). We apply this to Cradle's 50% attributable share of our base-case NPV estimate of Panda Hill.

The changes to our model assumptions along, with the downwards revised discount rate to 8% (from 10% previously), have resulted in a ~3% decrease in Panda Hill's NPV to US$360m (on a 100% basis).

We note that Cradle at end-Q3 must pay US$1.5m (its 50% share of the US$3m) to RECB (the original vendor) as part of the purchase agreement for the Panda Hill mining licence (10 November 2015). At end-Q1 2016, Cradle had A$2.9m

(~US$2.1m) in cash, while we estimate its corporate level needs over the next 9-month period at US$0.5-1.0m. We also note that Cradle has a ~US$1.1m credit if and when further funding is required, as Tremont is liable to match the value of the 6.2m new shares issued by CXX as part of the above mentioned purchase agreement, prior to the latter having to make any further contributions. Thus we understand that CXX has enough money to fund a maximum size of FEED budget of ~US$1.5m.

Cradle Resources – sum-of-parts valuation

	US$m	A$/sh*
Panda Hill, NPV_8 – 50% attributable basis	179.8	1.50
Risk adjustment - 50% reduction	-89.9	-0.75
Project valuation	**89.9**	**0.75**
Corporate-level costs, NPV_8	-23.7	-0.20
Net cash (estimate)	2.1	0.02
Cash from in-the-money options	2.1	0.02
Company valuation	**70.3**	**0.59**

*154.73m current issued shares, plus 11.98 in-the-money unlisted options A$1 = US$0.72
Source: Mirabaud Securities estimates

Our A$0.59/share risked valuation (from A$0.56/sh previously) offers ~75% upside to CXX's current share price, and we therefore retain our recommendation at BUY. We also retain the SPECULATIVE qualifier owing to the inherent funding risks.

Project sensitivities

We have also created a series of sensitivity tables in order to estimate the potential impact of changes to a number of basic variables such as the niobium price, discount rate and niobium recovery in converter where the project is most sensitive, as well as the project's costs (capital and operating).

The first set of tables below illustrates Panda Hill's NPV and IRR sensitivity to a range of Nb prices, against the nominal discount rate in the first, and Nb recovery in the converter in the second table. They both indicate a robust project mainly due its relatively high IRR (23.3%) at our conservative model assumption (ie Nb price of US$40/kg), while offering significant upside on likely higher niobium prices.

Panda Hill NPV (US$m) sensitivity to real Nb price and discount rate

	US$36/kg	US$38/kg	US$40/kg	US$42/kg	US$44/kg	US$46/kg
12%	112	154	196	238	280	322
10%	166	217	267	318	368	418
8%	238	299	**360**	420	481	541
6%	331	406	480	555	629	704
4%	455	548	641	734	827	919
IRR (%)	18.8%	21.1%	**23.3%**	25.4%	27.4%	29.2%

Source: Mirabaud Securities estimates

Panda Hill NPV (US$m) sensitivity to real Nb price and Nb recovery in converter

	US$36/kg	US$38/kg	US$40/kg	US$42/kg	US$44/kg	US$46/kg
98%	257	319	382	444	505	567
97%	247	309	371	432	493	554
96%	238	299	**360**	420	481	541
95%	228	288	349	409	469	529
94%	218	278	337	397	456	516

Source: Mirabaud Securities estimates

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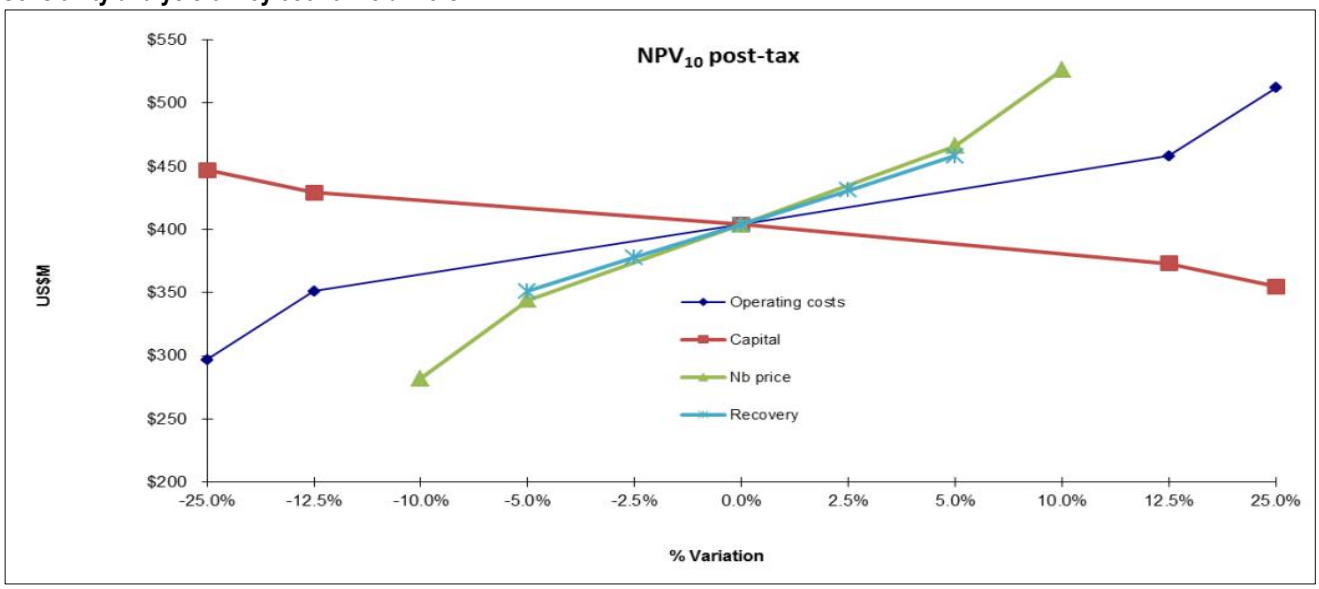
Sensitivity analysis of key economic drivers



Source: Cradle resources

Summary operating estimates (100% basis) – calendar years

CY to Dec. 31		2015A	2016F	2017F	2018F	2019F	2020F	2021F	2022F
Ore processed	kt	-	-	-	-	1.13	1.24	1.30	1.30
Nb_2O_5 grade	%	-	-	-	-	0.71%	0.72%	0.74%	0.72%
Concentrator recovery	%	-	-	-	-	58%	60%	60%	61%
Conversion recovery	%	-	-	-	-	96%	96%	96%	96%
FeNb produced (66% Nb grade)	kt	-	-	-	-	4.8	5.4	5.8	5.7
Nb price	US$/kg	-	-	-	-	40.0	40.0	40.0	40.0
On-site cash operating costs	US$/kg	-	-	-	-	24	22	20	20
Total cash costs	US$/kg	-	-	-	-	27	25	23	23
AISC	US$/kg	-	-	-	-	28	26	24	23
Capital expenditure	US$m	-	4	147	63	3	3	3	97

Source: Mirabaud Securities estimates

Summary financial estimates (unfunded, 50% Cradle-attributable basis) – financial years to 30 June

FY to Jun 30		2015A	2016F	2017F	2018F	2019F	2020F	2021F	2022F
Profit and loss									
Gross revenue	US$m	-	-	-	-	31.5	67.0	73.9	76.29
Operating costs	US$m	-	-	-	-	(22.9)	(44.8)	(44.3)	(43.8)
G&A	US$m	(4.0)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)
EBITDA	US$m	(4.0)	(1.5)	(1.5)	(1.5)	7.1	20.7	28.1	30.9
Depreciation & amortisation	US$m	-	-	-	-	(1.5)	(3.1)	(3.5)	(4.5)
EBIT	US$m	(4.0)	(1.5)	(1.5)	(1.5)	5.6	17.5	24.6	26.4
Interest & FX change	US$m	1.5	-	-	-	-	-	-	-
Tax	US$m	-	-	-	-	-	-	-	-
Net profit	US$m	(2.5)	(1.5)	(1.5)	(1.5)	5.6	17.5	24.6	26.4
Cash flow									
Cash-flow from operations	US$m	(1.6)	(1.5)	(1.5)	(1.5)	7.1	20.7	28.1	30.9
Cash-flow from investing activities	US$m	1.2	(3.0)	(36.7)	(52.5)	(16.5)	(1.5)	(1.5)	(25.1)
Cash-flow from financing activities	US$m	0.2	-	-	-	-	-	-	-
Net cash flow	US$m	(0.2)	(4.5)	(38.2)	(54.0)	(9.4)	19.1	26.6	5.8
Year-end cash balance	US$m	2.4	(2.1)	(40.4)	(94.3)	(103.8)	(84.6)	(58.0)	(52.2)
Ratios									
EV/EBITDA	x	na	na	na	na	5.1	1.7	1.3	1.2
PE	x	na	na	na	na	6.7	2.2	1.5	1.4

Source: Mirabaud Securities estimates

A$1 = US$0.72

Appendix: the niobium market

Introduction

Niobium is a lustrous grey, soft, rare, transition metal used in the production of high-grade steel. It is an alloying agent (usually with the form of FeNb, which is a mixture of ~66% of Nb and ~34% of Fe), which when added to another material (steel) creates a final product (high-strength, low-alloy steel - HSLA) with substantial benefits (it is corrosion resistant, adds strength, reduces weight, improves flexibility and durability, and exhibits superconductivity properties). Its name comes from Greek mythology: Niobe, daughter of Tantalus, as Nb's chemical properties are very similar to those of tantalum.

Niobium faces strong competition from other refractory metals, particularly vanadium (in HSLAs) and tantalum, for applications in the dominant metal-oxide semiconductor (MOS) computer technology. Niobium, despite having a high melting point (2,468°C), has a low density in comparison with other refractory metals. When very pure, it is comparatively soft and ductile.

Niobium is the 33rd most common element in the Earth's crust (20ppm on average), with a market of >US$4bn pa with growth dynamics, mainly in anticipation of further increases in consumption in BRICS and, in particular, from China. Niobium is found primarily in Brazil (~90%) and Canada (~9%), which account for about 99% of total reported niobium production (world reserves at 2.7Mt of contained niobium).

Uses of niobium

Niobium is used to enhance steel by adding strength while reducing weight, improving flexibility and increasing durability (anti-corrosive properties). These qualities make niobium-bearing steels desirable to the automobile-manufacturing industry and to constructors of large-scale, high-stress bearing structures (eg bridges, high-pressure oil and gas pipelines).

The main marketed niobium product is standard grade (~66% Nb) FeNb, which is mainly used as an alloying agent in the production of HSLA, accounting for around 90% of total niobium consumption (HSLA accounts for ~85% of total Nb consumption).

Niobium producers by final product

Producer	% of Nb market	% of Nb market	Product	Applications	Principal Markets
CBMM China Molybdenum Niobec / Magris	76% 7% 7%	90.0%	Standard-grade FeNb (60-66% Nb)	HSLA* - 94% Stainless steel - 3% Heat-resistant steel - 3%	Auto industry - 25% Infrastructure - 45% Pipelines - 20%
CBMM	3.0%	3.0%	Vacuum grade FeNb (99% Nb)	Super alloys	Aircraft engines Power generation
CBMM	3.5%	3.5%	Nb metals and alloys (50-65% Nb)	Superconductors	Particle accelerators Small-tonnage uses
CBMM	3.5%	3.5%	Nb chemicals (>99% Nb)	Ceramics Catalysts	Optical Electronics

Source: Mirabaud Securities

*HSLA usually contains no more than 300ppm of Nb (300g of Nb/t of crude steel or 450g of FeNb/t

Infrastructure - ~40% of total Nb consumption

Infrastructure (45% of world FeNb consumption or 40% of total Nb consumption):

- Millau Valley bridge (40kt HSLA): 250ppm of Nb reduced weight by 60% (saving in steel and concrete)

- Oresund bridge (82kt HSLA): 220ppm of Nb (total cost of Nb US$0.5-1.0m) resulted in cost savings of ~US$25m
- Commerzbank Tower (19.5kt of steel incl. 10Mt of HSLA): 300-500ppm of Nb, resulted in a weight saving of 60kt (vs. the reinforced concrete option).
- The addition of 200ppm (0.02% or US$8/tonne) Nb to a tonne of steel can increase its strength by up to 30%

Automotive industry - ~21% of total Nb consumption

Automotive industry (25% of world FeNb consumption or 21% of total Nb consumption):

- Nb enables significant cost benefits by improving fuel efficiency, reducing vehicle weight and environmental emissions as well as increasing passengers' safety.
- ~US$10 of Nb (300gr) added to a car (mid-sized car) will reduce a vehicle's weight by >100kg, which introduces a 5% fuel efficiency (or 0.5l/100km)
- 100kg weight reduction translates into a 6% reduction in CO_2 emissions (9g/km). EU legislation sets mandatory emission reduction targets for new cars (penalties may be as high as €95 for every g/km over the limit), from >150 g/km of CO_2 before 2010 to 130 g/km of CO_2 in 2015 to 95 g/km of CO_2 by 2020 (>35% CO_2 emissions reduction).
- Between 2007 and 2015, the use of HSLA in cars in North America was forecast to grow from 11% to 40%. This would double total world consumption of Nb.

Oil & gas pipeline - ~18% of total Nb consumption

Pipelines (20% of world FeNb consumption or 18% of total Nb consumption):

- The main application for stronger and lighter steel (HSLA) pipes is to transfer natural gas over long distances under high pressure. As a result the increased consumption of natural gas will drive demand for HSLA steel.
- Natural gas transportation pipelines account for ~60-70% of total pipeline construction (the main use of HSLA steels).

The above result in a **cost effective** and **environmentally friendly** metal **(reduces carbon footprint)** with numerous known applications which are continuing to grow with potential end-users' increasing understanding of niobium's many beneficial properties.

Supply–demand drivers

Supply – concentrate market

Niobium occurs in the mineral pyrochlore and columbite, which contain niobium and tantalum in varying proportions. The mineral pyrochlore (97% of Nb) is mined primarily for its niobium content. Columbite is mined primarily for tantalum with niobium extracted as a by-product.

Current producers vs. Cradle Resources

	CBMM	China Molybdenum (Catalao)	Magris (Niobec)	Cradle Resources (Panda Hill)
Country	Brazil	Brazil	Canada	Tanzania
Type	Open-pit	Open-pit	Underground*	Open-pit
Resources (Mt)	1765	75	698	178
Resource Grade	2.2%	1.2%	0.4%	0.5%
LOM (years)	>100	-	30	>30
Capacity (FeNb kt)	120	9.5	8.5	8.2
Final Product	FeNb, alloys, oxides	FeNb	FeNb	FeNb
% of total production current (future)	87% (83%)	7% (8%)	6% (5%)	0% (5%)
Production Cost	US$11/kg Nb	US$15/kg Nb	US$22/kg Nb	US$18/kg Nb

Source: Mirabaud Securities

* Magris Resources will decide if Niobec will be proceeding with the block-caving model for future expansion

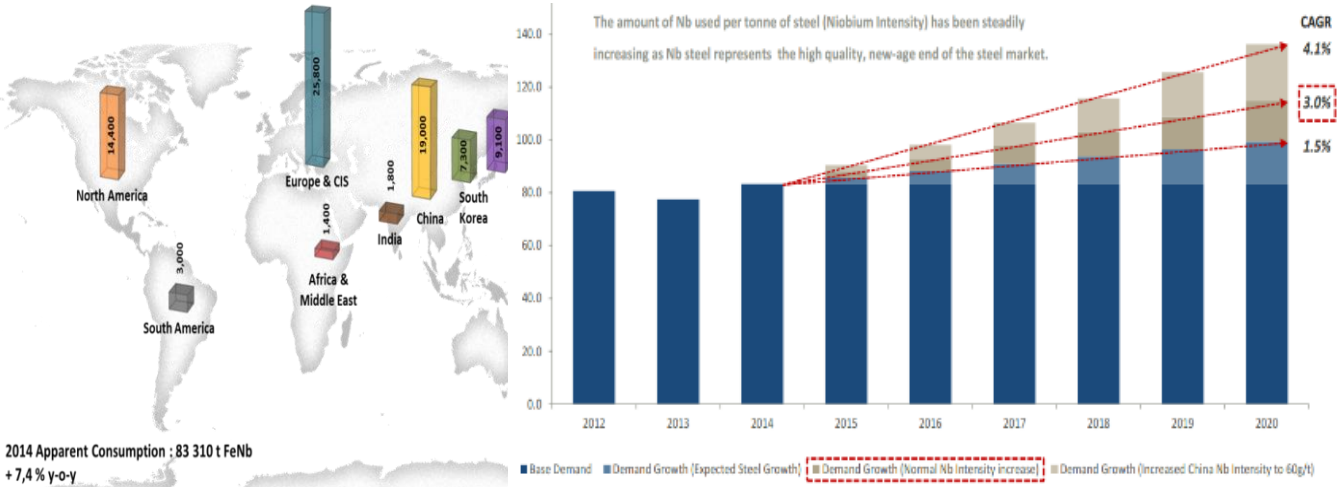
Almost 100% of current primary Nb production comes from three mines in the Americas (CBMM and Anglo American in Brazil and Niobec in Canada – see table below). Panda Hill thus will become the first primary niobium producer to come on stream since 1976. All three producers convert pyrochlore concentrate to FeNb prior to sale, with CBMM being the only producer to offer a variety of other lesser-used niobium products (such as niobium metal, oxides and alloys).

Demand – twofold growth

The ferroniobium market is expected to grow in a twofold way; growth in steel production as well as growth in the niobium intensity used, which is estimated to exceed the increase in the output of steel.

With HSLA steel production the dominant end-use, **Nb demand** is closely correlated to global steel production. Rising steel demand over the past decade, mainly in the BRIC countries (particularly in China), has resulted in a compound annual growth rate in FeNb demand of ~10% over the last ten years. We expect solid growth in steel production to continue, albeit perhaps at a slower rate compared with the past decade, and FeNb demand, which is currently 90-100ktpa, may outpace this growth if the trend established is maintained.

Annual FeNb consumption (by country) and global FeNb demand five-year forecast



Source: Cradle Resources (compiled using data provided by Roskill and World Steel Association)

One reason for this historical outperformance relative to steel production growth is the **intensity of niobium's use in steelmaking -** as customer requirements for higher-spec steels increase, so steelmakers must increase the amount of niobium used to produce steel capable of meeting these higher standards. According to Niobec, the average FeNb content of steels was approximately 40g/t in 2000. Across the next eight years this figure rose by over 60%, to 65g/t. Average global FeNb intensity levels in steelmaking fell sharply in 2008 in the wake of the global credit crisis, but quickly rebounded and have remained in the 50g/t range over recent years, but with a large degree of geographic variation – **intensity levels in the US (>100g/t), EU and Japan (~80g/t) are higher, but in the majority of the emerging-market economies (China ~30g/t) they are significantly below the 2013 global average of ~45g/t.** Thus, we expect a minimum 3% annual growth in global demand for Nb over the next 5 years, as a result of both a growth in the Nb intensity used and an increasing demand for steel from emerging nations, the Nb's market main driver (see graph above).

Given that Nb represents a very small percentage of the total cost of producing steel (<0.5%), yet adds significant value to those steels by virtue of its strength, weight and durability characteristics, we would expect the intensity of use to continue to rise (by a minimum of 15% within the next five years). In particular the emerging economies, which account for ~35% of current world consumption (China, India, Russia and Turkey), will see incremental growth in intensity.

China, the world's largest steel producer (with its share of world production rising from 1% in early 1990s to ~40% today), is the biggest HSLA steel producer (and thus FeNb consumer). We expect to see increased HSLA steel production (HSLA steel currently accounts for just 10% of all steels produced, compared with around 20% in the developed world), as well as an increase in the quality of China's steel production with an increase in intensity of Nb use.

FeNb pricing – not demand-driven

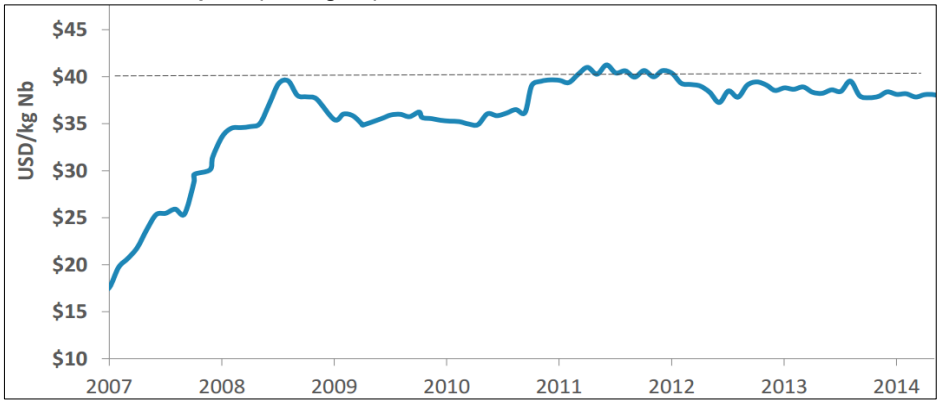
Almost 95% of FeNb production is sold under long-term contracts between producers and consumers, with only ~5% being sold via the spot market. Although contract prices are not disclosed, trends can be seen from average import values.

FeNb prices are not demand-driven but are largely determined by CBMM, as a result of both its dominant position in the market as well as due to the apparent willingness of its two competitors to let CBMM lead. Moreover, the significant technical advantages offered by the use of Nb, combined with the fact that FeNb constitutes a very small proportion of the overall cost of producing a niobium-bearing steel (typically less than 0.5%), means that demand is relatively inelastic to price. These are also contributing factors to CBMM's ability to influence prices.

Clearly, given its position as the overwhelmingly dominant producer, and ability to expand production significantly over the medium to long term, CBMM has the ability to discourage any prospective new supply by dropping its prices. However, we believe this is a highly unlikely scenario, as the required price drop would be substantial and would therefore have a significantly detrimental impact on the group's own profitability. Even in that case, Panda Hill, as the second lowest cost producer along with the Catalao mine, would not be affected to the same extent as the Niobec underground mine which is the highest cost producer (see p16).

The 2006-08 increase in Nb prices (after a lengthy period of stability), was mainly a result of CBMM's marketing efforts (mid-2000s) which succeeded to more than double Nb prices to current levels (5-year average of slightly below US$40/kg Nb).

Historical niobium price (US$/kg Nb)



Source: Roskill

The relatively steep price increase between 2006 and 2008 (see graph above), with a simultaneously increase in production, indicates a demand-inelastic price environment as well as a market ready to accept a price increase. We believe FeNb prices will continue to rise gradually in the medium to long-term, without being massively impacted by extra production added from potential new producers, given the absence of undeveloped projects with either the quality characteristics or the size of the existing producers (see p16)

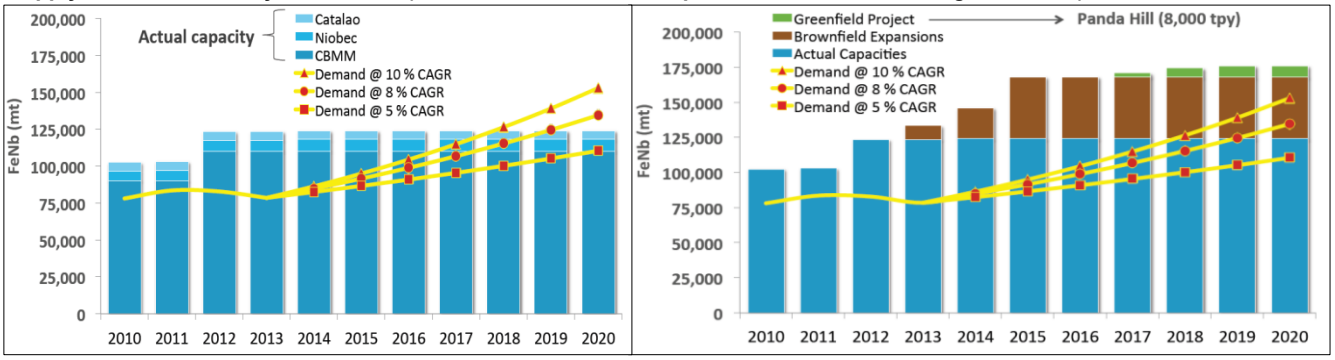
World forecast FeNb and Nb capacity, production, cash cost

	Resources (Mt)	Reserves (Mt)	Grade (Nb_2O_5 %)	Capacity (kg of FeNb)	Nb production (kg of Nb)	Cash cost US$/kg Nb	Market share
			Current – status				
CBMM	1765	440	2.2%	120,000	79,200	10	86.9%
Catalao	75	4	1.2%	9,500	6,300	18	6.9%
Niobec*	698	416	0.4%	8,500	5,600	23	6.2%
Total	***1913***	***860***	***1.4%***	***138,000***	***91,100***	***11***	***100.0%***
			Expansion				Date
CBMM				30,000	19,800		-
Catalao				4,100	2,700		2017
			Total Capacity				
CBMM				150,000	99,000	11	83.2%
Catalao				13,600	9,000	15	7.5%
Niobec*				8,500	5,600	22	4.7%
Panda Hill	***178***	***-***	***0.5%***	***8,200***	***5,400***	***18***	***4.6%***
Grand Total				**180,300**	**119,000**		**100%**

Source: Roskill, Iamgold, Mirabaud Securities

*Niobec's expansion not included due to uncertainty

Supply – demand seven-year forecast (base-case scenario vs. expansion scenario including Panda Hill)



Source: CAMET, Cradle Resources

Why Panda Hill?

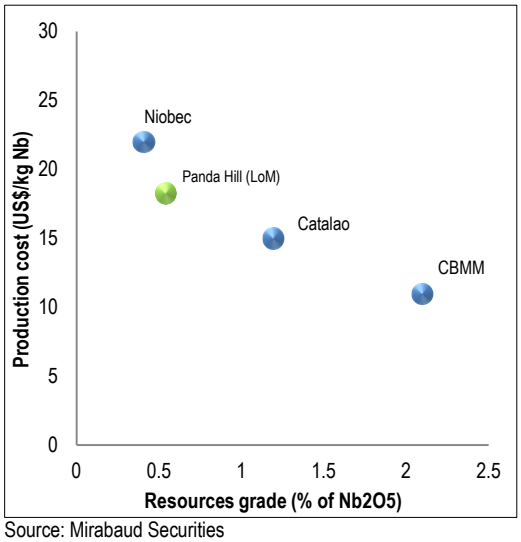
In such a concentrated market, for a project to become economically viable and remain unaffected by price variations as well as by its competitors, it should have a number of key characteristics (open-pittable, low strip ratio, high grade, simple metallurgy and low operating costs). Panda Hill has all these characteristics, while it is located in a mining friendly country and is well-served by excellent local infrastructure (paved highway, rail and close to an international airport).

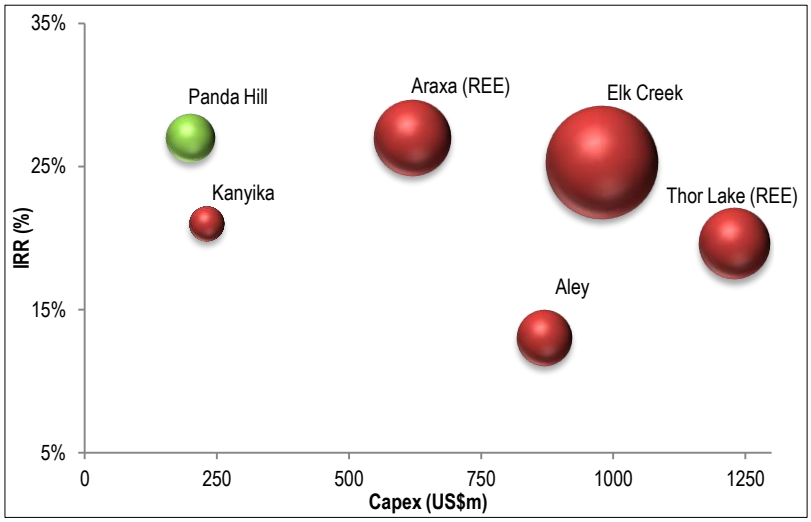
A number of other niobium deposits are known but remain undeveloped, in most cases owing to permitting obstacles, high capex needs (see graphs in p16) or reliance on other minerals (mainly rare earth elements and tantalum) for their economic viability, with Nb being a by-product in most cases.

Of the main undeveloped resources (see chart below), only Panda Hill, Elk Creek and Alley can be considered true primary niobium projects, with Aley having difficult metallurgy and significantly lower grade than the established producers

and Elk Creek lying at substantial depth below surface. With respect to the other projects, niobium occurs with a suite of other minerals (eg rare earth elements, tantalum and zirconium), which can present processing challenges and may also mean development prospects are tied to the economic viability of those other commodities. As a result we do not foresee a new entrant from a primary Nb producer, particularly not one with a project of similar quality, in the near future.

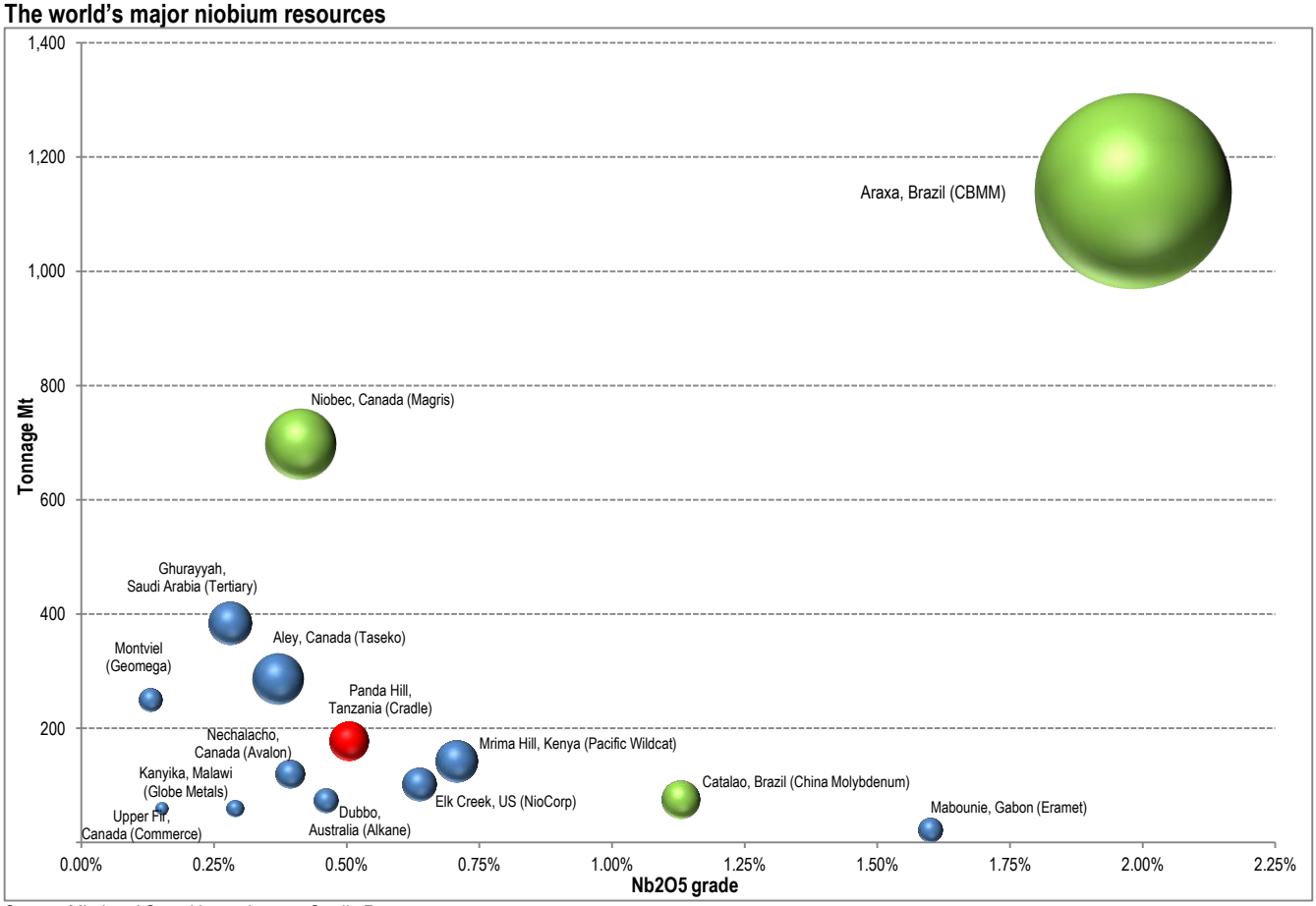
Panda Hill vs. producers (left) and other development project's (right - bubble size: project's NPV)





Source: Mirabaud Securities

The world's major niobium resources



Source: Mirabaud Securities estimates, Cradle Resources

Panda Hill supplementary valuation based on recent sector deals

The niobium market, despite its oligopolistic features, has been very active recently, with four deals taking place in the last five years. In 2011 (March and September) CBMM sold a 15% shareholding in the company to a Japanese and Korean steel consortium for US$1.95bn and another 15% stake to a Chinese consortium for US$1.98bn, while in late-2014 Iamgold sold its 100% owned Niobec mine to Magris Resources (a PE group) for a total consideration of US$530m (comprising US$500m in cash and US$30m in royalties).

Anglo American has recently (28 April) sold its niobium and phosphate assets in Brazil for US$1.5bn to China Molybdenum. The two businesses generated a combined EBITDA of US$146m in FY2015, with Catalao's contribution being ~35%. However, in our view that does not reflect the real value split between the phosphate and niobium assets, as the latter is in a ramping up phase after US$100m having being spent for its expansion to ~9.0Mtpa. Thus, we believe that a 55:45 split between the niobium and phosphate assets better reflects their true value. Consequently, that would put a value of ~US$825m on the Catalao mine.

Panda Hill, as an open-pittable, low-technical-risk deposit with relatively high-grade which allows for low operating costs, should be rated closer to the Catalao mine rather than the Niobec mine. We estimate that when in production, Panda Hill will be ranked as the second cheapest niobium producer alongside Catalao, behind only the big CBMM, with a relatively long life-of-mine of ~30 years LoM (see graph above).

In an attempt to value Cradle on an EV multiple basis, we apply to the company a range of EV multiples based on the above-mentioned deals. We expect higher-quality deposits to trade at higher multiples; however, for the purposes of this exercise we conservatively assume that Panda Hill, which in our view should be ranked closer to Catalao rather than Niobec (see graphs in p16), be rated at a 50:50 weighting of the two projects, implying an EV of ~US$75/kg of annual FeNb production. The latter gives Cradle (50% of Panda Hill) an unfunded value of US$306m (we estimate Cradle's funding needs at ~US$105m), in-line with our funded discounted model cash flow of ~US$180m, which is our preferred valuation method for Cradle, .

From an EBITDA point of view, based on Niobec's deal, we estimate that the sale price implies a ~6x EBITDA while for Catalo's recent agreement this ratio increases to ~7.5x EBITDA (we are assuming 6.8kt sales at a Nb price of US$40/kg and an EBITDA margin of ~40% - last 2 year average). For Cradle, based on our above mentioned split assumption between the two other mines, we calculate an average multiple of 6.5-7.0x EBITDA. That, combined with a life-of-mine average annual EBITDA of ~US$100m, values Panda Hill at US$650-700m and thus Cradle (50% of Panda Hill) at ~US$325-350m.

Cradle project-based valuation

	Deal size ($m)	% of the company	Implied equity valuation ($m)	Production kt of FeNb	EV/tonne production (t of FeNb)	Multiple (x)	EV/t attr. to Cradle	Cradle's valuation
CBMM	3,930	30%	13,100	120.0	109.2	0%	0	
Niobec	530	100%	530	8.5	62.4	50%	31.2	
Catalao	825	100%	825	9.5	86.8	50%	43.4	
Panda Hill		50%		8.2	74.6	100%	74.6	306

Source: Mirabaud Securities

RECOMMENDATIONS HISTORY

Cradle Resources Ltd

Market index FTSE AIM Basic Resources

Date	Market Index	Stock Price (A$)	Valuation (A$)	Opinion
02 July 2014	2,683	0.19	0.50	SPECULATIVE BUY
04 February 2015	1,860	0.15	0.55	SPECULATIVE BUY
31 March 2015	1,902	0.22	0.56	SPECULATIVE BUY
23 May 2016	1,903	0.34	0.59	SPECULATIVE BUY

RATINGS, CERTIFICATION AND DISCLOSURE

RATINGS SYSTEM

BUY: The stock is expected to generate absolute positive price performance of over 10% during the next 12 months.

HOLD: The stock is expected to generate absolute price performance of between negative 10% and positive 10% during the next 12 months.

SELL: The stock is expected to generate absolute negative price performance of over 10% during the next 12 months.

RISK QUALIFIER: Speculative: The stock bears significantly higher risk that typically cannot be valued by normal fundamental criteria and investment in the stock may result in material loss.

The ratings are applicable to all research produced after 1 January 2016.

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Each Investment Analyst of Mirabaud Securities LLP whose name appears as the Author of this Investment Research hereby certifies that the recommendations and opinions expressed in the Investment Research accurately reflect the Investment Analyst's personal, independent and objective views about any and all of the Designated Investments or Relevant Issuers discussed herein that are within such Investment Analyst's coverage universe.

INVESTMENT RESEARCH DISCLOSURES

The following disclosures relate to this document:

Cradle Resources Ltd (CXX AU): 2, 3

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