

# NELLY VANADIUM MINE

San Luis, Argentina

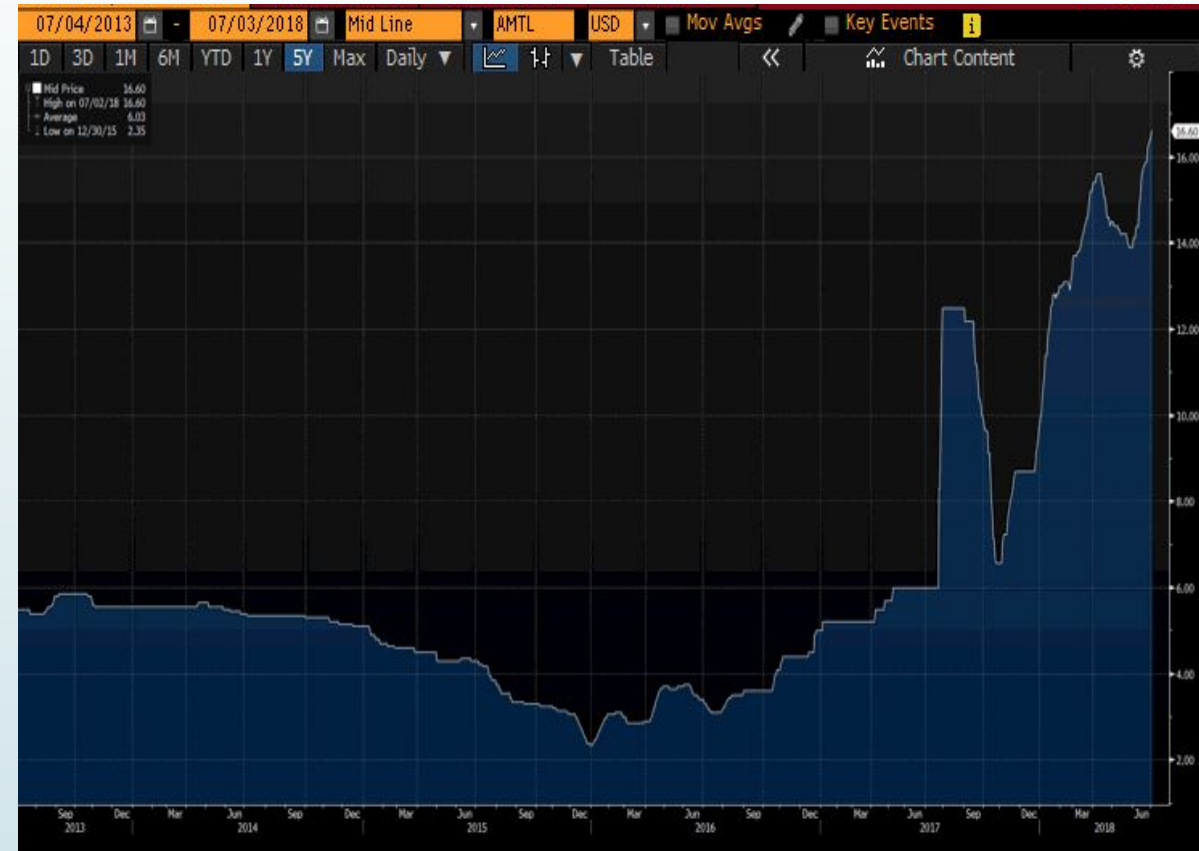
*“Opportune time to re-open a vanadium mine”*

Investor Presentation

July 2018

# Vanadium supply tightening...

- Twin effects – global supply bottleneck and rising demand – have underpinned a >200% rise in the vanadium price since 2016
- China – which supplies c.50% of global vanadium – is using more of its output following new rules to double rebar requirements (post-recent earthquakes) and has shut polluting mines, reducing its output by circa 10% and propelling a search for new supply chains
- Traditionally, the steel industry consumes 90% of global vanadium, but at the margin demand from the renewable battery sector is starting to take-off



\* Source: Bloomberg

- In short, with demand for scalable energy storage accelerating, reflecting wider renewable energy adaption, Vanadium Redox Batteries (VRBs) are a preferred scalable energy storage solution

# ...Opportune time to re-open a vanadium mine

- Key VRB pros: scalability, suitable for grid connection, 20-yr lifespan, instant energy release, excellent charge retention / discharge and using only one element in electrolyte form:  $V_2O_5$
- The Nelly Vanadium Mine has been in a moth-balled state for nearly six decades – minimal vanadium was extracted due to the rudimentary technology deployed between 1949-57
- However, under Argentina's laws, it's a simple process to reactivate the mine and would take less than 12-months for production to recommence, provided the company is able to define an economically viable mineral resource or ore reserve under the JORC Code (2012) and if the renewal process is expedited
- Currently, as structural change favours emerging vanadium suppliers, the mine offers significant exploration upside with historic channel sample grades up to 1.9%  $V_2O_5$ \* and additional polymetallic mineralisation for copper, lead, silver and zinc\*
- Placing this in context, the mine comprises several vanadium-rich polymetallic sheeted vein systems aligned N-E to S-W, but only one was partially exploited during 1949-57 leaving most of the deposit intact
- Excluding Cu, Pb, Ag and Zn credits, legacy reference reports suggest a 0.9-1km mineralised trend up to 5.5m wide and 40m deep with up to four incremental unmined veins\*

# Unique high-quality asset

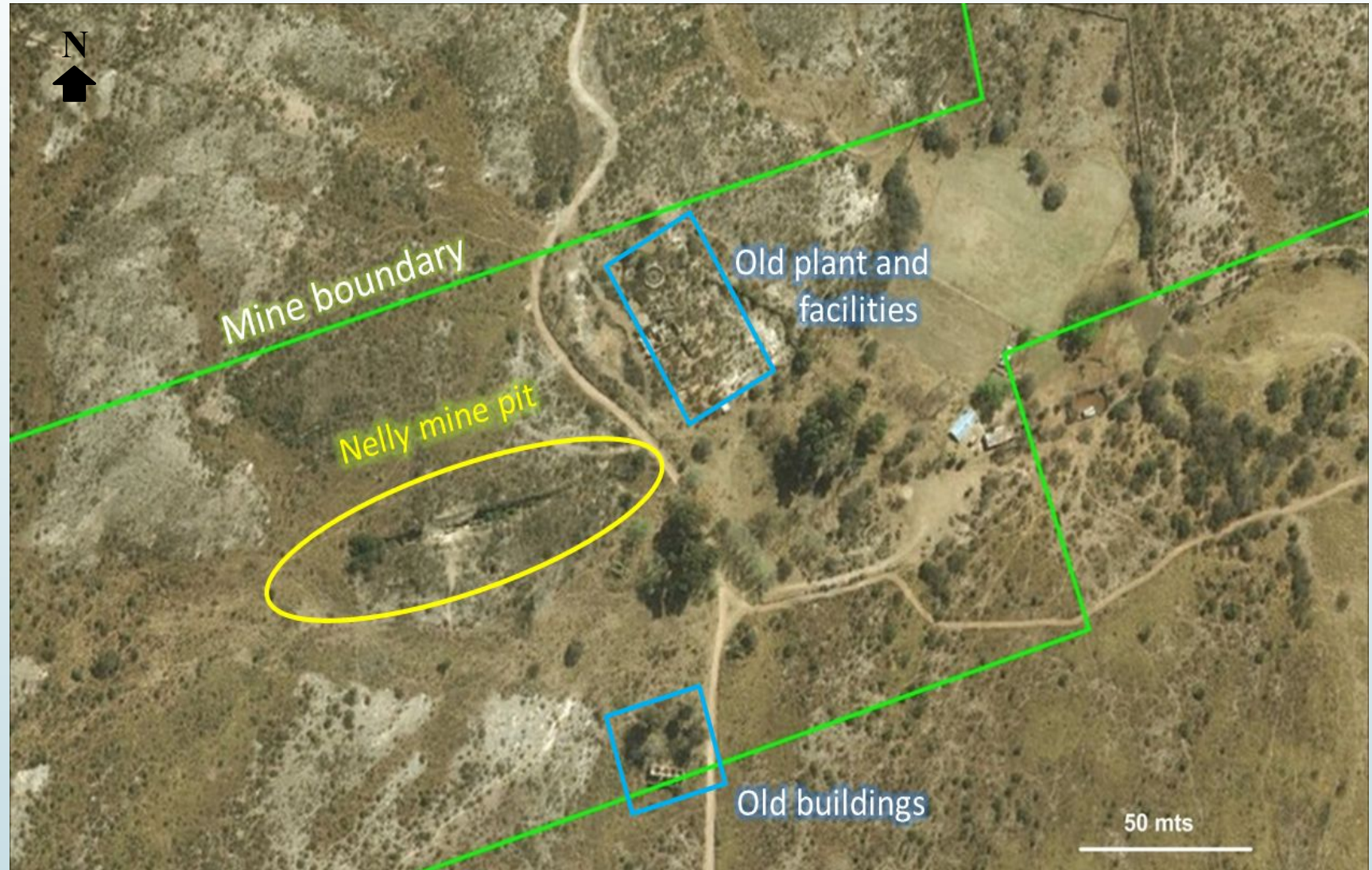
- Nelly Vanadium Mine is on 53 hectare tenement located in San Luis Province, Argentina
- Legacy records show minimal vanadium was extracted during its 1949-57 lifecycle
- Historic records show channel sampled material that had assay grades of up to 1.9%  $V_2O_5$ \*



\* HDY ASX Announcement 3/July/2018

# Top-down view

- Satellite picture shows historic plant, facilities and living quarters
- Initially, the mine was developed as an open pit, then underground galleries
- Reflecting the significance of the deposit for the era, it was rare for operating mines to have facilities and staff living on site

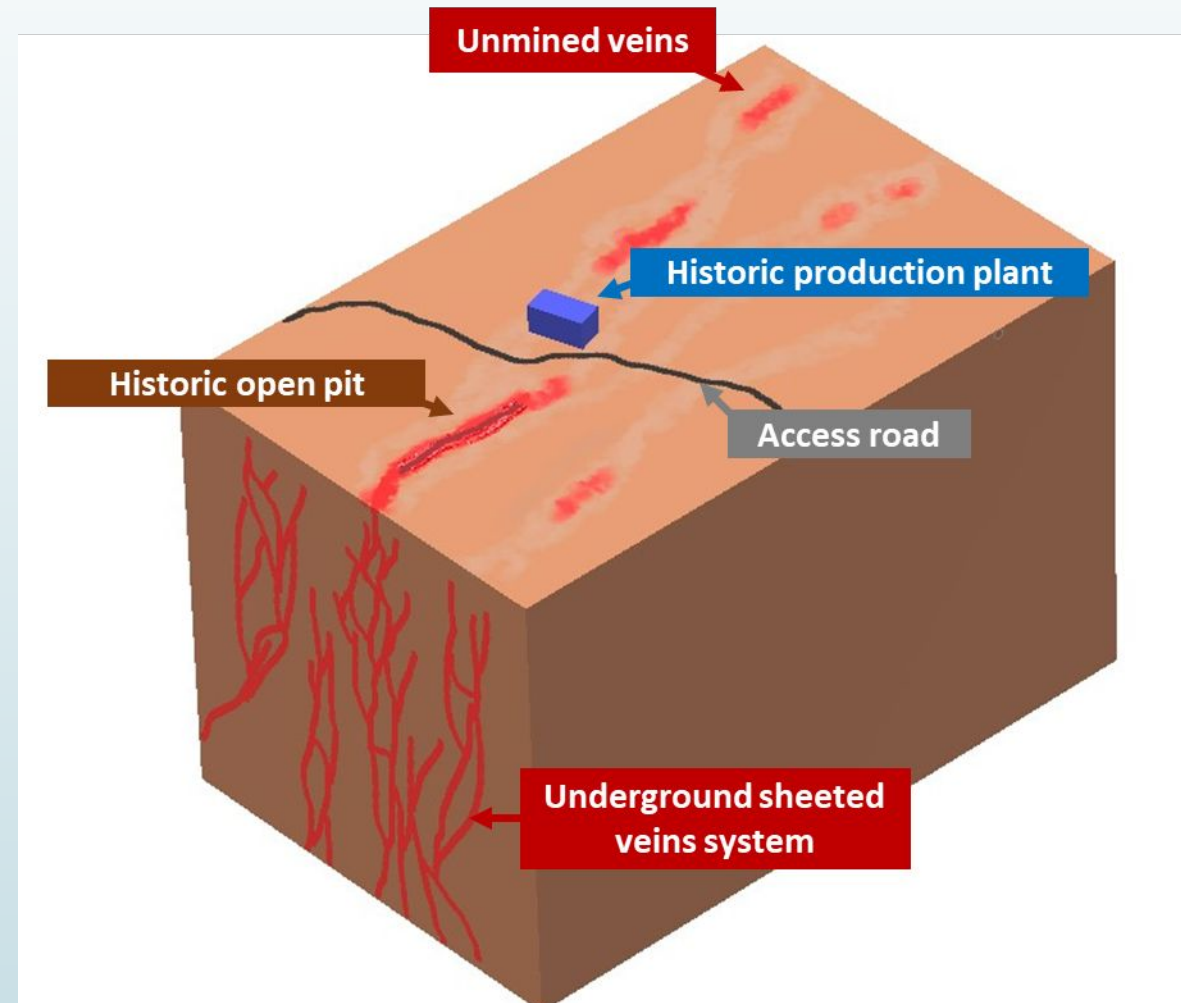


# Significant upside and advantages

- Historic studies have all confirmed mineralisation for vanadium, copper, zinc, silver and lead but the mine and surrounding area was materially under-explored
- As such, exploration upside is significant with the potential to define a shallow near surface ore body from modern exploration techniques
- Fast tracking production is feasible and attractive, since regulations to reactivate legacy mines are relatively straight forward, provided the company is able to define an economically viable mineral resource or ore reserve under the JORC Code (2012) and if the renewal process is expedited
- Infrastructure is reliable with ready access to the mine via highway – sealed and well formed gravel roads – that connect to railroads and ports then onto global markets
- The mine is in the Las Aguadas district and is only 170km from San Luis' capital city
- Mains power and water supply is reliable while the local communities / governments are mining friendly given the industry is a key employer and contributor to the region

# Mineralisation model shows vein system

- Mineralised veins at surface are emplaced in a structural trend aligned N-E to S-W
- Most of these comprise parallel veins creating a sheeted system
- Mineralised veins have been mapped outcropping within alteration halos at surface but the underground is completely under-explored
- The schematic model (right) shows possible underground extensions in a vanadium-rich polymetallic vein system \*
- The model will be tested systematically with modern exploration techniques and equipment



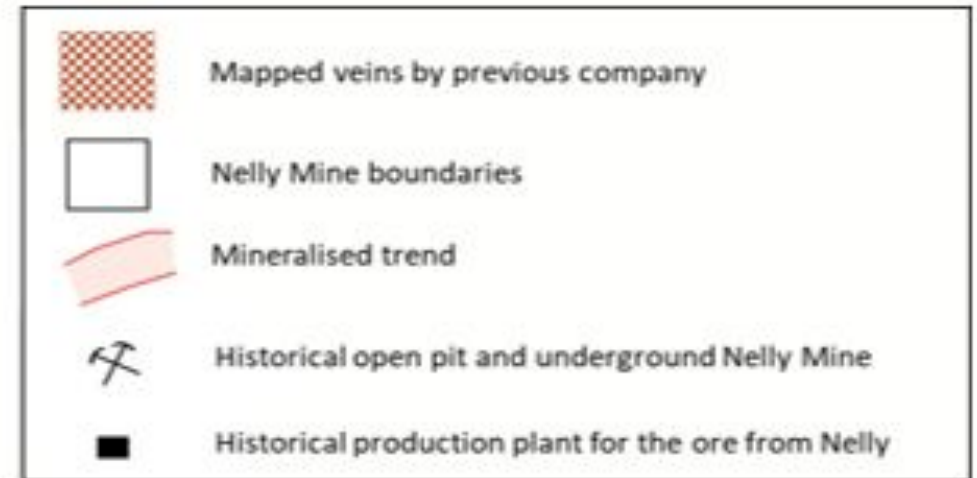
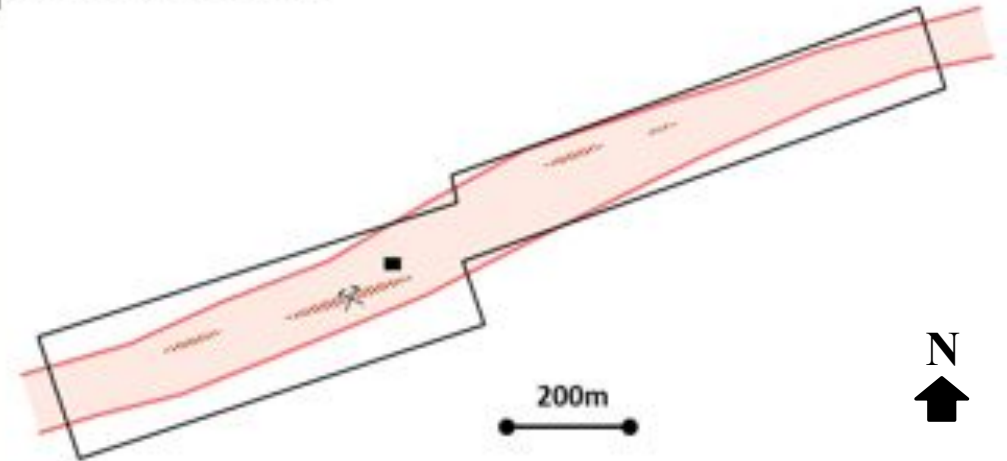
\* HDY ASX Announcement 3/July/2018

Note (i) above image is not to scale & (ii) further exploration techniques would be required to determine the extent of the structure and the grade of the underground vein system

# Mineralised trend

- Reference reports confirm a 0.9-1km mineralised trend running through the project area
- Four vein outcrops were historically mapped in the project area
- Only one of the veins was historically mined from 1949-1957, leaving most of the deposit intact
- Basic exploration methods were used, hence, the potential for discovering additional mineralisation is high through the utilisation of modern exploration methods

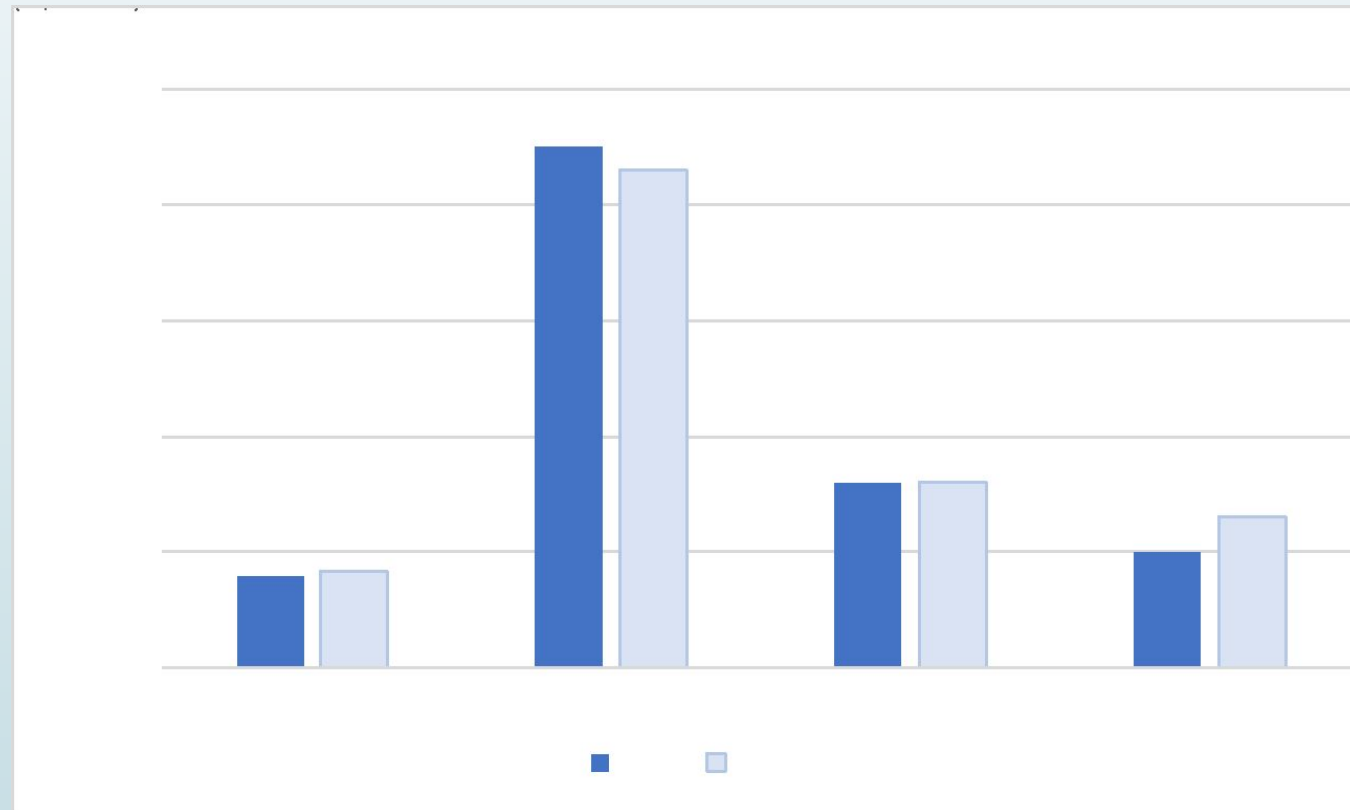
Top-down view





# Supply-side dynamics at work...

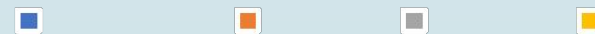
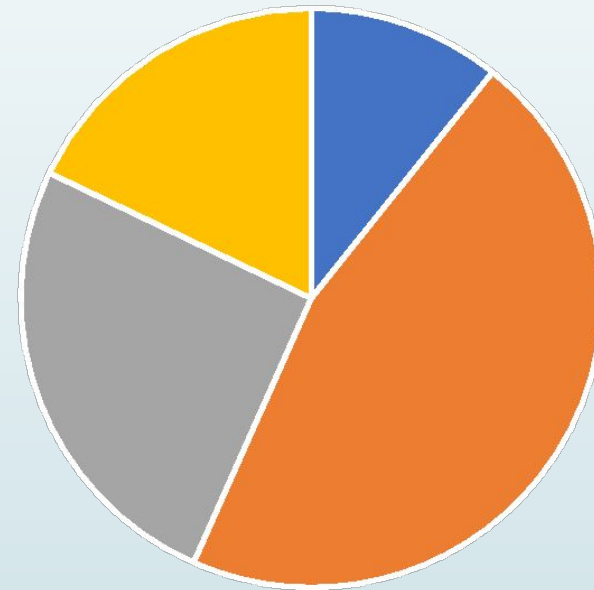
- On the supply side, China's clamp down on polluting vanadium mines reduced its output nearly 5% YoY in 2017 to 43,000t
- Higher output from South Africa resulted in only a 2% increase in global production to 80,400t



Source: USGS

# ...limited new options available

- Outside the big three, USGS lists Australia with the fourth largest Vanadium reserves
- The USGS details no data for South America but Brazil produced 8,400t in 2017, placing it fourth after South Africa
- Although there is no macro data for South America, there are active and historic vanadium mines in Brazil and Argentina
- In the geology team's view, Argentinean projects can be viewed attractive if there is the potential to rapidly define a shallow near surface ore body utilising modern exploration techniques



Source: USGS

# Demand-side applications accelerating

- Traditionally the steel industry has driven vanadium demand, but at the margin it is now the stored energy sector
- As such, with demand for scalable energy storage accelerating, reflecting wider renewable energy adaption, VRBs are a preferred scalable energy storage solution (refer Appendices)
- Key VRB positives comprise:
  - ❖ Scalability and suitable for grid connection;
  - ❖ 20-yr lifespan and instant energy release;
  - ❖ Excellent charge retention / discharge; and
  - ❖ Using only one element in electrolyte form:  $V_2O_5$
- This transformation is propelling vanadium towards energy commodity status



# APPENDICES

# A: Vanadium explained

- Vanadium is a soft, ductile and very rare metal
- Periodic table symbol *V* and atomic number 23
- Vanadium can be found in numerous mineral forms and as a trace element in oil deposits
- Typical ores are vanadinite, carnotite and patronite
- Vanadium must be processed into vanadium pentoxide ( $V_2O_5$ ) for market requirements

**Vanadium**



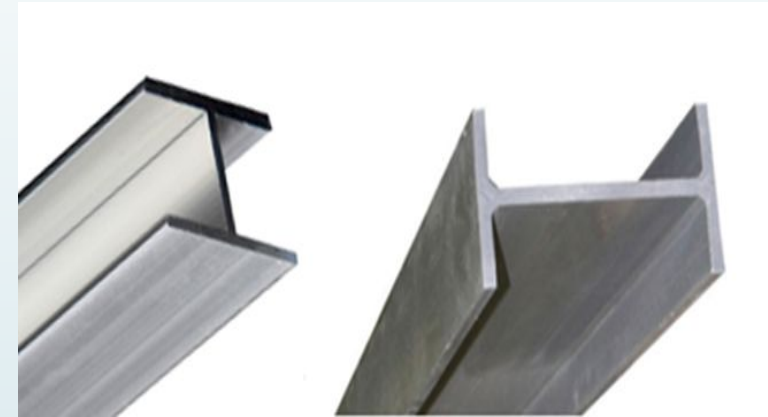
**Vanadium Pentoxide**



## B: Vanadium uses – traditional...

- Vanadium is used for alloys (85%), acid production, ceramics and batteries
- Vanadium is added in small amounts ( $< 0.2\%$ ) to structural steels
- The alloy improves steel toughness, ductility, and strength owing to the grain refining effect of vanadium carbide precipitates
- These steels are used in automotive components, such as hoods and door panels, in oil and gas pipelines, and in structural steel
- Notable legacy – Vanadium was first used in the production of the *Ford Model T* ...

**Structural steel products**



**Ford Model T**



# ...and hi-tech applications

- Vanadium Redox Battery (VRB) technology provides a commercial solution for the grid storage of green energy
- VRBs can connect to power plants, electrical grids or solar energy sources

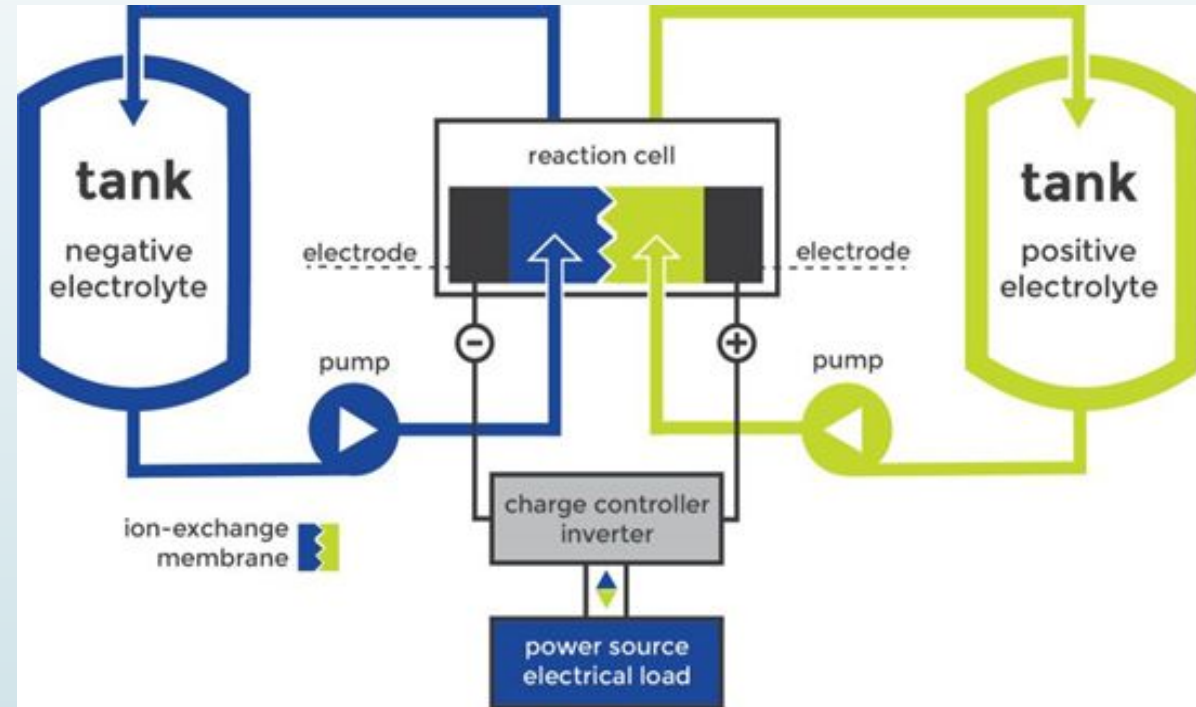


# How VRBs work and key advantages

- Vanadium ions permit a rechargeable flow to store or dissipate energy

## VRB Advantages:

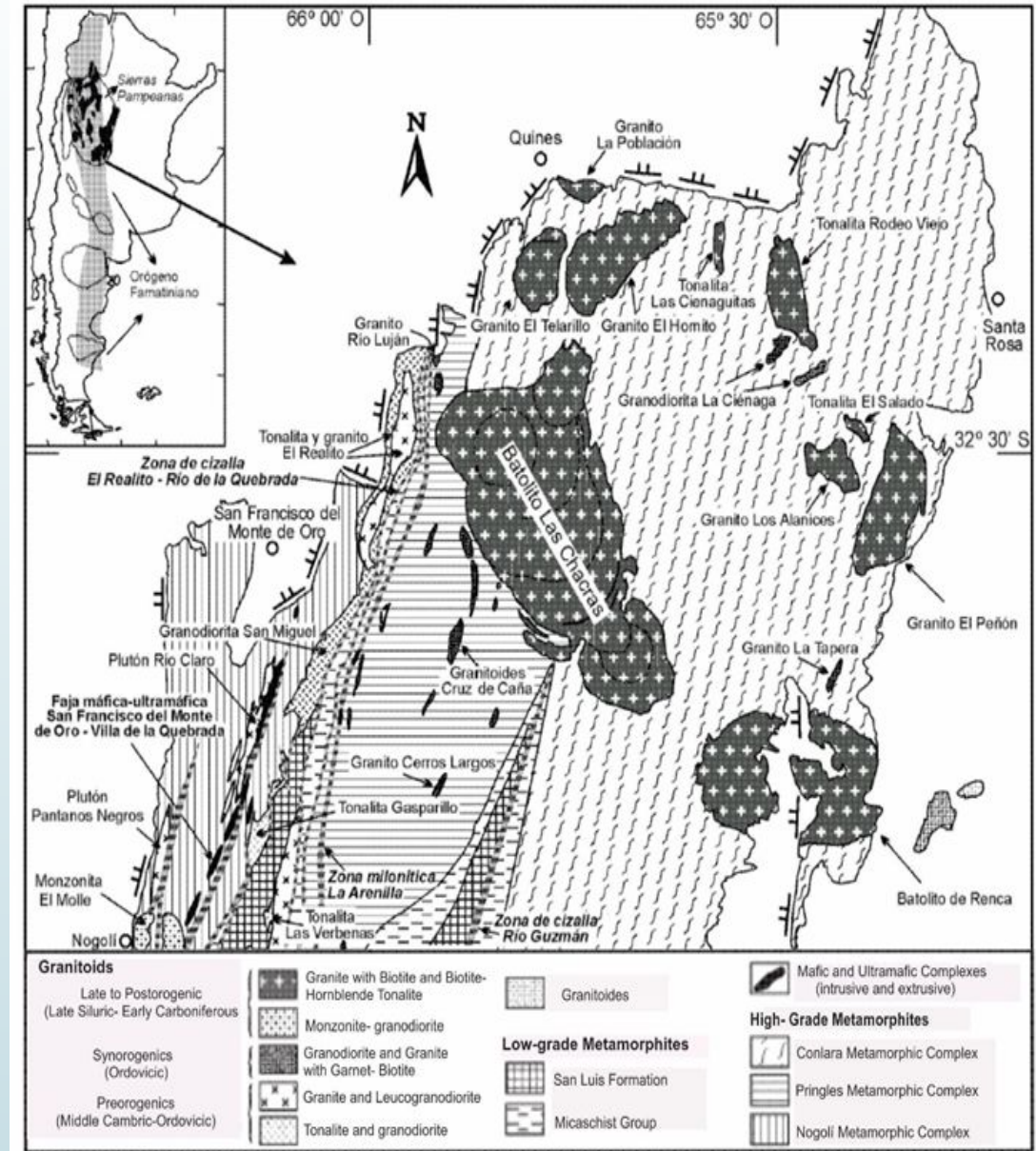
- The fluid electrolyte storage tanks provide scalability in energy capacity
- The potential to be left completely discharged for long periods of time
- The electrolyte is aqueous and inherently safe and non-flammable





# C: Regional geology\*

- The Nelly Vanadium Mine tenement covers 53.1 hectares (green area below)
- Mainly precambrian-cambrian high to low grade metamorphic rocks with pre, syn and post-orogenic granitic intrusions of variable dimensions



\* HDY ASX Announcement 3/July/2018

# D: Local geology and mineralisation\*

- Characterized by schist, migmatites, acid intrusive rocks (granites, tonalites, diorites), pegmatites, aplites, basalts and hydrothermal veins
- The ore is located within three parallel veins – called north, central and south veins
- The central vein is the most visible on the surface, with 170m of outcrops over a strike of 0.9-1.0Km and a width up to 5.5m wide
- The north vein has 500m of outcrops and is circa 3.5m at its widest point
- Mineralisation is from primary / secondary genesis
- Minerals comprise different species of Cu, Pb, Zn, Ag and vanadium
- Vanadium ore is distributed in fractures and, in some cases, can be seen leeching from the rock

**Main pit section along central vein at Nelly Vanadium Mine**



\* HDY ASX Announcement 3/July/2018

# E: Operations in 1959 vs ruins 2017

- Onsite production plant was used to treat vanadium minerals extracted from the mine
- Historic ore treatment methods were experimental compared to modern extraction techniques
- Plant, facilities and living quarter ruins were visible during a recent site visit



# E: Historical workings...

- All workings were developed over the mineralized veins
- The central vein was mined through three levels that were accessed by two shafts and through the open pit
- Once extracted, the mined material was transported to the plant for production stages

Satellite image shows open pit at Nelly Vanadium Mine



# ...one of the mine shafts

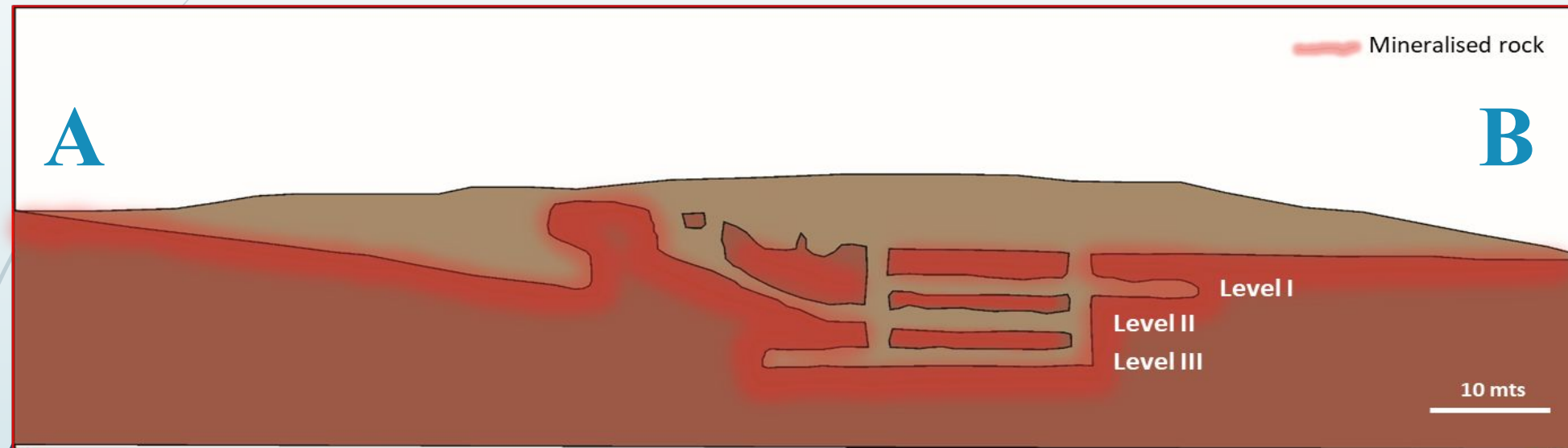
- Historic documents show channel sampled material that had assay grades of up to 1.9%  $V_2O_5$  \*
- The mineralised veins are steeply dipping
- Ore was processed onsite, with the final product sold to national industries for alloys / acid production



- During 1949-57 the mine's processing plant produced  $V_2O_5$  and  $VO_3NH_4$
- Historic production was minimal, due to experimental conditions involved in operating the onsite concentration processes, compared to modern extraction techniques

# E: Nelly Vanadium Mine cross-section

- Cross section based on 1945-57 development plans relative to a satellite image showing the open pit and mine



# E: Historic vanadium assays\*

- Data available from a thesis submitted to the University of Cordoba, Argentina (Alessi 1959)
- The study included 21 historical channel samples collected from the mineralised veins in the open pit and underground galleries
- Assay results on those samples indicated high-grade vanadium mineralisation
- Three highest values were 1.4%, 1.8% and 1.9% V<sub>2</sub>O<sub>5</sub>
- The assay results population had an arithmetic average of 0.81% V<sub>2</sub>O<sub>5</sub> and a length weigh average of 0.82% V<sub>2</sub>O<sub>5</sub>

Historical Sample	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
% V <sub>2</sub> O <sub>5</sub>	1.1	0.7	1.1	1.0	1.0	0.7	1.4	0.5	0.2	0.6	0.5	0.3	0.4	0.6	0.4	0.6	1.4	0.4	1.8	1.9	0.5

Source: Historic samples from Nelly Vanadium Mine and % V<sub>2</sub>O<sub>5</sub> (Alessi 1959)

\* HDY ASX Announcement 3/July/2018

# F: Mineralised specimens from NVM\*

Stockwork found next to mine pit



Stockwork full of minerals



Secondary copper minerals



Secondary copper minerals and boxwork filled with mineralization

\* Mineralised specimens from Nelly Vanadium Mine (“NVM”) are under analysis to determine mineral species



# F: Mineralised specimens from NVM\*

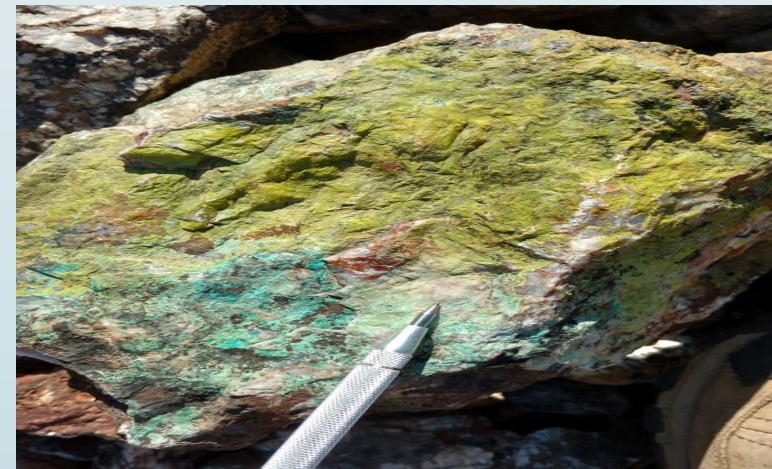
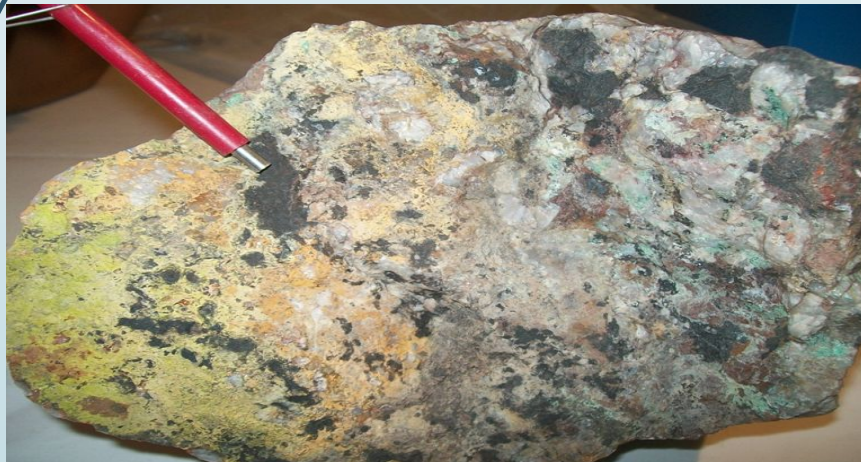


Bladed and polyhedral replacement textures in quartz



Secondary copper minerals. Metallic grey sulphides

Secondary copper minerals, green, red & black minerals



Bluish secondary copper minerals, green and redish minerals

\* Mineralised specimens from Nelly Vanadium Mine ("NVM") are under analysis to determine mineral species

# Disclaimer

This presentation has been prepared by Nelly Vanadium Pty Ltd (Company). It contains general information about the Company's activities current as at the date of the presentation. The information is provided in summary form and does not purport to be complete. This presentation is not to be distributed (nor taken to have been distributed) to any persons in any jurisdictions to whom an offer or solicitation to buy shares in the Company would be unlawful. Any recipient of the presentation should observe any such restrictions on the distribution of this presentation and warrants to the Company that the receipt of the presentation is not unlawful. It should not be considered as an offer or invitation to subscribe for or purchase any securities in the Company or as an inducement to make an offer or invitation with respect to those securities. No agreement to subscribe for securities in the Company will be entered into on the basis of this presentation or any information, opinions or conclusions expressed in the course of this presentation.

This presentation is not a prospectus, product disclosure document or other offering document under Australian law or under any other law. It has been prepared for information purposes only. This presentation contains general summary information and does not take into account the investment objectives, financial situation and particular needs of any individual investor. It is not financial product advice and investors should obtain their own independent advice from qualified financial advisors having regard to their objectives, financial situation and needs. The Company nor any of their related bodies corporate is licensed to provide financial product advice.

You should not act or refrain from acting in reliance on this presentation, or any information, opinions or conclusions expressed in the course of this presentation. This presentation does not purport to be all inclusive or to contain all information which its recipients may require in order to make an informed assessment of the prospects of the Company. You should conduct your own investigation and perform your own analysis in order to satisfy yourself as to the accuracy and completeness of the information, statements and opinions contained in this presentation before making any investment decision.

Recipients of this presentation must undertake their own due diligence and make their own assumptions in respect of the information contained in this presentation and should obtain independent professional advice before may any decision based on the information. No representation or warranty, express or implied, is made in relation to the fairness, accuracy or completeness of the information, opinions and conclusions expressed in the course of this presentation. To the maximum extent permitted by law, no representation, warranty or undertaking, express or implied, is made and, to the maximum extent permitted by law, no responsibility or liability is accepted by the Company or any of its officers, employees, agents or consultant or any other person as to the adequacy, accuracy, completeness or reasonableness of the information in this presentation. To the maximum extent permitted by law, no responsibility for any errors or omissions from this presentation whether arising out of negligence or otherwise is accepted. An investment in the shares of the Company is to be considered highly speculative.