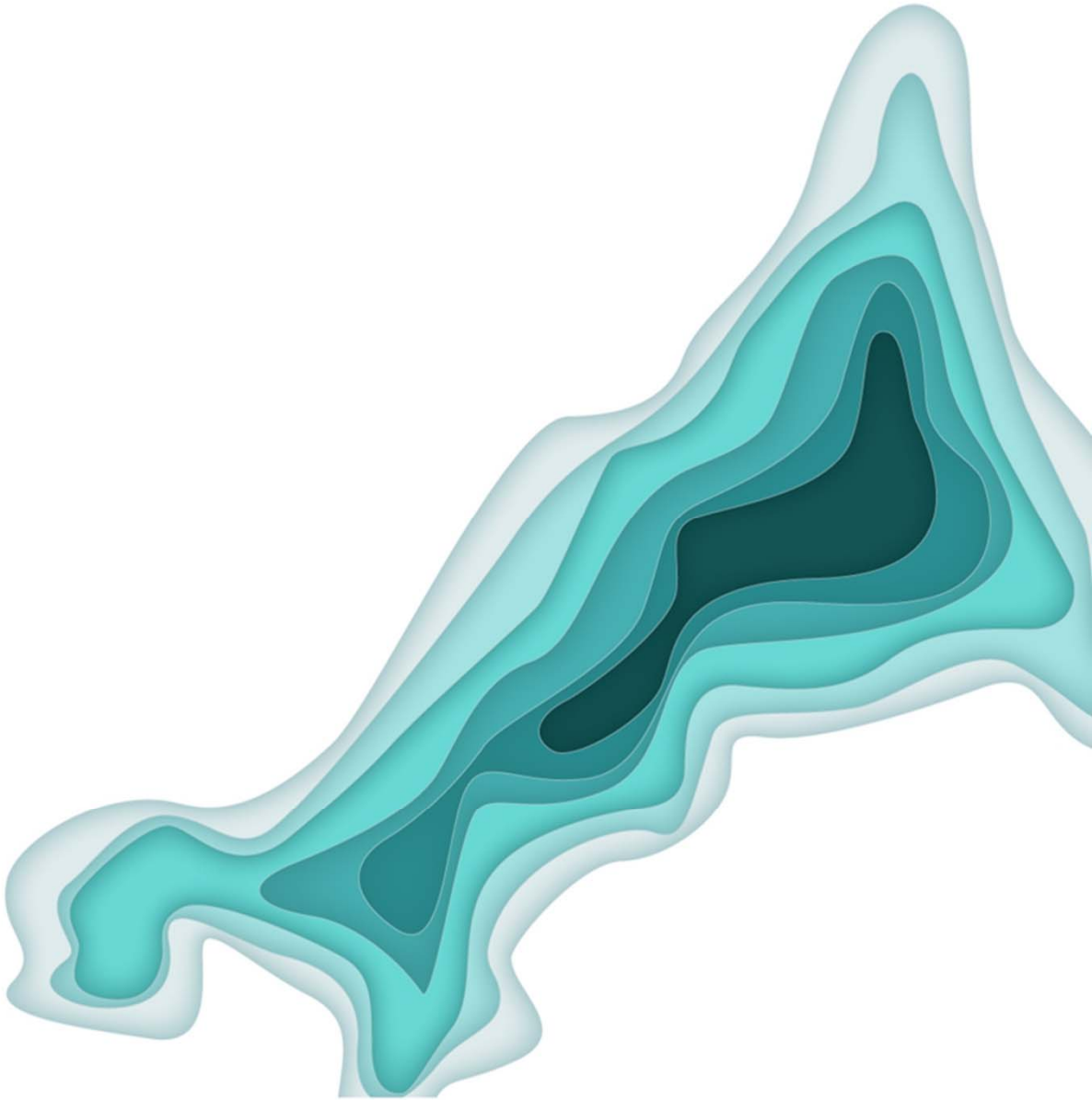
Cornish Lithium

REMIX Workshop
May 2018

Lucy Crane
Geologist
Cornish Lithium Ltd



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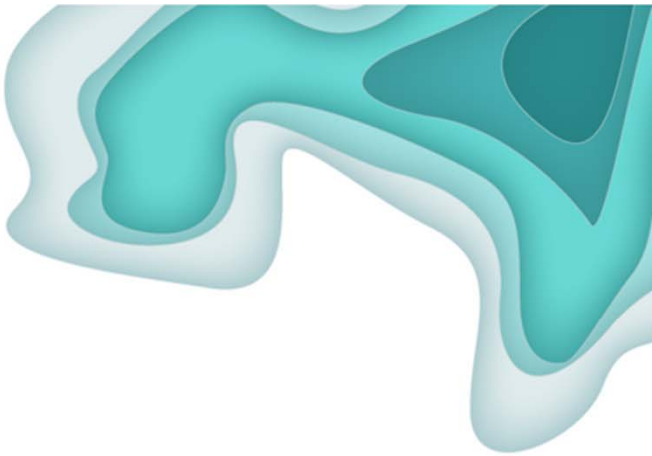


A New Metal

from an

Old Mining Area

Cornish Lithium

Contents

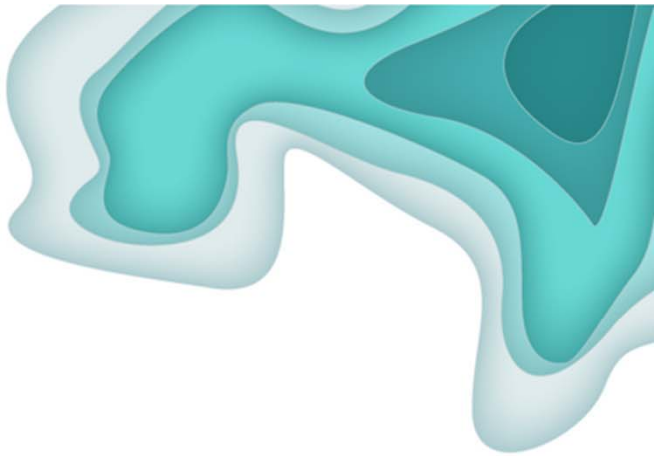
- Introduction to Cornish Lithium
- Current lithium exploration
  - Brines vs. hard rock
- Extraction technologies
  - Direct extraction of Li from brines
- Lithium potential in Cornwall
  - Historic occurrences of lithium brines
  - Historic data and mapping
  - 3D modelling
- Summary

Cornish Lithium

Cornish Lithium

- Founded in 2016 by Jeremy Wrathall, a mining engineer turned investment banker
- Secured mineral rights to explore for lithium in brines for approx. 300km^2 Cornwall in January 2017
- Raised £1million to commence exploration in August 2017
- Company is private
- Technical office in Penryn

Cornish Lithium



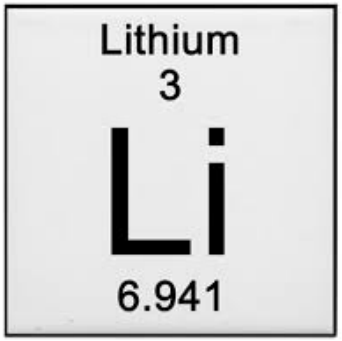
Lithium Supply

Find – Mine – Process

Cornish Lithium

Lithium in Context

- We have been mining copper for at least 4000 years
- Lithium mining is an industry in its infancy
- The lithium-ion battery was first commercialised in 1991
- Lithium now becoming a critical metal
- Virtually all current production comes from “legacy” assets
- Supposedly a large mineral endowment – but not of economic deposits
- Mining industry has a huge task ahead
- New exploration, mining and processing methods needed



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The electric car age has arrived

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An unstoppable revolution

Electric Vehicle Revolution is Accelerating

"EVs will make up 54% of global sales by 2040." *Bloomberg New Energy Finance*

Recent company announcements

- **Volvo** – all new models will be EVs from 2019
- **VW** – 25% EV mix by 2025, 1M EVs p.a.
- **Mercedes** – 10 EV models, 15-25% EV by 2025
- **BMW** – 0.4M EVs by 2020
- **Porsche** – 50% EVs by 2023
- **Ford** – 13 EV/PHEV models by 2020
- **Tesla** – 1M units by 2020

Recent country announcements

- **France** – 100% EV by 2040
- **UK** – 100% EV by 2040
- **Norway** – 100% EV by 2025
- **India** – 100% EVs by 2030
- **China** – 2M EV by 2030
- **Netherlands** – 100% EV by 2025
- **Germany** – 100% EV by 2030

"...around 2021 battery costs will reach $100/kWh, bringing EVs to cost parity." Tesla CFO Deepak Ahuja

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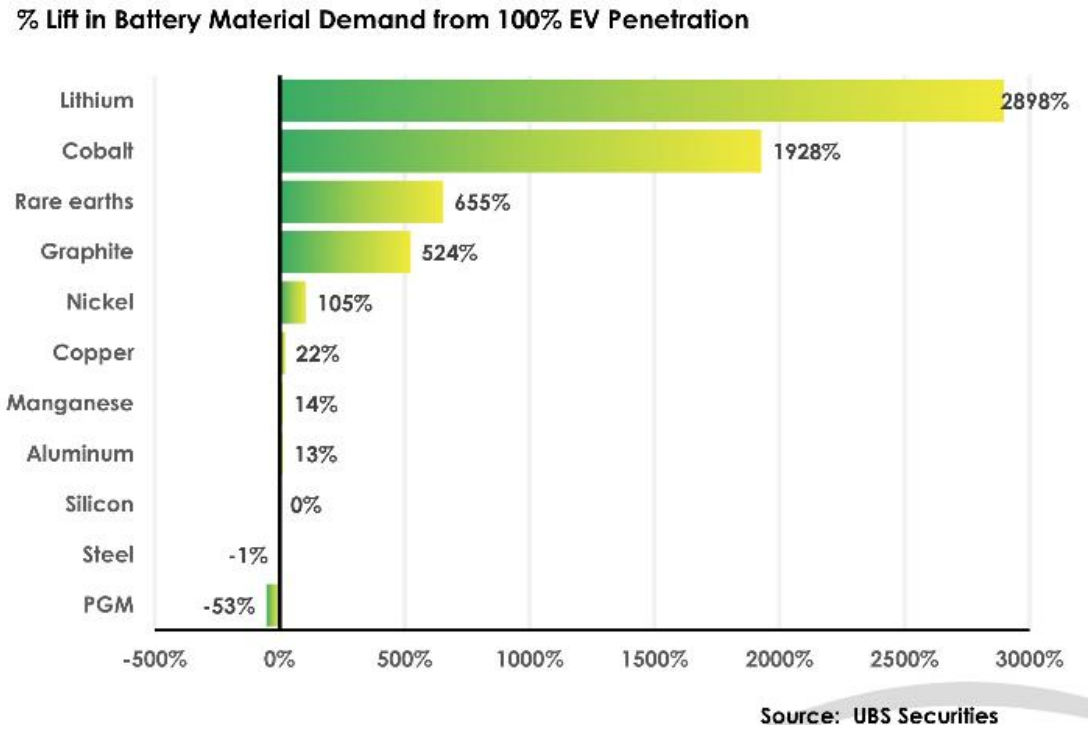
Dramatic increase in lithium demand

Lithium is the Commodity most-Impacted by Growth in EVs

Lithium supply must increase 30x in a 100% EV world



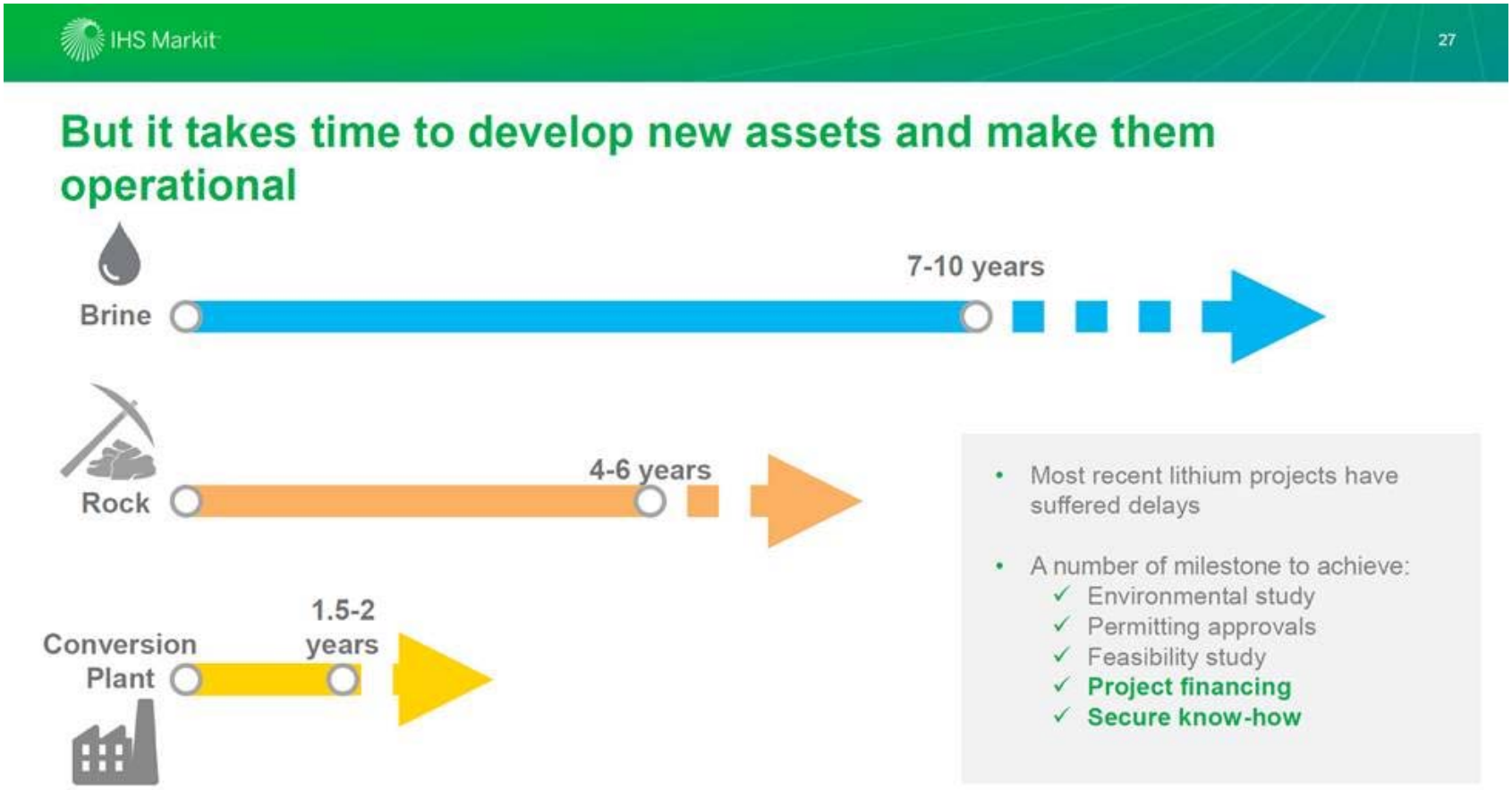
Lithium demand

“In terms of new lithium supply the industry needs all the supply it can get. SQM, traditionally conservative of its lithium estimates, is expecting an 800,000tpa LCE market by 2027. These numbers are staggering considering the market was at 180,000tpa LCE in 2017.”

Source: Mining Journal – Interview with Simon Moores – MD Benchmark Mineral Intelligence - 5th September 2017

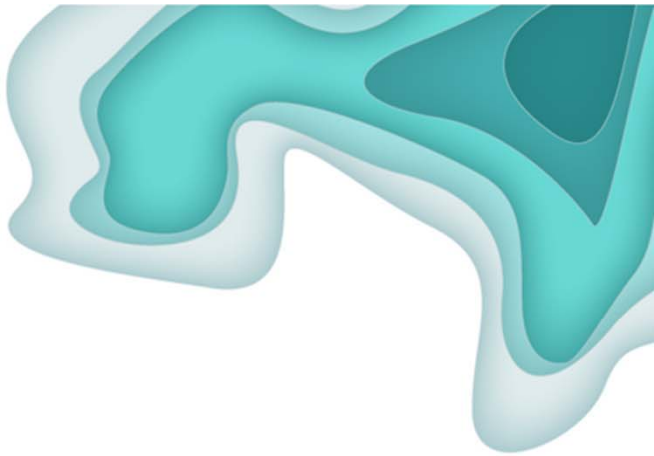
Cornish Lithium

Mining projects take time



Source: IHS Markit

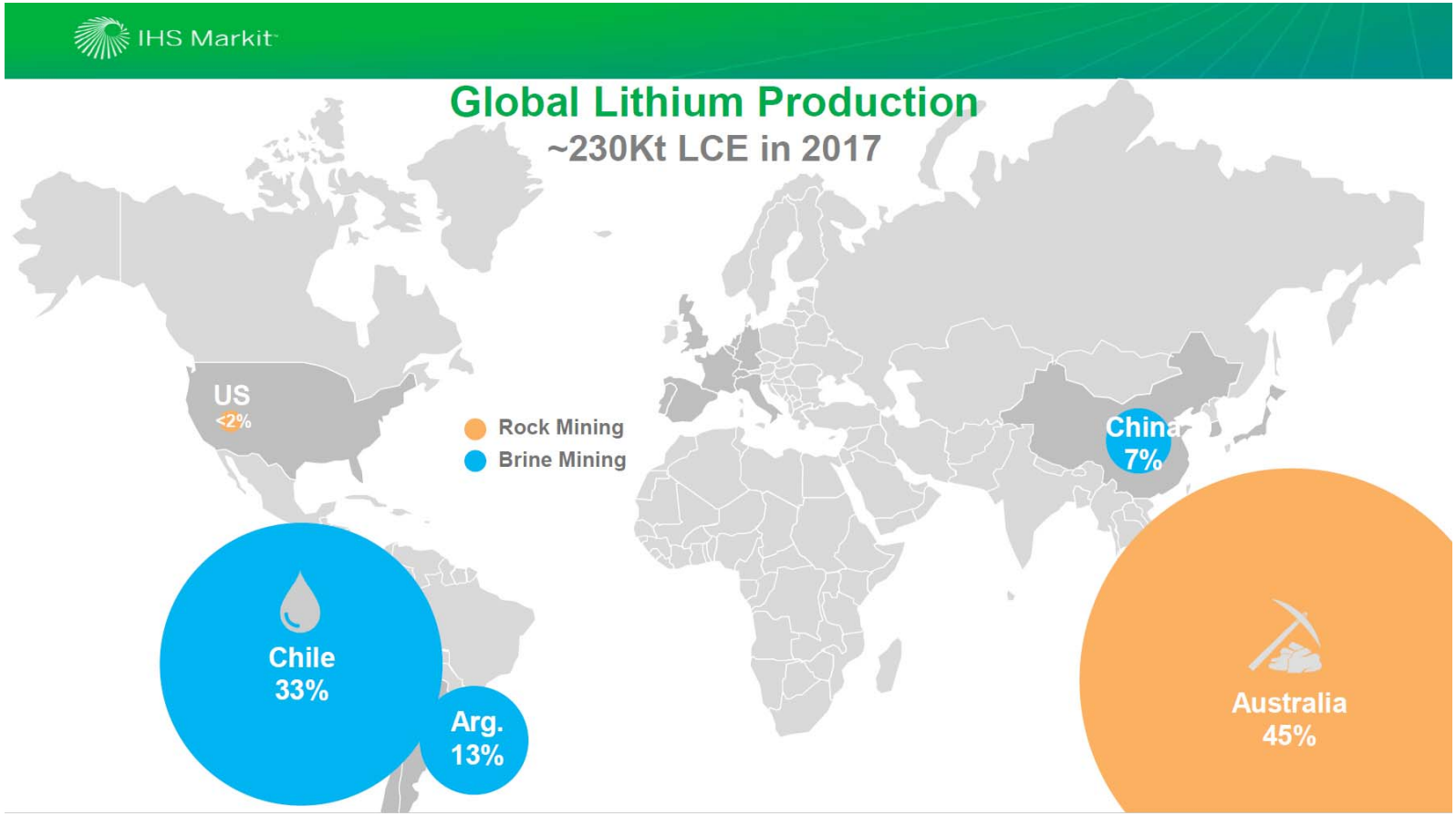
Cornish Lithium



Where is lithium currently mined? And how?

Cornish Lithium

Where is lithium mined?



Source: IHS Markit

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What does a lithium mine look like?

Cornish Lithium

Deposit types

Brine

The most common form of lithium extraction is from salt brines

- Much cheaper
- Slower (18 months of evaporation time)
- High start-up costs

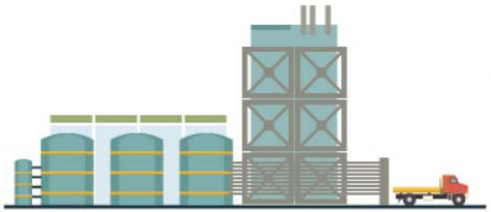
Spodumene

Crushing, roasting, and leaching lithium ore

- Faster, lower start-up costs
- More expensive
- Additional costs to upgrade to battery grades

Mechanical Brine Extraction

- Cheaper
- Over 90% lithium recovery rate
- Environmentally Responsible
- Not yet commercially proven



There are companies such as Tenova Bateman, who have created mechanical brine extraction processes with revolutionary technology to extract lithium from salar brines with over **90% recovery**.
(Traditional evaporation methods typically yield under 40%)

While this process is not yet widely available to producers, it has the potential to lower the cost of production.

Clay

Similar process to spodumene

Not proven yet to be viable on commercial basis

Source: Visual Capitalist

Cornish Lithium

Hard Rock - Greenbushes (Talison)

Source: The Australian Mining Review

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Brine - Olaroz (Orocobre)

Source: Orocobre

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Never easy

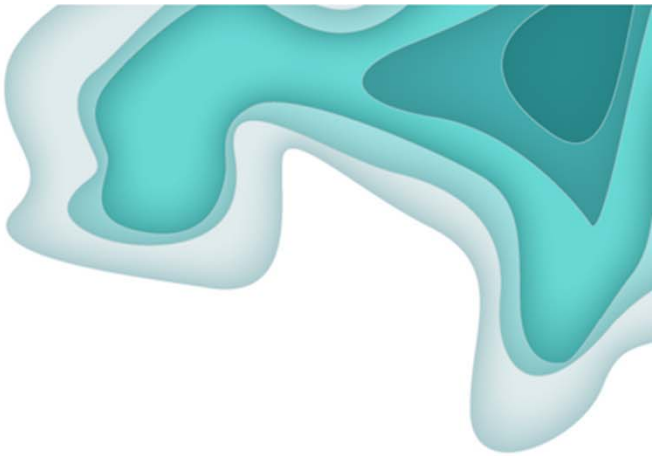
Orocobre reports 29% drop in lithium production at Olaroz due to low evaporation rates

06 April 2018

Orocobre Limited reported that lithium production at Olaroz in northern Argentina for the March quarter was 2,802 tonnes, down 29% from 3,937 tonnes in the December quarter. The company said that the lower production rate in the March quarter was due to evaporation rates that were 24% below those in 2017 with reduced solar radiation from cloudy conditions and above normal rainfall.

Source: IHS Markit

Cornish Lithium



Lithium Extraction

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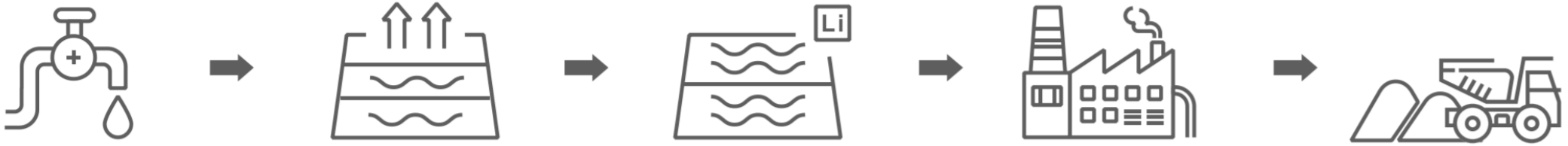
Conventional brine processing



Pump lithium brine from the salar

Use solar evaporation to concentrate lithium brine in shallow ponds

Process concentrated lithium brine in a plant

Ship lithium carbonate

Source: Lithium Americas

Lithium Brine Processing

Old Technology

SQM's Evaporation ponds in Chile. Source: Reuters / Ivan Alvarado

New Technology

Brine from production wells pumped in to extraction plant

↓

Reverse osmosis concentrates Li brine

↓

Concentrated brine passes through ion exchange system

↓

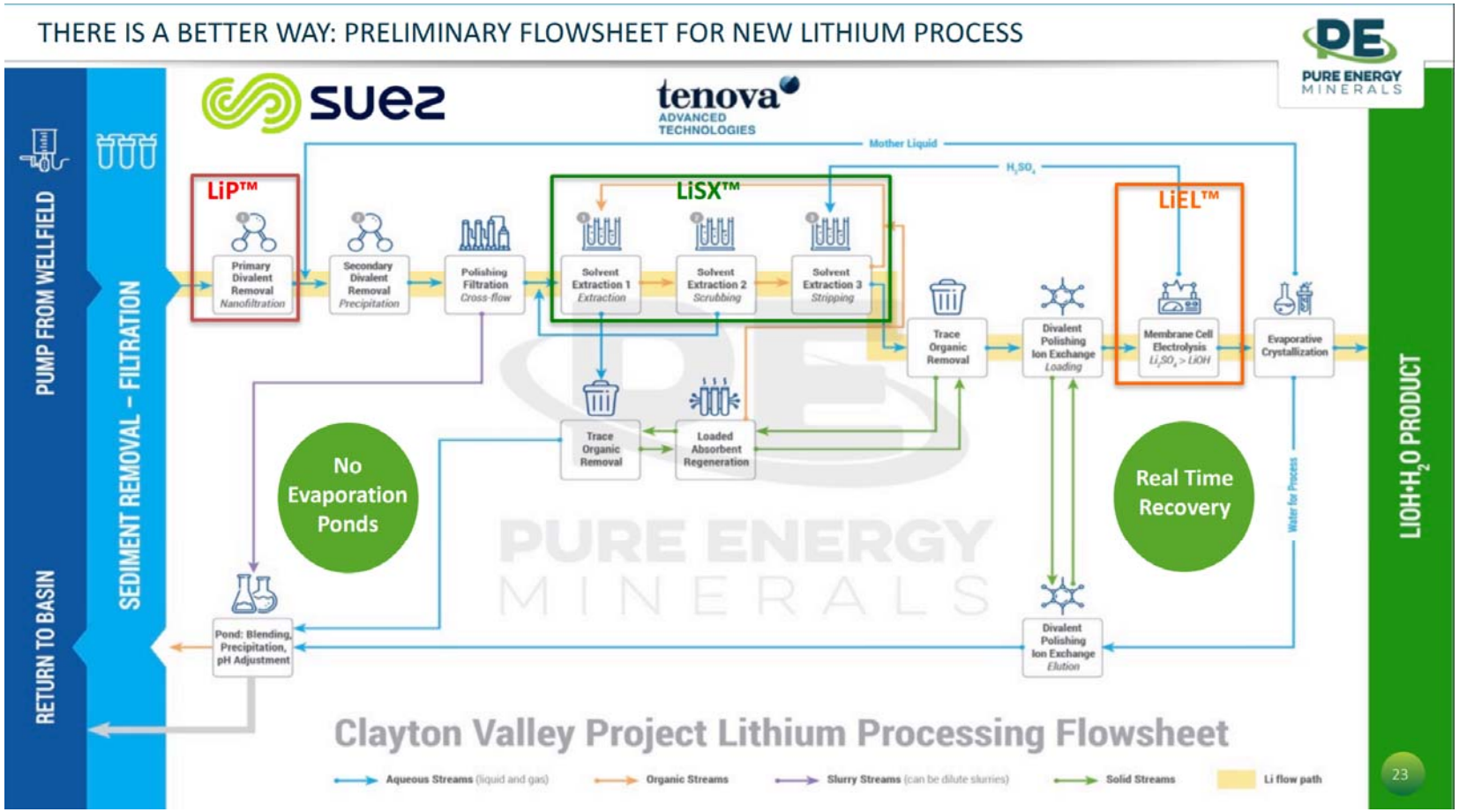
Precipitation of products: LCE or Li Hydroxide

New processes to extract lithium directly from brine have been developed by the following companies:

posco enirgi group VEOLIA tenova PurLucid TREATMENT SOLUTIONS ERAMET

Cornish Lithium

New tech – Pure Energy



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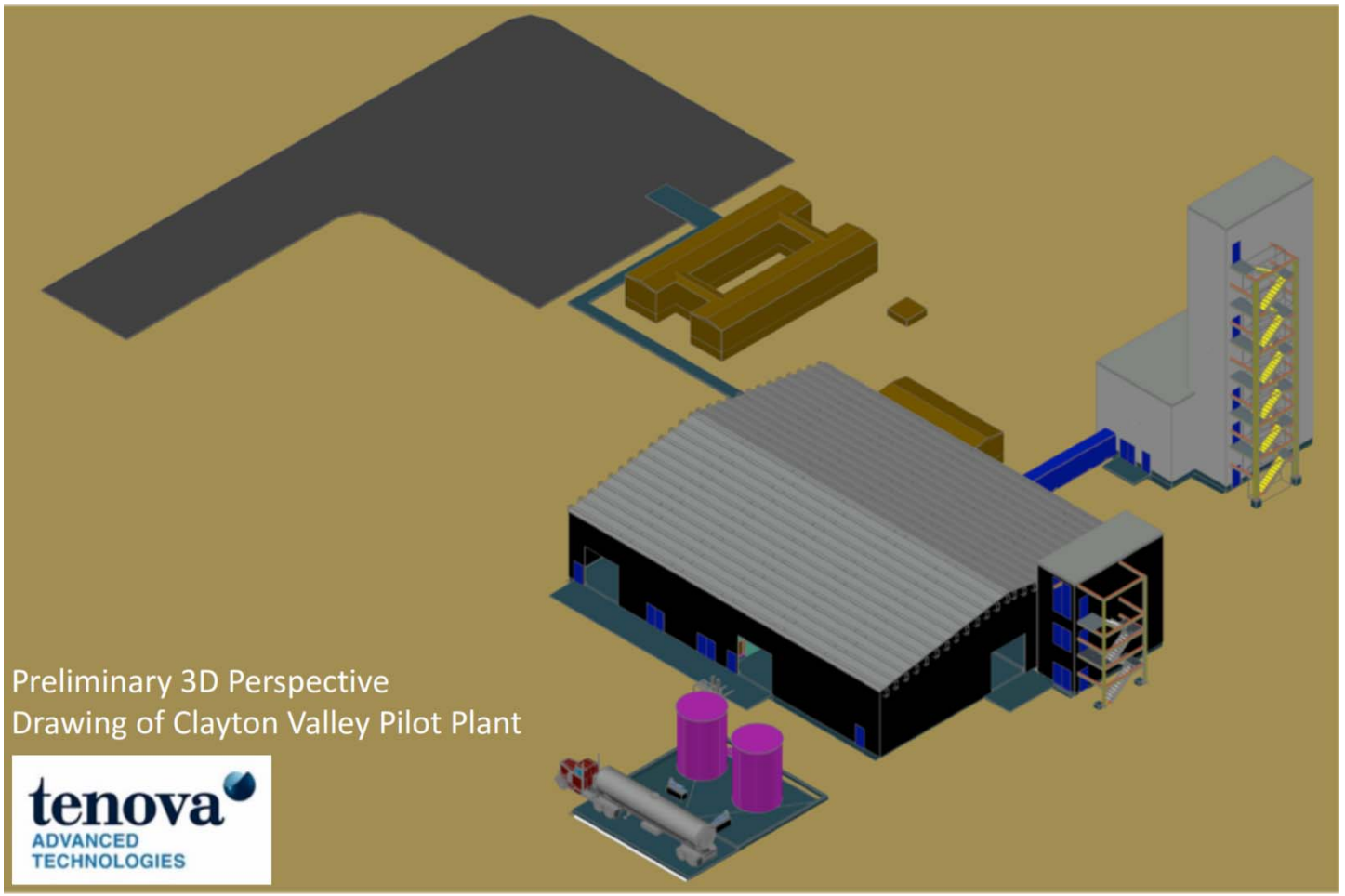
Low environmental impact



Source: Pure Energy Minerals

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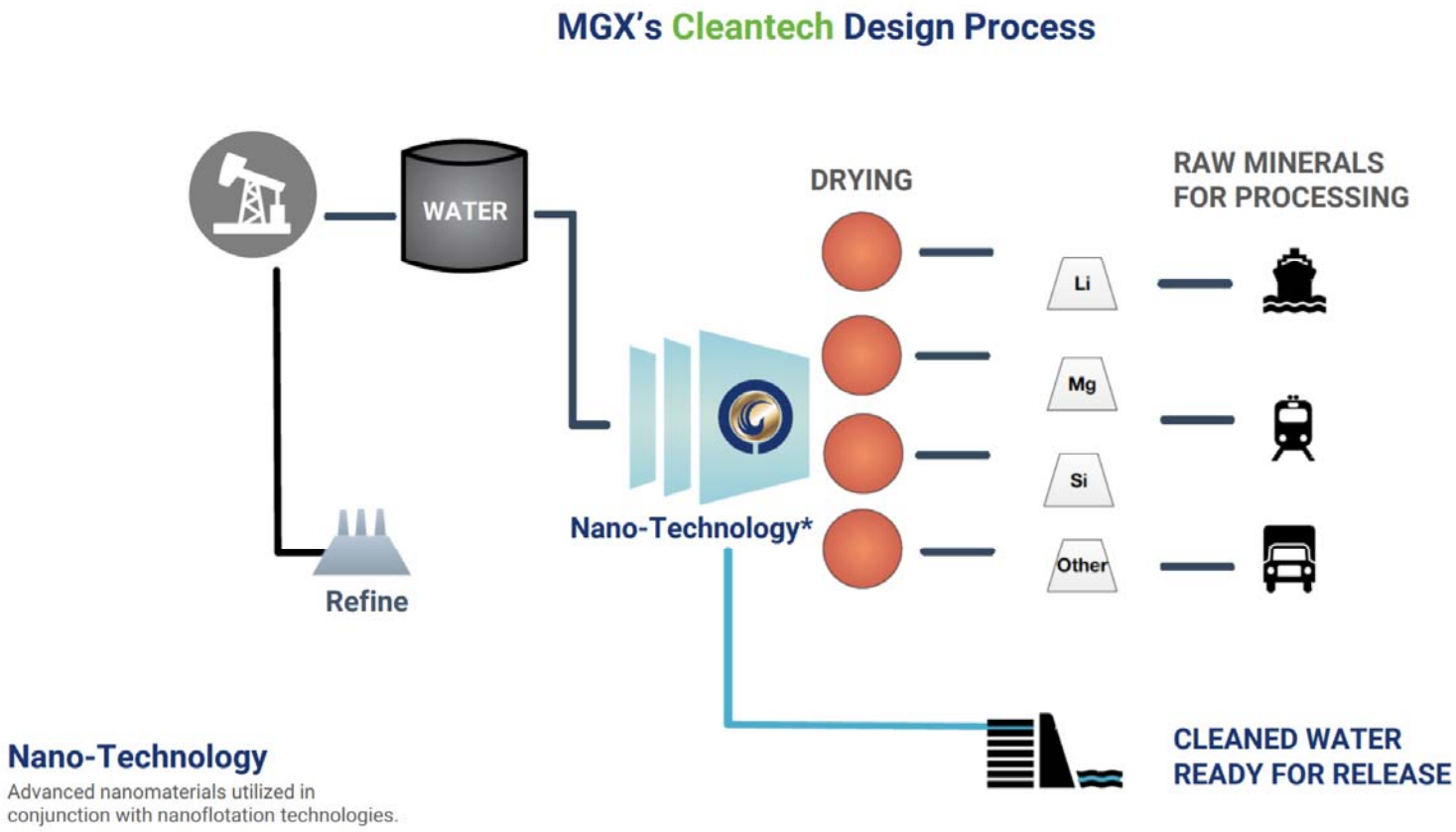
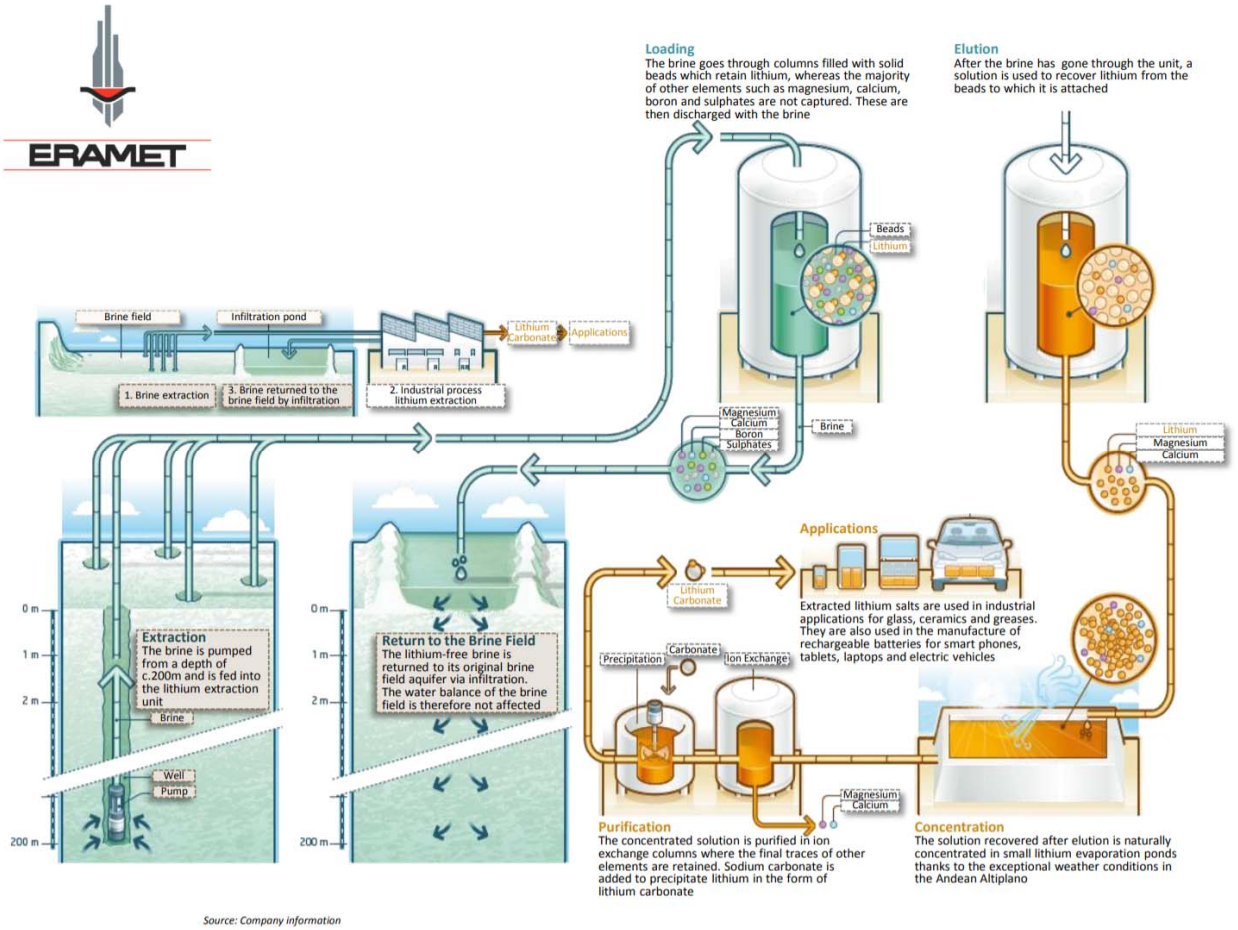
New tech – MGX



New tech – Eramet



Source: Eramet

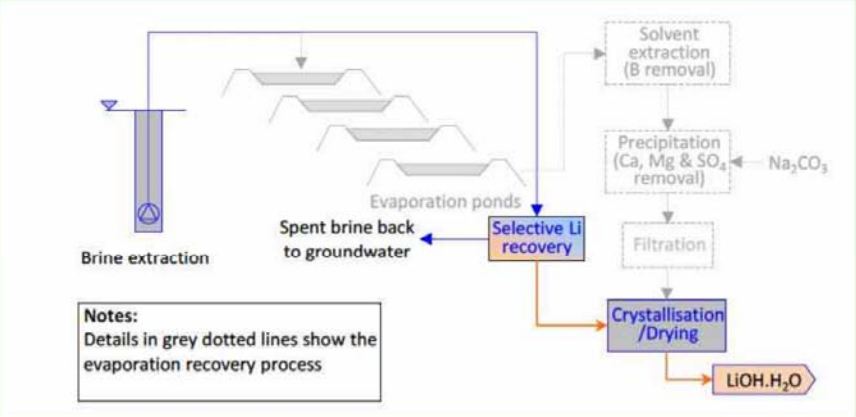
New tech – Synexus

Proof of Concept Study - Synexus

Lithium Recovery using Membrane Separation

Selective Recovery of Lithium (and other cations) using Membrane Technology

- a possible alternative to the natural evaporation process
- could provide a process route to produce lithium hydroxide directly from the raw brine
- no need to remove contaminants like magnesium by liming, as would be required in the natural evaporation process.
- with further refining the technology could also permit the recovery of potassium and other cations if desired.



Block Flow Diagram of selective lithium recovery process (Synexus).

Source: International Lithium

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Extraction technologies

Hard rock

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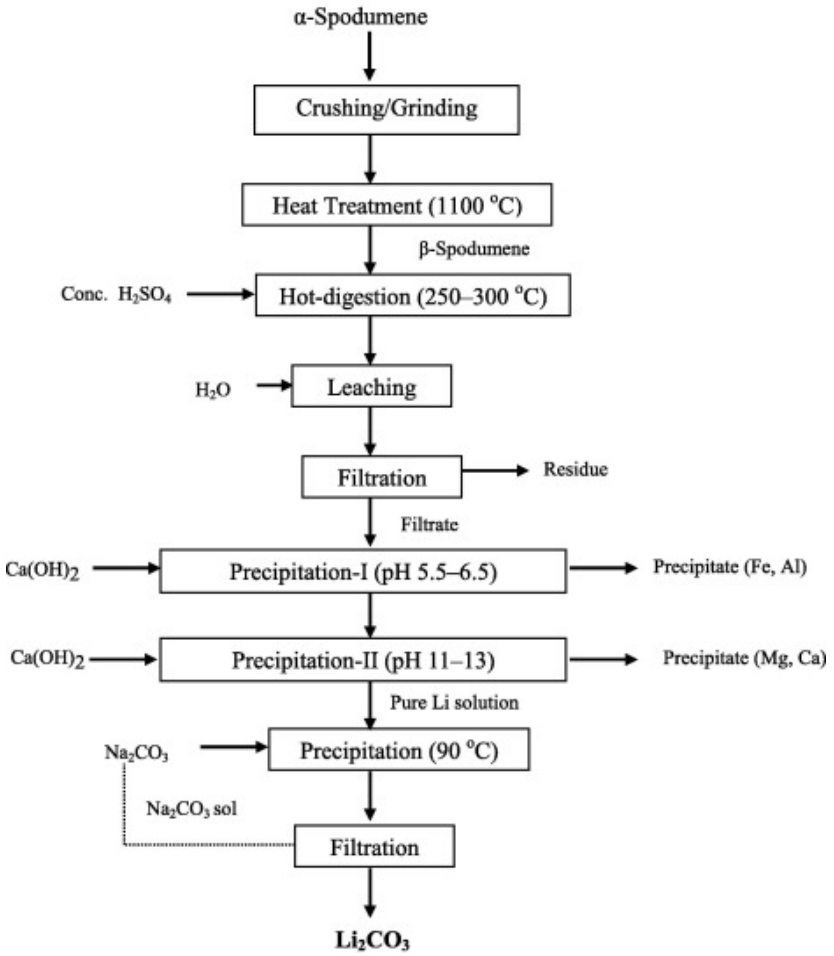
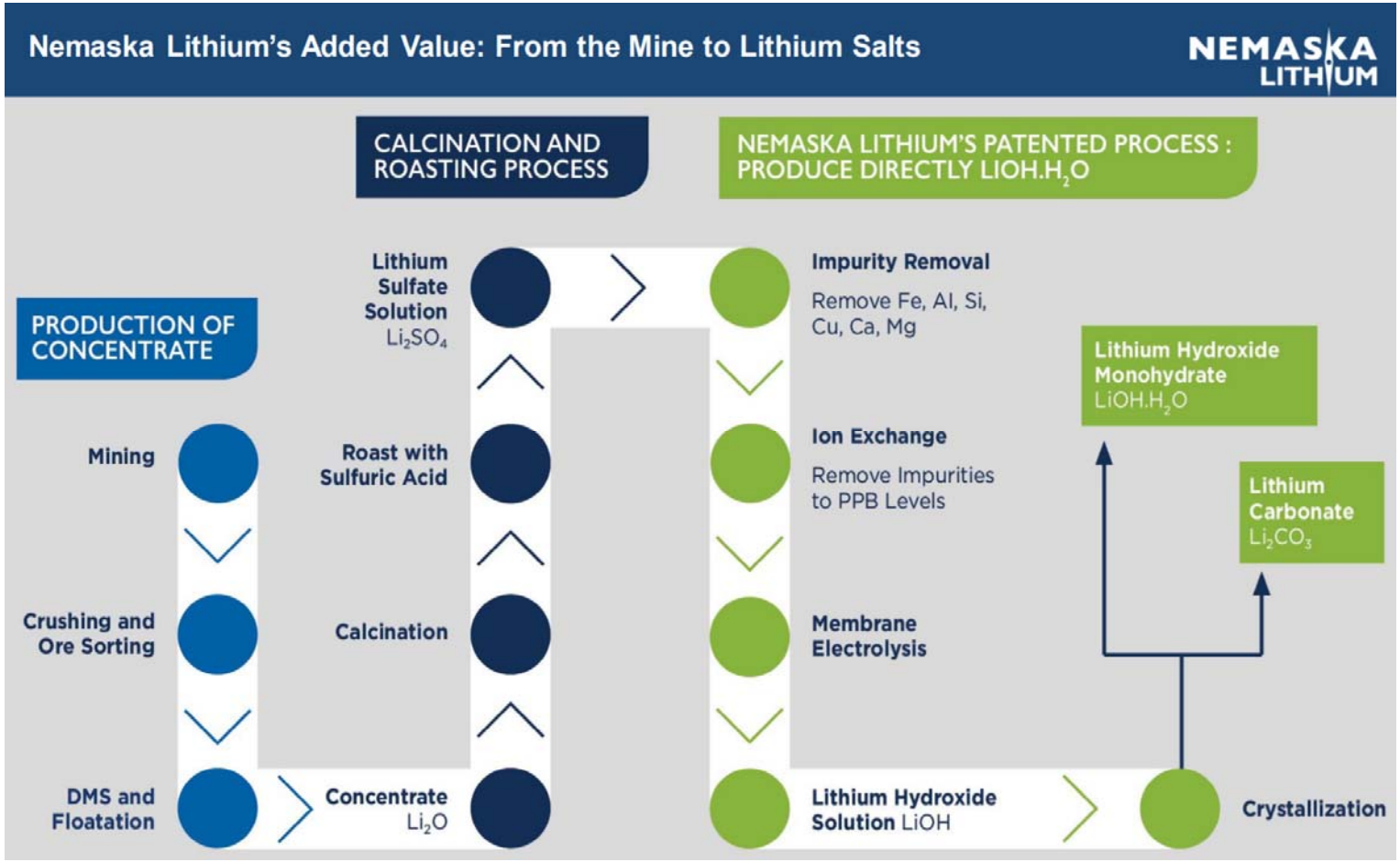
Old tech - Spodumene



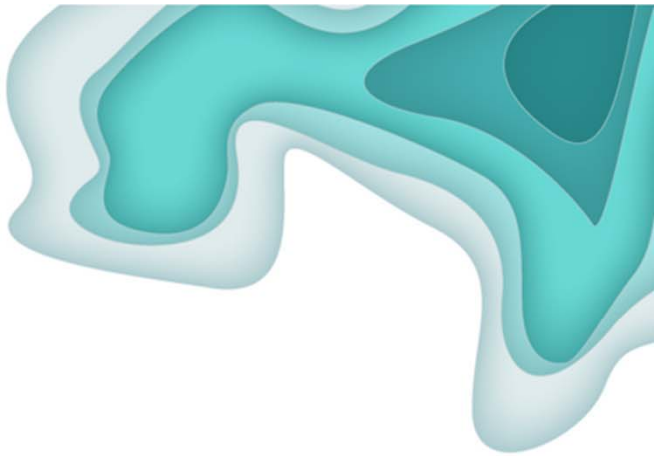
Source: Science Direct

Cornish Lithium

New tech - Nemaska



Cornish Lithium

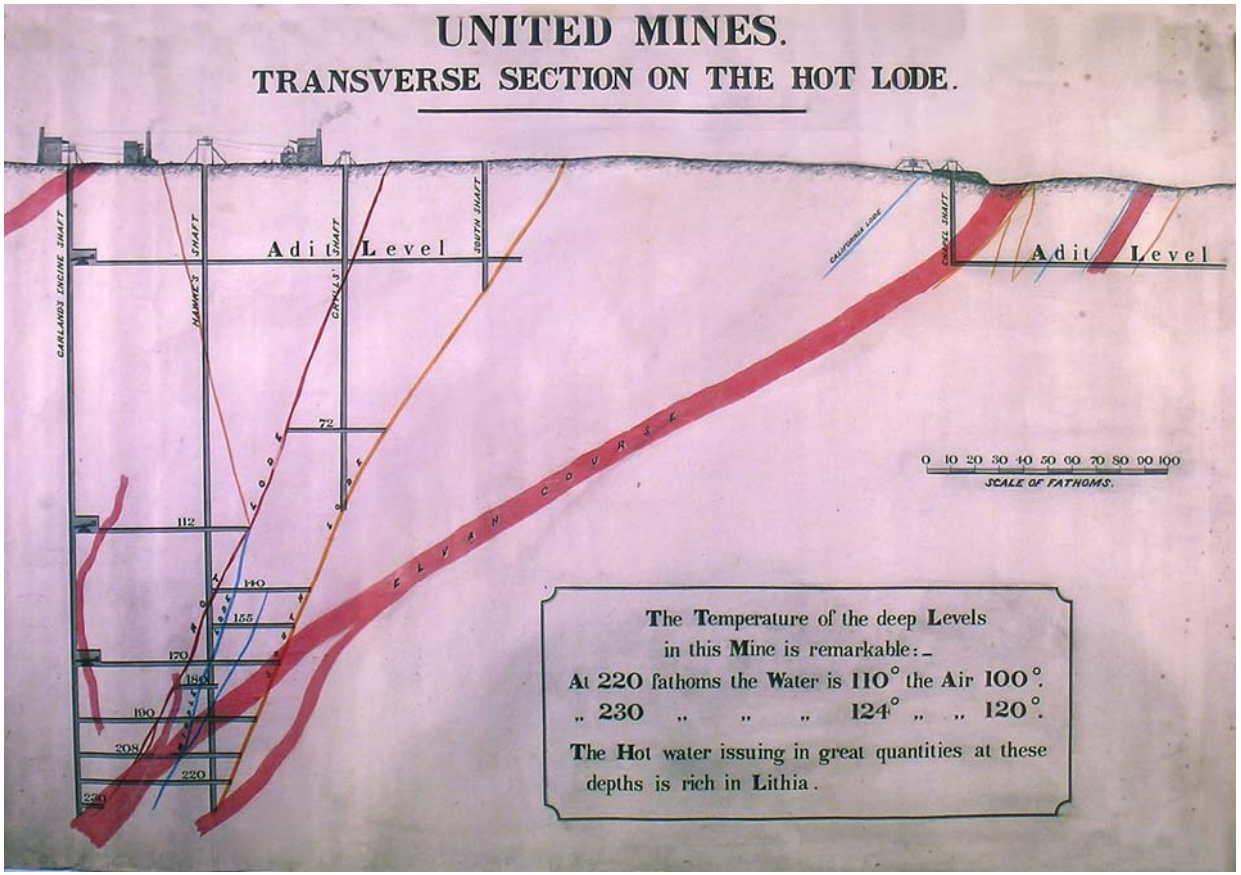


Lithium in Cornwall

Cornish Lithium

- Cornish Lithium aims to establish a lithium production industry in the UK
- Numerous historic records indicate the presence of lithium in underground hot spring brines over a large area in Cornwall
- We believe that advances in extraction and process technology make the extraction of lithium from such sources possible
- Cornish Lithium has secured rights to explore and commercially develop lithium contained in brine over approximately 300km^2
- The company is currently private

Lithium in Hot Springs – 1864



Wheal Clifford abandoned mine plan – R103 transverse section

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

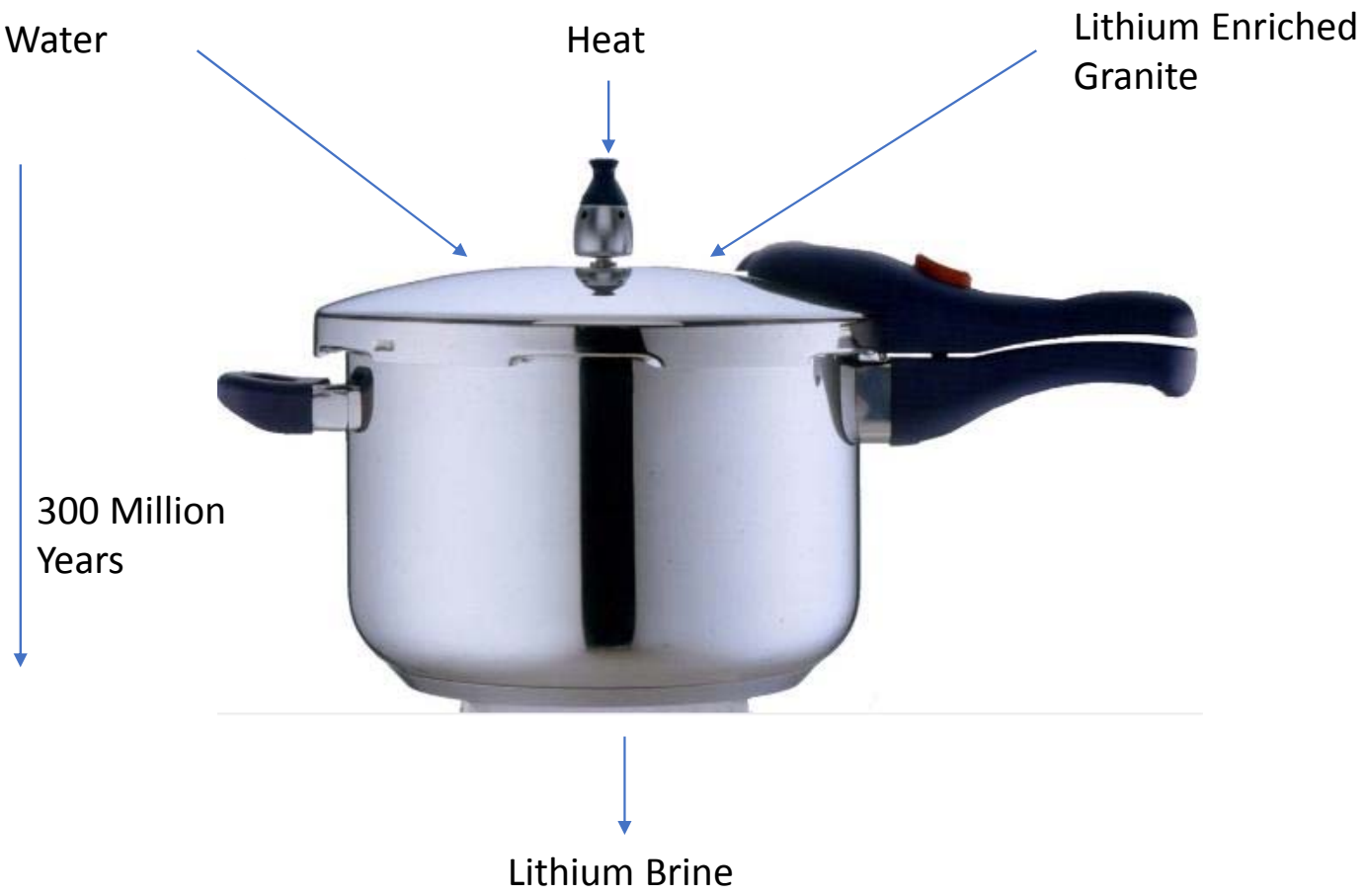
Chemical Examination of a Hot Spring containing Cæsium and Lithium in Wheal Clifford, Cornwall, by W. A. MILLER, *M.D., Treas. R.S., Prof. Chemistry King's Coll., London.**

IN the course of conversation with Sir C. Lyell a few months ago, he mentioned to me the existence of a remarkable hot spring in one of the Cornish mines, occurring at a great depth below the surface, and of which no detailed chemical examination had been published. The interest attending such an examination was obvious, and it was arranged that a supply of the water should be forwarded to me for analysis. Mr. Horton Davey, of Redruth, at the request of Sir C. Lyell, kindly superintended the collection of the water. Part of this water, which was to be examined for its gaseous constituents, was received into glass Winchester quart bottles, filled by immersion in the spring to within a very short distance of the neck, the stoppers inserted and securely fastened.

The occurrence of so large an amount of lithium, being eight or ten times as much per gallon as has been found in any spring hitherto analysed, invests this water with unusual interest and importance;

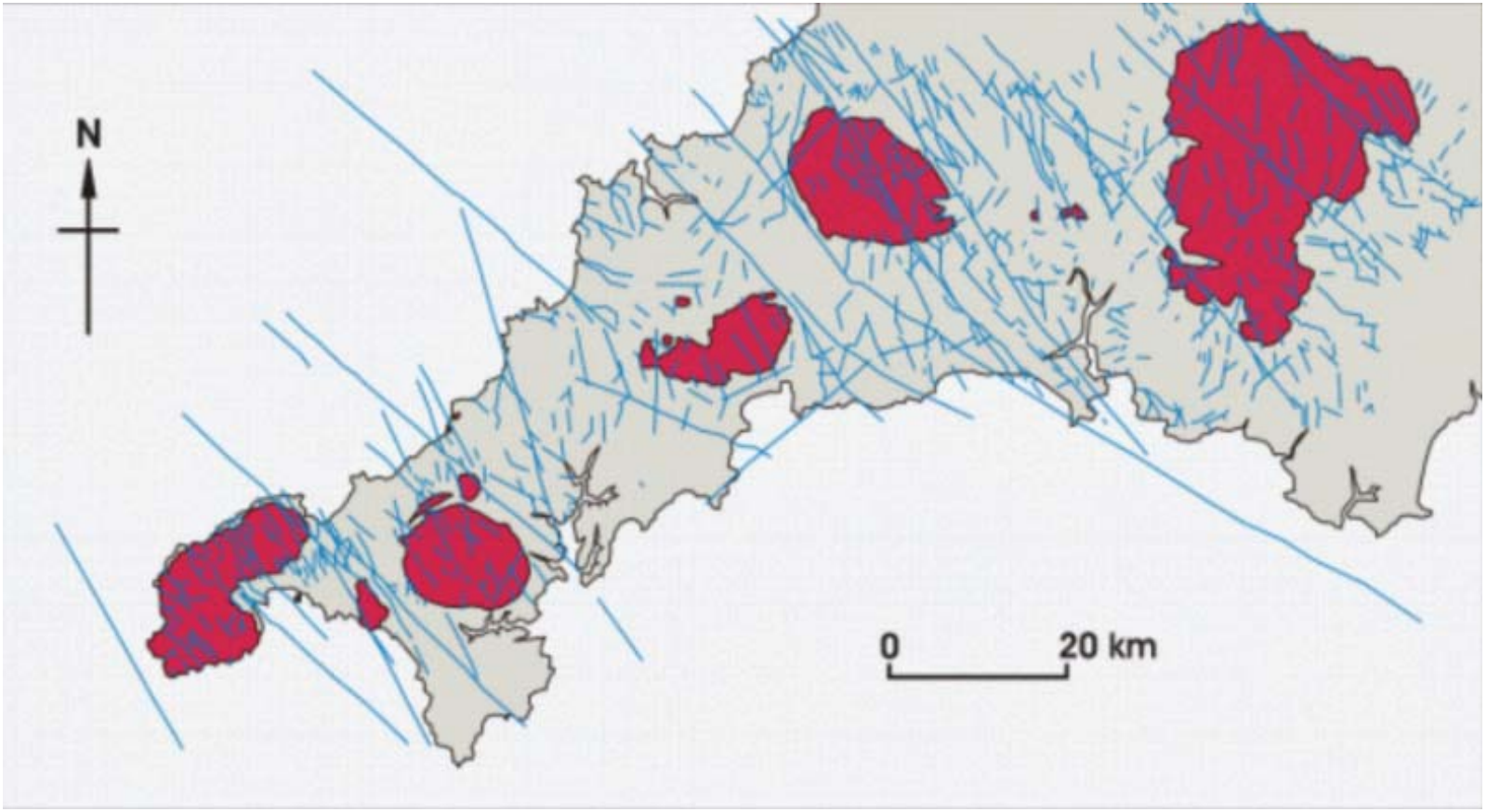
Miller, W.A., 1864, Chemical examination of a hot spring containing caesium and lithium in Wheal Clifford, Cornwall: Chem. News, v. 10, p. 181-182; Mining and Smelting Mag., v. 6, p. 197-198

Cornwall – A giant pressure cooker

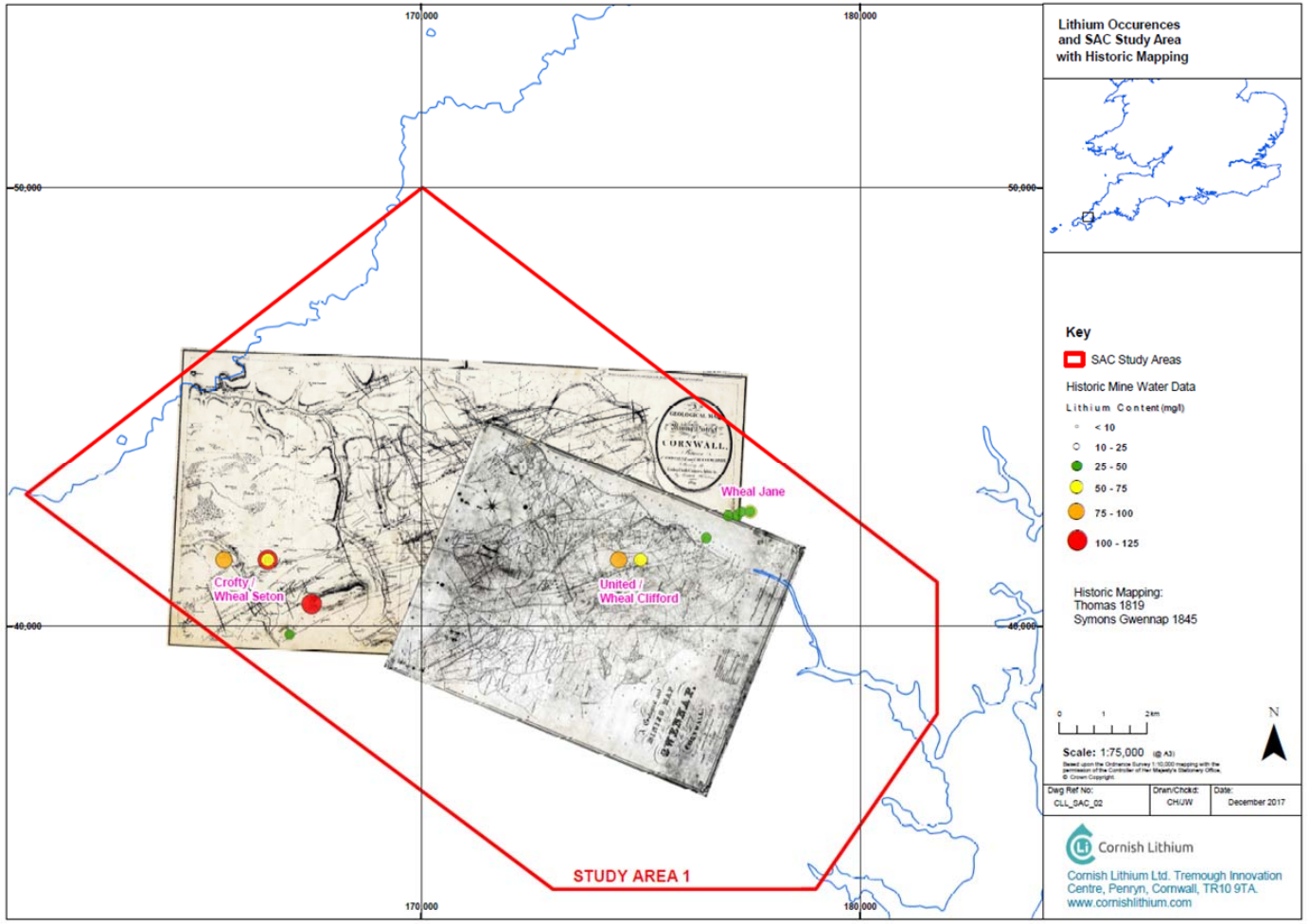


Cornish Lithium

Faults appear to be the geological key



Applying modern GIS to historic data



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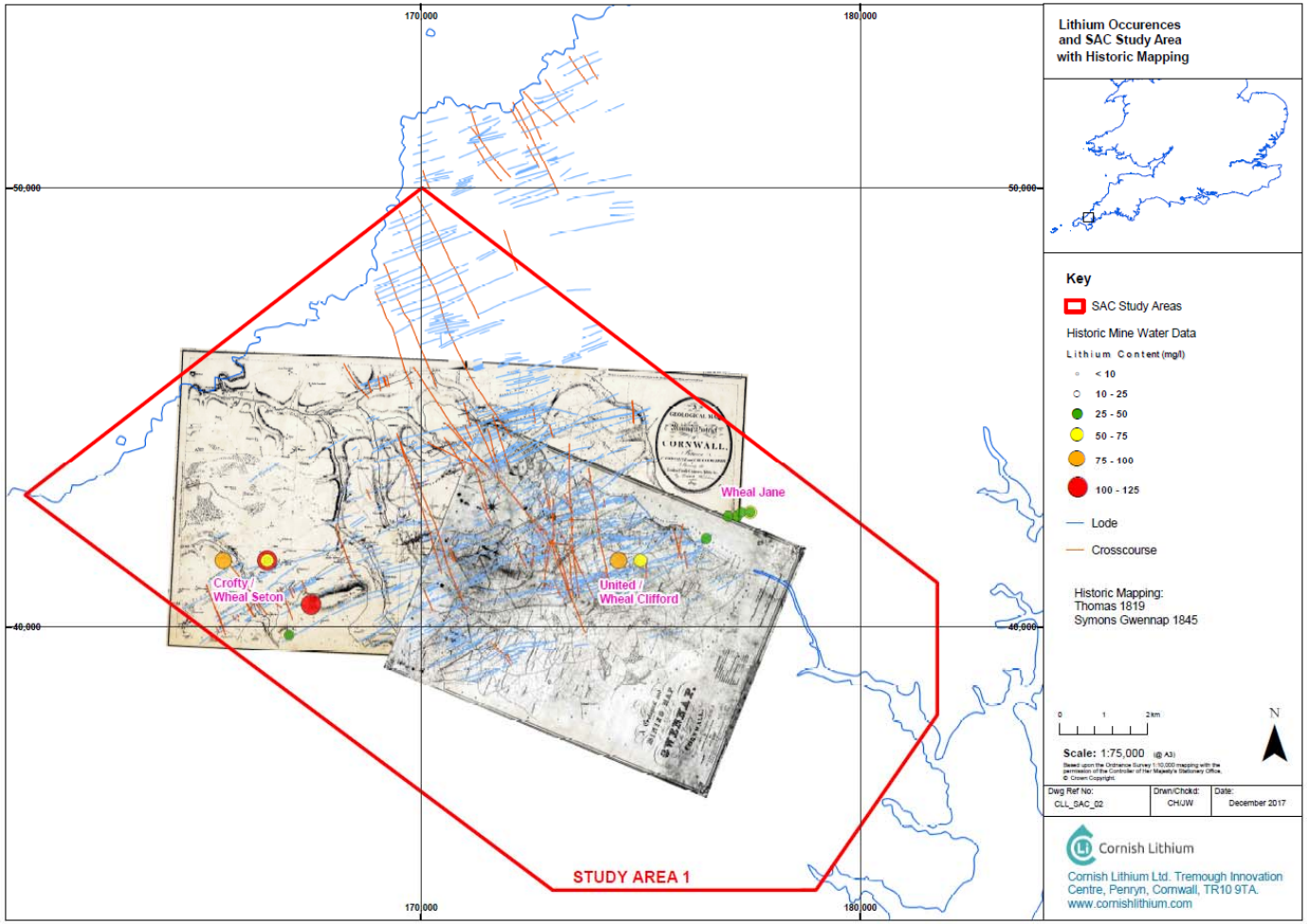
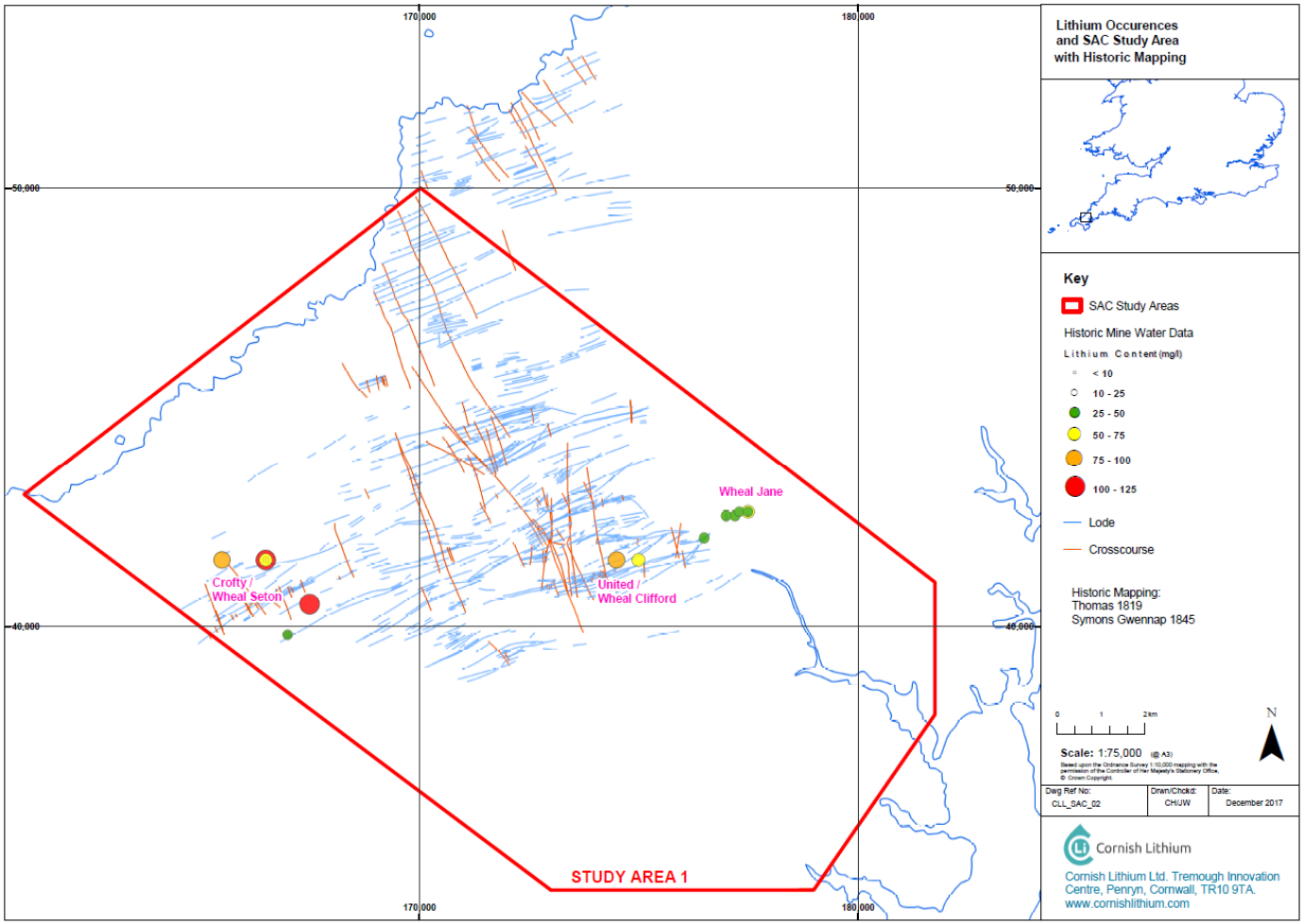
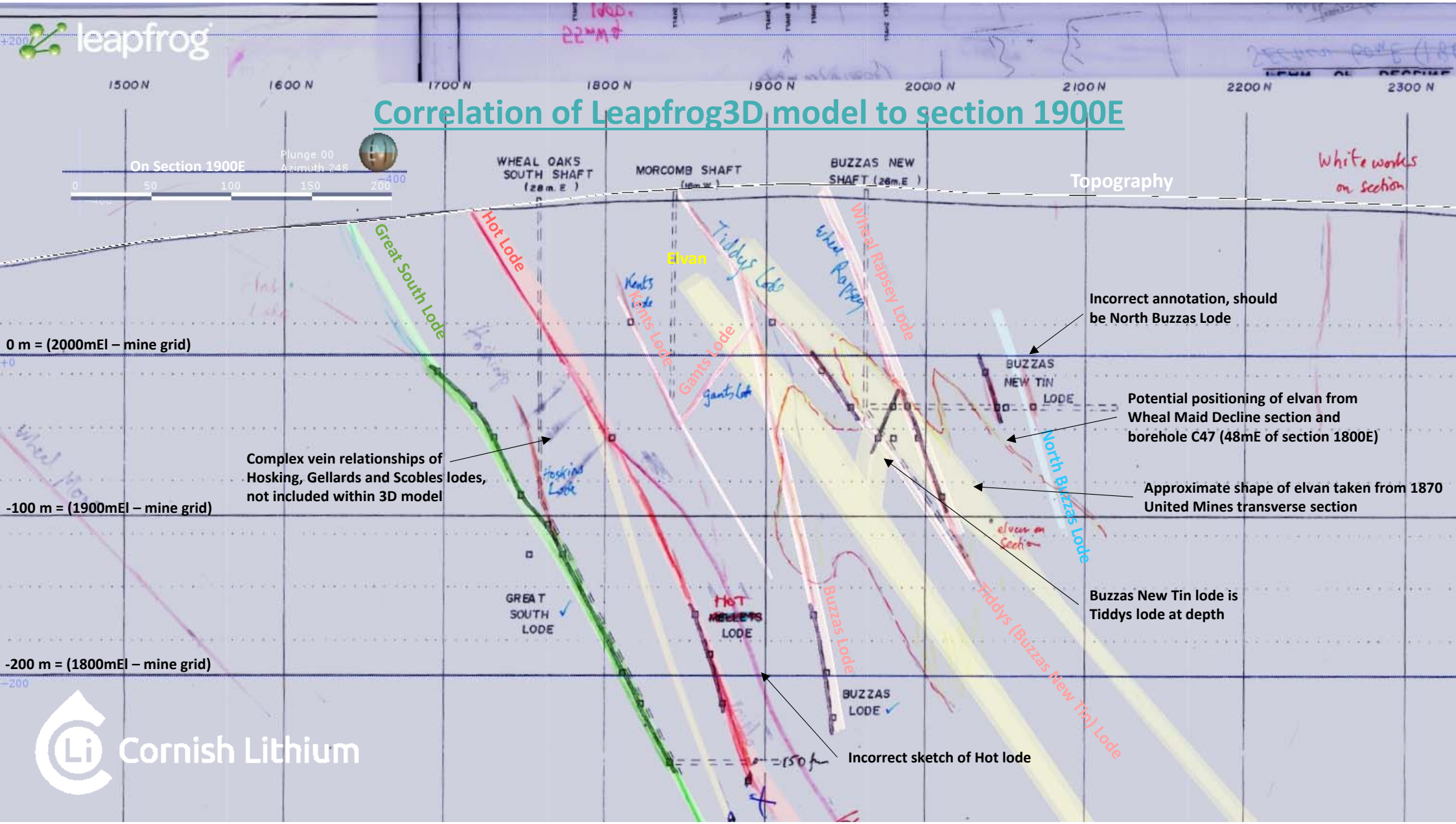
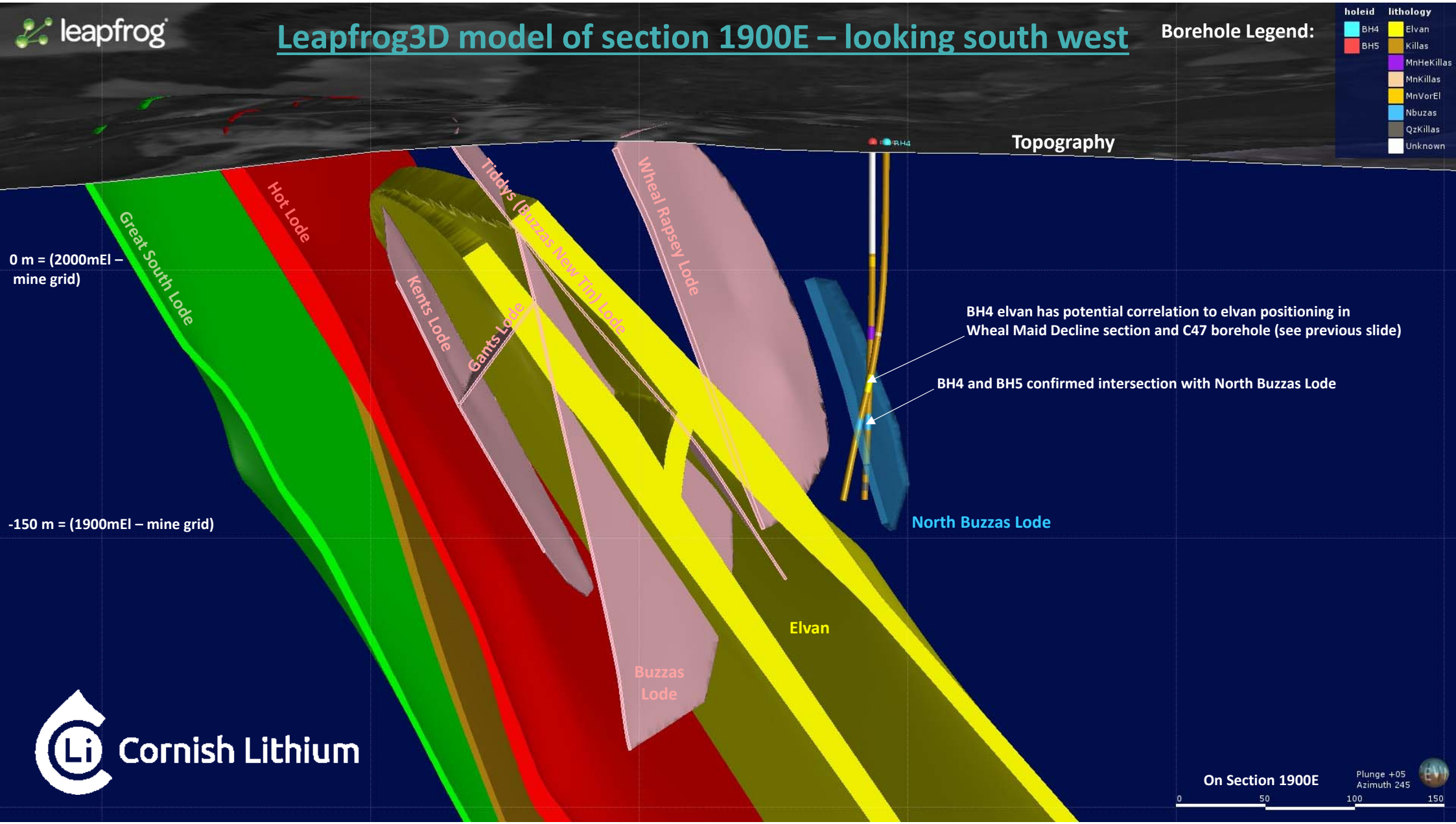


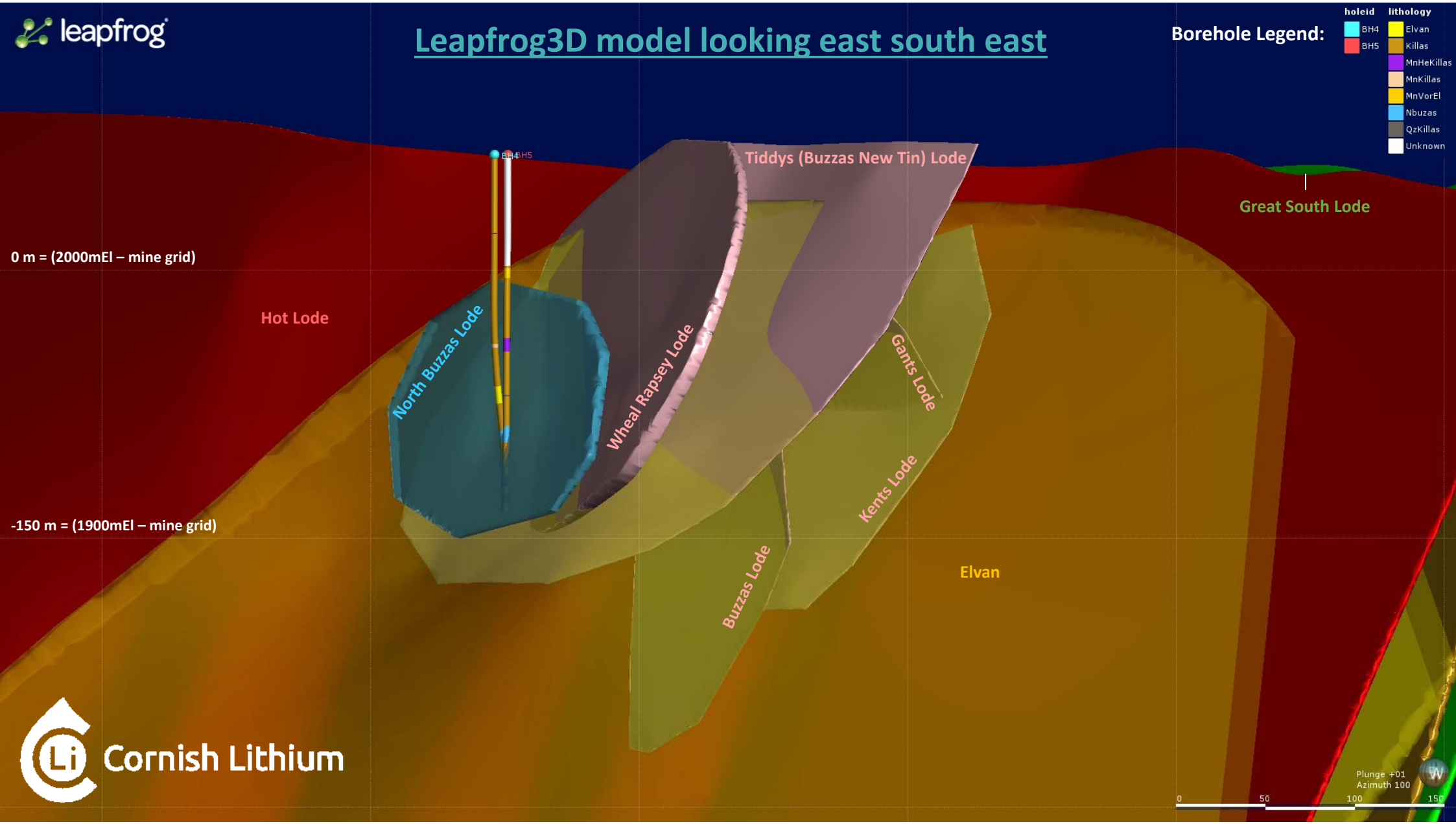
Cornish Lithium

Applying modern GIS to historic data




leapfrog
1500 N
1600 N
1700 N
1800 N
1900 N
2000 N
2100 N
2200 N
2300 N
Correlation of Leapfrog3D model to section 1900E
On Section 1900E
Plunge 00
Azimuth 248
0
50
100
150
200
400
WHEAL OAKS SOUTH SHAFT (28m.E)
MORCOMB SHAFT
BUZZAS NEW SHAFT (28m.E)
Topography
White works on section
Great South Lode
Hot Lode
Elvan
Tiddys Lode
Kents Lode
Gants Lode
Wheal Rapsey Lode
North Buzzas Lode
Hosking Lode
Buzzas Lode
Tiddys (Buzzas New Tin) Lode
BUZZAS NEW TIN LODE
GREAT SOUTH LODE
HOT LODE
BUZZAS LODE
0 m = (2000mEl – mine grid)
-100 m = (1900mEl – mine grid)
-200 m = (1800mEl – mine grid)
Incorrect annotation, should be North Buzzas Lode
Potential positioning of elvan from Wheal Maid Decline section and borehole C47 (48mE of section 1800E)
Complex vein relationships of Hosking, Gellards and Scobles lodes, not included within 3D model
Approximate shape of elvan taken from 1870 United Mines transverse section
Buzzas New Tin lode is Tiddys lode at depth
Incorrect sketch of Hot lode
Cornish Lithium


leapfrog
Leapfrog3D model of section 1900E – looking south west
Borehole Legend:
holeid
lithology
BH4
BH5
Elvan
Killas
MnHeKillas
MnKillas
MnVorEl
Nbuzas
QzKillas
Unknown
Topography
BH4
Great South Lode
Hot Lode
Tiddys (Buzzas New Tin) Lode
Wheal Rapsey Lode
Kents Lode
Gants Lode
0 m = (2000mEl – mine grid)
-150 m = (1900mEl – mine grid)
BH4 elvan has potential correlation to elvan positioning in Wheal Maid Decline section and C47 borehole (see previous slide)
BH4 and BH5 confirmed intersection with North Buzzas Lode
North Buzzas Lode
Elvan
Buzzas Lode
Cornish Lithium
On Section 1900E
Plunge +05
Azimuth 245
0
50
100
150


leapfrog
Leapfrog3D model looking east south east
Borehole Legend:
holeid
BH4
BH5
lithology
Elvan
Killas
MnHeKillas
MnKillas
MnVorEl
Nbuzas
QzKillas
Unknown
Tiddys (Buzzas New Tin) Lode
Great South Lode
0 m = (2000mEl – mine grid)
Hot Lode
North Buzzas Lode
Wheal Rapsey Lode
Gants Lode
Kents Lode
Buzzas Lode
Elvan
-150 m = (1900mEl – mine grid)
Cornish Lithium
Plunge +01
Azimuth 100
0
50
100
150

Cornish Lithium

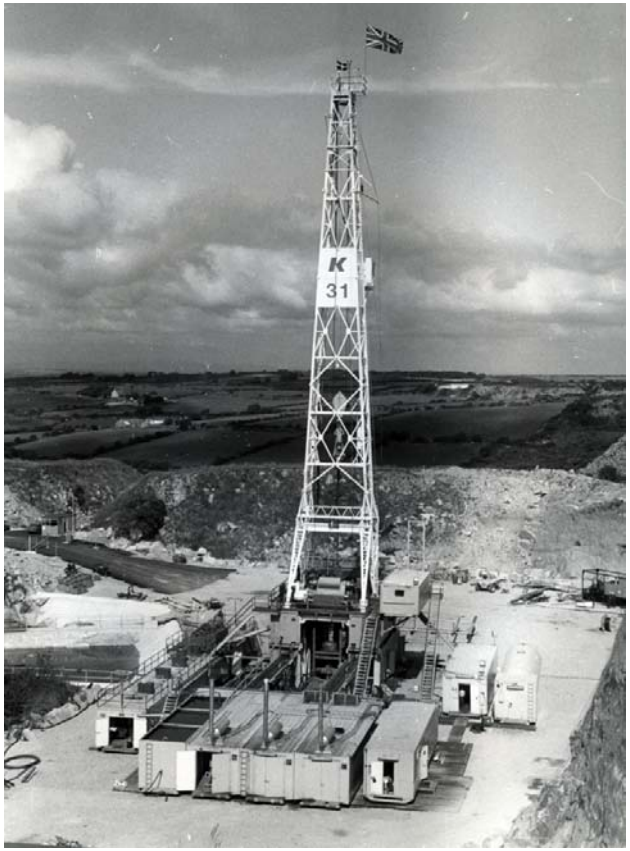
Why was the potential not recognised before?

- Cornwall has had no real exploration for at least 30 years
- There was no large scale market for lithium
- Processing options were not available
- All metal mining in Cornwall ceased with closure of South Crofty mine in 1998
- The mineral rights system in Cornwall makes exploration difficult

Cornish Lithium

Exploration Sequence

- Desktop research
- Geophysics
- Test boreholes
- Feasibility work
- Drilling of initial production wells
- Pilot Li extraction plant
- Production



Andrew Besley, “Hot rocks drilling rig at Rosemanowes quarry near Penryn” *cornishmemory.com*, accessed January 3, 2018, http://cornishmemory.com/item/BES_20_010

Cornish Lithium

Summary

- Newly developed techniques make a new lithium industry in Cornwall possible
- Underground mining in Cornwall was plagued by upwelling hot water which made working conditions very challenging. It is this same water that contains lithium
- The mineral rights secured by Cornish Lithium (~300 km^2) make this the largest unified exploration effort in the history of Cornwall
- Agreements have been secured over the most prospective areas for lithium and other minerals contained in brine
- Demand for lithium is set to increase rapidly in the near future
- The UK Government have highlighted lithium as a metal of strategic importance to UK industry