

AGM - 28th June 2019

**Developing new
technology for the
recovery of essential
energy and
infrastructure metals for
today's world**



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Metals resources are finite.

How do we supply a growing world population with base metals?

Build new mines?

Get more from existing mines?

Shares issued	1,888,730,149
Recent share price; market capitalisation	0.03p; £0.50m
AIM code	AXM

Focusing on the recovery of essential technology metals

- Good progress in Turkey with Deep South Resources at the polymetallic Kapili Tepe property and with Proses for the establishment of a semi industrial scale processing plant for lower grade zinc oxide ores.
- Industry interest in using AmmLeach[®] for base metals recovery from amenable deposits as the focus on limiting capital deployment and reduction in All-in Sustaining Costs
- Continued granting of important patents for leaching of base metals oxides using AmmLeach[®] and sulphides using HyperLeach[®] in key mining jurisdictions.
- Research and development HyperLeach[®] initiatives hold encouraging potential
- Investigating a range of potentially complementary and value accretive corporate opportunities in the natural resources sector.

Highlights

Focusing on the recovery of essential technology metals

Metaleach™

MetaLeach® is our wholly owned subsidiary and will revolutionise the extraction processes for many base metals deposits by reducing costs, enhancing operating margins and increasing production.

Ammleach.

Our core technology has major economic, technical and environmental benefits. Unlike some new technologies, it requires no special purpose built equipment. The proprietary ammonia process selectively extracts base metals from ores under ambient temperature and pressure conditions.

Hyperleach™

A proprietary process which utilises chlorine based chemistry for the extraction of metals, especially copper, zinc, nickel, cobalt, molybdenum and rhenium from sulphide ore deposits and concentrates.

Background

Our world will be ever more dependent upon high technology metals

- Revolution for the electrification of transportation; more than 500m passenger and 40m commercial EVs are forecast on the road by 2040 ⁽¹⁾
- Significant new sources of material supply will be needed by 2030 for EVs, as well as global demographic demand growth and energy storage applications in power supply, according to Glencore ⁽²⁾ viz:

Copper: +3Mtpa

Nickel: +1.3Mtpa

Cobalt: +263ktpa

(1) Bloomberg NEF – Electric Vehicle Outlook 2019

(2) Glencore presentation - Bank of America Merrill Lynch, 14/05/2019 Global Metals, Mining & Steel Conference



Lithium global demand forecast ⁽³⁾ to increase from c. 270kt Lithium Carbonate Equivalent (LCE) in 2018 to >1Mt LCE by 2025.

(3) Albemarle Corp. Investor Presentation, May 2019

Background

Our world will be ever more dependent upon high technology metals

- **Aluminium** – aerospace, transportation, construction, packaging
- **Copper** – construction, transport, infrastructure, equipment
- **EV & Energy** - metals use for Evs and energy storage:

Cobalt - ~ 50% of world's resources and supply from DRC

Lithium - Li-Ion batteries

Vanadium - vanadium flow batteries

Zinc - Zinc Air battery technology for grid storage applications from a solar generation station.

Nickel - Li-Ion battery cathode combination of Ni-Mn-Co.
Demand for high-purity class 1 nickel may increase massively to 570Kt in 2025.



Source: Rio Tinto



Overarching this, the best method, in our opinion, for extracting these metals where ores are amenable is

Hydrometallurgy - an efficient and environmentally friendly leaching technology

Patented IP - major operational, economic and environmental advantages

- No associated concentrate costs, i.e. transport, smelter & refinery charges (which can be > 40% of contained metal value).
- Uses conventional equipment but major capital and operating cost savings (typically 30-40%) possible due to magnitude of reagent (ammonia cf acid) consumption differential.
- Aside from the very substantial capital and cost savings, AmmLeach® has several major operational and environmental advantages over conventional acid leaching.
- Much simpler process circuits because of the low level of impurities in the leach solutions, and hence lower capital to clean up.
- Significantly lower decommissioning/closure costs – no acid mine drainage liability.
- The main targets for the AmmLeach® process are copper, cobalt and zinc oxide deposits.



Countries with the most prospective geology for hosting high acid consuming copper (Cu), cobalt (Co) and zinc (Zn) oxides are:

- Australia (Cu & Co) – possible Accudo projects
- Turkey (Zn, Cu) - opportunities with Deep South Resources and Proses
- Iran (Zn, Cu)
- DRC (Cu, Cu/Co)
- Zambia (Cu & Co) – agreement with Duard Capital
- Peru (Cu & Zn)
- Chile (Cu)
- Mexico (Cu & Zn)
- Central America (Zn)
- USA (Cu & Zn)

Testwork done on many different opportunities worldwide

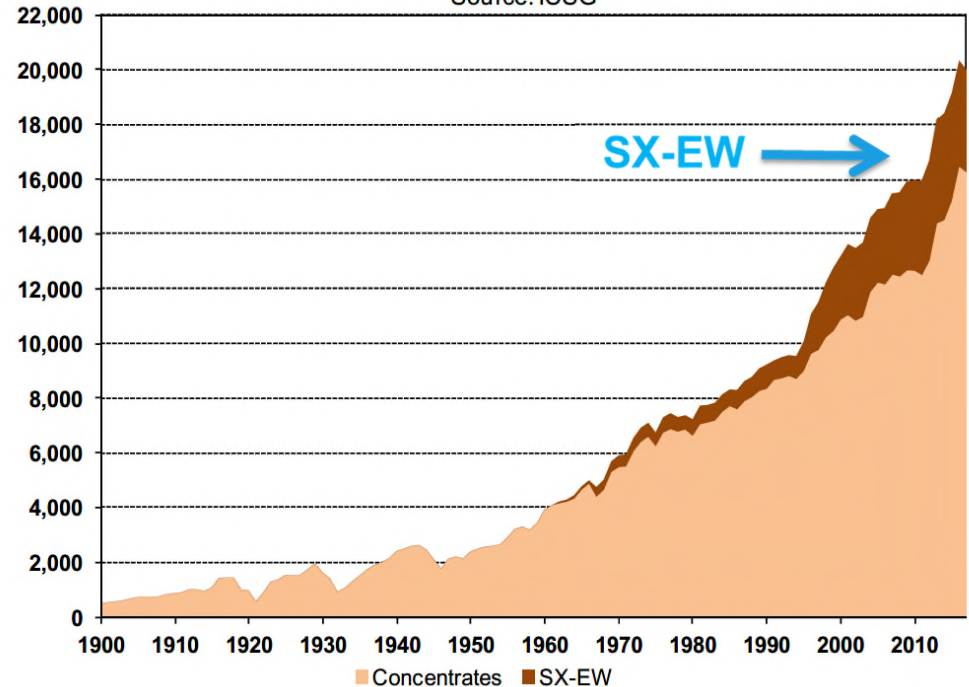


- Sulphides ~80% of world primary copper production
- Conventional treatment is to produce concentrates and ship to smelter
- Copper production from copper oxides using SXEW ~20%
- Average internal combustion engine car uses about 20kg of copper, mainly as wiring; a hybrid needs about 40kg and a fully electric car has around 80kg.

World Copper Mine Production, 1900-2017

(thousand metric tonnes copper)

Source: ICSG



- Sulphides >95% of world primary zinc production but average head grade < 7% zinc
- Conventional treatment is to produce concentrate and ship to smelter - Roast – Leach - Electrowin process
- Zinc oxides represent the highest grade undeveloped near surface base metal deposits
- Economics dictate direct shipping oxide ores limited to grades >20-25% zinc, yet world class resources of <20% ore exist, especially in Mexico & Turkey
- Significantly lower cash operating costs than sulphide ores forecast
- Partnership with Proses, a mineral processing specialist in Turkey, to investigate the commercial use of AmmLeach® in Turkey



Business development

Cobalt

- Major **AmmLeach**[®] opportunity - tested numerous samples from Cu-Co deposits and run a demonstration mini
- EV revolution - some 60% of cobalt is used in batteries, with >50% mined in the DRC, which has over half of the world's known reserves
- Industry pressure for “*responsible sourcing*” of commodities, especially cobalt given concerns about mining practice in the DRC
- Pressure on companies to trace the cobalt they use and to source it outside of the DRC; e.g. Zambia, Australia



- HyperLeach[®] is a hydrometallurgical heap leach or tank leach process for the extraction of metals, especially copper, zinc, nickel and cobalt from sulphide ore deposits and concentrates
- Nearly all base metal sulphide ores are processed and concentrated on site before being shipped to a smelter and refinery for further processing
- The costs involved in selling an ore concentrate are significant and include transport, shipping, smelter and refinery charges and penalties
- The process utilises chlorine based chemistry to solubilise metals from ores under ambient temperature and pressure conditions
- R&D investigations for potential use in copper and nickel-cobalt projects

Lithium recovery

R&D initiative

- Lithium processing technology R&D project with Dr N. Welham investigating the potential direct dissolution in a heap leach of lithium from lithium bearing minerals under ambient temperature and pressure conditions
- Although results mean no further work is planned at this stage, Alexander retains a keen interest in the lithium mining and processing sector



Source: International Energy Agency

Summary

Innovative mineral processing solutions for a high tech world

- World demand for key technology metals set to increase significantly, fuelled by EV and global demographics related use in infrastructure/energy generation/storage.
- Hydrometallurgical extraction of base metals at the mine best production route.
- IP exposure to essential high technology metals – Cu, Co, Zn, Ni.
- Alexander is focused on royalty and/or licence fee structure, minority project interests and complementary opportunities in the mining sector.



Enquiries

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