The MinEx CRC National Drilling Initiative in NSW

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• MinEx CRC: expanding the frontiers of mineral exploration in NSW
The NSW mineral discovery challenge

• NSW’s known metal occurrences and deposits occur almost exclusively in areas where prospective basement is at or near-surface.
• Mineral exploration has also focussed almost exclusively on these areas.
• Explorers need new tools and new data to give them the confidence to explore in covered terranes.
GSNSW strategy for the National Drilling Initiative

Learning from the Southern Thomson Orogen

- 5 year NCF project – GA, GSNSW, GSQ
- Related ARC Linkage – UoN, UQ, QUT
- Geophysics (AEM, MT, gravity, seismic), geochemistry, geochronology and drilling
  - 7 drillholes in NSW (60,000 km²)

A SUCCESSFUL PROJECT

- Development of geophysical techniques to “see through” cover
- Refined understanding of depth and nature of cover (often < 250 m)
- Improved understanding of basement geology – tectonics, timing, setting
- Improved understanding of mineral potential and clear evidence of mineral systems

NSW Data pack released May 2018

No discernible exploration uptake
National Drilling Initiative in NSW

- Focus for GSNSW will be on pre-competitive data acquisition including drilling in five areas.
- These areas are undercover extensions to known mineralised terranes.
- GSNSW will assess legacy materials and data, and undertake targeted mapping, and geochemical and geophysical surveys prior to drilling.
- The data collected will also provide information on potential groundwater resources in the areas (collaboration with NSW Office of Water, GA, UoN, others).

NSW area selection

- First pass constraints
  - Define cover and basement
  - <500m (all) cover to basement
  - Outcrop areas excised
  - Avoid sensitive land (National Parks, aquifers)
- Initial grid costing
  - ~ 5 x 5 km spacing
  - Max hole depth = 500 m (incl. 40 m into basement)
  - RoXplorer® cost of $50/m
  - Lab-at-Rig® cost of $25/m
- Refine grid (current work)
  - Legacy data audit and gaps, incl. existing drilling
  - New geophysics, geochemistry, geochron and mapping
  - Land clearances (environmental and cultural constraints, land access)
GSNSW NDI commitment - $15.9 million

- $4.4 million cash, to be invested in drilling in NSW
  - Based on first pass grid costing
- $11.5 million in-kind
  - $3.5 million new geophysics (AEM, mag/rad, gravity)
  - $0.6 million analytical costs (hydrogeochem, biogeochem, geochem, geochron, mineralogy)
  - $5.0 million staff in-kind
  - $2.4 million depreciated value of existing data
- Through MinEx, this investment will leverage significant additional research

Three phases – key activities

- Pre-drilling phase
  - audit and gaps of legacy materials and data
  - geophysics acquisition and modelling
  - mapping, logging, sampling, analysis, geochron
  - biogeochemistry, hydrogeochemistry.
- Drilling phase
  - data handling, computation
  - analysis (e.g. HyLogger™, isotopic).
- Post-drilling phase
  - interpretation and 3D modelling.
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<th>Phase</th>
<th>Activity</th>
<th>FY18/19</th>
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<th>Area</th>
<th>Target basement</th>
<th>Cover</th>
<th>Potential mineralisation</th>
<th>Key scientific aims</th>
<th>Pre-drilling work program</th>
<th>ND drilling</th>
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<tr>
<td>North and South Cobar</td>
<td>Siluro-Devonian basins, Ordovician basement.</td>
<td>Late Devonian and possible Mesozoic basins, Cenozoic regolith.</td>
<td>Cobalt style polymetallic, Besshi-style volcanic-hosted massive sulfides, possible magmatic systems.</td>
<td>1. Map the geology under cover, particularly key horizons.</td>
<td>1. Resampling of legacy materials.</td>
<td>232 holes 14,685 m</td>
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<td>2. Understand the geodynamic history – including thermal history, basin architecture, fit deformation.</td>
<td>2. Geophysics: AEM, infill gravity, magnetics and radiometrics.</td>
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<td>3. Understand controls and timing of mineralisation.</td>
<td>3. Improve existing mapping, including geochronology.</td>
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<td>Mundi</td>
<td>Willyama Supergroup, ~1550 Ma igneous rocks, key Neoproterozoic horizons.</td>
<td>Neoproterozoic to Devonian basins, Mesozoic Eromanga Basin, Quaternary Elysium Basin, Cenozoic regolith.</td>
<td>Broken Hill type Pb-Zn-Ag iron ore Cu-Au, Mississippi Valley type Pb-Zn, unconformity U possible magmatic systems.</td>
<td>1. Map the geology under cover, including characterisation of key time slices and interfaces.</td>
<td>1. Resampling of legacy materials.</td>
<td>2024</td>
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<td>2. Understand the expression of basement geology and mineral systems in cover.</td>
<td>2. Geophysics: AEM, infill gravity, magnetics and radiometrics.</td>
<td>65 holes 14,844 m</td>
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<td>3. Correlate basement geology between NSW and SA.</td>
<td>3. Improve existing mapping, including geochronology.</td>
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<td>Forbes</td>
<td>Macquarie Igneous Province (MIP), Siluro-Devonian basins and igneous rocks.</td>
<td>Late Devonian basins, possible Mesozoic Great Australian Basin, Cenozoic regolith.</td>
<td>Porphyry Cu-Au, epithermal systems, volcanic-hosted massive sulfides, orogenic gold, possible magmatic systems.</td>
<td>1. Map the geology under cover, including phases of the MIP.</td>
<td>1. Resampling of legacy materials.</td>
<td>2025</td>
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<td>2. Understand the expression of basement geology and mineral systems in cover.</td>
<td>2. Geophysics: AEM, infill gravity, magnetics and radiometrics.</td>
<td>233 holes 22,735 m</td>
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<td>3. Understanding of the geodynamic history, e.g structural controls, magmatic history, Siluro-Devonian basin fit deformation.</td>
<td>3. Improve existing mapping, including geochronology.</td>
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<td>Dubbo</td>
<td>Macquarie Igneous Province (MIP), Siluro-Devonian basins and igneous rocks.</td>
<td>Permo-Triassic Sydney Basin, Mesozoic Surat Basin and volcanic rocks Cenozoic regolith and volcanic rocks.</td>
<td>Porphyry Cu-Au, epithermal systems, volcanic-hosted massive sulfides, orogenic gold, possible magmatic systems.</td>
<td>1. Map the geology under cover, including characterisation of key time slices/interfaces.</td>
<td>1. Resampling of legacy materials.</td>
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<td>2. Understand the expression of basement geology and mineral systems in cover.</td>
<td>2. Geophysics: AEM, infill gravity, possible magnetics and radiometrics.</td>
<td>234 holes 17,172 m</td>
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<td>3. Identification, location and nature of MIP under cover.</td>
<td>3. Improve existing mapping, including geochronology.</td>
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Activities to date

Audit and gaps

• Report for each of the five focus NDI areas.
• Includes previous mapping, geophysics, geochronology, palaeontology, field observations, geochemistry etc.
• Inform work program and research opportunities for each NDI area.
• Underway, will be published by end of 2019.
• Examples from Mundi NDI report, by Chris Folkes
Initial focus on Cobar

- Northern and southern extensions of the Cobar Basin under cover, up to a depth of 500 m.
- Long history of mining, with limited current mine life.
- Recent advances in understanding from GSNSW mineral systems work.
- Exploration interest and significant potential for discovery.
- Community support for mineral exploration and mining.

Cobar community consultation

Cobar to Lake Cargelligo ahead of AEM and hydrogeochemistry

- Community leader meetings (February 2019)
- Community information sessions (April 2019)
Cobar hydrogeochemistry

- GSNSW now has two kits and trained up
  - Thanks Nathan Reid, Rob Thorne (CSIRO)
- Designed to test:
  - Different aquifers & geology
  - Calibration with AEM
- Two trips sampled 86 sites
  - 16 geochronology

Cobar AEM

- Collaborative acquisition with Geoscience Australia
  - 12/09/19 to 19/10/19 – acquisition by NRG
- Early Dec 2019 – expecting data conductivity depth inversions (CDIs) from NRG (the coloured sections for interpretation)
- End March 2020 – processed layered inversions from GA.
- Proposed PhD to undertake detailed interpretations and modelling
- CSIRO research work?
Cobar biogeochemistry

- Joe Schifano PhD project (UNSW) in the greater Cobar region:
- Cypress pine trees are the target plant
- Common in the region and have deep root systems
- >2000 samples collected
- ~ 50 elements analysed
- Initial results indicate potential to map covered geology, including direct indications of mineralisation

Cobar timeline

- Q4 2018: Communications strategy, industry consultation, EOI AEM
- Q1 2019: EOI AEM participants agreement signed, Meet community leaders, Community workshop
- Q2 2019: Audit and gaps
- Q3 2019: Mag/Rad acquisition, Gravity acquisition, Drilling (South Cobar)
- Q4 2019: Drilling (North Cobar), EOI MAA / EL process consultation
- 2020: Waterbore sampling
- 2021: Mapping and sampling
- 2022: Drilling planning, clearances, land access agreements etc.
Other activities

- Mundi field trip and core viewing July 2019
  - Linked to Uncover Curnamona conference
- UoN Embedded Researcher has been advertised
  - 24 applications were received, 5 shortlisted
  - Interviews held in Monday 11 November and a preferred candidate has been identified
  - Selection imminent
- NSW NDI Researcher workshop held in Newcastle on Thursday 7 November – well attended, successful day
The UNCOVER imperative

- The future of the Australian mineral industry hinges on its ability to successfully explore the 70% of the continent that lies undercover.
- To do this the industry needs new tools, technologies and data.
- Just as geological surveys mapped the surface geology to provide a framework for mineral explorers in the 20th century, we need to map the undercover geology to create a framework for 21st century mineral discovery. “Mapping with a drill rig”
- MinEx CRC NDI is a significant first step on that path.
- 10 years is just the start of a long road.

Outcome of the NDI in NSW

Improved understanding of the basement geology and its expression in cover sequences across five areas of the state … … supporting development of new tools and methodologies for successful exploration undercover… … to open up vast new frontiers for explorers, generating a wave of discoveries that will underpin a strong mineral industry and economy for future generations of Australians.