Mineral potential of the East Lachlan Orogen revealed
Prospectivity using spatial data analytics

GSNSW is completing a statewide mineral potential mapping project that will:

- Develop mineral system models and identify economic potential for key mineral systems
- Replace the 'potential' layer in the current Mineral Resource Audit mapping
- Have results which can trigger land-use referrals
- Include Kenex spatial analysis
- Identify land-use pressures
- Result in availability of good metallogenic mapping, seamless geology and derivative maps.
Methodology

• Weights of evidence (WofE) approach was used:

• Training data selected by GSNSW experts for each mineral system.

• Predictive maps generated and WofE used to quantify spatial association with training points for each mineral system.

• Selection of predictive maps for inclusion in mineral potential maps and running models for each mineral system:
  • Maps need to be statistically valid, geologically meaningful, and practically useful.

• Mineral potential map produced.
Southern NEO

1. **Intrusion-related tin-tungsten** (IR Sn-W)  

2. **Intrusion-related gold** (IR Au)  

3. **Orogenic gold-antimony** (orogenic Au-Sb)  

**Data package**

Curnamona and Delamerian-Thomson

1. Shear-hosted iron-oxide copper gold (Copper Blow type)
   GS2018/0371
2. Orogenic gold
   GS2018/0372
3. Volcanic-associated massive sulphide (Grasmere type)
   GS2018/0370
4. Broken Hill type Pb-Zn-Ag
   GS2018/0400

Data package
East Lachlan Orogen

1. Porphyry centred Cu-Au (Mac Arc)

2. Orogenic Au
   - Tabberabberan
   - Kanimblan

3. Volcanic-associated massive sulphide

4. Post Ordovician magmatic hydrothermal skarn systems
## Datasets used in the ELO analysis

<table>
<thead>
<tr>
<th>Data type</th>
<th>GSNSW source database</th>
<th>Zone 55E (ELO)</th>
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</thead>
<tbody>
<tr>
<td>Radiometric ages</td>
<td>Geobank radiogenic isotopes</td>
<td>1727 analyses</td>
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<tr>
<td>Whole-rock geochemistry</td>
<td>Geobank whole rock geochemistry</td>
<td>6133 analyses</td>
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<tr>
<td>Mineral occurrences</td>
<td>Geobank MetIndex</td>
<td>12169 observations</td>
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<tr>
<td>Petrographic observations</td>
<td>Geobank petrology</td>
<td>56126 observations</td>
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<tr>
<td>Field observations</td>
<td>Geobank field observations</td>
<td>94548 observations</td>
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<tr>
<td>Structure points</td>
<td>Geobank field observations, MetIndex and seamless geology</td>
<td>37945 compass readings</td>
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<td>Fold axes</td>
<td>Geobank field observations and seamless geology</td>
<td>2864 recorded</td>
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<td>Drillholes (including lithology logs)</td>
<td>Geobank drillholes and wells</td>
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<tr>
<td>Drillhole assays</td>
<td>Geobank assay results</td>
<td>2903474 analyses</td>
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<td>Surface major element analyses (pXRF)</td>
<td>Geobank assay results</td>
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<tr>
<td>Surface trace element analyses (soil, stream sed, pXRF)</td>
<td>Geobank assay results</td>
<td>62367 analyses</td>
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<tr>
<td>Reactive rocks layer</td>
<td>Seamless geology</td>
<td>Complete</td>
</tr>
<tr>
<td>Igneous metal fertility</td>
<td>Seamless geology, whole rock geochemistry</td>
<td>Complete</td>
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<tr>
<td>Fault attribution</td>
<td>Seamless geology</td>
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<td>Metamorphic map</td>
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<tr>
<td>Geology</td>
<td>Seamless Geology</td>
<td>Complete</td>
</tr>
<tr>
<td>Geophysics</td>
<td>Statewide 50m grid magnetics, gravity, radiometrics, mag and grav worms</td>
<td>Surveyed and complete</td>
</tr>
</tbody>
</table>
Porphyry Cu-Au

- Ordovician to early Silurian porphyry Cu-Au mineralisation associated with fertile magmas within the Macquarie Arc.
- The mineral systems knowledge tested using spatial analysis:
  - 215 spatial variables tested
  - 164 produced a statistically valid result
  - 80 correlated well with the training points
Porphyry Cu-Au

- Most highly prospective areas around the Cadia and Cowal districts.
  - Cadia East, Ridgeway, Copper Hill, Cowal, E39, Gidginbung in highly to very highly prospective area
  - Cargo, Combella, Peak Hill, Marsden, Yiddah in moderately prospective area

- Other highly prospective areas are located around Gidginbung, Copper Hill, and Glendale.

- Northparkes highlighted as weakly prospective.
  - Lack of faults mapped in the district
  - Deposit geometry at E26

- Kaiser is in an unprospective area
  - Absence of mapped intrusions and structures.
  - Seamless is being updated to resolve this.
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  - Combella to NW is in prospective area.
Porphyry Cu-Au

• Tested 33 different magma fertility parameters

• Modelling results emphasise importance of moderately to very strongly oxidised magmas that were also K-enriched.

• Regional-scale faults showed only moderate correlation with training points.

• Some areas haven’t had the same intensity of historic exploration and may represent opportunities.
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Polymetallic Skarn

- Mid-Silurian to mid-Carboniferous polymetallic skarn mineralisation associated with Tabberabberan and Kanimblan Cycle intrusions.
  - Skarns related to Benambran Cycle intrusions (e.g. Big Cadia) and metamorphic reaction skarns (e.g. Red Hill) were excluded.
- The mineral systems knowledge was tested using spatial analysis:
  - 228 spatial variables evaluated
  - 153 produced a valid predictive map
  - 89 correlated well with the training points
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Polymetallic Skarn

Highly prospective area around Cow Flat area and Young Granodiorite.

Prospective area is typically < 1km of causative intrusion and within the pluton’s contact metamorphic aureole.
Orogenic Au

• Low sulfide structurally controlled quartz veins related to Early Carboniferous Kanimblan Orogeny within/adjacent to Hill End Trough.

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Kanimblan vs. Tabberabberan

- Similar source maps used in each model
- Both mineral systems relate to greenschist facies metamorphism
  - Higher grade during Tabberabberan, making it difficult to map for Kanimblan
- Kanimblan system uses pre-existing structures from Tabberabberan
- Parts of Hill End Trough prospective for Tabberabberan orogenic Au despite dominant event being Kanimblan in the area.
VAMS Mineral System

- Stratabound accumulations of sulfide minerals hosted in deep-water extensional basins that formed in the Middle Silurian (Tabberabberan Cycle).

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VAMS Mineral System

- Highly prospective area around Mount Costigan to Wet Lagoon.
- Low to moderate prospectivity to south of Bathurst Batholith

- Elevated prospectivity in the Tumut Trough highlights untapped potential.
- Modelling confirms key ideas about basin bounding and extensional faults, exhalative horizons, and syn-volcaniclastic sedimentary rocks.
- Challenge to map the causative heat sources/intrusions for the mineral system.
VAMS Mineral System

- Exploration heat map indicates there are still some relatively underexplored areas with moderate to high VAMS potential.
- May represent exploration opportunities for industry.
Outputs

- A Mineral System Atlas for the Eastern Lachlan Orogen is downloadable as a digital data package from DIGS:
- A wide range of predictive maps have been created.
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