Metallogenic analysis – Defining and mapping mineral systems

Vladimir Lisitsin
Geological Survey of Queensland
Outline

• Mineral system maps – aspiration and reality
• From mineral occurrence databases – to hierarchical metallogenic objects
• From traditional geological datasets – to mappable expressions of mineral systems
• Need for the geological surveys to revive the old concept of metallogenic maps with new ideas?
Mineral systems – conceptual definition

• “All geological factors that control the generation and preservation of mineral deposits” (Wyborn et al., 1994)

• A common emphasis on defining a combination of individual critical and constituent processes

• The general concepts are translated into mappable targeting criteria and used in exploration targeting
Mineral systems – from concepts to maps

- Many alternative definitions, approaches, terms and tools
- Large uncertainties on the composition and structure of many mineral systems – how they operate
- A major challenge of translation from (uncertain) concepts to specific maps
- A challenge of self-organised criticality – mineral systems cannot be reduced to a combination of (uncertain) components
- Mineral system ‘maps’ are not readily available or comparable
Common maps insufficient

- Geology and mineral occurrences – essential but insufficient to map a mineral system
- Reasons for uneven distribution?
- Large-scale metallogenic controls within the province?

Geology and mineral occurrences – essential but insufficient to map a mineral system

Reasons for uneven distribution?

Large-scale metallogenic controls within the province?
Metallogenic objects as indicators of mineral systems

- Properties of known mineralisation is the most direct evidence of a mineral system
- Hierarchy of metallogenic objects:

<table>
<thead>
<tr>
<th>Metallogenic object</th>
<th>Common size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Province</td>
<td>n x 100 km</td>
</tr>
<tr>
<td>Zone</td>
<td>n x 10 km</td>
</tr>
<tr>
<td>Ore field</td>
<td>n km</td>
</tr>
<tr>
<td>Deposit</td>
<td>n x 100 m</td>
</tr>
</tbody>
</table>
1,000 recorded primary orogenic gold occurrences

- Province - the maximum spatial extent of the mineral system
1,000 recorded primary gold occurrences

8 significant ore fields with >1 t contained gold

Most deposits are in a single narrow metallogenic zone
The zone is oblique to the regional structures. It represents a major crustal domain boundary, as indicated by igneous geochemistry and regional metamorphic grades.
Summary

• Traditional geological maps are insufficient

• Need consistent maps of essential metallogenic information that would adequately characterise mineral systems:
  • Geochronology and genetic links of mineralisation
  • Lithospheric to local-scale domains and damage zones

• Geological surveys are uniquely positioned to collect and provide such information