MT PERCY GOLD DEPOSIT

THE ROLE AND SIGNIFICANCE OF PORPHYRY INTRUSIONS IN THE GOLD MINERALISATION PROCESS

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Gold Industry
Fourth Largest Commodity Sector in WA

- Gold price currently >US$ 1,350 p/oz. (>AU$ 1,800)
- Important safe haven during times of crisis
- Easy deposits have been found in mature districts
- Need to do things differently to find new deposits
Mineral Exploration
Driving Discoveries for a Growing World

Exploration geologists are responsible for finding the mines of the future

- Employ a wide range of technologies
- Work in varied and remote locations
- Changing roles and responsibilities
- We commonly use deposit case studies to guide exploration
Archean Orogenic Gold Deposits
Magmatic or Metamorphic?

- Porphyry stocks, sills and dykes are present in many Au deposits, particularly in Canadian deposits.
- Spatial association of these intrusives with mineralisation implicates them in deposit genesis.
- The Mt. Percy gold deposit contains three types of porphyry stocks and dykes.

(Groves et al., 1998)
The Kalgoorlie Gold Camp

>120 years of Continuous Mining

- One of the largest gold mining districts in the world (>1,200t Au); currently producing >800,000 oz. per annum
- Two ultramafic-mafic volcanic sequences, deposited between 2715 and 2690 Ma
- Intruded by ultramafic to felsic rocks
- Two dominant mineralisation styles: Fimiston and Charlotte (ca. 2640)

(Vielreicher et al., 1998)
Mt. Percy Deposit Geology (10t Au)

A Complex History

- Ore mined from three open pits (1985-1992)
- Two main stages of gold mineralisation (~2640 Ma)
- Three types of intrusive porphyry
- Key structures trend NE to NW
Early Events
Formation of the Rock Pile

- Deposition of Kalgoorlie sequence (2715-2690 Ma)
- Intense alteration of HLS and DCB
- Intrusion of the Williamstown (2,696±5 Ma) and Golden Mile (2680±9 Ma) Dolerites
- Intrusion of FQP (2670±5 Ma) and HAP(?) stocks (2650±6 Ma) followed by intense alteration
Stage 1 Mineralisation
Shear Zone Hosted Gold Mineralisation

- GM thrust fault forms with the Kalgoorlie anticline as a hanging-wall anticline.
- Development of stage 1 shear zone-hosted gold mineralisation during late D1 early D2
- Regional NE-SW compression leads to tilting of stratigraphy during D2
- Kersantite dykes are intruded ca. 2642±6 Ma
Stage 2 Mineralisation
Brittle Vein Hosted Gold Mineralisation

- NE trending, sub-vertical to NW dipping dextral-oblique-slip faults
- Sheeted vein network mineralization forms ca. 2640 Ma
## Intrusive Phases

### Temporal Association with Mineralisation

<table>
<thead>
<tr>
<th>Porphyry Type</th>
<th>Age(^\text{^})</th>
<th>In Core</th>
<th>Temporal Association with Mineralisation(^*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feldspar-Quartz Porphyry Stocks</td>
<td>2670±5 Ma U-Pb zircon</td>
<td><img src="#" alt="Image" /></td>
<td>None</td>
</tr>
<tr>
<td>Hornblende-Albite Porphyry Stocks</td>
<td>2650±6 Ma U-Pb zircon</td>
<td><img src="#" alt="Image" /></td>
<td>Overlap Possible</td>
</tr>
<tr>
<td>Kersantite (Lamprophyre) Dykes</td>
<td>2642±6 Ma U-Pb zircon</td>
<td><img src="#" alt="Image" /></td>
<td>Synchronous</td>
</tr>
</tbody>
</table>

\(^\text{^}\)All ages from Vielreicher et al. 2010

\(^*\)Gold mineralisation ca. 2640
Implications for Exploration
Porphyries as an Indicator of Prospectivity?

- Temporal and spatial correlations support the possibility of a genetic link between porphyries and gold mineralisation.
- At the mine scale porphyries are volumetrically too small to have been the only source of gold.
- Geochemical similarities to the Mt Shea intrusive complex, which underlies part of one of the best endowed gold belts in the world.
Key Learnings and Impacts
Research Critical to Improved Exploration Outcomes

- Applied research teaches valuable skills and encourages critical and lateral thinking
- Mineralisation is spatially and temporally associated with mineralisation at Mt Percy
- Characterising porphyry types could help significantly in understanding the prospectivity of gold belts
- Additional research now needs to be undertaken to support a genetic link
Thank You for Listening

Questions?

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- LA-ICPMS Instruction (CODES, UTAS): Leonid Danyushevsky
References

- Vielreicher NM, Groves DI, Snee LW, Fletcher IR, McNaughton NJ (2010) Broad synchroneity of three gold mineralisation styles in the Kalgoorlie Gold Field: SHRIMP, U-Pb, and $^{40}$Ar/$^{39}$Ar geochronological evidence. Econ Geol 105:187–227
Regional Correlations

Similarities to Mt Shea

- Oxidised, calc-alkaline, negative Nb anomalies, REE patterns, trace element patterns, ages and a wide range in: SiO$_2$ content, chromium, nickel, barium and Sr/Y ratios
Las​er-​ablation-​ICPMS

- LA-ICPMS analysis undertaken at the ARC Centre of Excellence in Ore Deposits (CODES), UTAS
- Pyrite from stage 1 mineralisation contains high As (up to 1500 ppm) and shows very similar Ni-Co-As ratios to Fimiston style gold mineralisation
- Pyrite from stage 2 mineralisation contains much lower As (up to 220ppm) and contains higher Ni-Co ratios
Porphyry stocks and dykes are collectively:
- of I-type origin
- oxidised
- calc-alkaline

The porphyry-REE pattern suggests formation through fractional crystallisation from a monzodiorite parent magma.