Distinct mid-Carboniferous and mid-Permian gold systems of Cape York

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Outline

• Gold deposits of Cape York in the Coen Inlier and Horn Island: a general overview
• Geochronology of felsic dykes often spatially associated with / hosting Au deposits
• Geochronology of alteration related to mineralisation
• Ore geochemistry
• Regional and camp-scale metallogenic controls
Acknowledgements

Company support with site access and sampling:
- Alice Queen (Horn Island)
- Alice River Gold / Spitfire (Alice River)

Cooperative analytical work
- U-Pb zircon geochronology – Geoscience Australia
- Ar-Ar geochronology – Australian National University
- Re-Os geochronology – University of Alberta, Canada
- Oxygen isotope analyses – Scottish Universities
- Follow-up research – EGRU (JCU)

Mineral systems

- Au-Ag and Sn-W ore fields
- Previously insufficient information – geochemical association? age? deposit type(s)?
- Field work and sampling of significant deposits throughout the Coen Inlier and Horn Island
Horn Island region

- Horn Island ore field (>800 kg Au production)
- Minor production from Possession Island (<100 kg Au)
- Hard rock and alluvial tin mineralisation on the mainland

Horn Island region

- PZ geology – granites of the Badu Suite and (deemed co-magmatic) Torres Strait Volcanics – Badu Supersuite
- K-Ar dating of Badu Suite intrusives in 1960-s - 302-286 Ma
- But, new U-Pb (SHRIMP) data of the Torres Strait Volcanics – ~350 Ma
Horn Island Au mineralisation

Re-Os dating of molybdenite from two samples of Qtz-Mo veins cutting Badu Granite – 342-344 Ma

Ar-Ar of sericite alteration associated with Au mineralisation indicate mineralisation at ~320 Ma

Horn Island – new geology

• Badu Supersuite – early Carboniferous (>342 Ma)

• The oldest episode of Carboniferous magmatism in north Queensland?

• Gold mineralisation significantly post-dates Badu Supersuite (and associated Qtz-Mo veins) – at ~320 Ma
Coen Inlier

- Main Au ore fields
  - Coen (~1.5 t Au)
  - Ebagoola (~800 kg Au)
  - Yarraden (~550 kg Au)
  - Wenlock (~150 kg Au)
  - Alice River

- Minor Sn and W hard rock and alluvial fields
  - Archer River (314 t Sn)
  - Bowden (~80 t W)

Ore textures – Coen Inlier

May Queen, Ebagoola
Big Blow, Alice River
Golden Treasure, Ebagoola
Alice Queen, Alice River
Significant ore fields

Coen

- Core of the field produced ~90% of total gold (mostly from Great Northern mine)
- Steep qtz veins and breccias, trending NW-SE
- Only brittle fractures
- Pyrite-arsenopyrite±galena
- Au occurs in: fine grained qtz, comb qtz and late chalcedony

Significant ore fields

Alice River

- Alice Queen – the main producer of the field
- Core of the field contains ~95% of identified gold
- Pyrite-arsenopyrite±stibnite
- Free Au in fine grained grey and brown qtz – cut by later barren white comb qtz
- Only brittle fractures
Common host rocks - felsic dykes

Significant gold deposits often have a close spatial association with felsic dykes, particularly common in the Coen, Ebagoola and Yarraden gold fields.

Host rocks - Felsic dykes

Queenslander, Ebagoola
U-Pb Geochronology

• New U-Pb zircon SHRIMP data: the felsic dykes were emplaced across the region in a single early Permian episode (~283-285 Ma)

• Broadly synchronous with the Wolverton Granite (280.4 ± 1.5 Ma) and a rhyolitic plug at Spion Kop (281.6 ± 3.9 Ma)

• The first reliable geochronological constraints on the maximum age of gold mineralisation in the region

Ar-Ar geochronology

• Ar-Ar dating on pervasive sericite alteration of rhyolite dykes – ~280 Ma

• But, Ar-Ar dating of muscovite associated with Au mineralisation at Coen and W at Archer River - ~275 Ma

• Pervasive sericite in dykes – muscovitic and paragonitic illite, but in ore – muscovite (HyLogger)

• Au post-dates documented magmatism by 5 Ma?
Ore geochemistry

• Systematic multi-element geochemical analysis of gold deposits across Cape York
• ~200 samples analysed across the Coen and Horn Island regions
• >160 qtz vein samples with >1 g/t Au, 40 with >5 g/t Au

Ore geochemistry

• Coen region
  – Pyrite-arsenopyrite±stibnite ±galena
  – Au-Ag (10s, sometimes 100s ppm) – As (100s ppm) ± Sb (10s ppm), locally with Pb, Zn (±Te±Bi - <1 ppm)
  – Au / Ag ratio – often close to 1
• Horn Island
  – Galena-sphalerite-pyrite
  – Au-Ag-Pb-Zn
Regional structural controls

- Ore fields – near regional shear zones along lithological contacts of D granites and PR metamorphics
- Larger ore fields – within 10-20 km west of the boundary between the Savannah and Etheridge provinces
- PR province boundary – a metallogenic zone-scale metallogenic control, while shears – operated at a more local scale?

NE QLD – 275-285 Ma

- Widespread felsic magmatism across north-east Queensland at ~285-280 Ma
- Au deposits – often proximal to (minor) sub-volcanic intrusions of 285 Ma – mostly away from main plutons and cauldrons
Conclusions

- Cape York Au – 2 distinct mineral systems: mid-Carboniferous (Horn Island) and mid-Permian (the Coen region)
- Horn Island – **early Carboniferous** volcanics, granites and Qtz-Mo veins (~350-342 Ma), but Au mineralisation at ~320 Ma
- Coen region – single brief felsic magmatic event at ~280-285 Ma (U-Pb, Ar-Ar), but mica growth associated with gold and tin mineralisation at ~275 Ma (Ar-Ar)
- Isotopic evidence of a dominant meteoric source of auriferous fluids at several larger deposits ($\delta^{18}$O$_{VSMOW}$(qtz) <7‰ – the epithermal Au affinity) – but others are very different (13-16‰ – cooler magmatic fluid?)