The **Glenburgh Au** deposit, Gascoyne Province—evidence of metamorphosed Au?

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Outline

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- Orogenic Au in high met-grade terranes
- Glenburgh Au, what we already know
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  - Petrography
  - Au internal structure
- Relative timing of Au
- Absolute timing of Au
- Potential alteration signatures
Glenburgh Terrane

From Johnson et al (2013)
Orogenic Au in high met-grade terranes

The Continuum Model: Orogenic gold deposits form across a vertical crustal profile from 5-25 km at the peak of metamorphism and temperatures above 700°C to below 180°C

HOWEVER

Any hydrothermal fluid added to a rock above 600°C would induce partial melting or enter the melt and would not be able to precipitate Au

- Most orogenic Au deposits are known to have formed in greenschist facies rocks
- Griffins Find, Challenger, Big Bell, Tropicana (Australia), Renco (Zimbabwe) and Hemlo (Canada)

All have been argued to have formed pre- or post-peak metamorphism, never syn.
- Greenschist facies conditions ideal?
- Has major implications on exploration

Schematic representation of the continuum model (Groves, 1993)
**Glenburgh Au**

- Hosted along a discontinuous ENE trend in Paleoproterozoic *qtz-bt-fspar-gnt* gneisses
- Upper amphibolite (-granulite?) facies
- Au free milling
- 1 Million ounces resource
- Found through soil sampling
- Au the only pathfinder to Au!!

Do not know what **alteration** style or **lithology** the Au is associated with nor is the **age**, **style** and **setting** known.

**Peak Met @ ~1997Ma**

**Paradise Well P/T ~800-1000°C 7-10kbar**  
(Johnson et al 2010)
Project Objectives & Methods

1) Glenburgh Au deposit formed pre-, syn- or post-peak metamorphism?  
   [Petrography, Au etching]

2) **Timing** of mineralization at Glenburgh relative to known geological events in the region  
   [Petrography, mapping]

3) Whether there is (or is not) an **alteration signature** associated with the gold mineralization  
   [Drill core logging/HyLogger, petrography, mapping]
Folded, steeply north dipping package of interleaved:
- Leucosomes (qtz, fspar, gnt)
- Melanosomes/pelitic (bt)
- Amphibolites
  *Late* qtz-chl veining

*Upper amphibolite facies*

Folded garnet accumulation
HyLogger data

Measures differences in reflectance spectroscopy across the length of the core.

Highlights the lack of obvious alteration assemblage associated with mineralization.
Au Internal Structure

High purity Au veinlets on internal grain boundaries

Incoherent twinning
Pre-Peak Au? **YES!!**

1) Sulfide inclusions (well rounded) in interpreted peak-metamorphic mineral (Po associated with Au)

2) Au grains show very low Ag levels and effects of thermal moderation

3) Lack of obvious alteration assemblage

4) No correlation with a specific lithology
   (remobilised from original metasedimentary package)

   + No correlation with late structures
   + Evidence for vapour absent melting during peak-met
Absolute timing of Au

\[ \text{2035+12 Ma} \] pelitic migmatite maximum depositional age at Zone 126
(Wingate et al., 2015a)

+ 
Peak metamorphism at \[ \text{1991+2 Ma} \]
(Wingate et al., 2015a,b,c)

= \text{c. 44 Ma} \] window for mineralization at the beginning of the Glenburgh Orogeny

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### Glenburgh Orogeny

- **D1g**
- **D2g**

### Capricorn Orogeny

- **2005**
- **1991**
- **1965**
- **1950**

**PEAK MET**

- leucosome/amphibolite injection
- folding event
- qtz-chl veining
The alteration assemblage appears more *cryptic* in a **metamorphosed deposit** than normal. First pass suggestions on possible alteration signatures include:

1) Relatively higher **Ca** (tschermakite)
2) Relatively higher **Mg/Fe**
   (TMI lower in Fe over deposit trend)
3) Relatively higher **K** (K Radiometrics)
Conclusions

Pre-peak metamorphism Au mineralization associated with beginnings of the Glenburgh Orogeny

Possible back-arc basin setting to the Dalgaringa Arc (?)

Alteration signature suggestions: Ca, Mg, K

Potentially a metamorphosed Orogenic Au deposit (?) - Porphyry (?)

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