New insights into the igneous evolution and timing of mineralisation from geochronology of the Tarcoola Goldfields

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Hiltaba granites around Tarcoola

15 Hiltaba Suite Granite plutons interpreted in the Tarcoola Region (Budd, 2006)

**Geochemistry**
- Two geochemically distinct populations revealed

**Malbooma Supersuite** (red)
I-type, highly evolved, strongly fractionated

**Jenners Supersuite** (orange)
I-type, relatively juvenile, mildly fractionated

No relationships between age and chemistry

**Geochronology**
- 5 granites dated with SHRIMP
- Two distinct ages interpreted at c. 1590 and c. 1575 Ma
Granite geochronology

- Geochronology completed on 3 granites in the Tarcoola Region

- U-Pb zircon geochronology by Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry (LA-ICP-MS)
  Undertaken at Adelaide Microscopy, University of Adelaide
Cooladding Granite

Massive inequigranular and homogenous granite dominated by (<1 cm) K-Feldspar and lesser medium grained plagioclase + quartz with minor biotite + titanite and ilmenite.

Mafic enclaves (up to 25cm in diameter) in outcrop with feldspars at edges

Emplaced at 1582 ± 9 Ma
Konkaby West Granite

Massive inequigranular and homogenous granite dominated by (<1 cm) K-Feldspar and lesser plagioclase + quartz with minor biotite + titanite + ilmenite in aggregates.

Mafic schlieren in outcrop suggest magmatic shear or flow. Mafic enclaves <25cm in diameter in nearby outcrop

Emplaced at 1574 ± 9 Ma
**Structural constraints from granites**

Bulgunnia Shear Zone and Lake Labyrinth Fault bound the NW and NE edges of the Konkaby West Granite pluton, making them younger than $1574 \pm 9$ Ma.

Cooladding and Konkaby West granites interpreted as different plutons (Budd, 2006)

Can’t confidently be proven as ages are within uncertainty of each other, but still possible.
Pinding Granite

Massive and seriate-textured granite dominated by (<1 cm) K-Feldspar, quartz and plagioclase with biotite, minor muscovite and chlorite.

Granite assigned to the c. 1720 Ma Paxton Suite based on geochemical similarities (Budd, 2006).

GCAS images suggest the Pinding Granite truncates the c. 1656 Ma Tarcoola Formation.

Emplaced at 1591 ± 12 Ma (Hiltaba Suite)
Fractionation increases as granite ages become younger (with exception of Ambrosia)
Simplistic model:
1. Intrusion of a large igneous body into the lower crust prior to c. 1590 Ma
2. Emplacement of mildly fractionated and juvenile granites at c. 1590 Ma (Jenners Supersuite)
3. Emplacement of strongly fractionated, highly evolved granites at c. 1575 Ma (Malbooma Supersuite)

Larger dataset and more precise geochronology required
The timing of mineralisation at Tarcoola is considered to be coeval with intrusion of the Lady Jane Diorite.

1582 ± 5 Ma Lady Jane Diorite (hornblende $^{40}\text{Ar}/^{39}\text{Ar}$ age; (Budd & Fraser 2004))

1582 ± 5 Ma Sericite hosting mineralisation ($^{40}\text{Ar}/^{39}\text{Ar}$ age from 4 samples; (Budd & Fraser 2004))

Mineralisation textures don’t completely support model of concurrent mineralisation with the Lady Jane Diorite.

Mineralisation is observed cutting the Lady Jane Diorite.

Budd, 2006
Mineralised metagranite sample taken from the “Granite Shear” in the wall of the Perseverance open cut mine.

Granite Shear is a ~0.5m wide zone of sericite, calcite and silica alteration and high Au values.

The granite shear at this location:
- subvertical curvilinear feature subparallel to the mineralised Perseverance Fault ~50m to the west (both NNE-trending)
- two sets of slickenlines:
  (1) plunging 78 → 315
  (2) plunging 30 → 360
U-Pb monazite geochronology undertaken *in-situ* to assess relationship to mineralisation.

Monazites predominately occur in sericite alteration associated with pyrite, galena and minor gold mineralisation.

Monazite grain textures are clearly hydrothermal.

Strong evidence for monazite association with mineralisation.
Mineralisation age of $1564 \pm 15$ Ma, potentially suggesting mineralisation at Tarcoola is younger than the c. 1580 Ma Lady Jane Diorite.

Consistent with observations of mineralisation cutting the Lady Jane Diorite (Budd & Fraser 2004).

More precise geochronology required. Acquisition of TIMS data currently in progress.
Conclusions

Evidence for young formation/re-activation of structures (e.g. Bulgunnia Fault Zone and Lake Labyrinth Fault) younger than 1574 ± 9 Ma Konkaby West Granite.

Hiltaba Suite granites in the Tarcoola Region seems to reflect a single continuously evolving magmatic system with increasing fractionation as granites become younger.

1564 ± 15 Ma mineralisation age from hydrothermal monazite associated with pyrite, galena and gold mineralisation in Granite Shear at Perseverance open cut mine potentially contests current models for mineralisation associated with the timing of the c. 1582 Ma Lady Jane Diorite (Budd & Skirrow 2007).
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