Fisher East nickel sulfide prospects

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Location

Kalgoorlie Terrane: home to a majority of Ni deposits in the EGST and major focus of exploration

Kurnalpi Terrane: largely ignored, Ni deposits scarce

Is this terrane less prospective, or just under explored?
New deposits being discovered near Kurnalpi-Burtville Terrane boundary.

Testing prospectivity of the Kurnalpi Terrane by comparing komatiites at Fisher East to komatiites in the Kalgoorlie Terrane.
Key Research Aims

- Characterise volcanological setting and komatiite flow-field characteristics;
- Identify the style and composition of nickel sulfide mineralization;
- Determine petrogenesis and metallogenic prospectivity of the ultramafic succession;
- Focus towards nickel sulfide mineralization.

Methods:
- Core logging; 10 drillholes across 4 prospects
- Petrography
- Geochemistry; whole-rock and pXRF
- Hyperspectral work
Fisher East Prospects

**Deposit type:** Komatiite-hosted nickel sulfide deposit

Komatiites; talc-carbonate altered

Igneous textures destroyed

Deformation in drillholes evident, but extent unknown
Mineralization

5 types of komatiite-hosted nickel sulfide deposits, based on Lesher and Keays, 2002 classification

**Type 1 and 2 deposits** - most common in the Kalgoorlie Terrane

Type 1: massive sulfides on basal komatiite contact

Type 2: disseminated sulfides in cumulates
Mineralization

Typical “type 1” mineralization
Massive sulfides on basal contact between komatiites and metasedimentary units

Mineralization contact
Massive sulfides
Semi-massive sulfides
‘Matrix’ sulfides

Vein-like mineralization
Komatiite – secondary textural features

Chlorite rich matrix with carbonate ± quartz veins;

Talc rich matrix + carbonate knots;
Geochemistry of komatiites

MFED060 – Non-mineralized drillhole between Camelwood and Cannonball
Komatiite flow

A zone – chlorite rich matrix; more chlorite, higher Al₂O₃, Zr and Ti; **Spinifex**

B zone – talc rich matrix; higher MgO and Ni; **Cumulates and mineralization**

No primary igneous textures; based purely on secondary textures and geochemistry
Al₂O₃/TiO₂ ratios

Kalgoorlie komatiite data from the GEOROC database

Chondritic Mantle
Al-undepleted/Munro
Al₂O₃/TiO₂ ratio: ~20

Al-depleted/Barberton
Al₂O₃/TiO₂: ~10

Kalgoorlie Terrane samples from: Agnew, Mount Keith, Scotia, Kambalda, Rocky’s Reward, Six Mile Well, Yackabindie and Perseverance
Incompatible trace elements show crustal contamination – can be used as a proxy for mineralization.
Komatiite volcanic facies

- Layered Lava Lakes and differentiated Sills (LLLS)
- Channelized sheet flows (Kambalda Style) (CSF)
- Thin differentiated flows (spinifex) (TDF)
- Dunitic Conduit (DC)

Image from Le Vaillant and Barnes, 2014
Volcanic facies using whole-rock data

Komatiite Flow Facies Discrimination

Kalgoorlie Terrane data from the GEOROC database

Log (Ni/Cr)

LLLS
CSF
DCSF (DC)
TDDF (TDF)

Kalgoorlie Terrane
Fisher East

Layered Lava Lakes and differentiated Sills
Channelized sheet flows (Kambalda Style)
Thin differentiated flows (spirex)
Dunitic Conduit

Image from Le Vaillant and Barnes, 2014

Image from Le Vaillant and Barnes, 1999
Barnes et al., 2004

Barnes and Brand, 1999
Interpretation and Implications
Interpretations – Volcanic Architecture

Points to note

System with a lot of B zone comparative to A zones

Flows with high proportion of B zones = high flux magma pathways
(Hill, 2001, Barnes et al., 2004)

Ore zones contain thicker B zones – possible flow channels?

*Note for diagram: no horizontal scaling. Basal contact used as horizontal datum to depict variation in flow thickness.
Interpretations – Volcanic Architecture

Ni/Cr and Ni/Ti ratios – difficult to get definitive facies

- HOWEVER, definitely not in the DC or LLLS field
- Core logging: Higher proportion of B to A zone – rules out LLLS and TDF facies

Fisher East = CSF Facies

Positive for prospectivity
Interpretations – Primary melt characteristics

$\text{Al}_2\text{O}_3/\text{TiO}_2$ – Al-undepleted:
Komatiite melt source = shallow.

Fisher East; below chondritic mantle line:
• Primary source difference, e.g. Ti depletion?
• Alteration/contamination?
Fisher East Prospectivity

Fisher East: all the right ingredients to host a large nickel sulfide deposit

* Developed in a channelised high flux flow field
  * Rich in cumulates
  * Evidence of crustal contamination
Conclusions

Fisher East vs Kalgoorlie Terrane - Similarities

✓ Both Al - undepleted komatiites
✓ Both contain type 1 mineralization
✓ Both show crustal contamination
✓ Both have systems within the ‘Channelised Sheet Flow’ volcanic facies

Fisher East vs Kalgoorlie Terrane - Differences

❖ Some Kalgoorlie Terrane deposits have adcumulates
❖ Stratigraphy – komatiites directly associated by basalts or intermediate-felsic volcanics (Barnes and Fiorentini, 2012).

Kurnalpi Terrane: Less prospective or under explored?

Do other prospects along the Kurnalpi-Burtville Terrane boundary display the same level of prospectivity?

This study opens up the entire region prospectivity wise and calls for more exploration!
Questions?