The Architecture A1 Project

“What are the fundamental characteristics of mineralised (trans-lithospheric) fault systems?”

Review & Planning Workshop; Perth, May 03 - 04, 2004
I) **Overview of the pmd*CRC A1 Project**
- framework, personnel, project schedule, key deliverables

II) **Overview of work undertaken to date**
- highlights; key area studies, tectonic targets data base

III) **(Possible) future directions**
- hypotheses, issues
**Aim of the A1 Project**

To understand why some fault systems are mineralised, and why others are barren (set of critical parameters?)

**Objective of the A1 Project**

Predictive mineral discovery at significantly reduced risk

*(fundamental shift)*
A coherent concept aimed at predicting the mineral potential of major fault systems...

...via a multi-disciplinary approach (the A1 'template')
Tectonic Targets & Deposits Database

Key Area Studies (Mt Isa, Yilgarn, HBR, Lachlan)

database criteria
validate
input
geology, structure, tectonics, geochronology, geochemistry, geophysics (seismics, worming)

Process Understanding (critical parameters)

Application to Industry targeting at reduced risk

Modeling Scenarios (numerical, habitat)

+ literature
pmd*CRC projects!
# A1 Project - Participants

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<th>May 2002</th>
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<td>B. Murphy (20%)</td>
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### Project Schedule

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#### Tectonic Targets database
- **schema**
- **data entry**
- **web enabling**
- ?

#### Key area studies:
- Mt Isa
- HBRP
- Yilgarn
- WP

#### Geophysical Targeting Tools

#### Habitat Modelling

#### Numerical Modelling

#### Critical Parameters
**Key Deliverables** *(revised 12/03)*

- Data base *(initial design)*
- Data base *(population)*
- Data base *(web-enabled)*
- Synthesis of parameters
- Integrated Tectonic Targets & Deposits db (A1-F4)
- Key area datasets
- Habitat modelling
- Critical parameters
- Scenarios for modelling
- PhD project on HBRP
- PhD project on BBFZ

- Completed (12/02)
- Open-ended (124 entries since 08/02)
- Available 09/03 (proto-type; refinement ongoing & resource dep.)
- Ongoing (refined 12/04)
- Commenced 08/03; resource dep.)
- In progress (06/04 - 12/04)
- In progress (anticipated 12/04)
- In progress (anticipated 12/04)
- Initial concepts (04/03); refined scenarios by 06/04
- Completion in late 2005
- Completion in mid 2006
Results to 05/04

Geophysical Targeting Tools

Habitat Modelling

Tectonic Targets Database

Key Area Studies:

• Mt Isa Inlier
• Hodgkinson-Broken River Province
• Yilgarn Craton
• Woods Point
Results to 05/04

Geophysical Targeting Tools
(process understanding)

Habitat Modelling

Tectonic Targets Database

Key Area Studies:
• Mt Isa Inlier
• Hodgkinson-Broken River Province
• Yilgarn Craton
• Woods Point

➢ Mike Barlow
➢ Barry Murphy
➢ Barry Drummond
Results to 05/04

Geophysical Targeting Tools

Habitat Modelling
(data base output; critical parameters)

Tectonic Targets Database

Key Areas:
• Mt Isa Inlier
• Hodgkinson-Broken River Province
• Yilgarn Craton
• Woods Point

Terry Lees

Archaean Gold Database. Analysis by patn, 09/19/03 12:48:35.11 dend gold

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Results to 05/04

Geophysical Targeting Tools

Habitat Modelling

Tectonic Targets Database

Key Area Studies:

• Mt Isa Inlier
• Hodgkinson-Broken River Province
• Yilgarn Craton
• Woods Point
Data base illustrating commonalities between structures that host major ore deposits

(critical parameters)

Dimensions
- range of strike length
- width of fault zone/corridor
- dip geometry

Dynamics
- tectonic setting
- kinematic evolution
- duration of fault movement

Lithology and metamorphism
- dominant lithology hosting fault
- nature of basement
- metamorphic grade

Magmatism
- nature of dominant magmatism
- timing of magmatism
- method used to determine age

Mineralising events
- MIME?
- age of mineralising event

Mineralisation and alteration
- endowment
- alteration
- fluid source

Most important deposit
- name of deposit
- fault kinematics during ore stage
- source of ore-stage fluid

Geophysical data
- depth of Moho & LAB
- interpreted strike length
- Magnetics

Additional Information
- key reference number
- reliability rating
- Comments (key words)

References

Fault ID
1-11-130

- Global
- Independent of commodity or time
- Portable, searchable, expandable
~$35,000 development costs
(data entry, web-enabling, query builder)

124 entries to date

12 prompted entries

0 unprompted entries

<20 hits (Twiki) since 09/03

basis for habitat modelling
(critical parameters)
Results to 05/04

Geophysical Targeting Tools

Habitat Modelling

Tectonic Targets Database

Key Area Studies:
- Mt Isa Inlier
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- Woods Point
Does MIFZ demarcate boundary between two distinct lithospheric blocks?

Tectonic processes during amalgamation of NAC?

Fingerprint pre-Barramundi Orogeny basement rocks from E and W of MIF

(whole-rock geochemistry; Sm-Nd isotope systematics; forward modelling)
(includes data from OzChem db)
Forward modelling of Bouguer gravity data (GA DST)

Major change in gravity response across MIFZ?

Medium wavelength perturbations: changes in upper crustal rock densities

Long wavelength (>10km) perturbations: changes in medium - lower crustal rock densities
MIFZ basement study - major findings:

Chemical resemblance across basement lithologies

Crustal blocks must have been within close proximity of each other

Formed in arc-related setting; rapid uplift, erosion, arc magmatism (contribution from mantle wedge, crustal contamination, subducting slab)

Mt Isa Fault - inverted extensional fault or late-orogenic thrust?

No terrane-bounding suture - unlikely to cut the lower crust

Gravity gradient: mid- to lower crust density contrast due to boundary of mafic underplate and low-density basement rocks (Mesoproterozoic orogenesis)

Largest contrast west of May Downs Fault Zone & east of KLB (ancient sutures? Worms not delineated due to offset of sutures during shallow thrusting + underplating during Isan Orogeny)
Fractal dimension of major faults in the Mt Isa Inlier

(Blenkinsop & Bierlein, 12; since 02/03)

Correlation between endowment and non-linearity?

- yes!
- complex damage zones favourable

*(descriptive, not spatial)*
Tectonic evolution and mineral potential of the Menzies-Boorara Shear Zone

Morey, Weinberg, Bierlein, Lees, Murphy Y2, Y3, H1, H4; Placer, WMC, AngloGold, Harmony (since 02/03)
Super Pit

>1,000 tonnes Au

example of *not so* well-endowed major fault zone in *HDD* terrain

Compare and contrast MBFZ with Boulder-Lefroy FZ

Controls on location and size of gold deposits (*critical parameters*)?
• Gold mineralisation is only seen to be associated with D2-type events (i.e., no ‘Fimiston’ counterparts)

• No Te-bearing minerals within the sulphide assemblage. Asp + py + po + base-metal sulphides
MBFZ vs. BLF system:

Different kinematic evolution?

- D3-type ss deformation absent
- variable sense of shearing

Scale of shear zones

- primary SZ vs. secondary fault splay
- less discrete damage zone
- failure to focus ore-bearing fluids

Presence of granites, width of greenstones, thickness of competent units
Future work to test these hypotheses:

- Absolute age of mineralisation (Re-Os dating initiated)  
  Comparison with UWA SHRIMP work

- Detailed chemistry of alteration assemblage  
  - carbon isotope systematics  
  - quantitative analysis of carbonate assemblages

- Fluid inclusion P-T-x  
  (evidence of hypersaline fluids at Yunndaga)

- Analysis of ‘barren’ sections of MBSZ

- Regional geophysical interpretations (MB)
Tectonic evolution and mineral potential of the Hodgkinson Broken River Province

Vos, Bierlein, Barlow, Murphy; H1, H4, DMEQLD (since 01/03)

Compare and contrast geometry and kinematics of major faults in LDD terrain

Controls on location and size of gold deposits (critical parameters)?

Tectonic evolution of northern Tasmanides
Unravel the tectonic evolution of the **Hodkinson Province**

Link the tectonic evolution with the development of gold deposits

Understand the role of fault structures in the genesis of gold deposits

- Field investigations and absolute dating
- Geochemistry (tectonic setting of basaltic rocks)
- Structural interpretation of LandSat TM, grav/mag and GIS
- Fluid inclusions (nature and source of mineralising fluids)
Unravel the structural history of the **Broken River Province**

Link the structural history with the development of gold deposits

Understand the role of fault structures in the genesis of gold deposits

- Field investigations and absolute dating
- Fluid inclusions and sulphide paragenesis
- Geochemistry of dykes (provenance)
- Geophysical datasets
Tectonic evolution of the Woods Point Region

Bierlein, Schaefer, H1, GSV (06/03 - 10/03)

from VandenBerg et al. (2000)
Pilot study to fingerprint (Re-Os) dykes in suture zone between western and central Lachlan Orogen

Determine provenance of dykes, nature of basement

Constrain tectonic evolution of orogen

Implications for metallogeny
Age = 306 ± 67 Ma
Initial $^{187}\text{Os}/^{188}\text{Os}$ = 0.25 ± 0.1
MSWD = 379
(Possible) Future Directions

Continued development of web-enabled tectonic targets data base (improve functionality; increase input); cf issues
definition and ranking of critical parameters

Key area investigations
(PhDs; Yilgarn Craton; Mt Isa; Lachlan Orogen; Great Basin study?)

Geodynamic aspects (1st-order controls)

Continued development and testing of geophysical targeting tools

Modeling scenarios (lower crust decoupling), habitat modeling
**Issues** *(for discussion)*

Development & maintenance of data base resource-dependent (M1)

Need 250+ entries (on-line/off-line entry & delivery)

Integration with other data bases (Pasminco; SRK; UWA)

GIS framework

Data base management person?

Longer-term custodianship (GA; LW)?

Test and ground-proofing of criteria *(key area studies)*; modelling

Post-doc(s); integration with terrane projects