Oct-Dec 2005

Y4 Project Quarterly Report

predictive mineral discovery CRC

Highlights:

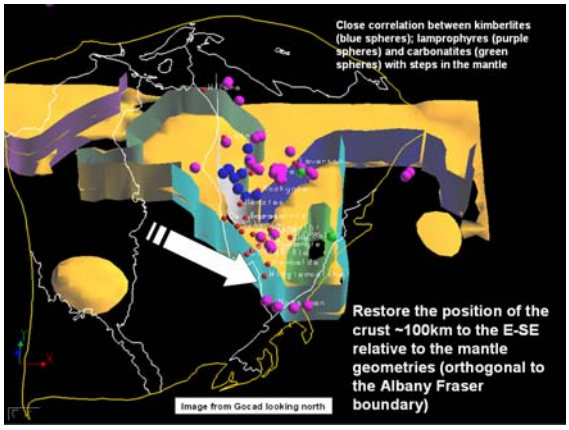
- Fresh look at mantle tomography
- Refining the Mineral Estimation Filter for alteration mapping
- Numerical modelling applied to granites, domes and Late-stage Basins
- Application of Thermal Hylogger
- New SHRIMP geochronology
- Laverton 3D map well advanced
- Successful pdt and 3D map making meeting held in Perth end November
- Student news
- News from Embedded Researchers

Big Edges predicting Big Systems?

The Y2 project speculated about the role of a fast S-wave velocity layer at 120-150 km depth (lower lithosphere). Inferences were made regarding delamination and generation of the Low-Ca granites, and steps or edges and the location of upper crustal structures.

Linking features in the tomography and our understanding of the distribution of gold deposits was enigmatic. However, when considering the likely effects of the Albany-Fraser orogeny, a 100km SE-directed shift was applied to the 4.8 km/s isosurface to reconstruct the likely spatial connection between the big edges and the demonstrably deep sourced intrusions (such as kimberlites, lamprophyres, and carbonatites).

When the shift is made, many of the big gold camps also lie on these



edges, suggestive of a deep connection and mantle role in the mineral system.

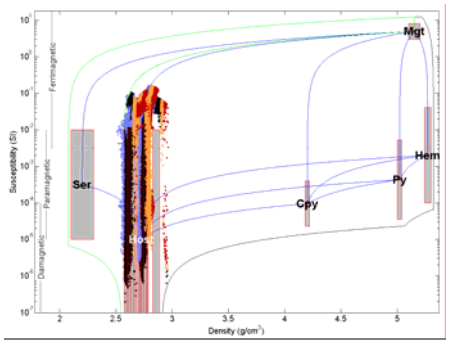
Being predictive at the largest scale, a stratgey of targeting along the big edges under shallow cover opens up a number of new areas worthy of consideration. More details including a Gocad project and a powerpoint are on Twiki at: https://pmd-twiki.arrc.csiro.au/twiki/bin/view/Pmdcrc/ProjectY4.

Mineral Estimation Filters to map alteration

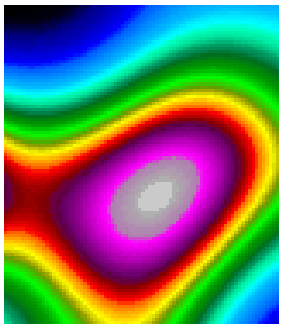
The technique of estimating mineralogy from inversions of magnetic and gravity data is being refined by Nick Williams as part of his PhD at the University of British Columbia. Nick gave a well-received presentation at the Y4 meeting and his talk is available at: https://pmd-twiki.arrc.csiro.au/twiki/pub/Pmdcrc/3DMappingWorkshopNov05/NickWilliams.ppt

The technique has been successfully applied to the IOCG system at Olympic Dam and the Ni system at Leinster.

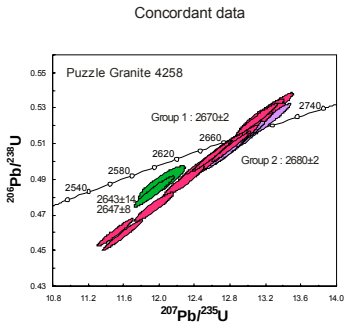
The technique will be applied to the orogenic-gold system around Laverton, and will utilise the 3D architecture and inversions already generated. We plan to map out in 3D the magnetite and pyrrhotite alteration systems around Wallaby and Sunrise and beyond within the 3D map.

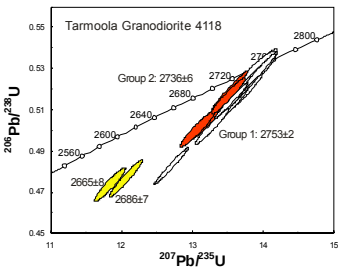


Nick Williams (GA-UBC) collecting rock property measurements around Leinster for mineral estimation filter work



Regional gravity response of Laverton district (residual removed) is an essential input for forward modelling





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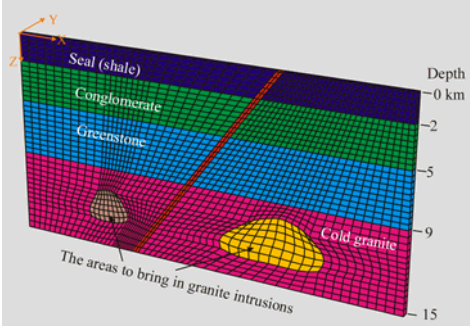
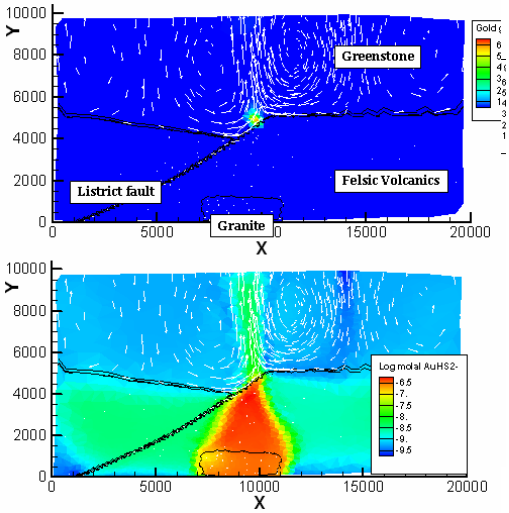
JCU-CSIRO combine to model the role of granite



Numerical modelling by Heather Sheldon and Yanhua Zhang (CSIRO) of deformation, heat transport and fluid flow is being used to understand why deposits are commonly found close to the late-stage basin unconformity. A simple, flat stratigraphic model with a fault cutting through sediments, greenstone and underlying granite (above) will be deformed in extension and compression, to identify situations which may cause fluid to move from sediments into the greenstone or vice-versa. A more realistic dome-and-basin geometry, including late (Low-Ca) granites intruded into the base of the model is next. The role of fluids produced by metamorphic dehydration reactions is also being explored. See https://pmd-twiki.arrc.csiro.au/twiki/bin/view/Pmdcrc/YilgarnLateBasin and https://pmd-twiki.arrc.csiro.au/twiki/bin/view/Pmdcrc/MetamorphicDevolFlux

Reactive transport modelling of granites by James Cleverley (JCU) is showing much initial progress. This picture (below) shows gold and Au(HS)2- concentration at 526K years (~500K years post granite cooling). Au is still being transported from the granite and fluid mixing at the intersection of this fluid in the greenstone unit causes gold precipitation of ~6 g/t (upper right).

Convection in greenstones is caused by the granite although the effect continues long it has cooled. More results and movies can be found on: https://pmd-twiki.arrc.csiro.au/twiki/bin/view/Pmdcrc/FastFloRTListFgranite



New Geochronology activities and results

The following rocks were U-Pb zircon dated at Curtin and the RSES using the SHRIMP by Natalie Koscitcin and Keith Sircombe (GA). These are preliminary data and should be treated with **caution**.

Puzzle Monzogranite	2643 ± 14 Ma (rims) complex zircons
Tarmoola Trondjemite	2665 ± 8 Ma
Moon Rock granite	2751 ± 6 Ma
Kirgella Rockhole granite	2732 ± 16 Ma
East Kirgella monzogranite	2637 ± 7 Ma, 2770 ± 13 Ma
Black Flag dacite	2661 ± 8 Ma, 2706 ± 5 Ma
Kurrawang Frm sandstone	~2715 Ma mode
Spargoville Frm	~2630, ~2670, ~2700 Ma modes, 2689 ± 2 Ma
Bee-eater, White Flag Frm	~2686 ± 5 Ma (9 GRAINS!)
coarse-grained monzogranite	~2627 ± 37 Ma (4 GRAINS!)

Eight samples of garnet-bearing pelites collected by Ben Goscombe (GSWA) are being processed for Lu-Hf dating by Roland Maas at the University of Melbourne. Results are anticipated by mid 2006.

Mine visits around Kalgoorlie with the students (Anthony and Joanna) and Peter Neumayr and Frank Bierlin (UWA), photographs from Paul Henson (GA)

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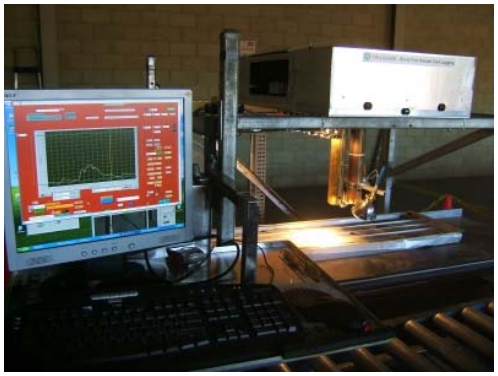
Embedded Researcher (ER) News

The new Wallaby-Granny Smith ER is Dr. Mark Pirlo, who has been collating previous R&D on the Wallaby deposit. A major research focus for 2006 will be validating the structural-fluid mixing model of John Miller. Results will be integrated with MERIWA 358/377.

A diamond hole from Red Hill (Kanowna Belle) has been characterised by PIMA, with initial indications showing that the ore zones are hosted in moderately large alteration zones that may be identified using short-wave infra-red spectra. The site will consider routine SWIR measurements of grade control samples, and integration into the ore reserve modelling procedure. Carl Young has also been developing a 3D architectural model of KB for near mine exploration.

At St Ives, thresholds of AlOH and MgOH depth/FeOH depth indices identify and correlate with Au-bounding structures. These are used to build-up the camp-scale alteration/structural architecture. A N-S trending magnetic surface delineated from magnetic susceptibility has been confirmed and mapped underground by Tony Roache.



Core logger in action at GSWA's facility in Kalgoorlie with samples from KB being zapped

Publications and workshops

The project was the main driving force behind the "How to make a 3D map" workshop held at the ARRC centre on 24th November (photo on right). The meeting was attended by nearly 50 sponsors, students and researchers. Topics included philosophy and pit falls of various aspects of the 3D world, included worms, seismic, gocad, inverse and forward modelling. A life demonstration of 3D Geomodeller was successful, as was a demonstration of Malcolm Nicoll's 'portable' 3D visualisation system. A repeat meeting for Eastern sponsors will be held on the 15th February at GA in Canberra.

Copies of the talks are on: https://pmd-twiki.arrc.csiro.au/twiki/bin/view/Pmdcrc/3DMappingWorkshopNov05.

A 2 day pdt was held on the 22-23rd November in Perth. The meeting was well attended by around 30 sponsors,

researchers and students, and focused on a mix of delivery of results and discussion themes based on the 5 questions. Copies of the talks are on: https://pmd-twiki.arrc.csiro.au/twiki/bin/view/Pmdcrc/YilgarnPdtNov05

The next project meeting is to be held at GA in Canberra (16-17th February) and will focus on finalising the integrated project presentations for the *pmd**CRC conference in April (Perth), as well as the science of Sunrise Dam.

pmd*CRC

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Paul Henson,
Peter Neumayr,
Regan Patton,
Roland Maas,
Terry Brennan,
Tony Roache,
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www.pmdcrc.com.au

Student News

Louis:

- Finished microprobe analyses of pre-, syn- and post-gold event at Golden Mile
- finished structural framework and chronology of events at the Golden Mile
- finished chemistry, geochronology and emplacement history of Golden Mile dykes

Joanna:

- preparedδ13C for analyses; finished FLINCs of different mineralisation styles,
- finished FLINCs hosted in porphyries;
- analysed sulphur isotopes of pyrites from different mineralisation styles
- prepared laser ICP-MS analyses on inclusions

Mehradad:

- whole rock geochemistry of selected samples from Kalgoorlie south.

Nick:

- Completed field work at Leinster and meetings with BHPB in Perth
- Paper on "Identifying sulphide mineralisation from physical property measurements: its development and application to mineral exploration inversions" for GSA Utah (Oct 2005)

Plans for next quarter

- Complete the Kalgoorlie-Kambalda 3D map and generate solid volumes
- Complete Laverton region 3D map
- Numerical modelling of role of Late-stage Basins, metamorphic devolatolisation, and granites in the gold mineral system
- Complete inversions of Laverton and explore mineral estimation filter technique
- Document inversion work-flow process
- Run the 3D map making workshop (15-02-06)
- Complete Sunrise structural report
- Project meeting 16-17 February (GA in Canberra) - working towards CRC Conference in April
- Write up results from A1, Y3 and Y2 projects
- Prepare for Magneto-Telluric survey and other field work (acquire following quarter)
- Integration of previous CSIRO modelling (NW-SE contractional) with new structural model for Wallaby

List of project events/acitivities/interactions

As usual the team travelled to various sites for liaison with sponsors. Visits were made to Sunrise Dam, Granny-Smith, St Ives, Kanowna Belle, and Leinster.

KP, JW, PN and Cam McCuaig, 0.5 day targeting workshop on St. Ives targets (6/10/05)

ERC meeting Y2 and Y3 post mortem, PN and RB presents (11-12. 10/05)

JW and PN at St. Ives to discuss targeting strategies (7-9/9/05)

JW, TR, CY, PN attend the GoldFields science conference (10-11/11/05)

NW with BHPB in Perth (14-21/10/05)

Yilgarn PDT in Perth (22-23/11/05)

3D Modelling workshop, PN, IR, PH, NW, RB presents (24/11/05)

PN, AM, JH, PH, and Frank Bierlein visit a range of open pits and mines in the Kalgoorlie area and New Celebration to cross fertilise the Ph.D. projects and discuss potential combined publications

JW, PN, KP, DC, RB, PH attend Placer research symposium (RB and DC presents) (30/11/05)

PH went (25-29/11/05) on a road trip from Kambalda to Sunrise via Kalgoorlie and Granny Smith showing the Laverton 3D map to the sponsors on site.

JW and PN with Leviathan geologists nominate targets beneath Victory-Defiance. A range of wireframes and targets are delivered and currently assessed by the St. Ives geologists team (16/12/05)

Mike Nugus from AngloGoldAshanti had meetings (16/12/05) with JM in Melbourne regarding the structure of Sunrise Dam.