# *pmd*CRC* Quarterly Report

**July 2005 to September 2005**

**Stage 2, Project Y4**
**Name of Project: Concepts to targets: a scale integrated mineral systems study of the Eastern Yilgarn Craton**

**Project leader:** Richard Blewett

**Project team:**

| | |
|---|---|
| GA | Richard Blewett, Terry Brennan, Kevin Cassidy, Dave Champion, Karol Czarnota, Bruce Goleby, Paul Henson, Malcolm Nicoll, Indrajit Roy |
| UWA | Louis Gauthier, Klaus Gessner, Johanna Hodge, Mehrdad Heydari, Klaus Petersen, Peter Neumayr |
| JCU | James Cleverley, Nick Oliver, Gerard Tripp |
| CSIRO | Alison Ord, plus one full time equivalent modeller, John Walshe |
| Uni Melb | Mark Kendrick, Roland Maas, John Miller, Dave Phillips, Tony Roache, Carl Young, embedded researcher (Wallaby) to be appointed |
| Monash | Anthony Morey |

**Partner institutions:** Geoscience Australia, The University of Western Australia, CSIRO EM, Monash University, The University of Melbourne, James Cook University

**Introduction / aims of project:**
The principal outcome for the Y4 project will be a multi-scaled 4D understanding of the world-class orogenic gold mineral system of the Eastern Yilgarn. A measure of our success will be the successful application of this understanding to the predictive targeting of undiscovered resources in near mine areas, as well as concepts and hypotheses that can be applied to targeting in data-poor areas.

To achieve this outcome the project aims to produce a series of well-constrained 3D maps at a variety of scales that integrate the structural–stratigraphic history and the alteration–fluid history with the evolution of the architecture. Using this scale integrated approach, the project will develop criteria to improve area selection, near mine exploration and ore shoot identification. It is envisaged that many of these criteria will apply in a generic sense to other terranes.

The project aims to develop a range of hypotheses from the geodynamic (whole of orogen to base of lithosphere) scale to the mine-site specific scale. These hypotheses will be tested with numerical models that will have local as well as generic applications.

The project will work closely with the sponsors to ensure that the research results and deliverables meet their needs and expectations, have an impact and deliver tangible value for predictive mineral discovery.

The project has fifteen (15) key deliverables, each with a set of milestones.

1. **New time-space event history database, charts, and maps**

*In progress:*

- Successful in bid for extra funds from the Geochron fund for extending Dr Rick Squire's MERIWA project researching stratigraphy and maps of the Late Basins and Black Flag "formation"
- Rick will work for Y4 in the fourth quarter

2. **Reports on an updated structural history/stratigraphy (unravelling the D's)**

*Key results:*

Structural mapping Black Flag Group, Mount Pleasant (Gerard Tripp)

- Significant structural stacking of the Spargoville and White Flag formations via detachment thrusting and fault-bend folding
- Ramp anticlines the most typical structural style with major post-stacking shortening of the sequence; regional map patterns and aeromagnetic trends match the structural style in outcrop
- F1 folds refolded into type-3 interference patterns, but only observed in D2 detachment zones; F1 folds trend consistently to the NW with moderate plunge
- F2 folds doubly plunging NW-SE with gentle plunges and shallow bedding orientations
- Detachment at the upper basalt (UB) nonconformity overprinted F2 folding; original nonconformity is exposed in small areas (locally) preserved by D2 synclines
- Upper Basalt detachment has a consistent top to NNE displacement vector, but does not repeat stratigraphy (possible intrusion control on kinematics?)
- Strong deformation fabrics on both margins of the Kurrawang Formation suggest the unit is a fault preserved allochthon rather than an unconformable in-situ basin margin

Regional cross-section compilation and 3D architecture of the Mount Pleasant dome (Gerard Tripp)

- New 3D model and gravity inversion shows regional F2 folds are generally shallow plunging structures with significant modification and doming near granitoids (eg. Liberty Granodiorite)

*Completed work:*

3. **Maps and reports of regional metamorphism and PT*t* history integrated with structural and alteration history**

*Key results:*

- Granitic intrusions drive convection in the surrounding country rocks, with up-welling above the intrusions and down-welling around the outside.
- Conductive heating creates a narrow thermal aureole around the intrusions, corresponding to upper amphibolite regions seen on the metamorphic facies map.
- Down-welling of relatively cold fluids in these convection cells *may* be sufficient to result in localised retrogression to lower greenschist facies (biotite destruction) in a narrow ring surrounding the intrusion. However, the occurrence of fluid fluxes sufficient to cause retrogression is sensitive to parameter values (especially permeability of the country rocks, which is poorly constrained), and the retrogressed area is always much smaller than the lower greenschist anomaly that is seen on the metamorphic facies map. The results of this study suggest that the low-grade "anomaly" is more likely to be part of the regional metamorphic pattern, than a true anomaly associated with intrusions.
- Heat from intrusions can also drive convection in nearby faults (convection cells form in the plane of the fault). Fluid may move up or down in the part of the fault that is closest to the intrusion; the direction depends on permeability of the fault and country rocks.

- Implications for mineralisation: The classical interpretation predicts that mineralisation will be associated with convective up-welling, assuming precipitation is due to decreasing solubility with temperature. Alternatively, mineralisation may be associated with down-welling, if the architecture and fluid flow pathways provide opportunities for the down-welling fluid to mix with a deeper sourced fluid.

*Completed work:*

- Julia Blockeel (visiting student from the Cambourne School of Mines, UK) has completed her MSc thesis on "Coupled thermal and fluid flow modelling of the Kalgoorlie region, Western Australia, and implications for mineralisation". A summary of her work is available on the TWiki (https://pmd-twiki.arrc.csiro.au/twiki/bin/view/Pmdcrc/YilgarnConvectionSummary) and a copy of her thesis will be available shortly. Her work investigated the thermal and fluid flow consequences of late-stage (post-folding) granitic intrusions in the Kalgoorlie region.

*In progress*:

- Acquired (from Ben Goscombe, NTGS ex GSWA) extensive compilation of metamorphic maps, PT data, new probe results, a new PT*t* and field gradient graph for the Eastern Yilgarn. These data and results will be key inputs to the metamorphic study of this project (Richard Blewett)

**4. Report on likely geodynamic models of the Yilgarn, with appropriate tests and possible analogues, and a workshop**

**5. 3D maps/GIS of specific districts to be build on Y2 regional 3D map (*Laverton, Kalgoorlie-Kambalda, Agnew*)**

*Milestones:*

- Kalgoorlie-Kambalda infill stratigraphy for area between Ida and Zuleika faults CD of new gocad objects provided to sponsors on CD (Terry Brennan)
- Provided sponsors with a CD of a Fracsis copy of the Y2 3D maps (Terry Brennan)

*Completed work:*

- Laverton solid geology completed with merge of Anglo, Placer and GA maps into rationalised single dataset. Map (GIS in ArcMap) posted on Y4 Twiki (Paul Henson)
- 3D fault architecture of Laverton completed (some questions remain though). Gocad map provided to sponsors for review and comment (Paul Henson)
- Merged gravity and magnetic datasets from Anglo, Placer and GA into complete dataset (Indrajit Roy)
- Magnetic and gravity worms calculated and completed (posted on Y4 Twiki) (Indrajit Roy)

*In progress*:

- Kalgoorlie-Kambalda infill stratigraphy for area between Ida and Zuleika faults. Still >60% to complete (Terry Brennan)
- Building GIS of Laverton region in ArcMap (Paul Henson)
- Laverton 3D map progressing to serial sections off the fault architecture (Paul Henson)
- Interpretation of 3D models of the Victory – Defiance – Conqueror, and Junction deposits and integration of the architecture with the alteration patterns to identify targets within these deposits and extrapolate architecture/chemistry outside to identify new regional targets. The 3D Leapfrog model of the Greater Revenge area was built in is largely completed and currently interpreted (Peter Neumayr and Klaus Petersen)
- Working with Kanowna Belle geologists to extend the 3D model of the Kanowna Belle deposit to depth. The work has involved compiling and checking existing geological data as well as building the Leapfrog 3D model for gold, lithology and alteration. (Carl Young)

- Underground mapping of several ore drives to re-interpret the lithological-structural model of Kanowna Belle (Carl Young)
- Underground mapping and drill-hole logging has shown that SW-dipping structures (S3) bound Au mineralization at Conqueror, Bellerophon, and Belleisle (Tony Roache)

**6. Map and report on the early extensional architecture and history**

*Key Results:*

Modelling and interpretation of the upper basalt stratigraphy, Kalgoorlie Terrane (Gerard Tripp)

- Stratigraphic thickness changes in the upper basalt unit can be modelled across major breaks when the co-magmatic sills are ignored, due to the along-strike thickness variability of the sills
- Packages of consistent thickness occur in NW-SE trending elongate belts, suggesting that NW-SE trending domain faults are potential boundary markers, and possible extensional breaks at "upper basalt time"
- Major thickness changes also occur across NE trending gravity features in the central Kalgoorlie district
- Possible interpretations include NE and NW extensional vectors, with the central Kalgoorlie gravity feature acting as a rift segment, or a basement transfer zone.
- Spargoville Formation reduced to a minimum at the culmination of the Mount Pleasant dome suggesting pre-shortening excision of stratigraphy, or primary variation in sedimentary facies

**7. Reports on the character of key faults, especially the deep-tapping 'cracks'. Acquire new data (*MT and tomography*).**

*In Progress:*

Nil activity this quarter other than planning field acquisition in April 2006

**8. Report on an improved geologically intelligent geophysical inversions, supported by a rock property database**

*Results:*

- New Mineral Estimation Filter correctly identified a high percentage (80%) of drill core samples from Perseverance being as ore. The filter also identified a majority of prospects and deposits surrounding the Olympic Dam IOCG deposit in South Australia as anomalous in regional-scale geologically-constrained inversion models (Nick Williams)

*Completed work:*

- Completed literature review on magnetic susceptibility of rocks and minerals (Nick Williams)
- Completed revisions on a pre-PhD paper submitted to Mineralium Deposita (Nick Williams)
- Prepared a presentation on the magnetic susceptibility of rocks and minerals for UBC-GIF Physical Properties working group (Nick Williams)
- Completed a presentation entitled "Identifying sulphide mineralization from physical property measurements: its development and application to mineral exploration inversions" for the Geological Society of America Annual Meeting and Exposition in Salt Lake City, Utah, in October 2005 (Nick Williams)

*In progress:*

- Further developed and expanded the mineral estimation filter. Developed applications for IOCG and Ni-sulphide exploration, hand sample measurements and inversion results, refined procedures, and optimised code. Have developed examples for exploration for Ni-sulphide deposits (using hand sample or drill core measurements), and IOCG deposits (using regional geologically-constrained inversion results). (Nick Williams)
- Developing a step-by-step guide to preparing and running gravity inversions for mineral exploration based on Perseverance inversion work. (Nick Williams)

- Prepared a draft report on the new improved mineral estimation filter. Significant revisions of the code since the draft was written mean some of the report will have to be reworked before it can be circulated (Nick Williams)

**9. Reports and chemical models on the end-member fluids (magmatic, basinal, meteoric, metamorphic, mantle?)**

*Milestones:*

- Continued analysis of the reduced end member fluid in the Conqueror area at St. Ives. This is a **breakthrough**, because fluid inclusion preservation of the reduced fluid system is extremely poor. The fluid inclusions were discovered in quartz inclusions in pyrrhotite in a gently SW dipping reduced fluid conduit, distal to the Conqueror ore system. Microthermometry and laser Raman analyses (the latter in collaboration with Terry Mernagh, Geoscience Australia) revealed that the reduced fluids are composed of CH4, CO2, and N2. Water, if present, is a subordinate component. (Klaus Petersen)

*Work in Progress*

- SEM follow up work on the reduced fluids at Conqueror revealed solid halite inclusions within pyrrhotite without a trace of fluid (Klaus Petersen)
- Continuation of fluid inclusion analysis of New Celebration fluids (Joanna Hodge)
- Writing of paper on the fluid evolution of the New Celebration gold deposits (Joanna Hodge)
- Preparation of C-O and S- isotope samples of selected alteration minerals at New Celebration (Joanna Hodge)
- Preparation of laser ICP-MS proposal for selected fluid inclusions at New Celebration (Joanna Hodge)
- Samples from St. Ives have been submitted for the noble gas study in collaboration with Mark Kendrick (Univ. Melbourne) and sample preparation has commenced. Preliminary fluid inclusion results from the Wallaby deposit have been assessed and are currently used to identify follow up fluid inclusion work to help identify the best samples for noble gas work. It is hoped that the data will add to information on fluid sourcing and depositional processes (e.g., phase separation). Especially information on fluid sources will have significant impact on area selection based on conceptual models. (Klaus Petersen)
- The aim of the KB project is to use micro petrographic and chemical techniques to help understand zonation observed by PIMA around the ore shoots and oxidised-reduced pathways. Initial PIMA results from samples from KDU1648 & KDU1879 confirm the already published results for KDU1648 and show similar changes in KDU1879, however there was an interesting haematite-stained zone that gave a phengitic response ($\lambda$AlOH – 2218 nm) in an otherwise chlorite altered conglomerate. More petrography and probe work to follow some of these issues up. (James Cleverley)

**10. Reports, maps and databases on integrated mineral paragenesis and architecture and chemical modelling for selected camps and deposits**

*Milestones*

- Completed paper on the geochemical evolution of the porphyries at the Golden Mile in a scientific paper and analysed selected alteration minerals with the microprobe. Corrections in progress (Louis Gauthier)
- Petrography on hydrothermal alteration of Fimiston-style mineralization completed (Louis Gauthier)
- Completed microprobe analyses of carbonates, white micas, tourmaline, tellurides, fahlores, gold, pyrite, arsenopyrite alteration of the Golden Mile (Louis Gauthier)

*Work in Progress*

- Carl Young assisted in the validation and interpretation of the Hylogger results with Melissa Quigley of CSIRO for four weeks. The results of the Hylogger analyses were validated through visual inspection and sampling, and the interpretation involved the definition of a composite

prospectivity scalar. The Hylogger results have also been integrated into the three-dimensional lithology, alteration and gold grade models

- Interpretation of whole-rock geochemical data from Hannons Lake and Otter-Juan areas (Mherdad Heydari)
- Atlas on the paragenesis of Fimiston-type mineralization near completion (Louis Gauthier)
- A major and trace element study of gold-bearing sulphide assemblages from the BTZ were analysed using LA-ICPMS – over 120 spots were analysed. Preliminary results suggest there is a bimodal distribution of gold within the sulphides. Currently testing the hypothesis that reducing conditions prevailed during hydrothermal alteration related to gold mineralisation. Possibly useful to help understand the geochemical nature of a reduced 'end member' fluid (Anthony Morey)
- Continued fluid inclusion analysis on New Celebration samples (Joanna Hodge)
- The Red Hill deposit is being used as a test project for developing characteristic spectral signatures of the ore. The aim is to present a system for the mine to routinely integrate PIMA analyses in ore definition, as the mine is currently having difficulty in maintaining gold grades and visual estimation of ore potential is not achievable (Carl Young)
- A target generation program in northeast of the Kanowna District requiring geochemical and PIMA processing (Carl Young)
- Peter Neumayr and Klaus Peterson at Kanowna Belle sampling for fluid inclusion, stable isotope, petrographic, multi-element and PIMA analyses.
- KB lithology gold grades and alteration modelled in Leapfrog. Underground mapping to test the existing models, with results used to re-design the existing wireframe models (Carl Young)
- Melissa Quigley analysed Hylogger results through visual inspection and sampling, resulting in the definition of a composite prospectivity scalar. Results integrated into the three-dimensional lithology, alteration and gold grade models.
- Processed multi-element data of Laverton for lithogeochemistry and alteration geochemistry of approximately 25000 samples, results to be integrated into exploration targeting process (Carl Young)
- To facilitate discrimination of lithologies using the multi-element data, a number of templates for the GAS software have been designed and made available to Placer geologists for routine use. These templates are based on the Porphyry Project conducted by W. Edgar in 2004, the AMIRA project P482, and datasets collected for several projects in Kalgoorlie (Carl Young)
- All SRD polished off-cuts where PIMA'd, where mica spectra could be detected the wavelengths where always 2197 and 2202 nm (close to pure end-member muscovite and confirmed with electron microprobe analysis). This is different from the normal paragonite (2190-92 nm) commonly found in other gold deposits in the district. (James Cleverley)
- Samples of laminated veins ('D3 veins'), sulphidised BIF and altered wallrock from the Sunrise Shear Zone show via SEM-cathodoluminescence that the veins are multi-generation with a phase of brecciation. The laminations focus multiple alteration events from 1) tourmaline-muscovite-rutile-apatite, 2) tourmaline-pyrite-gold and, 3) Mg- and Fe-dolomite-quartz vug filling. There is also a separate assemblage of sulphides in the quartz veins outside of the laminations. This assemblage is dominated by sphalerite-galena-tenentite-tetreahedite and complicated zone Pb-Au-Te-Ag minerals. (James Cleverley)

*Completed work:*

- Presented talk entitled "Hydrothermal Fluid Characteristics and Evolution in the Boulder-Lefroy Fault Zone at the New Celebration Gold Deposits, Western Australia" at the 8th Biennial SGA Conference, Beijing, China in August (Joanna Hodge)
- Prepared and dispatched samples for S isotope and C isotope analysis (Joanna Hodge)
- Conducting a sampling program from a series of holes that intercept different parts of the ore system at the 10090 RL. Samples collected for fluid inclusion, stable isotope, petrographic, multi-element and PIMA analyses (Carl Young)
- Generated Leapfrog models for gold, lithology, and alteration in Kanowna Belle and generated wireframe models from these models (Carl Young)

- Assisted in the validation and interpretation of the Hylogger results with Melissa Quigley of CSIRO (Carl Young)
- Underground mapping of several ore drives to re-interpret the lithological-structural model of Kanowna Belle (Carl Young)
- Generated GAS template files to assist in the processing and interpretation of multi-element data from other projects. Files to be used by Placer project geologists (Carl Young)
- Processed multi-element data for the Laverton district for the Project Generation team as part of their target generation program (Carl Young)

**11. Reports on integrated numerical models of fluid flow for generic and site specific scenarios**

*Work in progress:*

- Members of the numerical modelling team at CSIRO are working on two projects aimed at investigating the relationship between domes and mineralisation in the Yilgarn. Details of these projects (see below) were established through a number of phone, email and face-to-face discussions between Y4 team members at various locations, which enabled the modelling team to identify specific aspects of the Yilgarn mineralisation system that could be investigated through numerical models. Ongoing collaboration and discussion is an integral part of this work. For example, Yanhua Zhang visited GA in September to discuss preliminary model results, and a Y4 meeting during STOMP encouraged wider involvement in the modelling effort. Further information regarding numerical modelling for Y4 can be found on the Twiki (https://pmd-twiki.arrc.csiro.au/twiki/bin/view/Pmdcrc/ModellingYnew). Details of the numerical models follow.
- Yanhua Zhang is working on a crustal-scale model of deformation and fluid flow in the Kalgoorlie region. The model is based on the Gocad Yilgarn 3D model from Geoscience Australia; specification of detailed crustal architecture in the model reflects ideas derived from discussions involving several Y4 team members. The iVEC visualisation facility at ARRC (Perth) has been invaluable as a tool for examining the Yilgarn 3D architecture and identifying features to include in numerical models. Peter Schaubs assisted with mesh construction, which was a challenging task requiring a combination of Gocad, Patran and FLAC3D meshing tools. The first model examines crustal-scale deformation features and fluid flow drivers for a simple scenario where permeability is allowed to change and no external fluid sources are involved. Future models will explore more complex deformation and fluid flow conditions. Further details can be found on the TWiki (https://pmd-twiki.arrc.csiro.au/twiki/bin/view/Pmdcrc/CrustalScaleModels).
- Heather Sheldon is developing a numerical model to investigate the thermal, mechanical and fluid flow consequences that arise from emplacement of granitic magma in a dome at the base of the greenstones. This work will explore the ideas put forward by Henson et al. in their STOMP paper (Domes: the characteristic 3D architecture of the world-class lode-Au deposits of the Eastern Yilgarn). Preliminary results suggest that buoyancy of volatiles in the magma generates sufficient fluid pressure to result in shear failure of the overlying rocks, without any externally driven deformation. Ongoing work will explore the effect of extensional and contractional deformation. Further details can be found on the TWiki (https://pmd-twiki.arrc.csiro.au/twiki/bin/view/Pmdcrc/YilgarnGraniteDomeModels).

**12. Regional footprint maps of alteration and fluid flow based on geochemistry, ASTER, HYMAP etc**

Nil activity this quarter

**13. Map the chemical and PT gradients for selected sites (e.g., Wallaby, Sunrise, St Ives, KB), and regionally**

*Results:*

- Down-hole PIMA analysis demonstrated that high chlorite abundance relative to amphibole (MgOHdepth/ FeOHdepth<1.5), and Al-rich white mica (AlOHλ>2202nm) represent S3 within mafic and felsic host rocks, respectively. However, within the largest S3 (e.g., Belleisle), Al-rich white mica formed within mafic host rocks (Tony Roache), and
- Mg-rich chlorite (FeOH<2250nm) is a proxy for the position of Au mineralisation.

- The recommendation is to incorporate these threshold values into the top of fresh rock PIMA database in order to delineate linear trends of S3 and where the latter intersect with zones of Mg-rich chlorite

*Work in progress:*

- Generated GAS template files to assist in the processing and interpretation of multi-element data from other projects. Files to be used by Placer project geologists (Carl Young)
- Processed multi-element data for the Laverton district for the Project Generation team as part of their target generation program (Carl Young)
- Conducting a sampling program from a series of holes that intercept different parts of the ore system at the 10090 RL. Samples collected for fluid inclusion, stable isotope, petrographic, multi-element and PIMA analyses. In the process, several hypotheses have been erected for testing using the results of this first round of sampling and a subsequent sampling program in coming months (Carl Young, John Walshe, Peter Neumayr, Klaus Petersen)
- Down-hole PIMA analysis has followed up HyLogger results from Belleisle (Tony Roache)
- Construction of thermodynamic phase diagrams for a range of minerals and varying pH, fO2 to assist identification of fluid chemistry in the alteration record and support exploration geologists in drill core logging and interpretation (John Walshe)

**14. Reports on the integrated structural controls of ore shoots with the regional framework, linked to alteration and mineralogy (e.g., Wallaby, Sunrise, St Ives, KB)**

*Completed work:*

- Wallaby report and 3 A0 plates have been posted on Twiki Y4 site (John Miller)
- Paper on pyrite dating methodology has been posted on Twiki Y4 site (John Miller)
- 3-D Mohr circle analysis assessing fault reactivation of the Sunrise Shear Zone structure in compressional and strike-slip regimes at the Sunrise Dam gold deposit (John Miller)
- Selection of quartz samples from Wallaby gold deposit for noble gas study has been completed (done with Mark Kendrick)

*In Progress:*

- Compilation of structural data and Mohr circle analysis from Sunrise dam with a report to be completed in the fourth quarter of 2005 (John Miller)
- Report on the Leapfrog alteration modelling at Kanowna-Belle is in progress with a report to be completed in the fourth quarter of 2005 – Carl Young has supplied descriptions of alteration for report (John Miller)
- Blocking of Wallaby samples (awaiting new diamond saw blade) (John Miller)
- Compilation of pyrite dating from Revenge, Fimiston lodes and Mt Charlotte (data require correction for $^{36}$Ar produced from thermal neutron induced reactions on $^{35}$Cl - this has necessitated developing new data reduction program) (John Miller)

**15. Report on reactive transport models tested against specific sites where paragenesis and structure understood**

## Publications

*Conference Abstracts*

SGA 2005 Bejing abstracts

- Mapping of hydrothermal alteration and geochemical gradients as a tool for conceptual targeting: St. Ives gold camp, Western Australia, by Neumayr et al.
- Palaeohydrological evolution of the St. Ives gold camp, by Petersen et al.
- Mineral systems, hydridic fluids, the Earth's core, mass extinction events and related phenomena, by Walshe et al.
- Five questions for fun and profit: A mineral systems perspective on metallogenic epochs, provinces and magmatic hydrothermal Cu and Au deposits, by Walshe et al.

- Characteristics and evolution of hydrothermal fluids from the Archaean orogenic New Celebration gold deposits, Western Australia, by Hodge et al.

  STOMP Townsville abstracts
  - Structural and geochemical architecture of intrusion-associated lode-gold deposits, Eastern Goldfields, Yilgarn Craton, by Neumayr, P., et al.
  - Integrated structural and spectroscopic identification of foliation zones and alteration related to Au mineralization at St Ives, Kambalda, Western Australia, by Roache, T. & Yang, K.
  - Palaeohydrological evolution of the St. Ives gold camp, by Petersen, K., et al.
  - Two boxes we don't need: orogenic and intrusion-related gold systems, by Walshe, J., et al.
  - Domes: a characteristic architecture of world–class gold deposits, by Henson, P. et al.
  - Testing the Fools Clock: $^{40}Ar/^{39}Ar$ dating of pyrite, Miller and Phillips

1. Training courses
   - John Walshe, Tony Roache, 14.09.2005, Application of thermodynamic plots to reading the chemistry in the rock record, theory and core farm. St. Ives, 30 industry geologists.

2. Project meetings

| *Name* | *Date* | *Venue* | *Number of Researchers* | *Number of sponsors* |
|---|---|---|---|---|
| Fieldwork: John Walshe, Peter Neumayr, Klaus Petersen, Carl Young to sample across albite breccias and hangingwall structures of Fitzroy Fault | 18.-22.07. | KB | 4 | |
| Fieldwork and Targeting workshops: John Walshe, Peter Neumayr, Klaus Petersen, Tony Roache to present targeting concepts and workshop current targets | 01.-05.08. | St. Ives | 4 | 30 |
| Fieldwork: John Walshe, Tony Roache, Carl Young | 12.-16.09. | St. Ives, KB | 3 | |

3. Shortcourses

| Shortcourses | | | | | |
|---|---|---|---|---|---|
| Name | Date | Venue | Number of researchers | Number of sponsors | E&T affiliated event |
| Peter Neumayr, Klaus Petersen and John Walshe continue to provide on-site training and development for sponsors | During field visits through the quarter | On site: St Ives, KB, | variable | variable | No |

4. Collaboration
   - Immense collaboration between researchers and sponsors. Details may be found in work in progress reports above under each deliverable

- MERIWA project 377 was successfully established to support the embedded researcher program through 2005-2007.
- A new Embedded Researcher was appointed to the Wallaby site.