July-September 2007

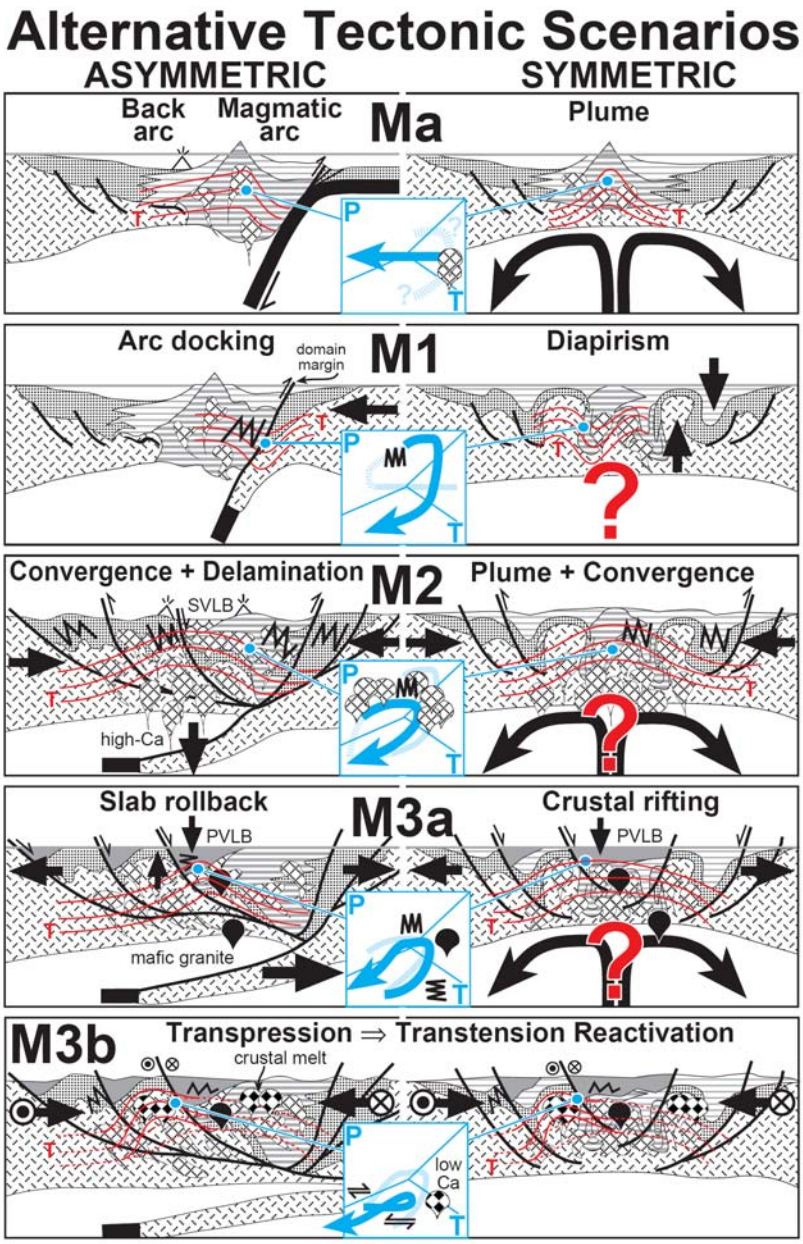
Y4 Project Quarterly Report

predictive mineral discovery CRC

Highlights:

- Metamorphic constraints on tectonics
- Targets at St Ives
- Detrital zircon update
- Progress in geological constraints of inversions
- Successful Y4 contribution to Kal'07 conference
- New map for St Ives
- Embedded Researcher and Student News

Breaking new ground with metamorphic research in the Yilgarn



Ben Goscombe has continued to deliver fantastic new insights into the broad-scale geodynamic evolution of the Yilgarn. Here is an example of two end member models that can be constrained from the detailed PT*t* studies. For more details and latest temperature, pressure and gradient transect sections across the Eastern Goldfields Superterrane contact Ben.Goscombe@adelaide.edu.au see also Twiki https://pmd-twiki.arrc.csiro.au/twiki/pub/Pmdcrc/ProjectY4/Goscombe_Oct_07.zip

pmd*CRC

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PROJECT TEAM

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Nick Williams,
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Rick Squire
Terry Brennan,
Tony Roache,
Yanhua Zhang.

Thank you to previous team members for being part of an exciting group that has broken new ground in predictive mineral discovery

At the sharp end – applying research to targeting

Eight members of the Y4 team spent two days following the Kal'07 conference (on Grand Final weekend) at a targeting exercise on site at St Ives. The aim of the exercise was to test the Y4 research results in terms of generating practical targets at a range of scales on sponsors data.

The researchers were mixed in with the sponsors geologists and we split into two teams, under the leadership of Napoleon and Nelson (after the local Trafalgar naming convention).

The two teams operated quite differently but independently developed similar if not identical targets in many instances.

The differences in approach largely reflected the specific skills sets of the two teams. The exercise involved a quick wrap up of the last Y4 meeting targeting exercise in May 07, and was a reminder of the larger scale 'target' of the 60x60km area that is St Ives.

The teams had a range of 'thinned' datasets that would be typically available in the public domain and provided by a survey (GSWA-GA). These datasets included regional geophysics such as aeromagnetics, radiometrics, gravity, geology, structure, mineral deposits etc.

The aim at this stage was to select six 5x5km targets and to rank them. This process took much of the first day and the two teams made presentations to the other about why the targets were selected and what datasets and concepts were used in the process.

….the real value from us the explorers was seeing the different approaches to defining targets by all the researchers and that not a single discipline was "better" than any other at defining targets (Janet Tunjic)

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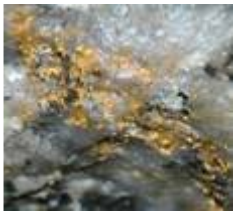
Interestingly, many of same targets were chosen, although there were differences in ranking. Of course the eyes were drawn to the large anomalies at Junction-Argo and at Victory-Defiance – however these areas were not available for further 'exploration' (in this simulation).

The second day was spent choosing 1x1km targets within two of the 5x5km boxes. The sponsors opened up their extensive datasets for the teams to explore with, and in the process were simulating the 'purchase' of detailed lithogeochemistry, gravity and magnetics, seismic, sub-audio magnetic, drilling, soil geochemistry and PIMA data. It was interesting which datasets were most utilised and which ones were best integrated for targeting purposes.

Of the two 5x5km boxes, one was the same and the other was different. The results (in the common 5x5km box) were compared and contrasted at the end of the day and as before at the camp-scale, many similar 1x1km targets were chosen.

The outcome was both informative and enjoyable for researcher and sponsor. The researchers learnt more about the constraints of exploration and the reality and practicality of applying their knowledge. The sponsors were able to see a different approach to targeting, new insights to the geology, and importantly a series of new targets to test! Thank you very much to St Ives Gold Fields for being such hosts and trusting the team with your data and insights. A good few days was had by all. The results will form a major section in Part II of the Final Report.

John Miller 'discovers' the next XX million ounces



Underground Victory-Defiance

Embedded Researcher (ER) and Student News

Tony Roache:

- *Is the only embedded researcher left on the 'books'.*
- Writing St Ives fluid and architecture for Y4 Final Report

Thank you to the Embedded Researchers for your significant contribution to the Y4 and MERIWA research. You helped bridge the sponsor-researcher space very effectively.

Nick Williams (UBC):

- Developed a complete physical property model building package for deriving models to constrain gravity and magnetic inversions based on raw geological data from maps, drilling, and sampling without the need for fancy model building software or arm-waving 3D interpretations.
- For more details see article here and on Twiki https://pmd-twiki.arrc.csiro.au/twiki/bin/viewfile/Pmdcrc/ProjectY4?rev=1;filename=2007_NW_PhD_September_update.zip

Elena Belyavtseva (CET-Curtin):

- Preparing candidature document for acceptance for the project for PhD studies
- Participated in the pre-conference field trip of Kal'07 and attended the conference
- Participated in the targeting exercise at St Ives

Thank you to the students that have contributed so much to the Y4 project. I wish you well in your careers and future as 'predictive mineral discoverers'

Major deliverable next quarter

- There is only one deliverable this quarter – the Final Report.
- The team is busy synthesising and writing up the last 3 year's research into the Final Report
- The report will be desktop published in the New Year, along with the other project reports from the *pmd**CRC
- This will be the final Quarterly Report to sponsors.
- I hope you have found them informative and useful
- A complete record of them is available on Twiki and they will be included in the Final Report (for completeness)

Y4 @ the Kal'07 conference: an integral success for Y4

KALGOORLIE '07 Old Ground. New Knowledge.

The Y4 team made a major contribution to the recent Kalgoorlie 2007 – Old Ground New Knowledge conference in Kalgoorlie (25-27 Sep). This was a major international conference that followed on from Kal'97 a decade ago. Much new research from the *pmd**CRC, AGCRC, CRCLeme, MERIWA and AMIRA projects, together with geological survey, industry, and university has occurred since then. Nearly 300 people attended a packed 3 days of conference to hear the latest insights of the last decade of research and discovery.

The Y4 project featured strongly, and we delivered twelve invited oral papers from the team (including one on applied numerical modelling from Warren Potma of the M9 project).

The papers ranged in scale and discipline from large scale tectonics/geodynamics to detailed fluid chemistry in the deposits.

The papers were universally well received and many of the new insights of the Y4 team were commended by the Director of the Geological Survey of Western Australia as highlights.

The team also presented 7 poster papers on a range of topics from modelling to geodynamics and metamorphism.

If you were not fortunate to join us at the conference, then please obtain a copy of the abstracts and talks/posters on https://pmd-twiki.arrc.csiro.au/twiki/bin/view/Pmdcrc/ProjectY4#Kalgoorlie_2007_conference_abstr

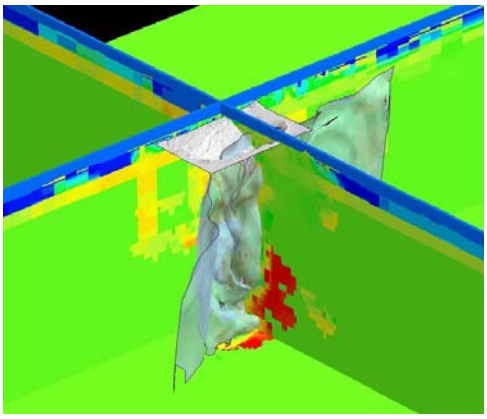
view along EG01 seismic line site of MT

Automatically build constraining physical property models for inversions

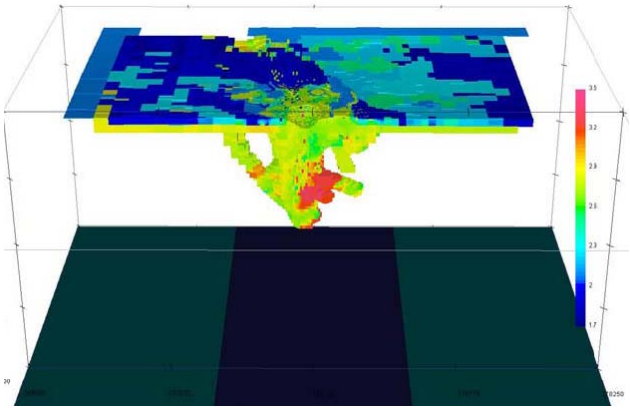
Nick Williams (nwilliams@eos.ubc.ca) has completed a first version of an entire physical property model building package that takes raw geological datasets and converts them into physical property constraining models for UBC–GIF gravity and magnetic inversions. This removes the arm-waving interpretation of subsurface geology in a data-poor environment and expensive 3D modelling packages and proprietary formats. Instead, the geological constraints for the inversion can be based purely on observations. Nick has added the flexibility to include full 3D geological interpretations. The choices of input datasets that are currently available are:

- ArcView shapefiles of outcrop and basement geology maps
- Surface physical property measurements
- Physical property measurements on drill holes
- Geology logs on drill holes
- 3D models and interpretations of geological zones, regions, or rock types

All of this information is automatically painted into a UBC–GIF inversion mesh to create physical property reference models, weighting models, and/or bounds models after guiding the user through a suite of options related to the incoming datasets. A user can include as much or as little information as is available to them. The user also has the option of defining a buffer zone around observations so that the model builder extrapolates the physical properties outwards some specified distance to replicate expectations of geological continuity, and to create fuller constraining models where data is sparse. The model builder users a series of basic GUI prompts to acquire all the necessary information from the user.

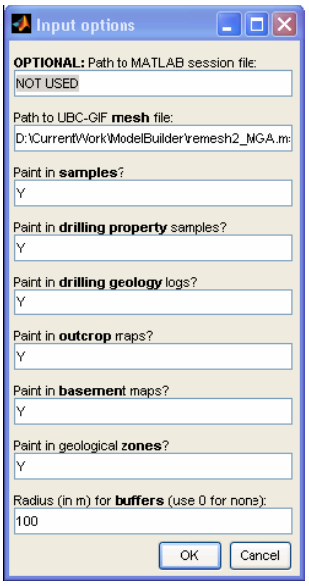


Left: Perspective view of the density reference model built from the geological datasets, looking down towards the northwest over the Perseverance deposit. The Perseverance pit surface is shown in pale grey. The Perseverance ultramafic footwall wireframe (from BHP Billiton) is shown in transparent pale blue. The blue->aqua->green->yellow->red colours on the slices (positions of slices in MGA94 indicated on image) show increasing observed densities. The uniform green regions represent default (unconstrained) densities of 2.7 g/cm^3. The red region shows high density (~3.1 g/cm^3) adcumulate rocks which show an excellent correlation with the position of the Perseverance ultramafic footwall contact (which itself was NOT used to derive the model). The yellow/orange regions to the west (left) of the footwall contact are various mafic sills within the footwall rocks (~2.9 g/cm^3). The blue zones at the tops of the slices show regions where the cells are either above ground or are strongly weathered to low density (~1.9 g/cm^3) regolith.



Right: Example of the new GUI prompt used by the model builder to determine which types of data need to be loaded.

For more information contact Nick Williams nwilliams@eos.ubc.ca



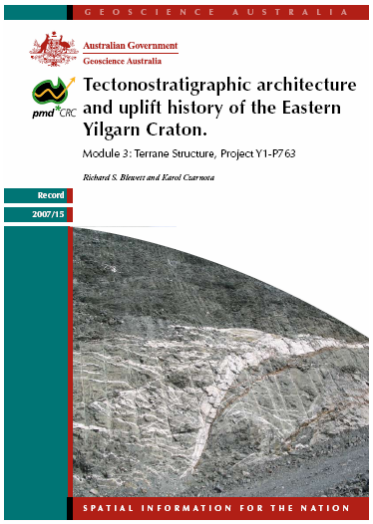
Above: Perspective view of a density reference model for Perseverance. Only those cells that contain enough data to assign non-default densities are shown. These are based on outcrop and basement maps, and drilling. Most of the surface cells contain low density regolith material (blue colours). Higher densities are found at depth in the model, notably the large red region corresponding to weakly serpentinised ultramafic adcumulate below the pit, and a thin mafic sill intersected in the western (left) most drill hole.

Kal'07 pre-conference field trip and Y1-P763 (Module 3) Final Report released open file

A pre-conference field trip was run between 21-24 September to show the results of the previously confidential Y1-P763 project. Thirty participants, most from industry (including three from Canada), were shown a traverse of the central corridor of the Eastern Yilgarn Super-terrane, with a unique view of the differing styles of mineralisation and the structural setting of some of the 'Goldfields' classic mines. The transect ran from Lawlers/Agnew in the west and finished east of Laverton, visited the Leonora district and some granite localities en route.

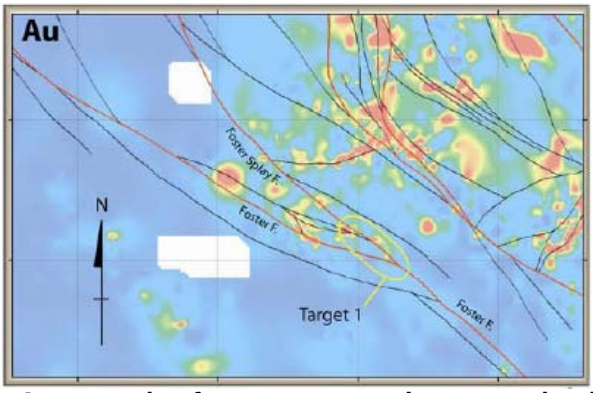
The aim of the trip was to link gold mineralisation with structure within a new overall geodynamic evolution for the Eastern Yilgarn. This trip was the first time that non-sponsors of the AMIRA P763-Y1 project were able to see the results. A comprehensive field guide was prepared, that drew on the P763 report (now GSWA Record 2007/19). https://pmd-twiki.arrc.csiro.au/twiki/bin/viewfile/Pmdcrc/ProjectY4?rev=1;filename=gsdrec_2007_19%5b1%5d.pdf

The excursion demonstrated the multiple gold mineralising events (extensional, compressional and strike-slip, both sinistral and dextral) and that these can be integrated into an overall geodynamic systems understanding through time. One of the aims of the excursion was to challenge the existing structural paradigm by examining its foundations and more generically to examining the first principles by which regional structural event histories are compiled. Participants were presented with a modified regional structural event history primarily based on field relationships integrated with geochronological, geochemical, seismic and map pattern constraints.



Final Report released as GA Record 2007/15

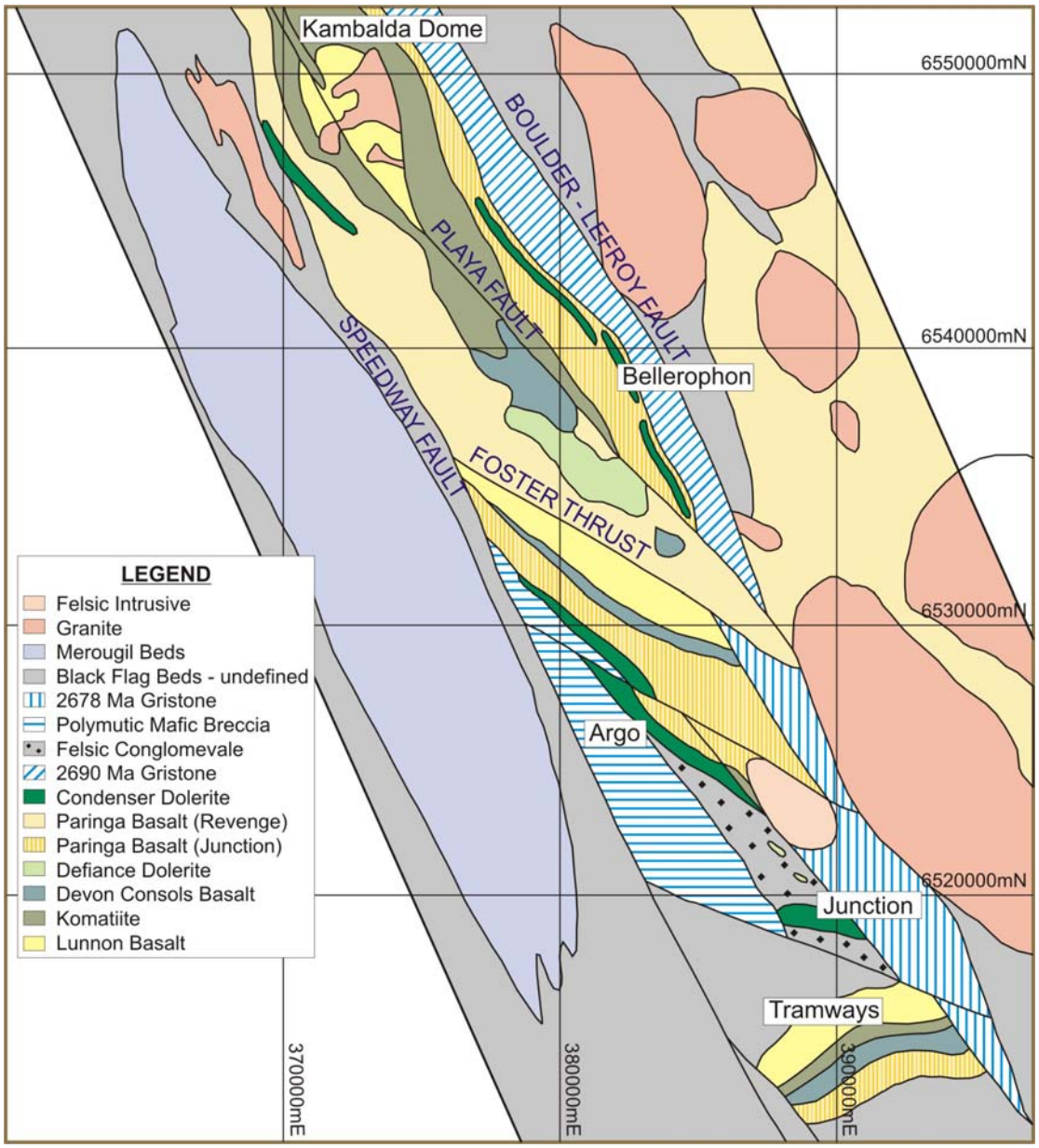
St Ives structural targets



An example of a new structural target and gold flitch sliced below the soil/regolith surface

A new structural map has been prepared for the St Ives camp, and is based on recent mapping by John Miller. John has defined 6 new targets and published a report https://pmd-twiki.arrc.csiro.au/twiki/bin/viewfile/Pmdcrc/ProjectY4?rev=1;filename=Miller_pmdCRC_target__memo.pdf, which describes the targets, together with likely analogues, structural certainty, host rocks, extent of testing, multi-element chemistry and follows with recommendations. This is another example of the *pmd**CRC applying its research in a practical way for sponsors. For more information contact John Miller (jmmiller@cyllene.uwa.edu.au)

New map of St Ives aids exploration



A refined geological map of the St Ives region, representing an integration of the region's geophysical, geochemical and lithological data, shows a more-complex stratigraphic and structural architecture and provides a clearer understanding of the distribution of the various Au deposits between the Kambalda Dome and Tramways. For example, the two largest deposits in the region, Junction and Argo, are confined to dolerites within a particular package (felsic conglomerate) of the Black Flag Group. Farther north, the Playa Fault defines a major boundary between units of the Black Flag Group and Paringa Basalt and thus represents a major structure in the region. The deposits between Victory and Revenge are located on the southwestern side of this major structure. The Bellerophon deposits northeast of the Playa Fault are hosted by a package of the gritstones in the Black Flag Group and may contain porphyry-style mineralisation. Therefore, Au exploration for the different Au deposits in the region should be focussed according to the type of deposit within particular northwest-trending corridors, rather than within a few kilometres of the (imaginary?) Kambalda Anticline. For more information contact Rick.Squire@sci.monash.edu.au

Update of detrital-zircon results

A comparison of SHRIMP and laser ablation ICP-MS U-Pb analyses of detrital zircons confirmed the following. In the Agnew region, the Jones Creek Formation has two distinct populations (~2800 and 2680 Ma), whereas the Scotty Creek Formation has a broad peak between about 2660 and 2730, plus several >3000 Ma grains. A sample of the 'least altered' Ballarat Turbidite from Kanowna Belle was quite disturbed, producing equivocal result: 2673+/-39 Ma (LA-ICP-MS) and 2654+/-38 Ma (SHRIMP). A sample of the felsic conglomerate (part of the Black Flag Group) overlying the pillow basalt at Argo in the St Ives region (LB269) produced a LA-ICP-MS age of about 2678+/- 3 Ma (n=32), which showed only broad overlap with the SHRIMP age of 2664+/- 34 Ma (n=14). A sample of feldspar-rich granule breccia from Kundana (LB393) was also strongly disturbed, but has an age around 2665 Ma with several zircons >3 Ga, thus does not match a similar-looking unit of the Black Flag Group from Bellerophon at St Ives that has a single age of about 2686 Ma. For more information contact Rick.Squire@sci.monash.edu.au

List of project events for the quarter

1. Project meetings

Name	*Date*	*Venue*	*Number of Researchers*	*Number of sponsors*
Fieldwork (RS)	25-29 June	St Ives	1	
ST Ives – talks to site and paper wiring (RB, PN, JW, AR)	17-19 July	On site at St Ives	3	Up to 25
St Ives – talks to site and presentation of targeting document (JM, RB)	21-22 August	On site at St Ives	2	
PL meetings with CSIRO team members (YZ, HS, AO)	23 August	CSIRO Perth	5	Up to 25
Y4 general meeting	20 September	CSIRO Perth	10	0
Y4 general meeting	23 September	Kalgoorlie	10	0
Fieldwork (RS)	24 September	St Ives	1	

2. Workshops

Name	Date	Venue	Number of researchers	Number of sponsors
Kal07 pre-conference field trip (RB, KC, HS, YZ, AO, BG)	21-24 September	Central Goldfields	6	12+
Y4 Targeting Meeting at St Ives (PH, KC, DC, EB, RS, JM, PN, JW, RB)	25-26 September	St Ives	9	7

3. Conferences/Symposia

Name	Date	Venue	Number of researchers	Number of sponsors
SGTSG (JM, KC)	July	Alice Springs	2	?
SGA Dublin (JC, JW, KP, KC)	August	Dublin, Ireland	4	many
Exploration 07 (NW)	9-12 September	Toronto, Canada	1	?
12th International Symposium on Water-Rock Interaction (YZ)	31/7 to 5 August 2007	Kunming, China	1	0
Kalgoorlie 2007 (RB, KC, PH, DC, PN, JW, JM, EB, JC, AO, HS, YZ)	24-27 October	Kalgoorlie	12	many

4. Short courses

Name	Date	Venue	Number of researchers	Number of sponsors
Peter Neumayr, Klaus Petersen and John Walshe continue to provide on-site training and development for sponsors		On site: St Ives	variable	variable