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Scale-integrated Concepts to Targets of a Gold Mineral System





SCALE 4: ORE SYSTEM DEFINITION

(1 km x 1 km area selection)

Y4 Team

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New structural targets in the Dome to Victory corridor: looking for analogues in a mature camp

John Miller

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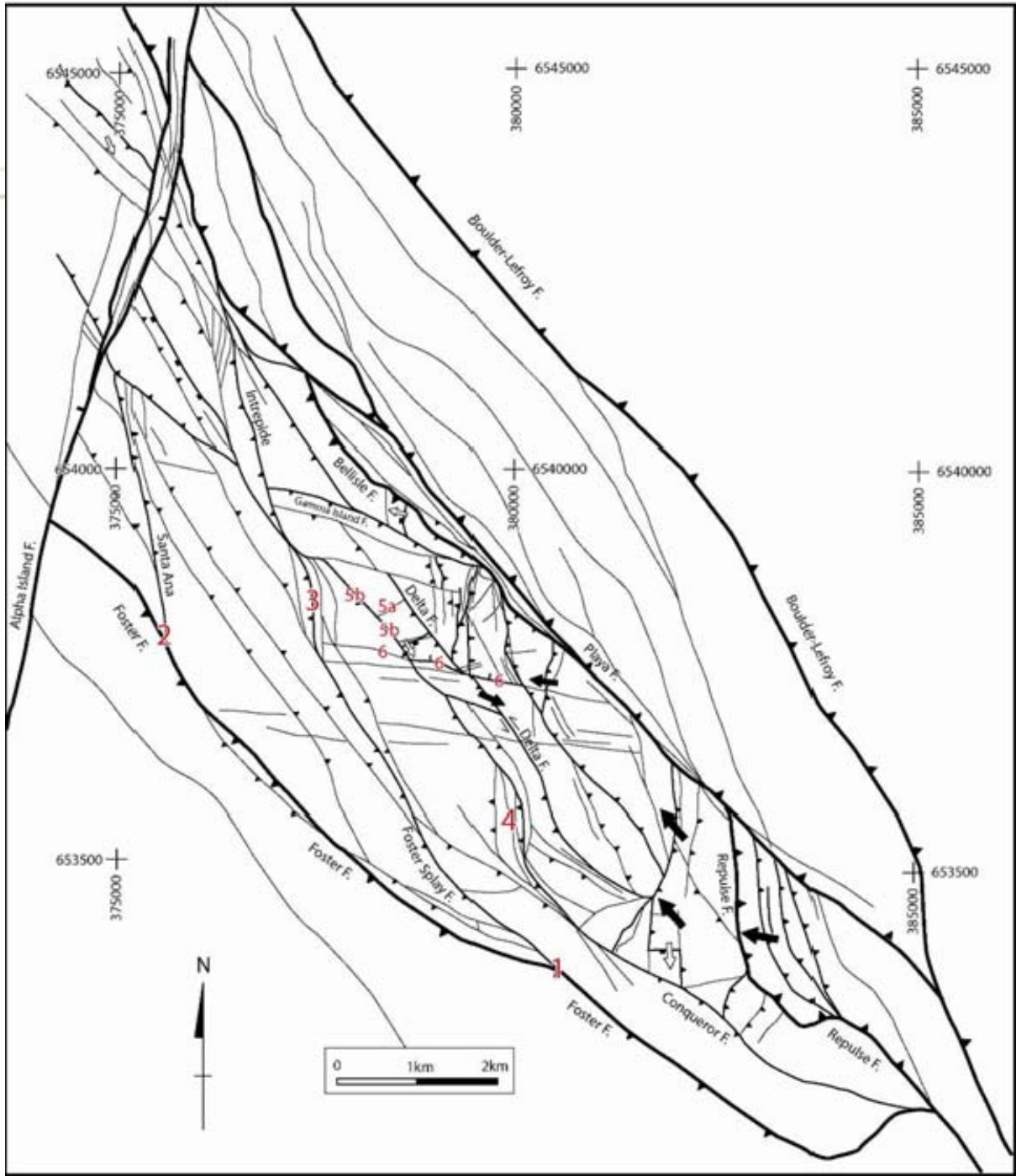
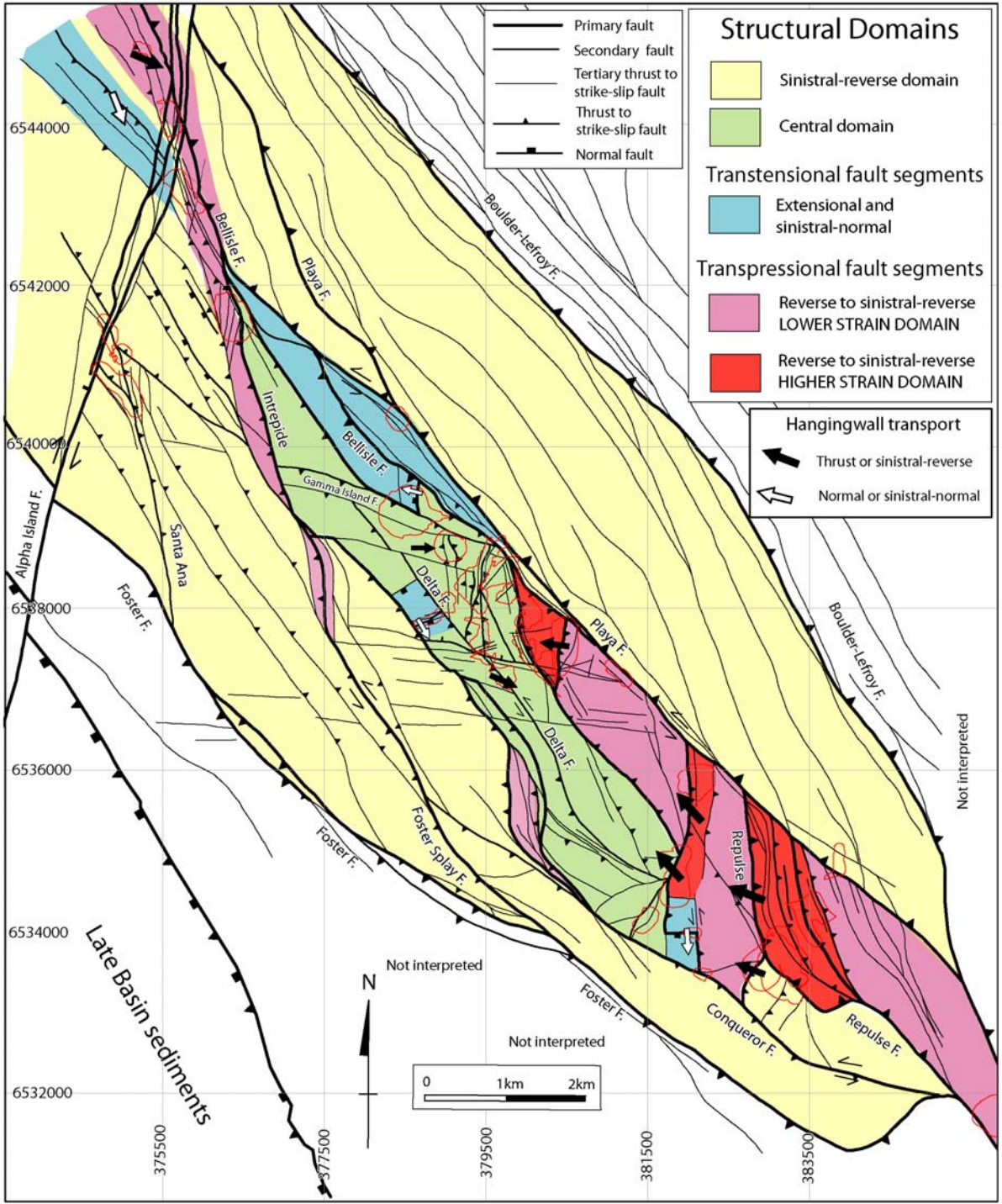
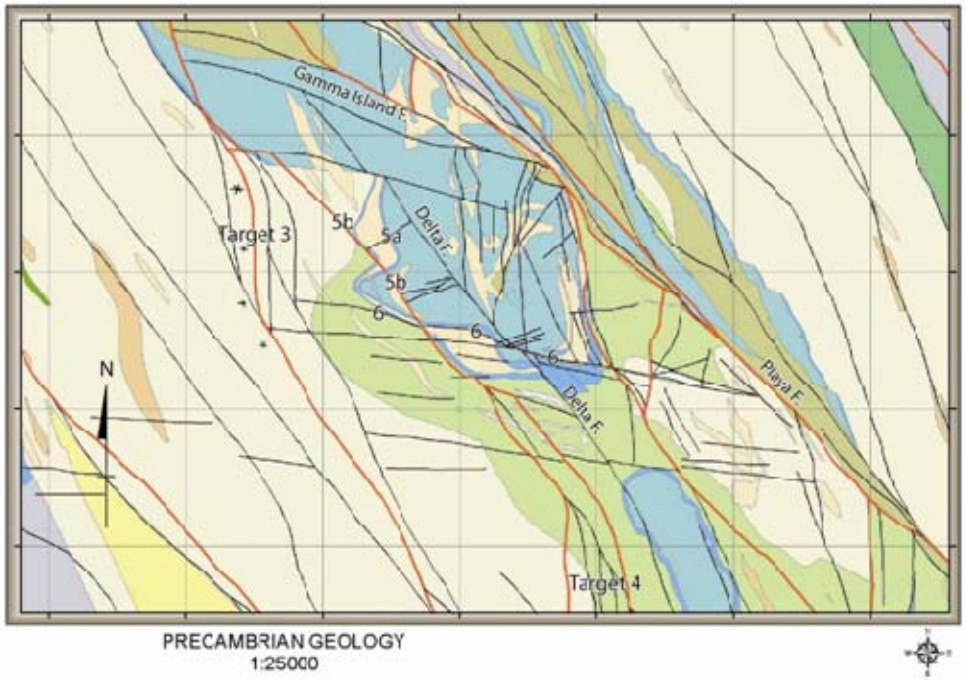
New structural map produced from 1:15000 scale interpretation highlighting the six new target areas (red letters).



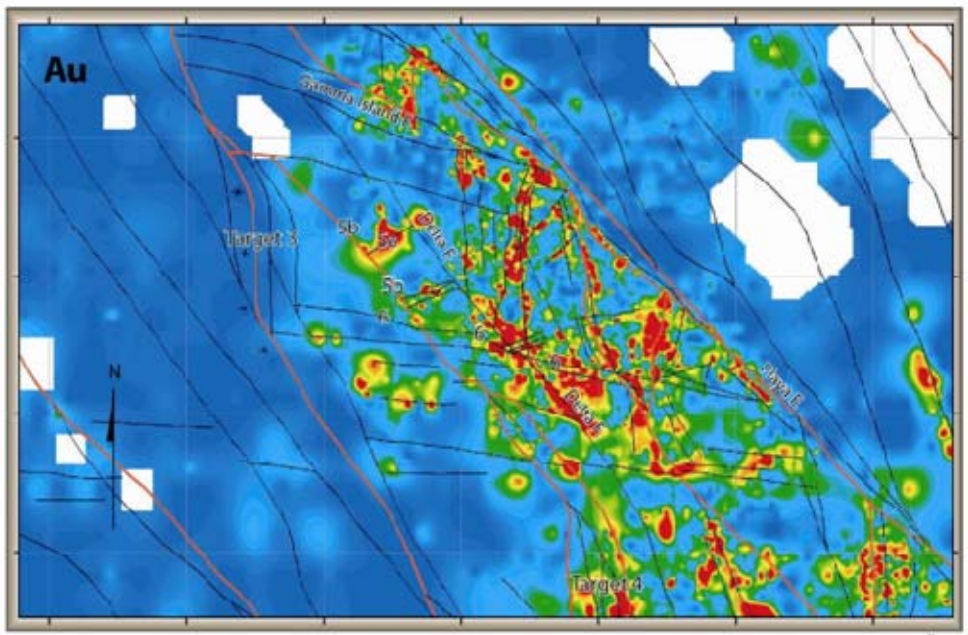


- **Utilised kinematics to define analogues**
- **Compressional versus transtensional jogs**
- **Assessed geochemical signals on each structure**
- **Will look at some of these targets (3-6)**

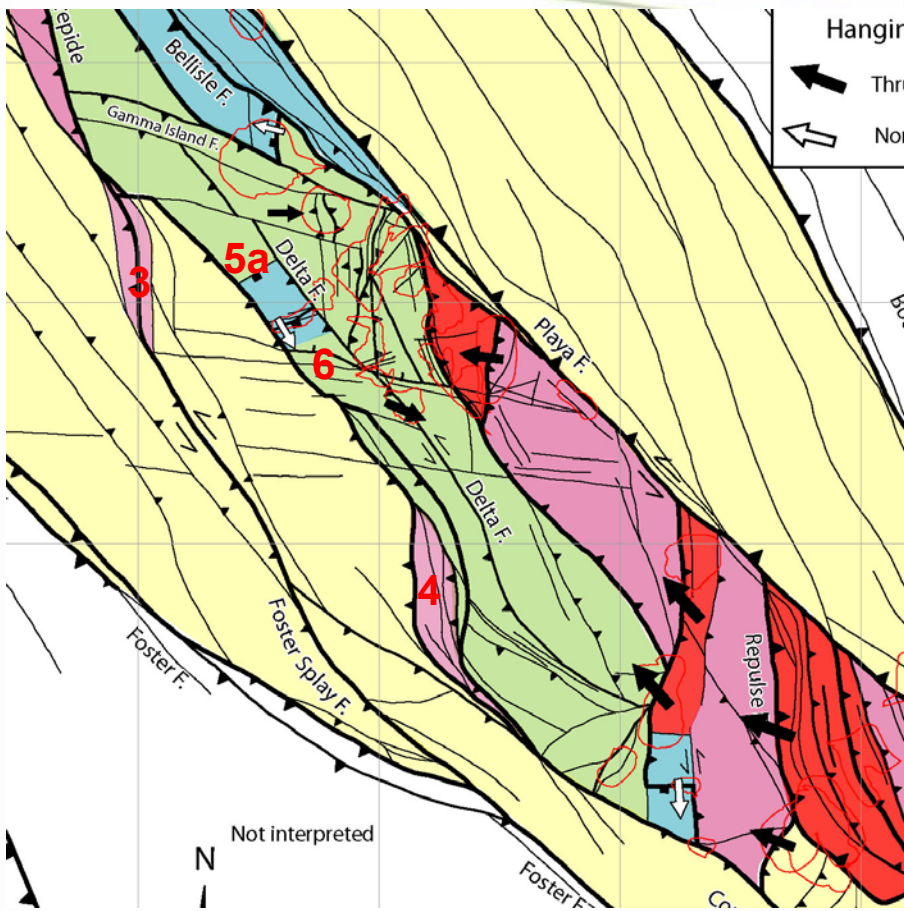
Gold and geology: Targets 3-6



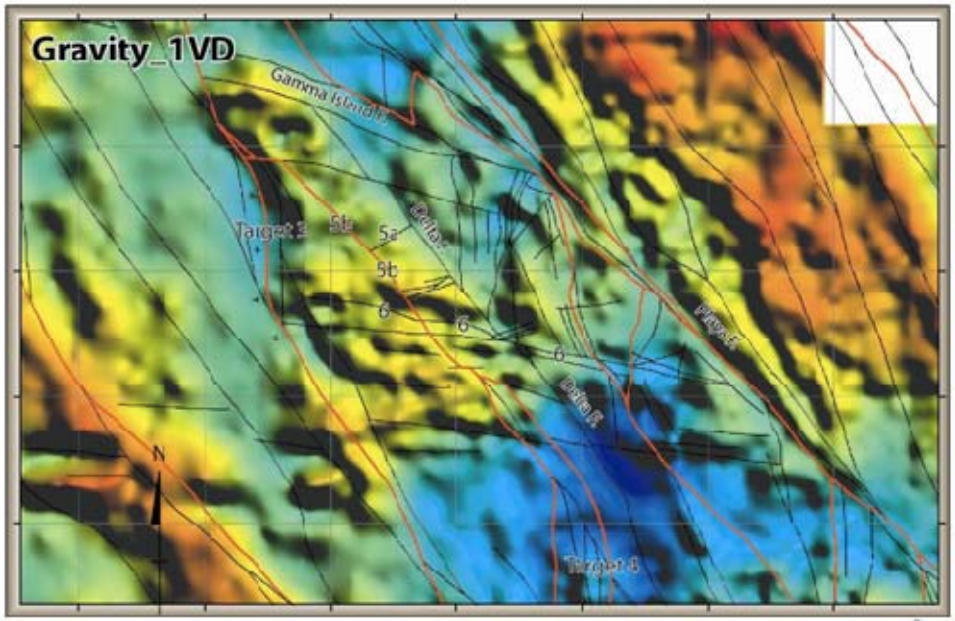
PRECAMBRIAN GEOLOGY
1:25000



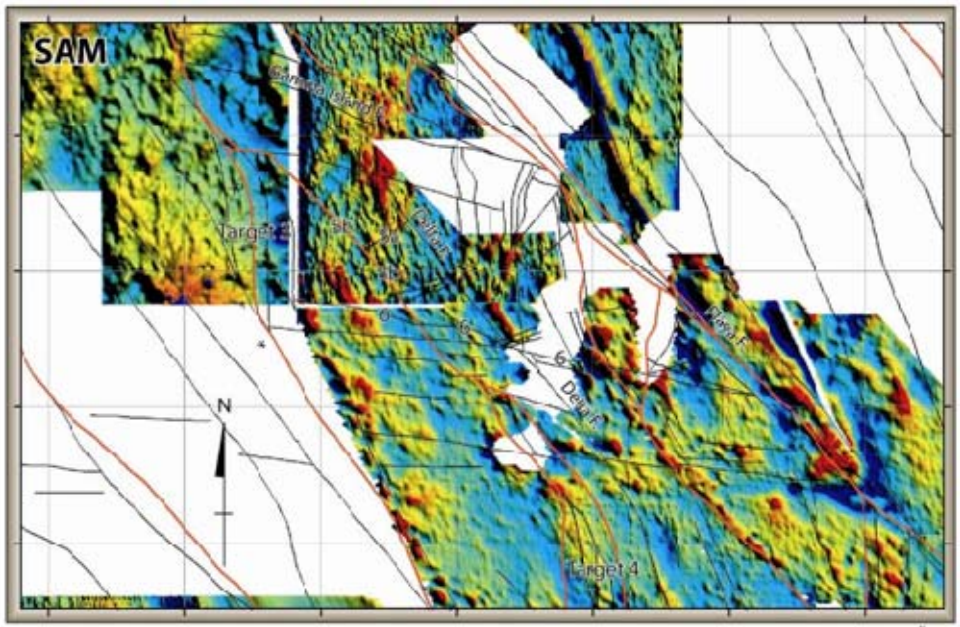
GOLD_FLITCH_265-285RL



Gravity and SAM: Targets 3-6

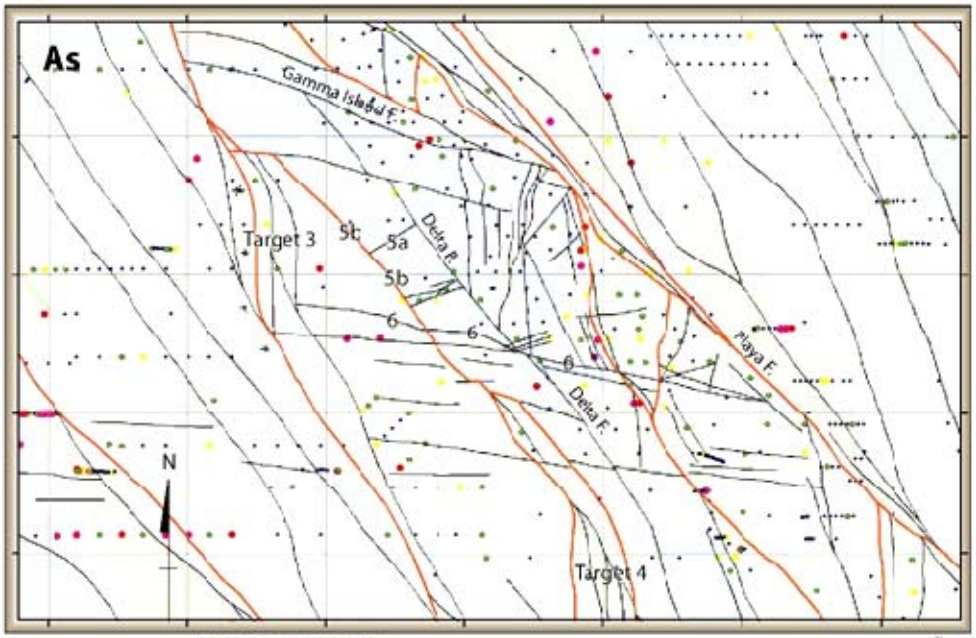


GRAVITY_1VD
1:25 000

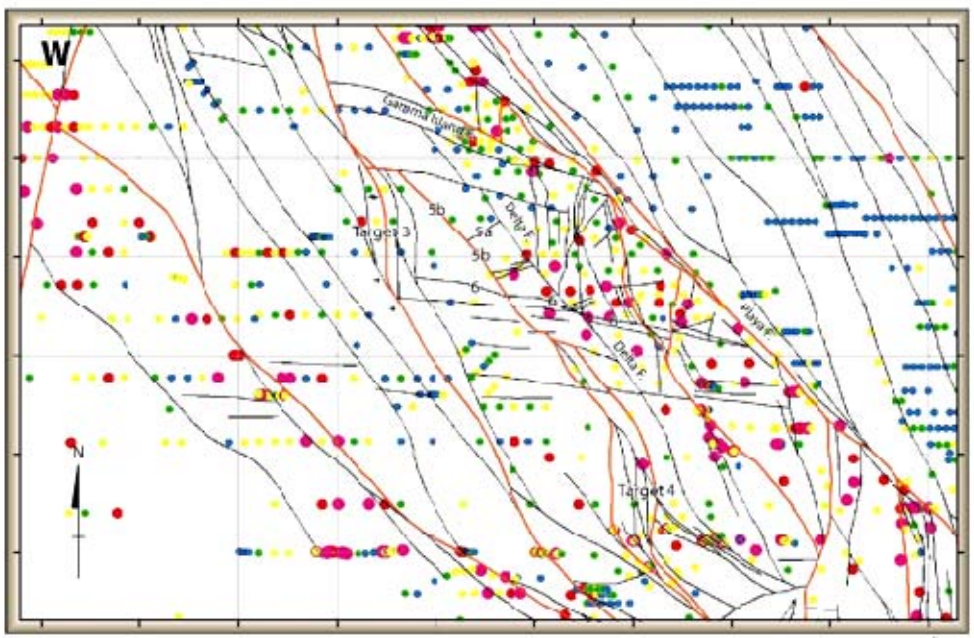


SAM

Geology, As & W: Targets 3-6



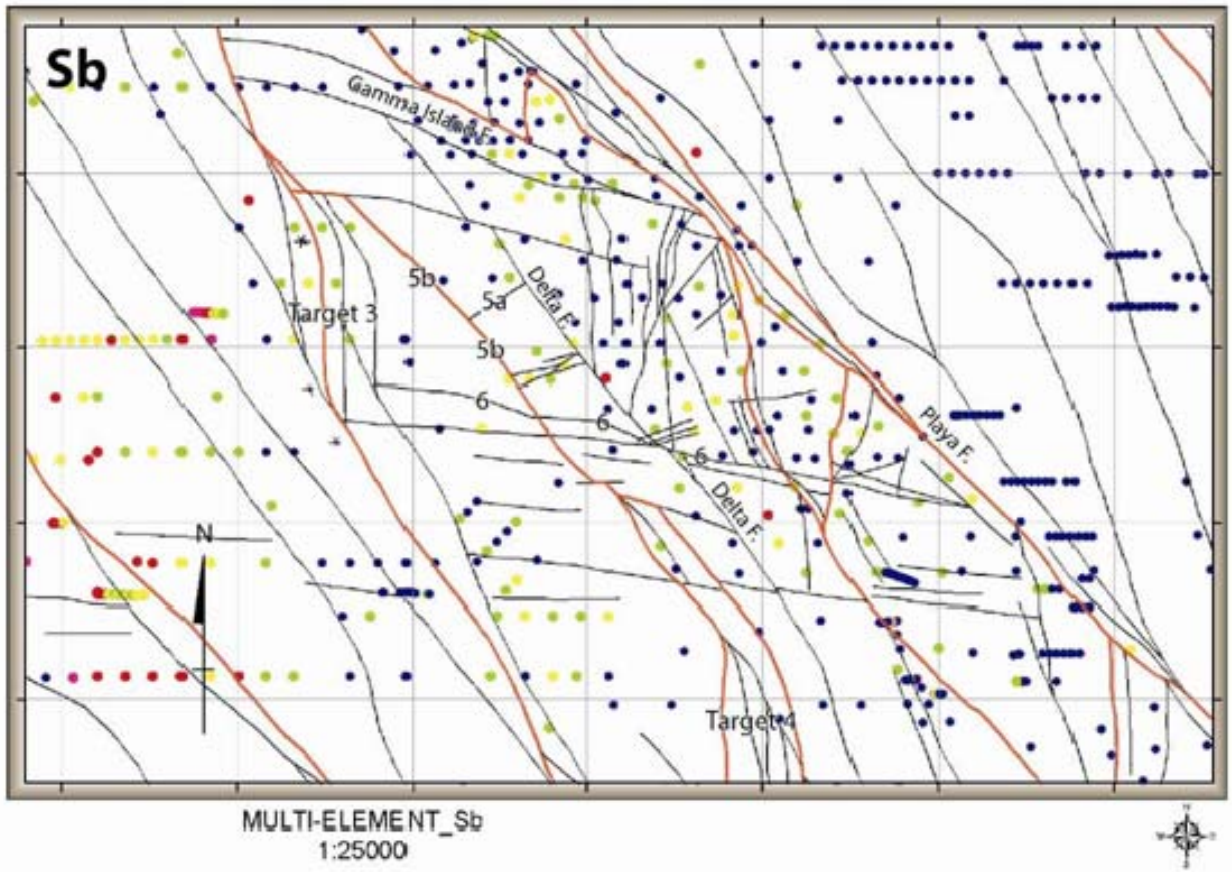
MULTI-ELEMENT_As
1:25000



W_Neptune
1:35000

Blue dots are lowest values and red dots are highest values. Green and yellow dots are intermediate values.

Sb: Targets 3-6



Blue dots are lowest values and red dots are highest values. Green and yellow dots are intermediate values.

Structure and Targets 5a, 5b

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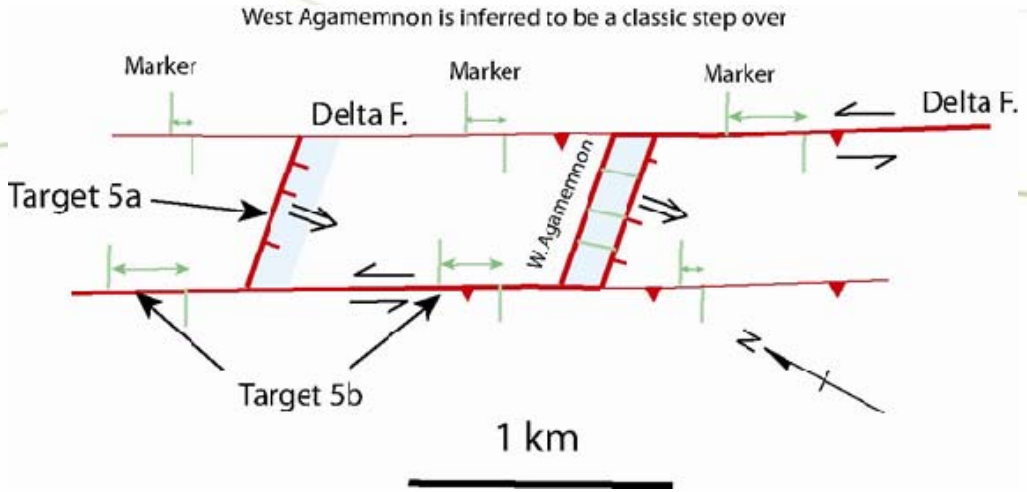

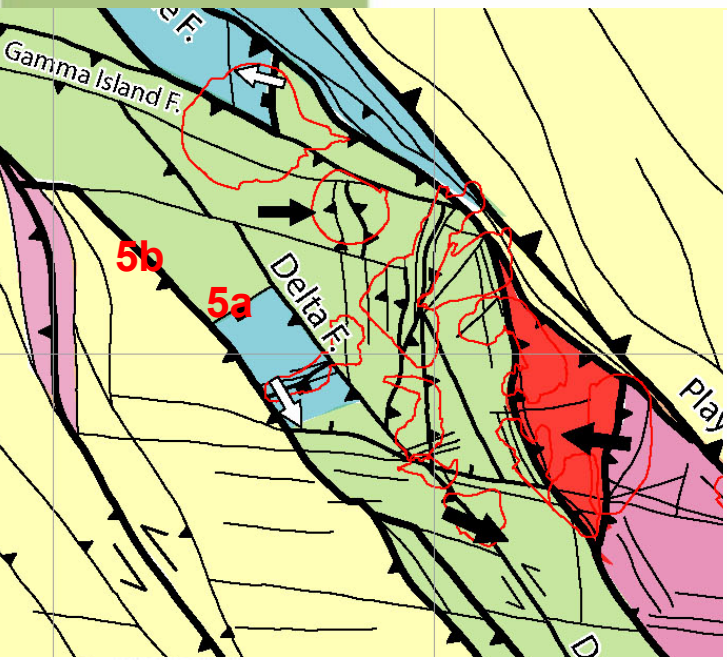

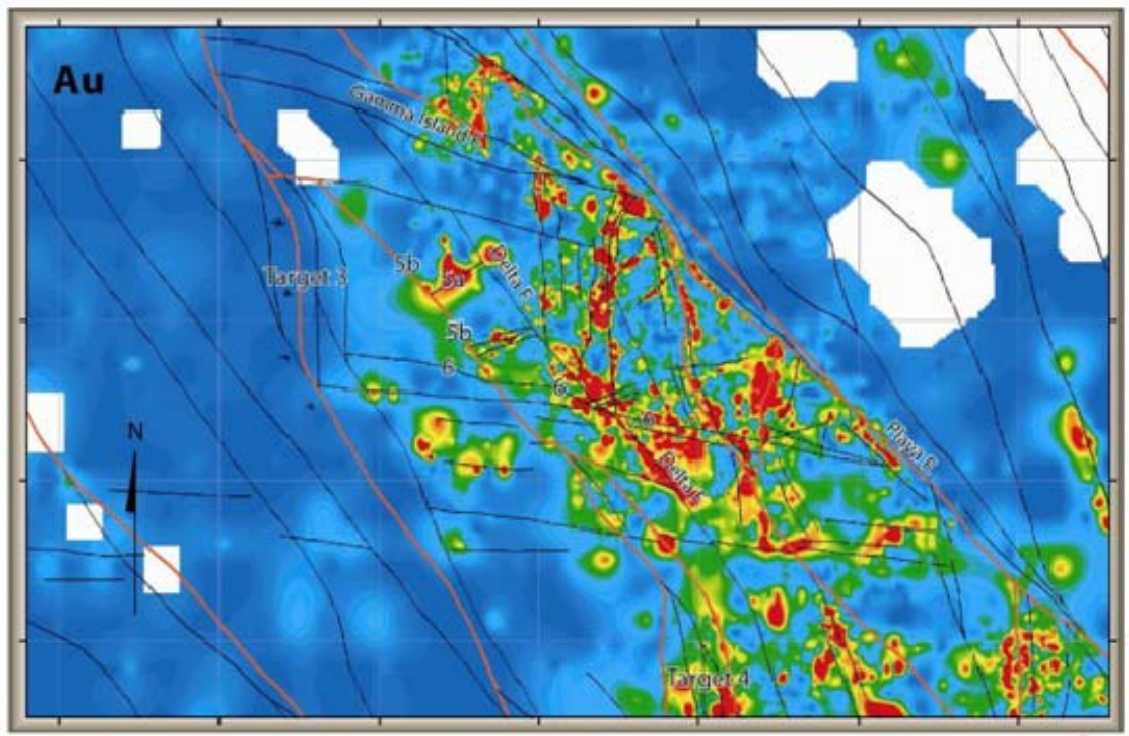

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Using mineralogy to infer hydrothermal alteration to predict a conceptual 1 km x 1 km scale target

Peter Neumayr and John Walshe

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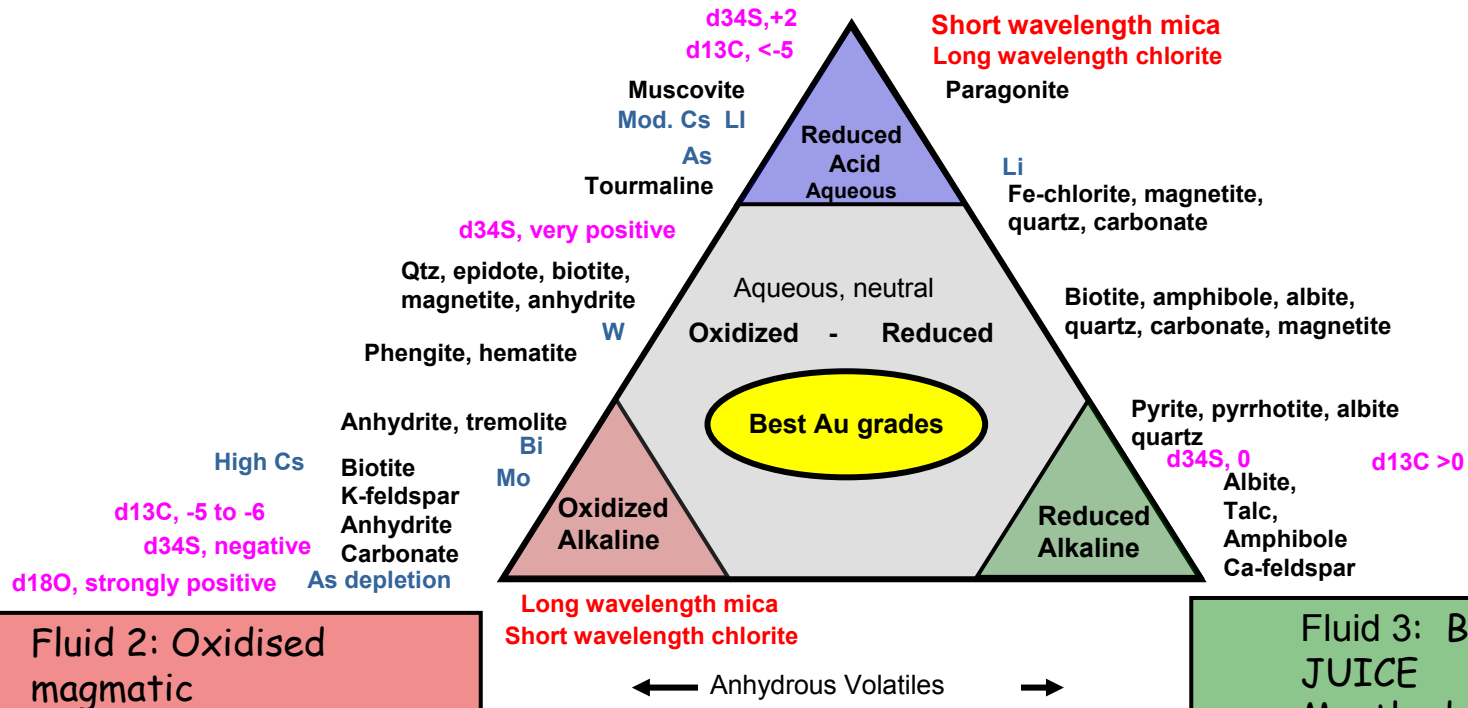
Three fluid diagram:
based on isotopes, geochemistry and mineralogy and fluid inclusions end members

Fluid1: Reduced crustal fluid
$H_2O \pm NaCl \pm CO_2 \pm H_2S$

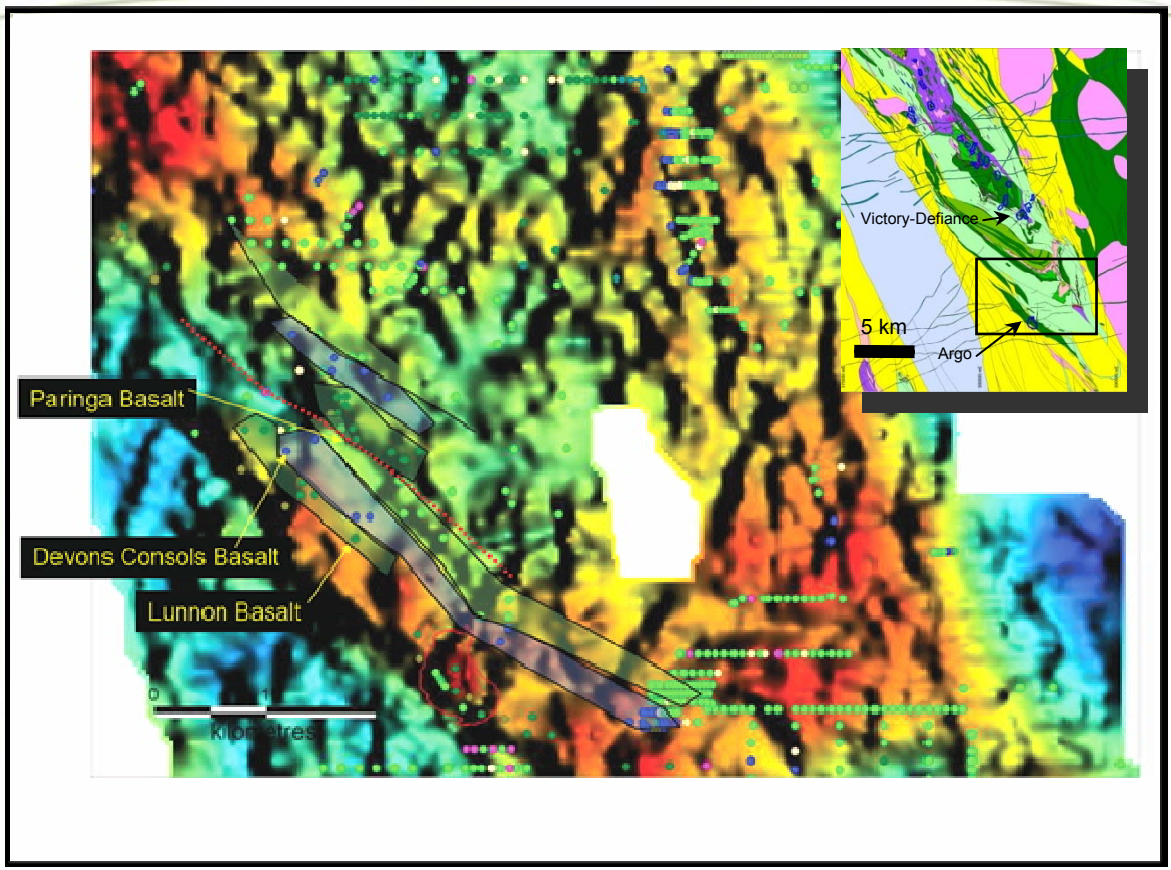


Fluid 2: Oxidised magmatic
CO_2 - SO_2
– volatiles; potassic

Fluid 3: BLACK/GREEN JUICE
Mantle derived
H_2,H_2S, CH_4, N_2, HCl, HF
sodic

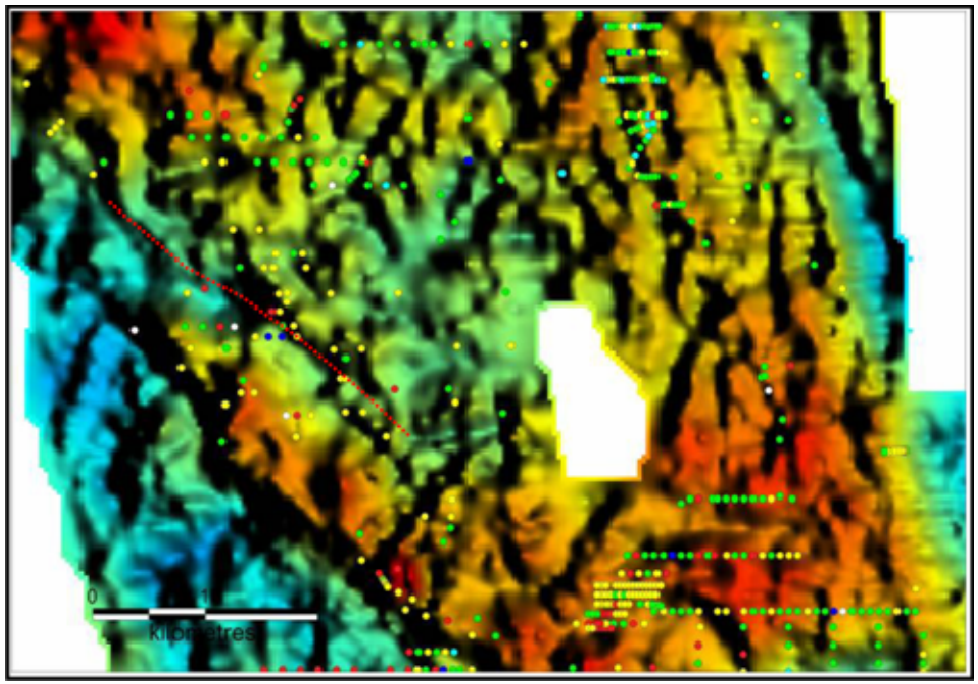
John Walshe, Scott Halley, Janet Tunjic

Gravity and Lithology



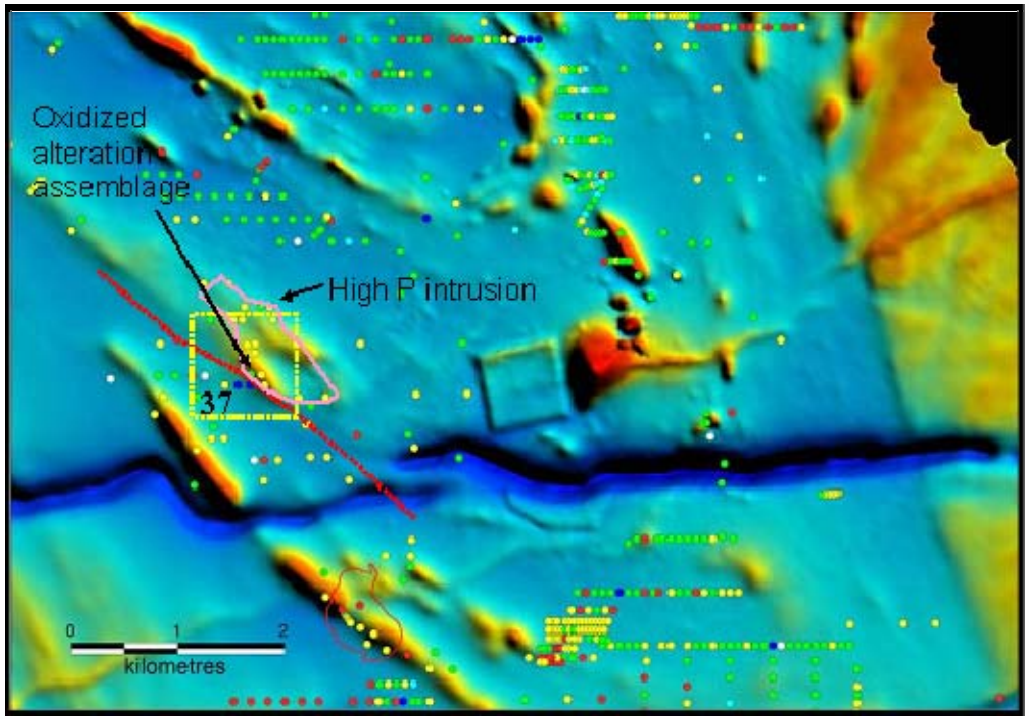
Detailed gravity image overlain with stratigraphy codes based on whole-rock, multi-element analyses. Note that the rock package Lunnon Basalt, Devons Consols Basalt, Paringa Basalt appears to be repeated, suggesting a thrust fault separation as indicated (red line).

Gravity and Phosphorus



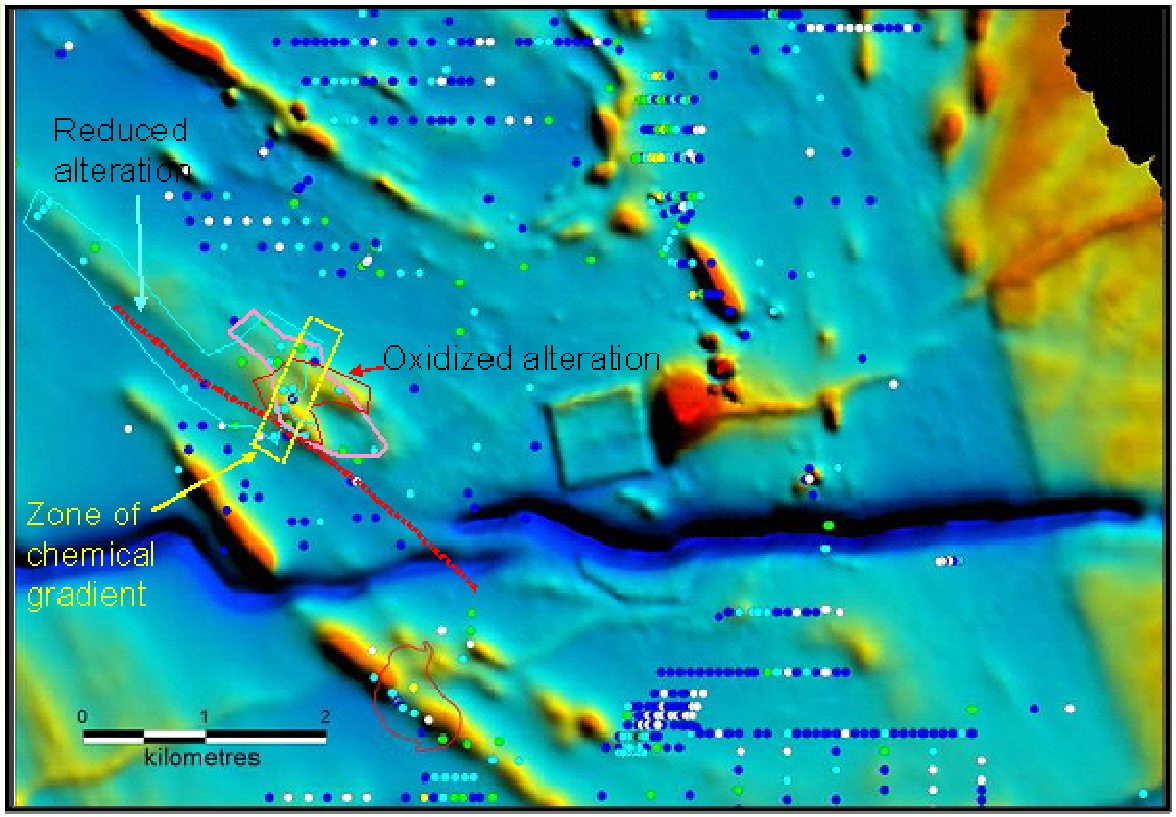
Detailed gravity image overlain by whole-rock P assays. High P values are likely associated with mafic porphyry intrusions which have been shown to be associated with gold deposition (e.g., Kanowna Belle).

TMI and Phosphorus



Target 37 is located in the 1 km x 1 km area shown with the yellow box.

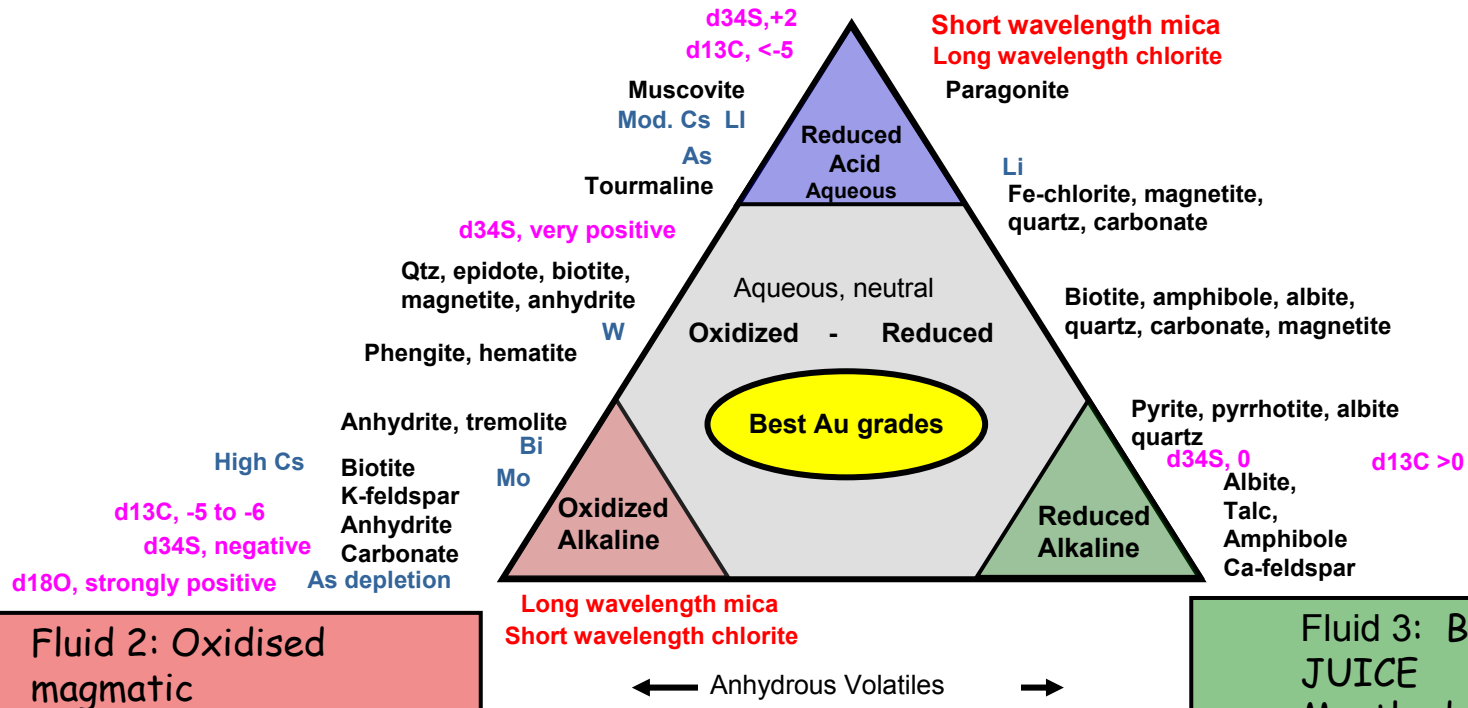
TMI and Arsenic



The interpreted zone of reduced alteration is based on the elevated As values, whereas the oxidised alteration is based on the location of the interpreted intrusion.

Three fluid diagram:
based on isotopes, geochemistry and mineralogy and fluid inclusions end members

Fluid1: Reduced crustal fluid
$H_2O \pm NaCl \pm CO_2 \pm H_2S$



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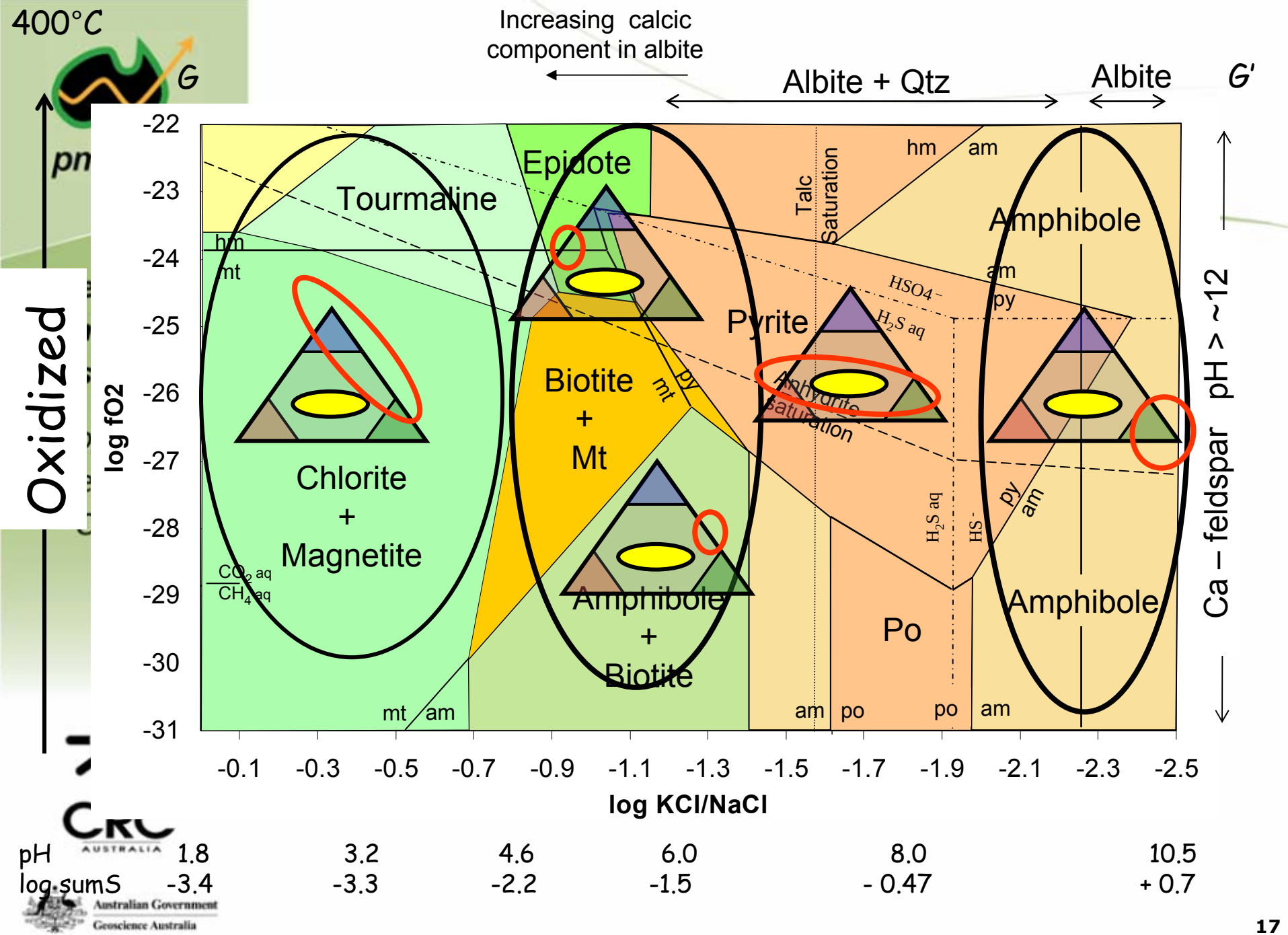
CO_2 - SO_2
– volatiles; potassic

Fluid 3: BLACK/GREEN JUICE
Mantle derived
H_2,H_2S, CH_4, N_2, HCl, HF
sodic

John Walshe, Scott Halley, Janet Tunjic


400°C
G
pn
Oxidized
Increasing calcic component in albite
Albite + Qtz
Albite
G'
Tourmaline
Epidote
Talc Saturation
hm
am
Amphibole
hm
mt
HSO4-
H2S aq
am
py
Pyrite
Biotite + Mt
py
mt
Anhydrite Saturation
Chlorite + Magnetite
CO2 aq
CH4 aq
H2S aq
HS-
py
am
Amphibole + Biotite
Po
Amphibole
mt
am
am
po
po
am
log fO2
-22
-23
-24
-25
-26
-27
-28
-29
-30
-31
-0.1
-0.3
-0.5
-0.7
-0.9
-1.1
-1.3
-1.5
-1.7
-1.9
-2.1
-2.3
-2.5
log KCl/NaCl
Ca – feldspar pH > ~12
pH 1.8 3.2 4.6 6.0 8.0 10.5
log sumS -3.4 -3.3 -2.2 -1.5 - 0.47 + 0.7
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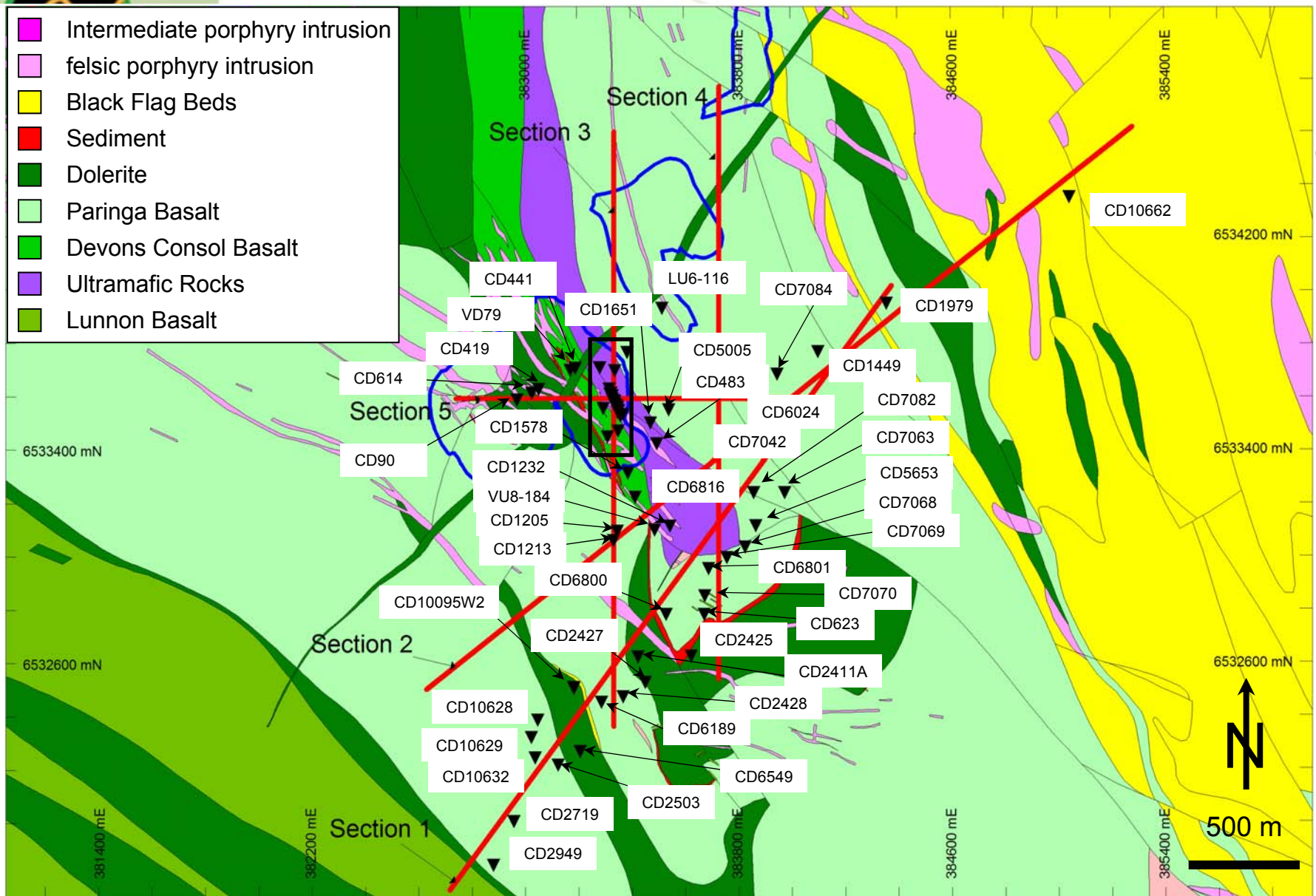
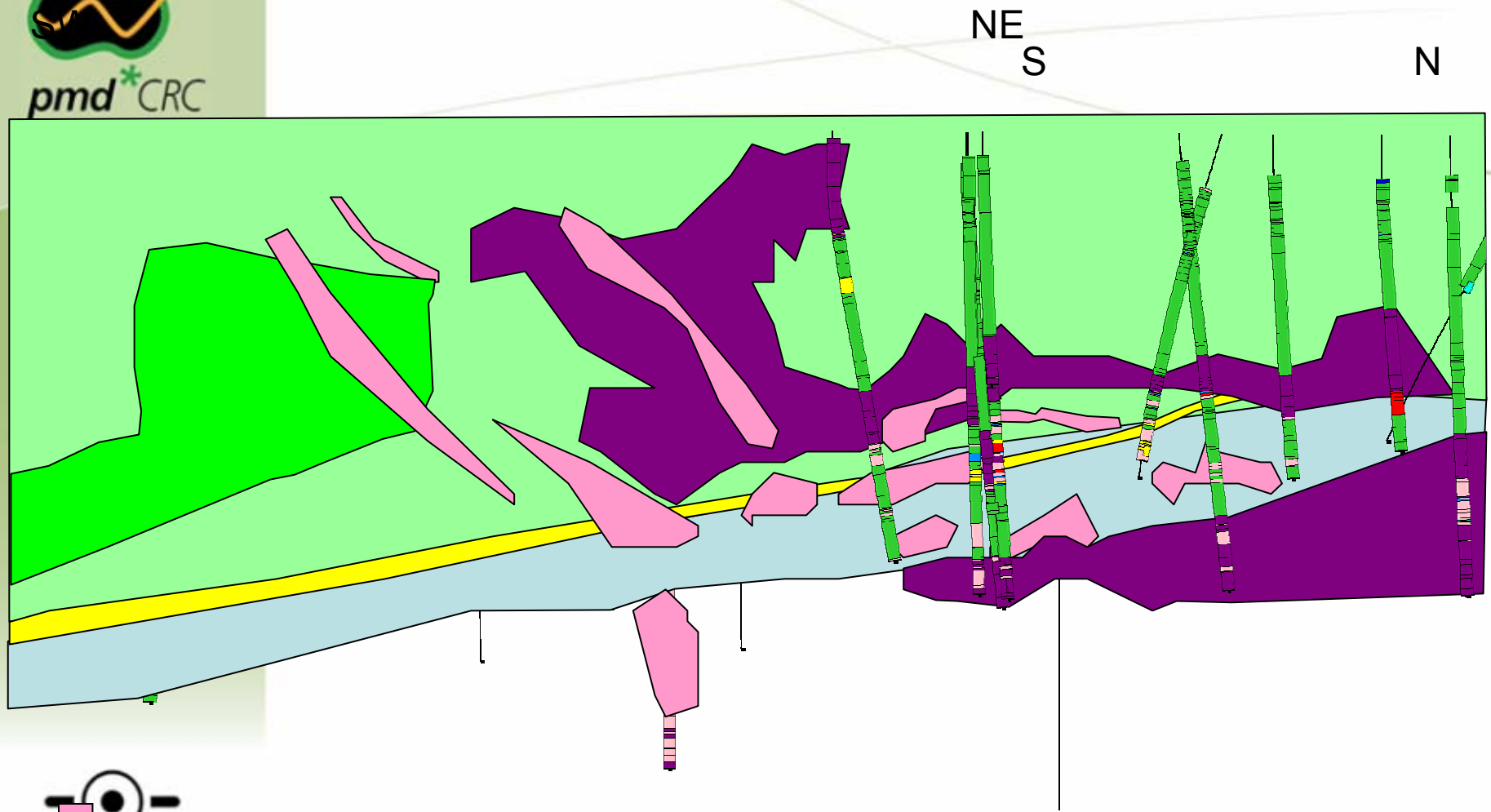
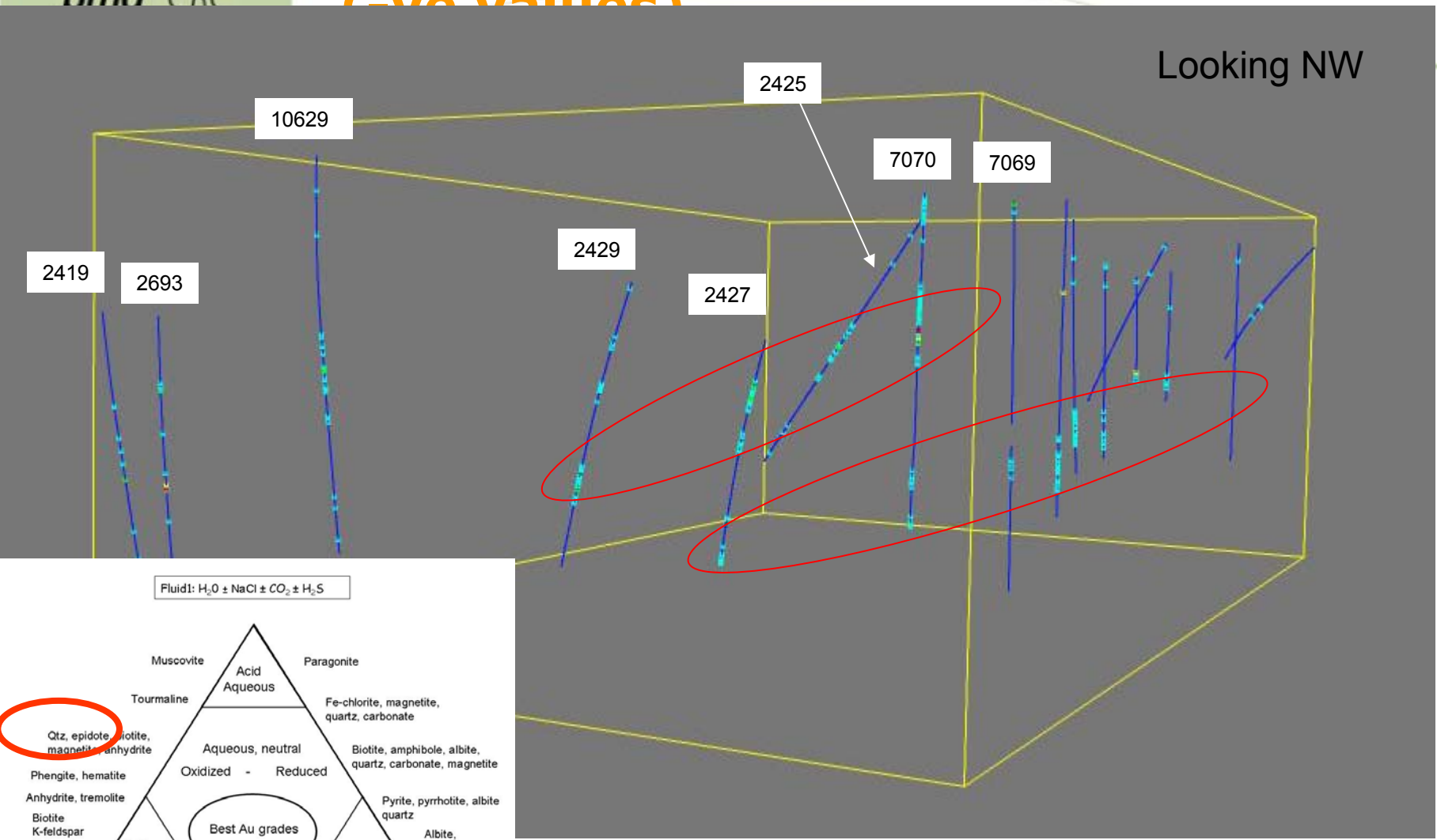

Intermediate porphyry intrusion
felsic porphyry intrusion
Black Flag Beds
Sediment
Dolerite
Paringa Basalt
Devons Consol Basalt
Ultramafic Rocks
Lunnon Basalt
Section 1
Section 2
Section 3
Section 4
Section 5
383000 mE
383800 mE
384600 mE
385400 mE
381400 mE
382200 mE
6534200 mN
6533400 mN
6532600 mN
CD10662
CD441
LU6-116
CD7084
CD1979
VD79
CD1651
CD419
CD5005
CD1449
CD614
CD483
CD7082
CD6024
CD1578
CD7042
CD7063
CD90
CD1232
CD6816
CD5653
VU8-184
CD7068
CD1205
CD7069
CD1213
CD6801
CD6800
CD7070
CD10095W2
CD623
CD2427
CD2425
CD2411A
CD10628
CD2428
CD6189
CD10629
CD10632
CD6549
CD2503
CD2719
CD2949
N
500 m

Integrated Section

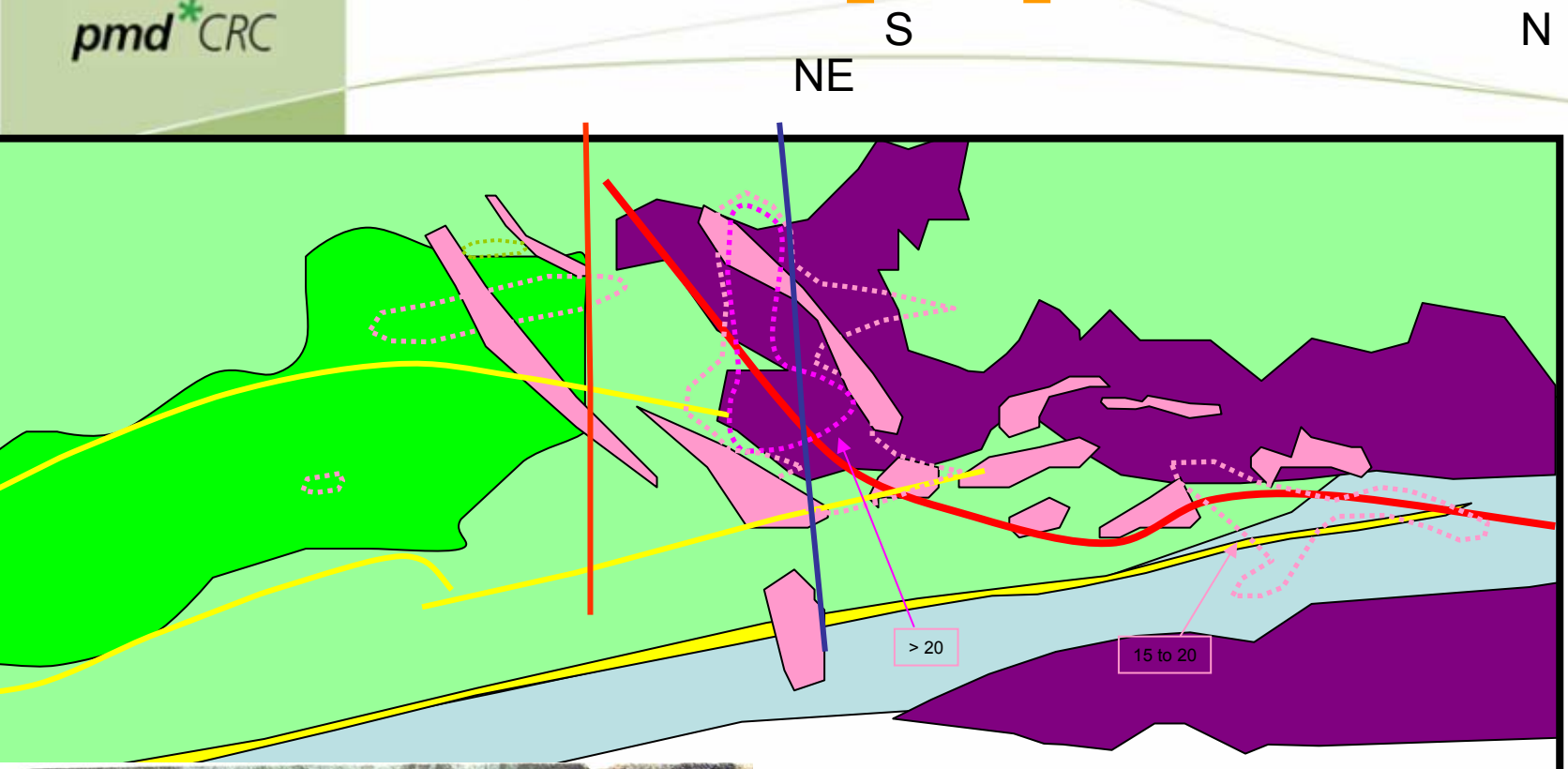


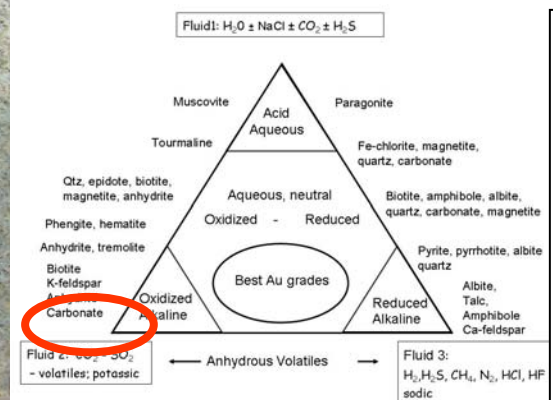
- Felsic porphyry intrusion
- Defiance Dolerite
- Paringa Basalt
- Kapai Slate
- Devons Consols Basalt
- Kambalda Komatiite/ultramafic rock

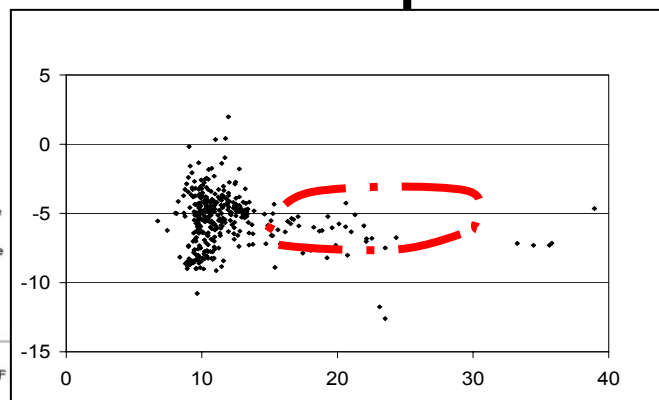
Relating epidote (hyperspectral) to δ ^{34}Spy (-ve values)



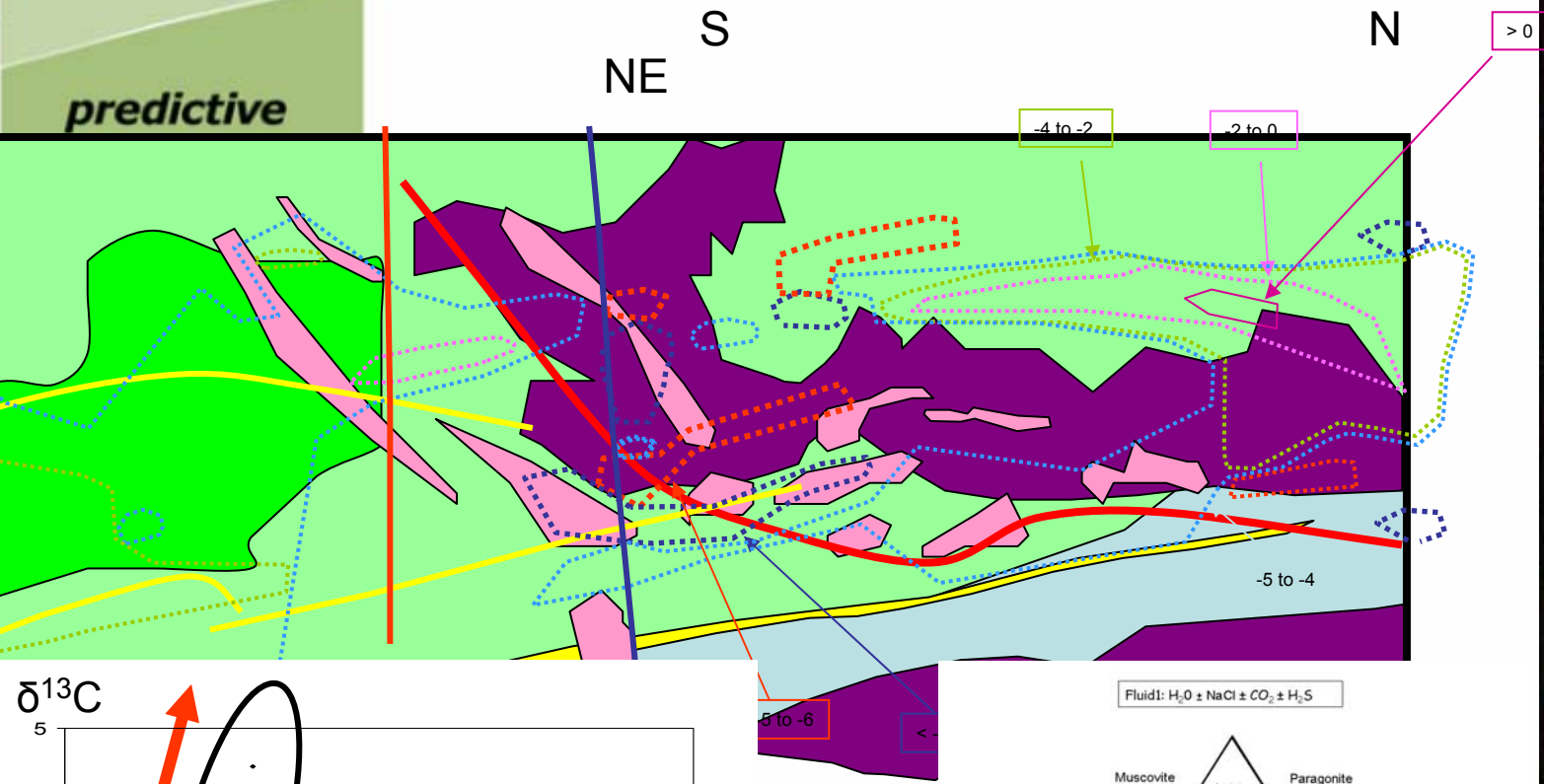
Minerals & Isotopes: Tracking the CO_2-SO_2 fluid

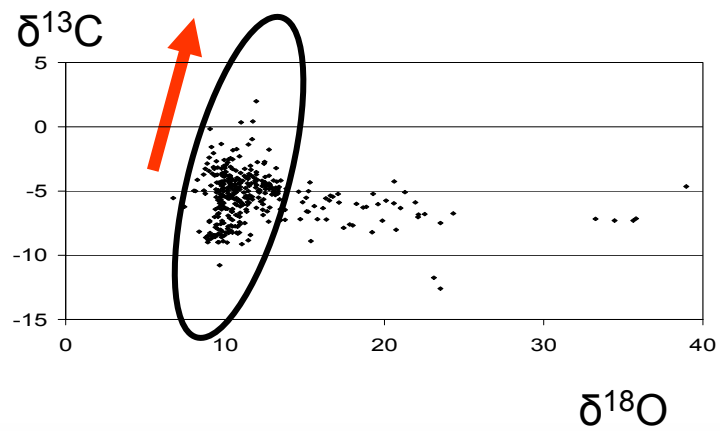


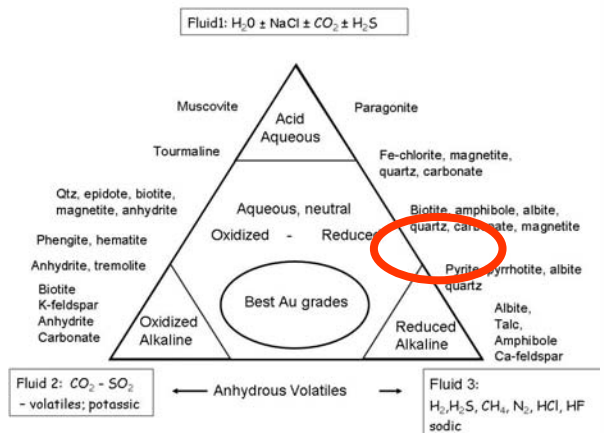




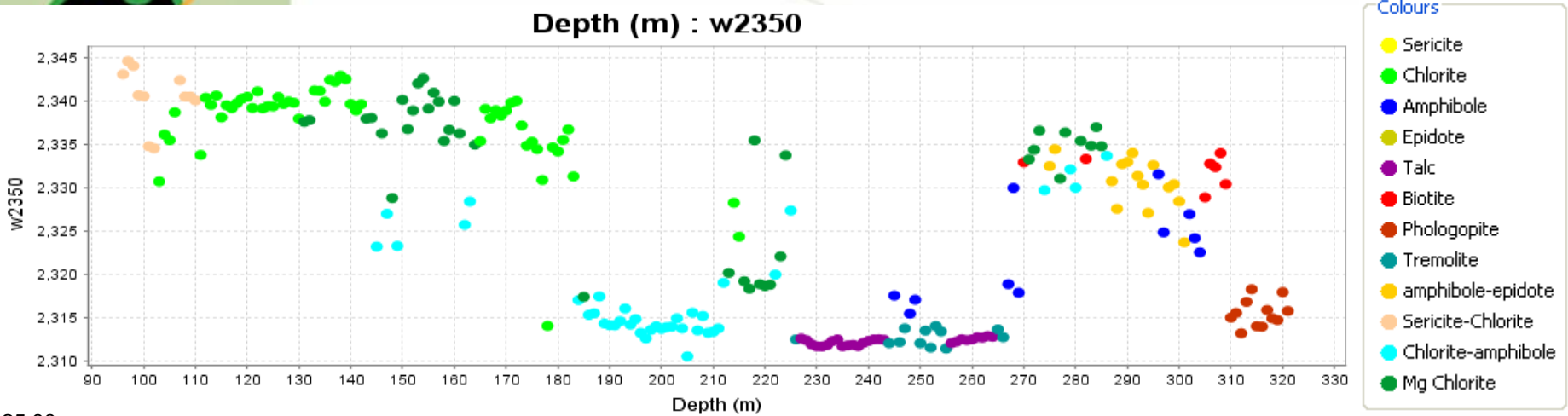
Tracking the H_2 flux
Positive deviation of $\delta^{13}C$ – H_2 driving CO_2 reduction

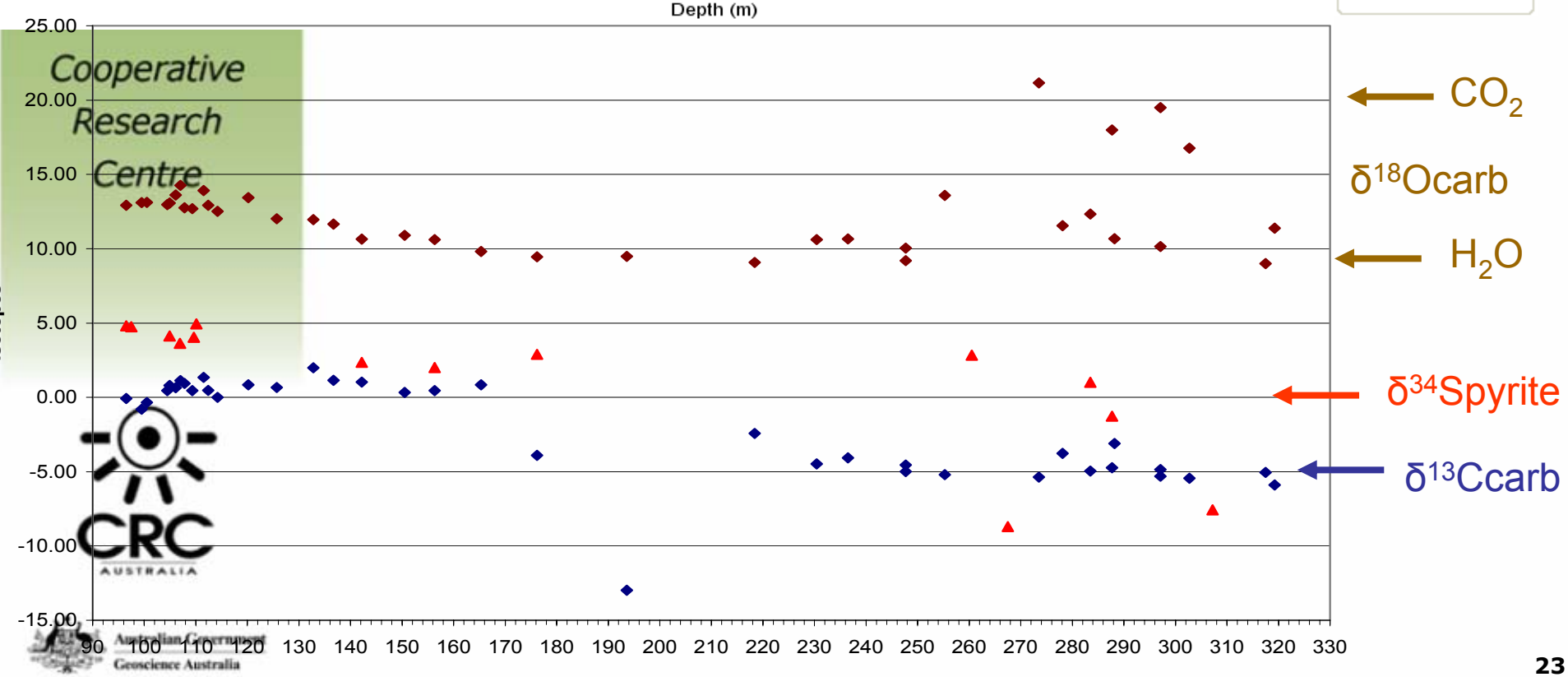






CD5026





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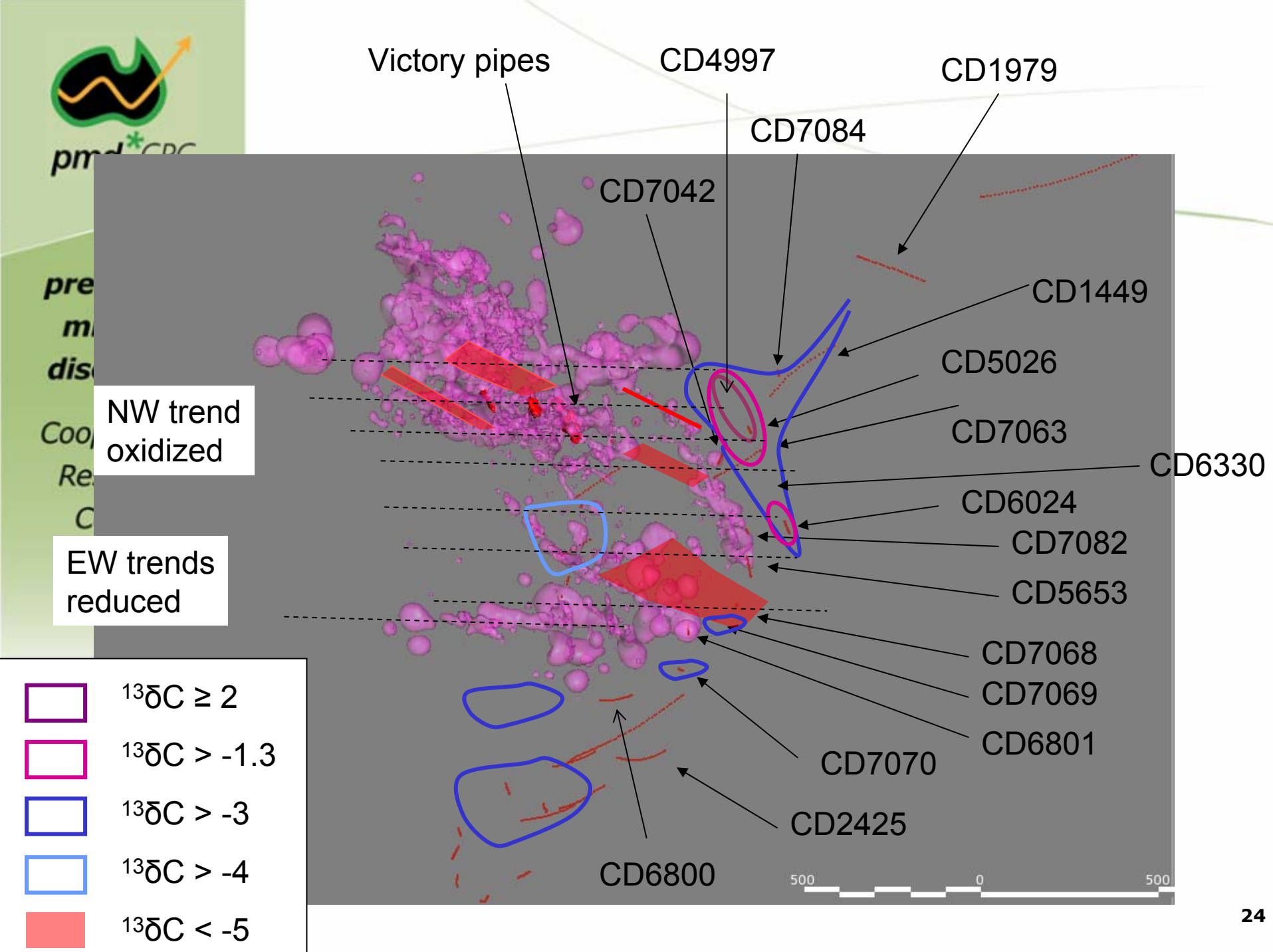
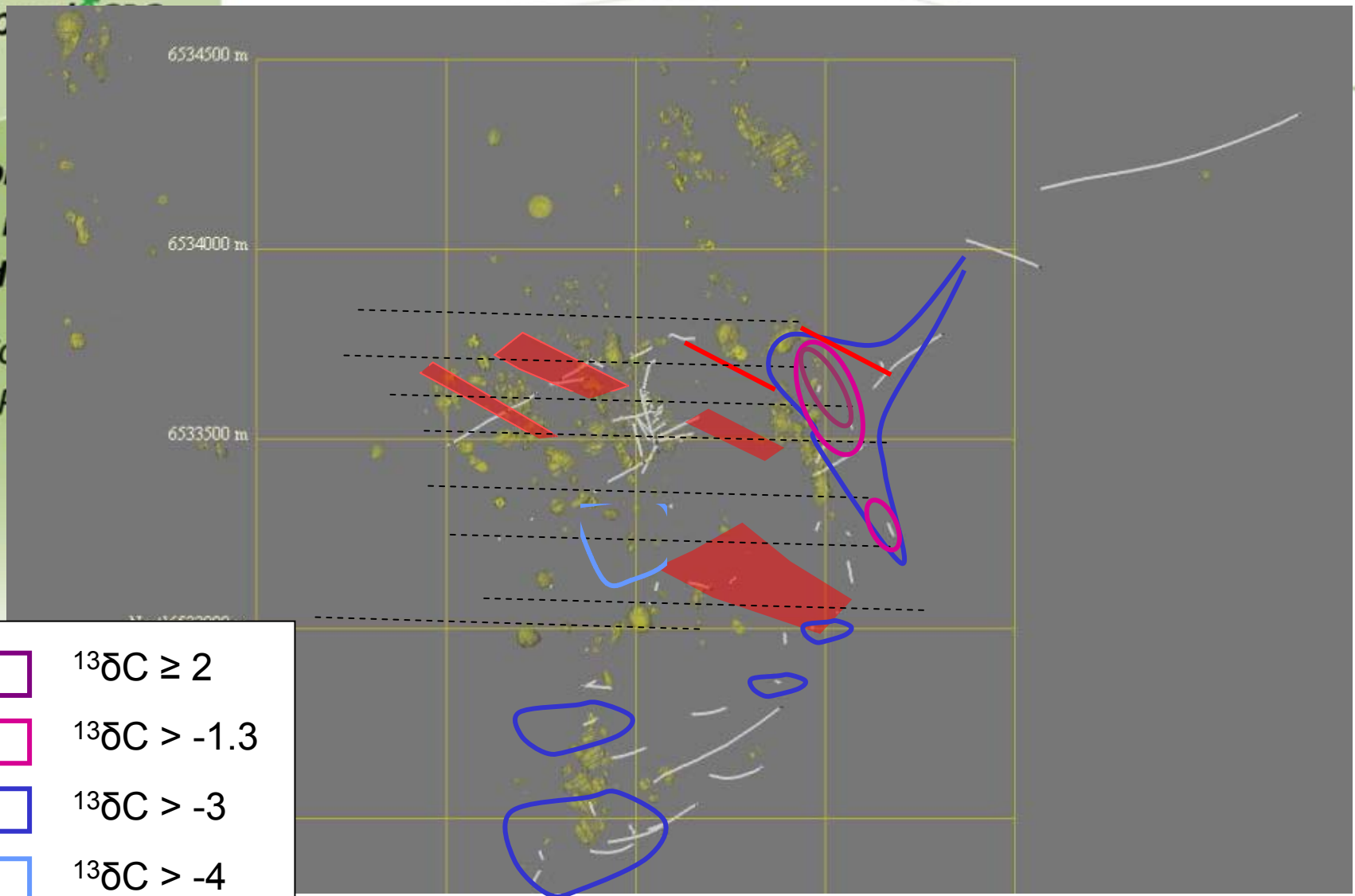
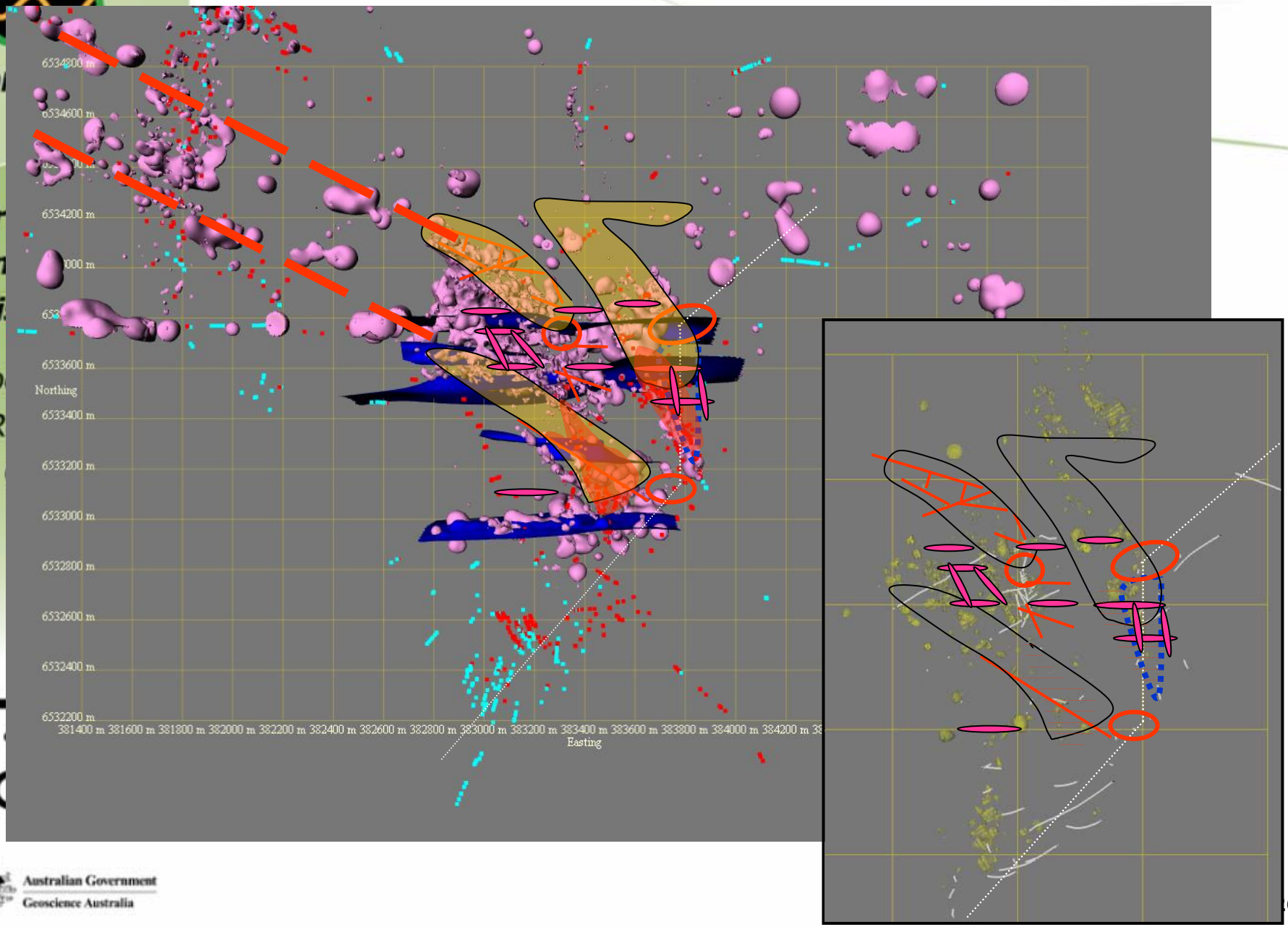

Victory pipes
CD4997
CD1979
CD7084
CD7042
CD1449
CD5026
CD7063
CD6330
CD6024
CD7082
CD5653
CD7068
CD7069
CD6801
CD7070
CD2425
CD6800
NW trend
oxidized
EW trends
reduced
$^{13}\delta C \geq 2$
$^{13}\delta C > -1.3$
$^{13}\delta C > -3$
$^{13}\delta C > -4$
$^{13}\delta C < -5$
500
0
500


6534500 m
6534000 m
6533500 m
$^{13}\delta C \geq 2$
$^{13}\delta C > -1.3$
$^{13}\delta C > -3$
$^{13}\delta C > -4$
$^{13}\delta C < -5$


6534800 m
6534600 m
6534200 m
6533600 m
Northing
6533400 m
6533200 m
6533000 m
6532800 m
6532600 m
6532400 m
6532200 m
381400 m 381600 m 381800 m 382000 m 382200 m 382400 m 382600 m 382800 m 383000 m 383200 m 383400 m 383600 m 383800 m 384000 m 384200 m
Easting

CD4097

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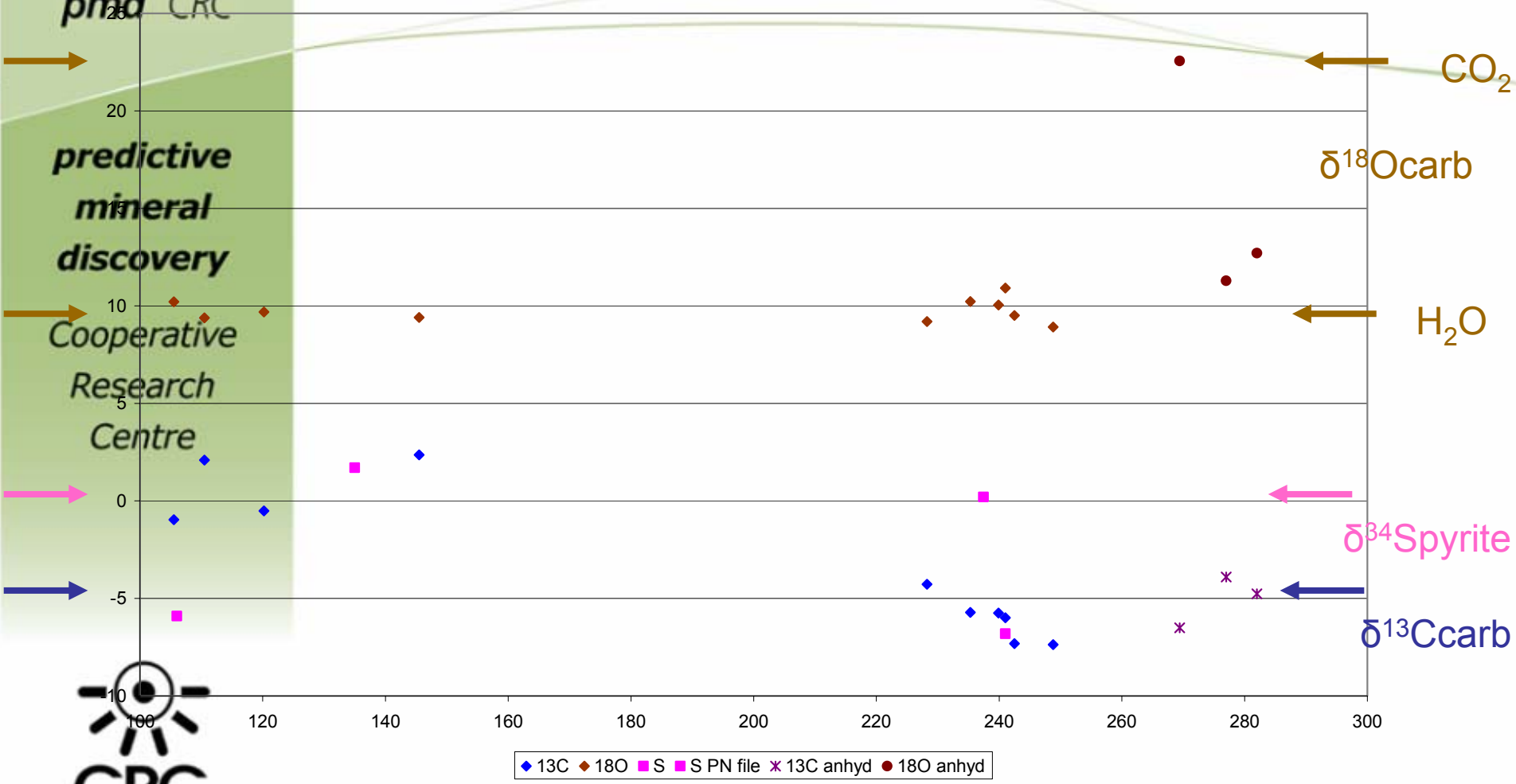

CO_2

δ^{18}Ocarb

H_2O

δ^{34}Spyrite

δ^{13}Ccarb

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CO_2

$\delta^{18}O$

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H_2O

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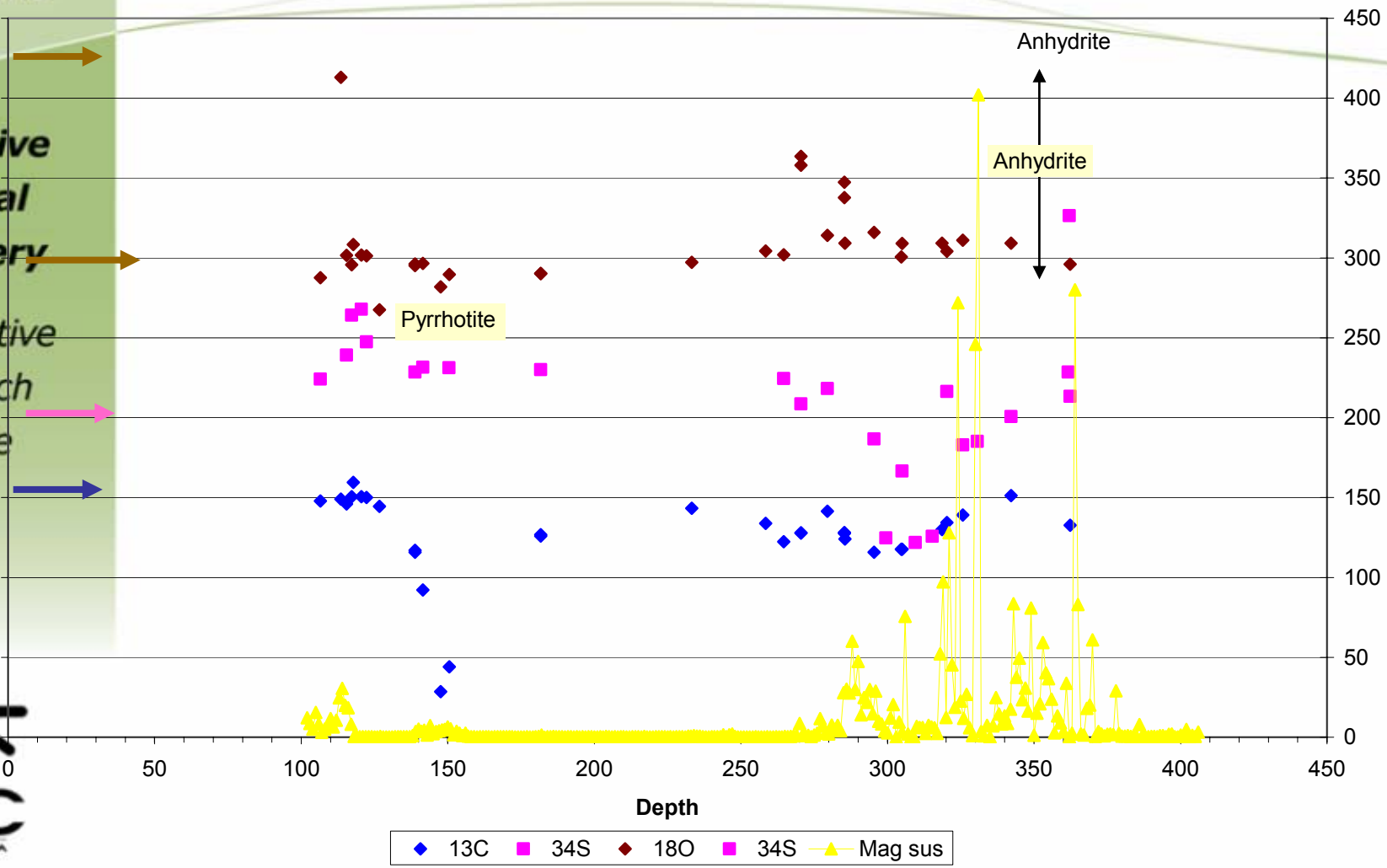
$\delta^{34}S$

$\delta^{13}C$



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Zone of reduction above mineralization /pathway of H_2-CH_4 -fluid

$3CH_4 + 4SO_2 = 3CO_2 + 2H_2O + 4H_2S$

CD5653: Carbonaceous Kapai in switch from oxidized to reduced zone in flat structure

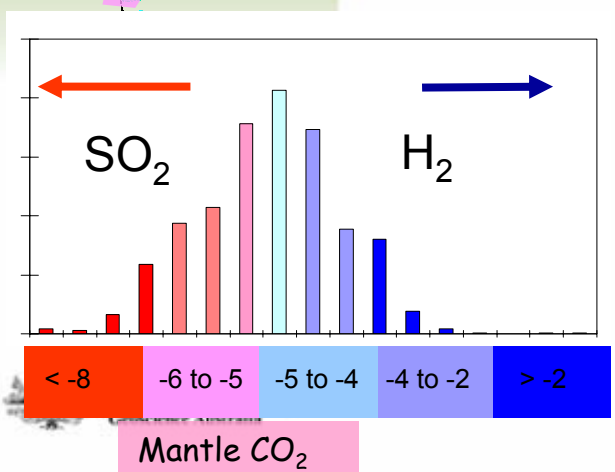
Detectable zone of reduction above East Repulse

Flat structure

East Repulse

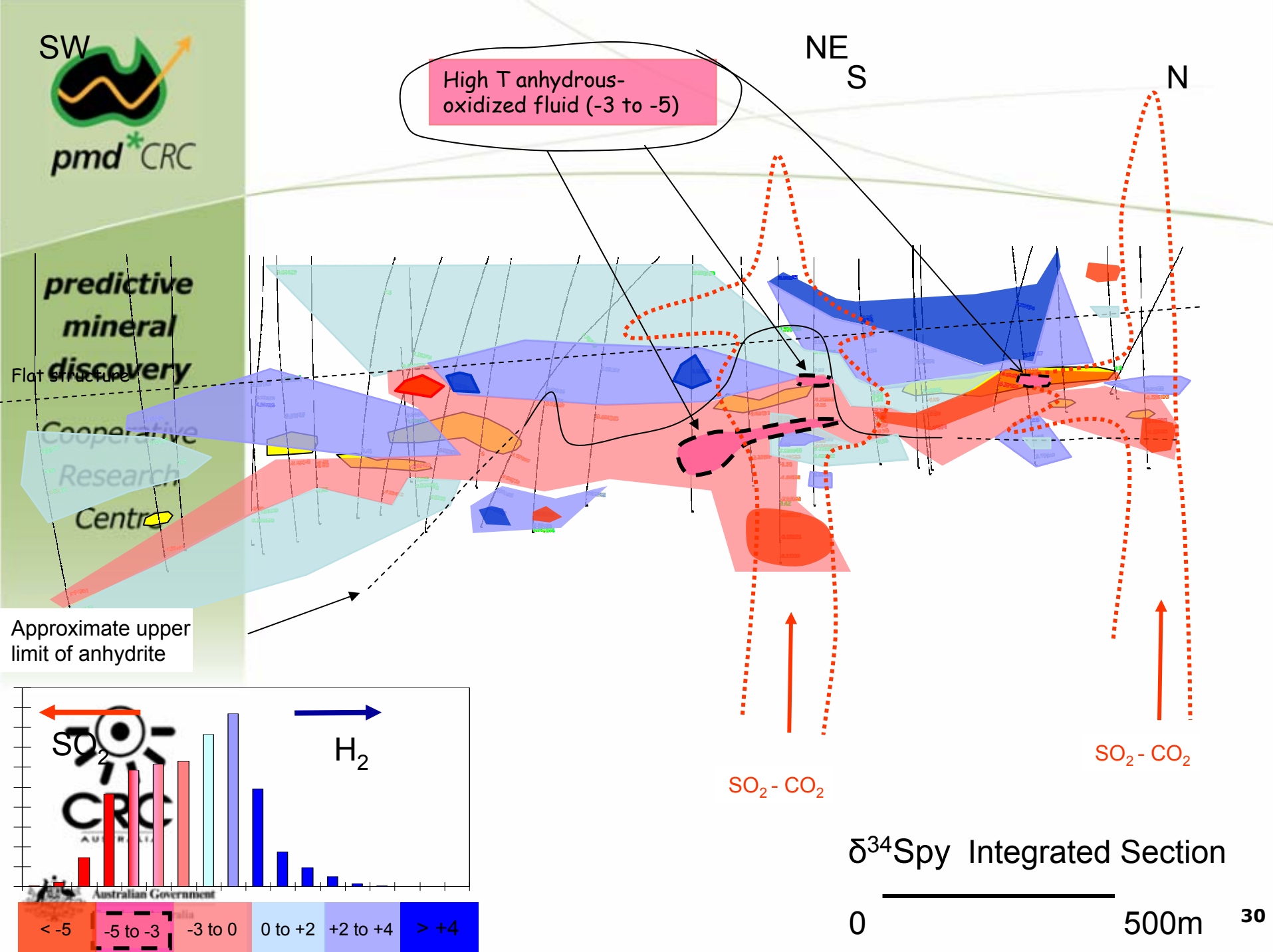
SO_2 - CO_2

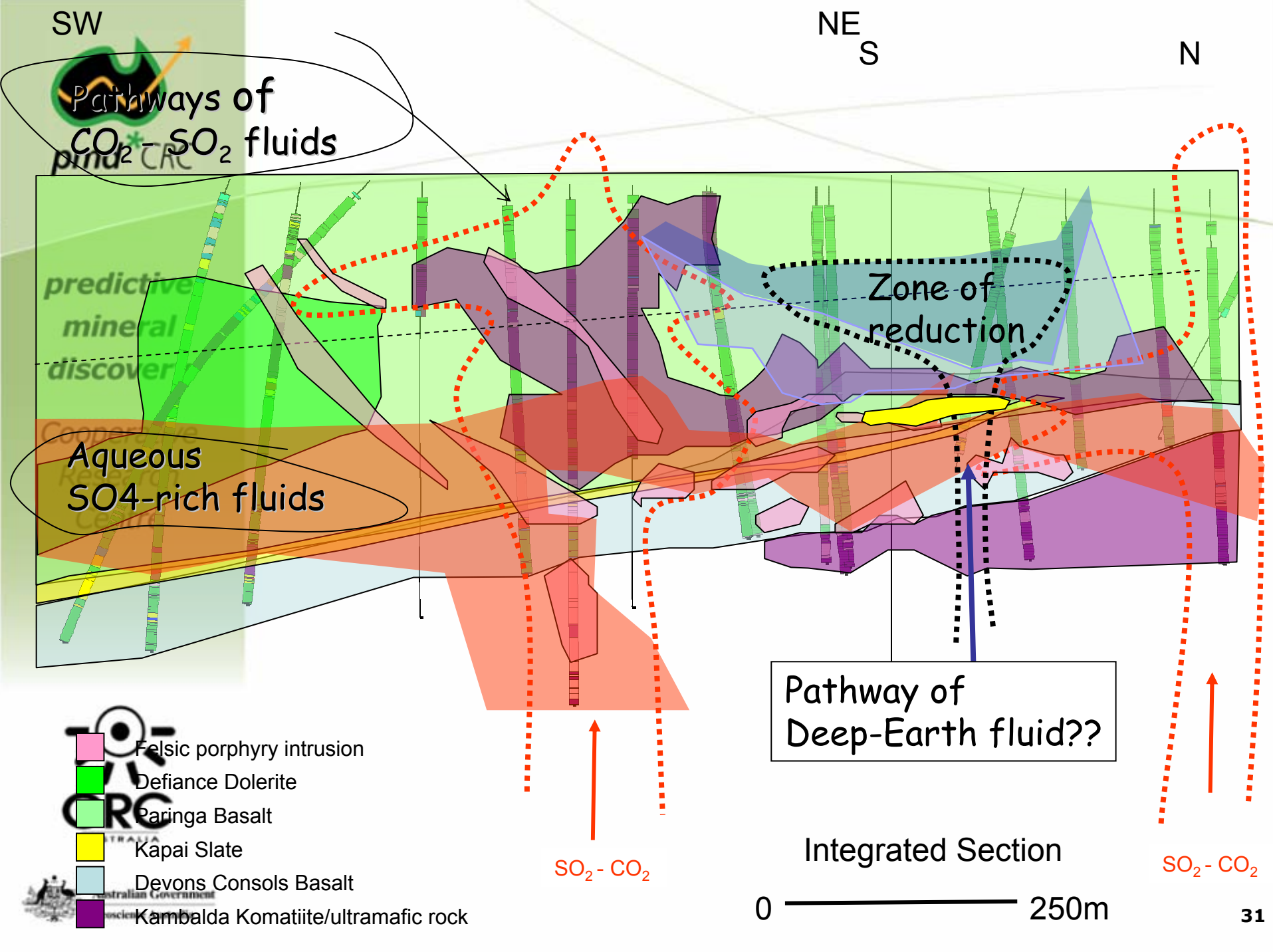
SO_2 - CO_2



$\delta^{13}C$ Integrated Section

0 500m


SW
NE
S
N
High T anhydrous-oxidized fluid (-3 to -5)
predictive mineral discovery
Flat structure
Cooperative Research Centre
Approximate upper limit of anhydrite
SO2 - CO2
SO2 - CO2
SO2
H2
CRC
Australian Government
< -5
-5 to -3
-3 to 0
0 to +2
+2 to +4
> +4
δ34Spy Integrated Section
0
500m


SW
NE
S
N
Pathways of
CO_2 - SO_2 fluids
predictive
mineral
discovery
Cooperative
Research
Centre
Zone of
reduction
Aqueous
SO4-rich fluids
Pathway of
Deep-Earth fluid??
Felsic porphyry intrusion
Defiance Dolerite
Paringa Basalt
Kapai Slate
Devons Consols Basalt
Kambalda Komatiite/ultramafic rock
SO_2 - CO_2
SO_2 - CO_2
Integrated Section
0
250m

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Using structural analysis to predict the location of ore shoots in an extension-related gold system

Richard Blewett and Karol Czarnota

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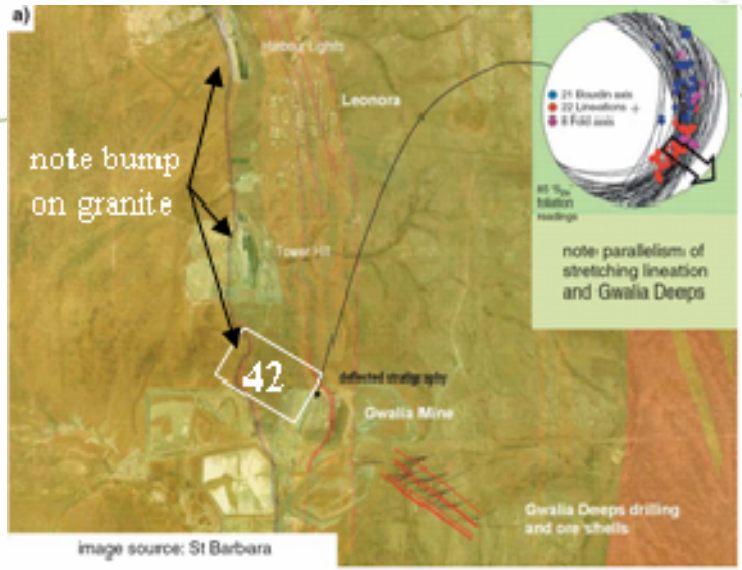
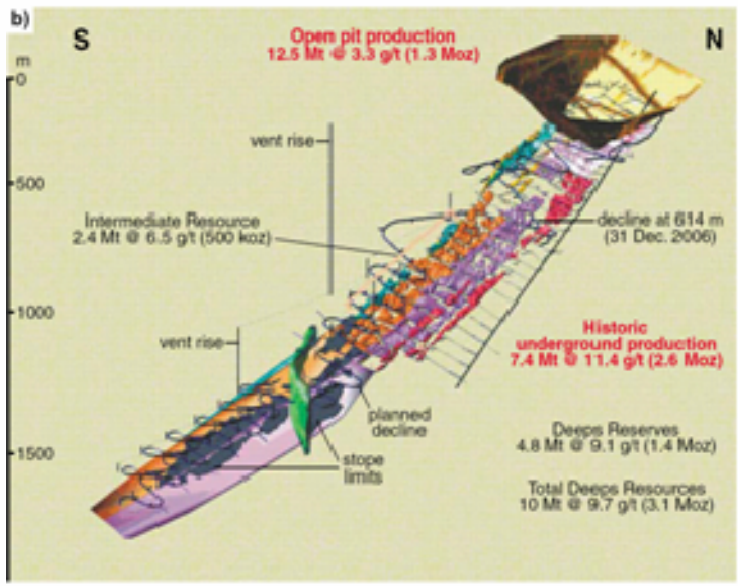
The extensional gold system





Maximum damage case adjacent to big granite dome exhuming old stratigraphy (eg Leonora and Lancefield)

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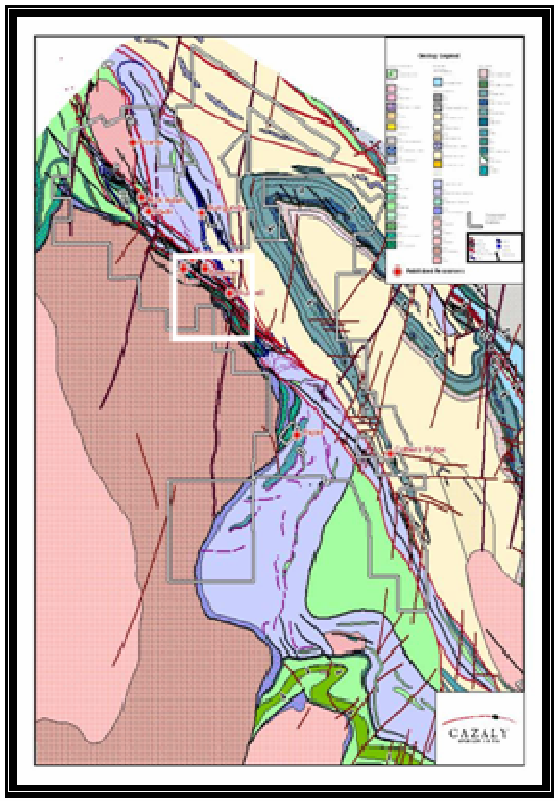
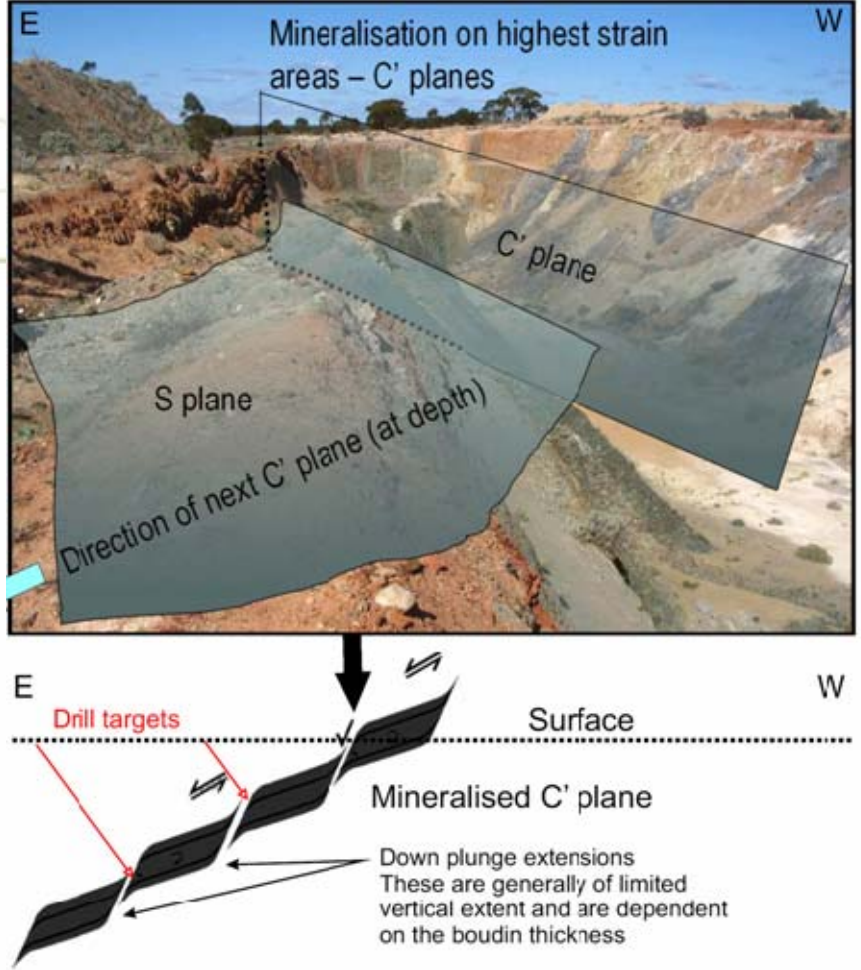
Kunanalling camp

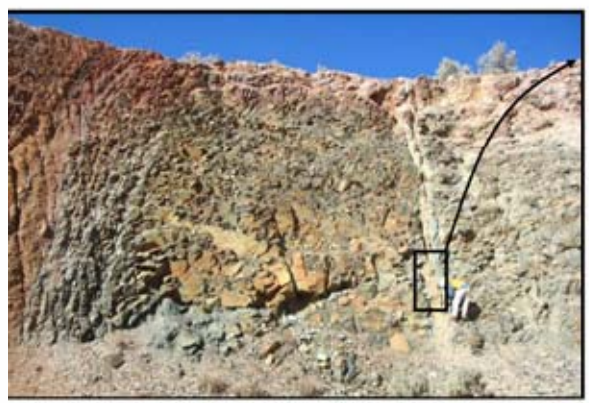


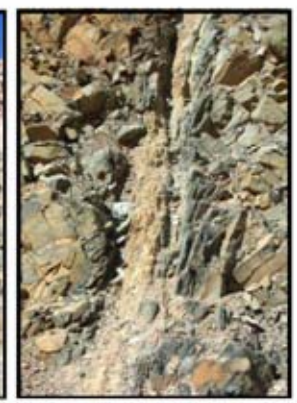
Lower damage case with small granite dome and less excision

Kunanalling camp



Lower damage case with small granite dome and less excision





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1 km x 1 km targeting using spectral (gridded PIMA) data: an example from Kanowna Belle

Simon Van Der Wielen &

John Walshe

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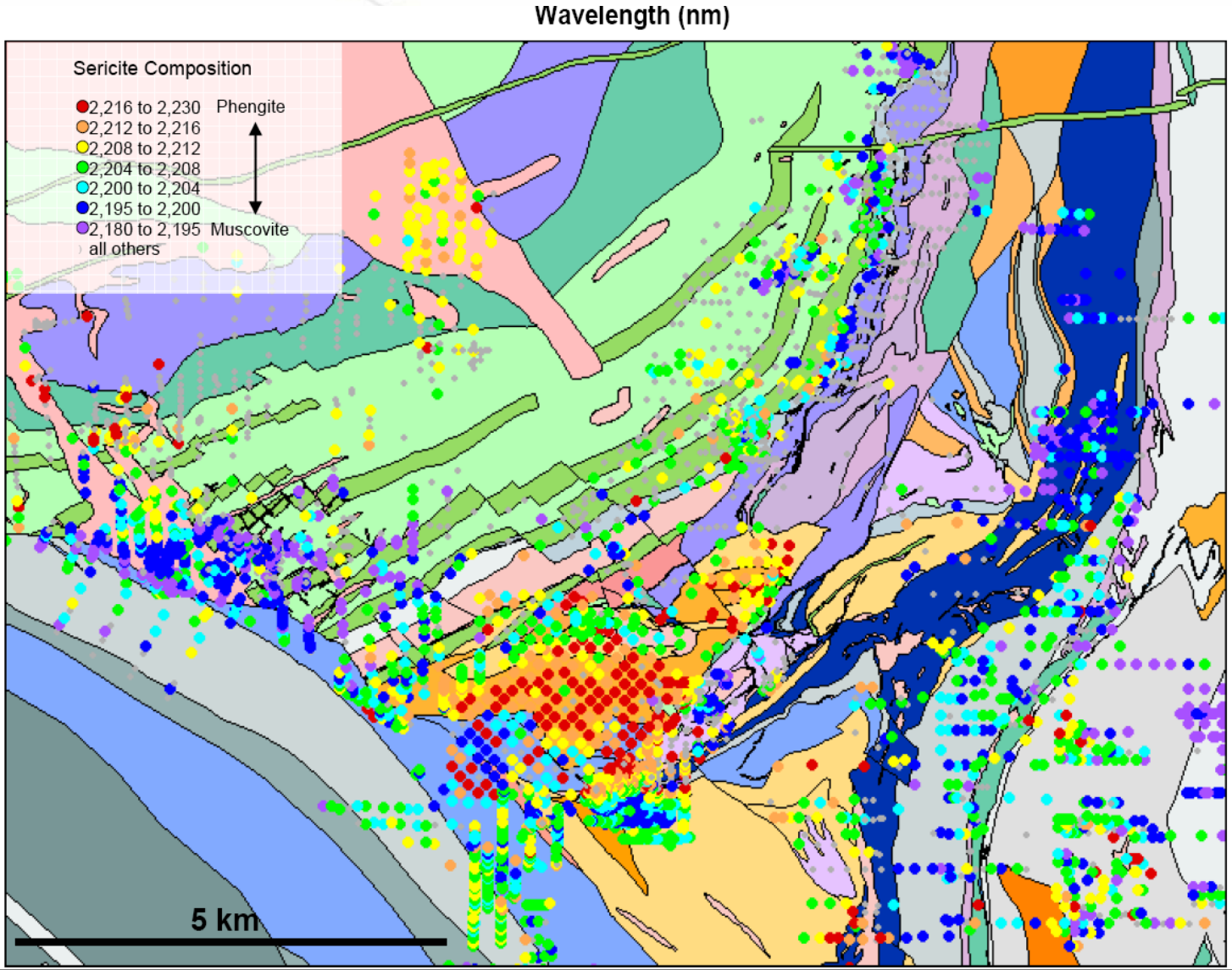

Standard presentation of PIMA-ASD point data – with density sufficient for gridding

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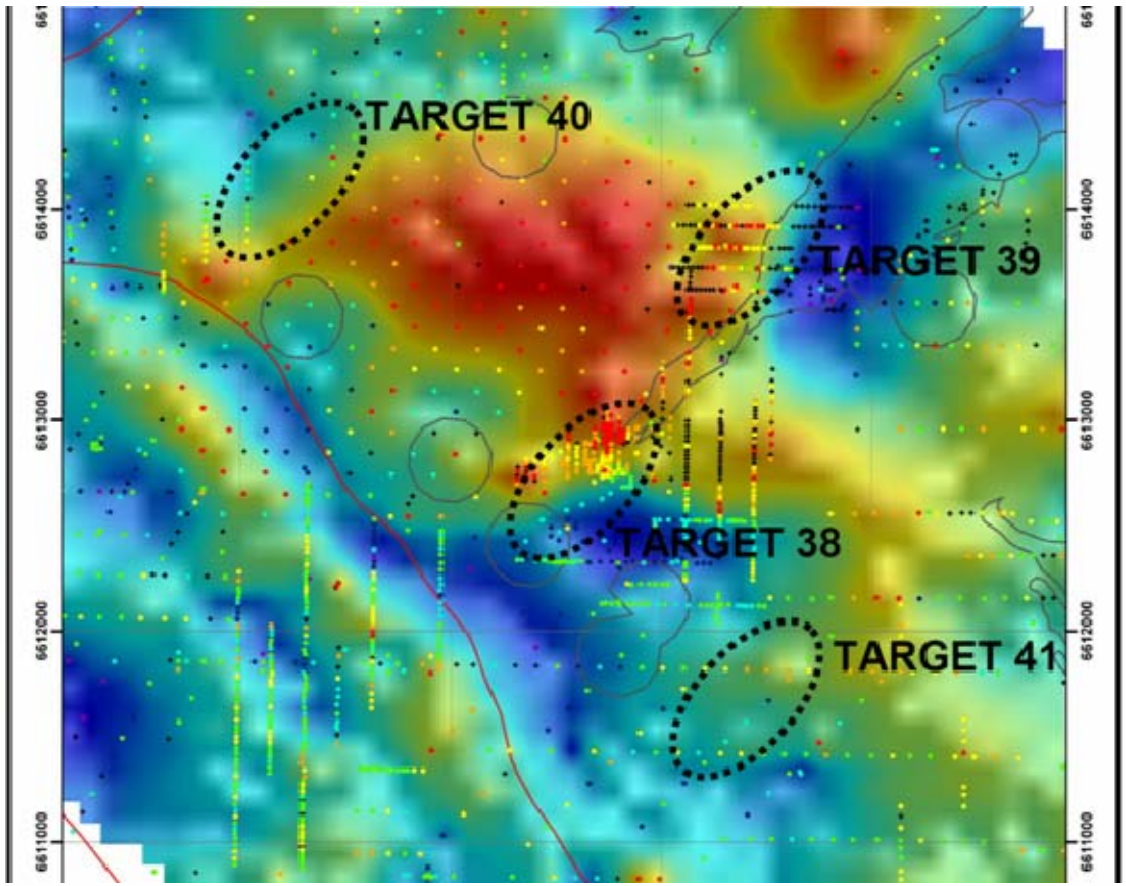
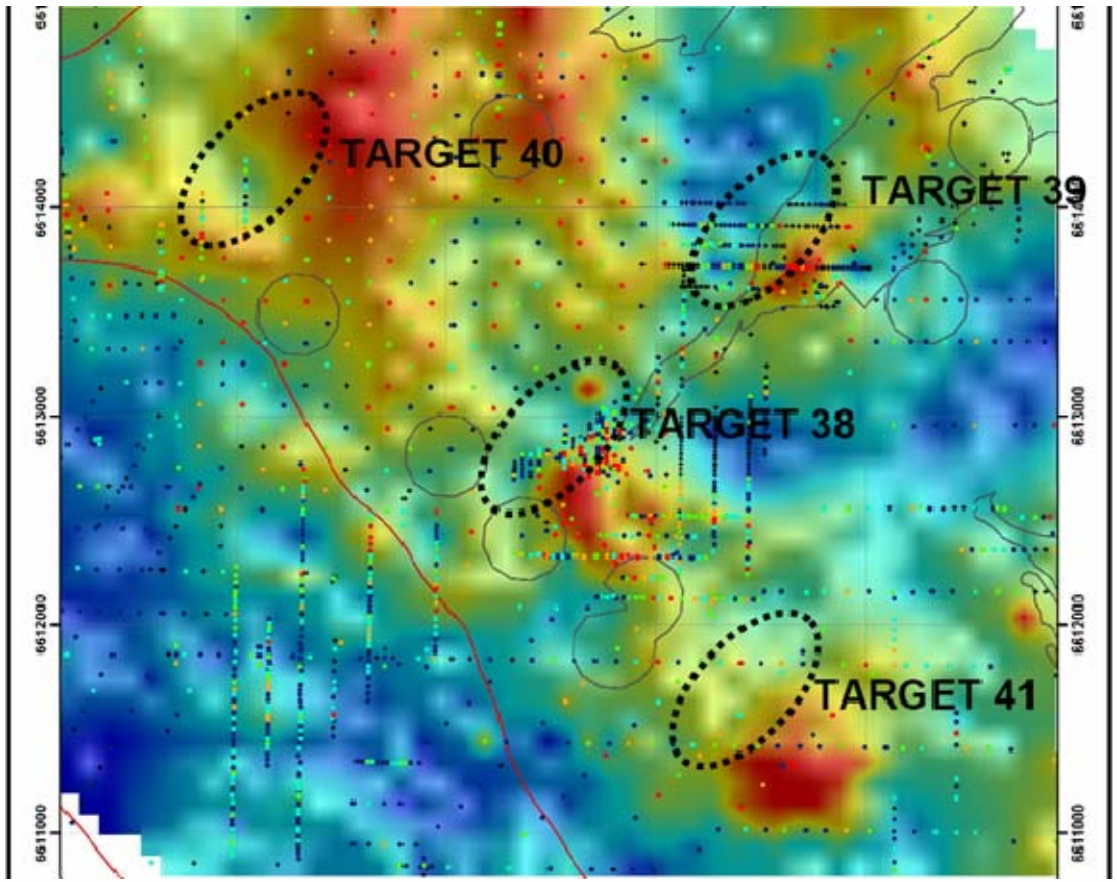
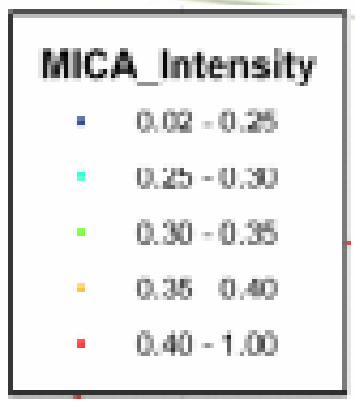
Mica AlOH wavelength



PIMA mica wavelength of the AlOH feature, colour scale – red represents phengitic mica and blue muscovitic mica and coloured points showing the location of PIMA samples.

Mica Intensity





PIMA mica intensity, colour scale – red represents phengitic mica and blue muscovitic mica and coloured points showing the location of PIMA samples.

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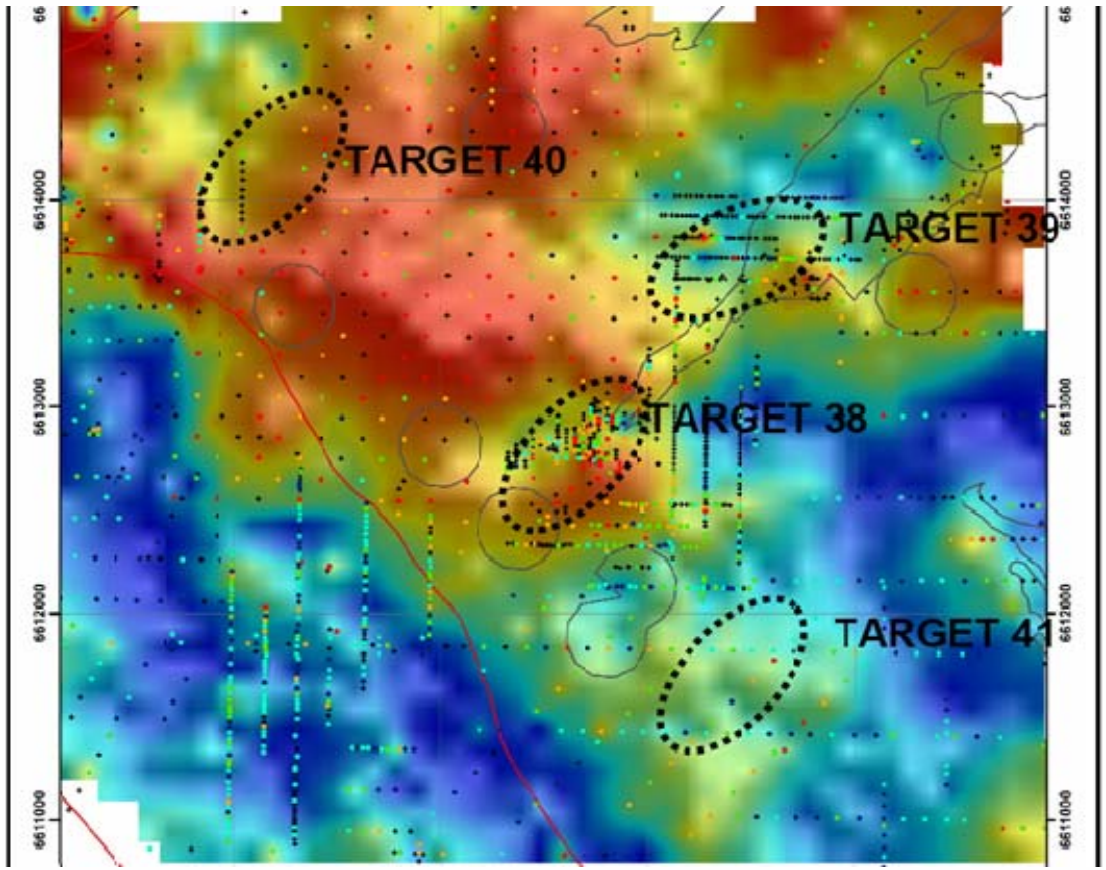
Mica Crystallinity



PIMA mica crystallinity, colour scale – red represents phengitic mica and blue muscovitic mica and coloured points showing the location of PIMA samples.

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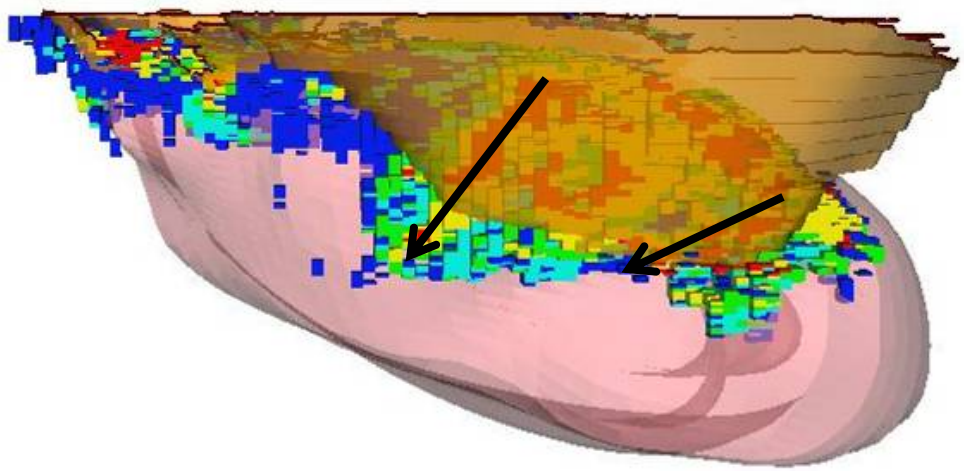
Using computer simulations to predict the location of near mine resources: Tarmoola example

Warren Potma and Heather Sheldon

Australian Government
Geoscience Australia

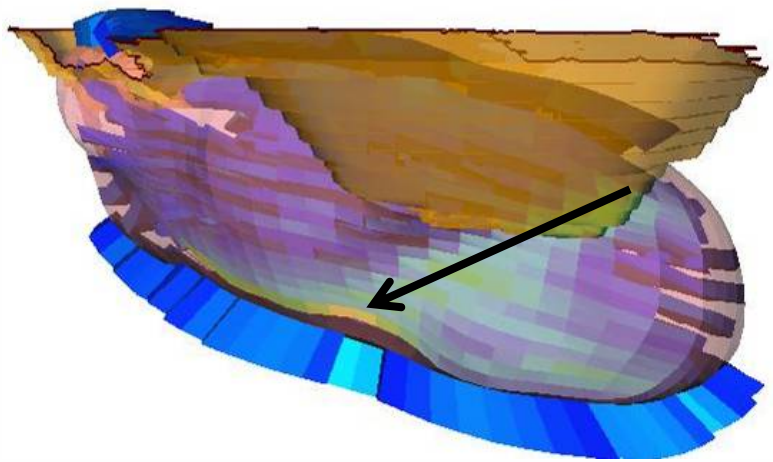
Reverse engineered deposit

Resource Model

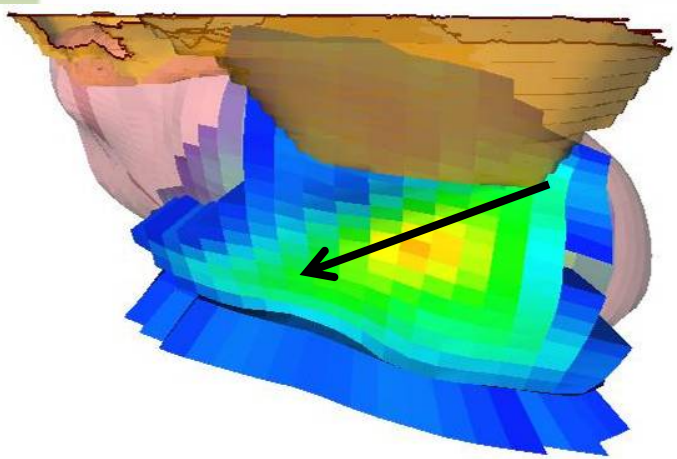


Simulations reproduce observed plunging shoots, extending much deeper than current resource estimates (partially tested, with high grade intercepts encountered)

Numerical model: Dilation

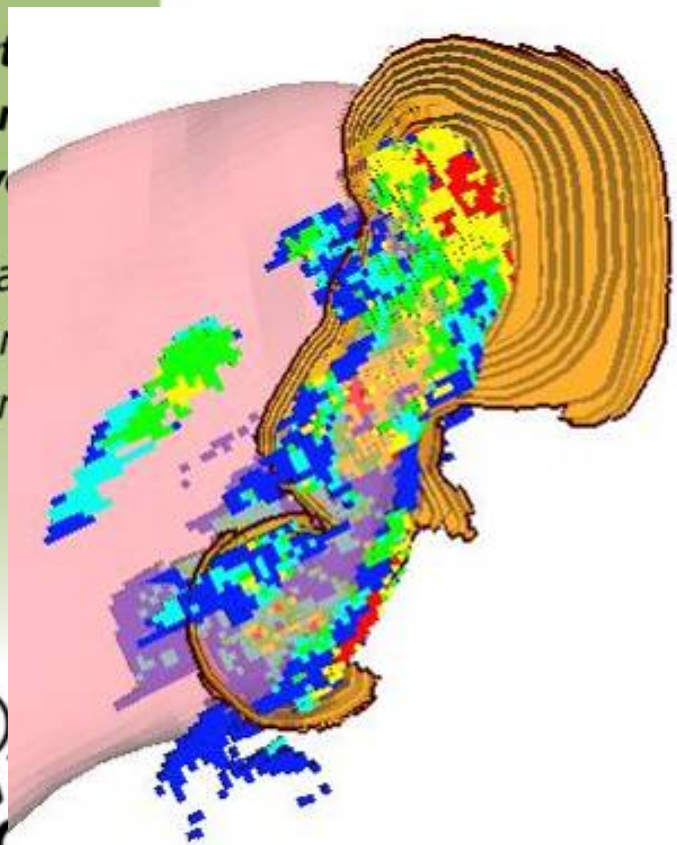


Numerical model: Cumulative Fluid Flux

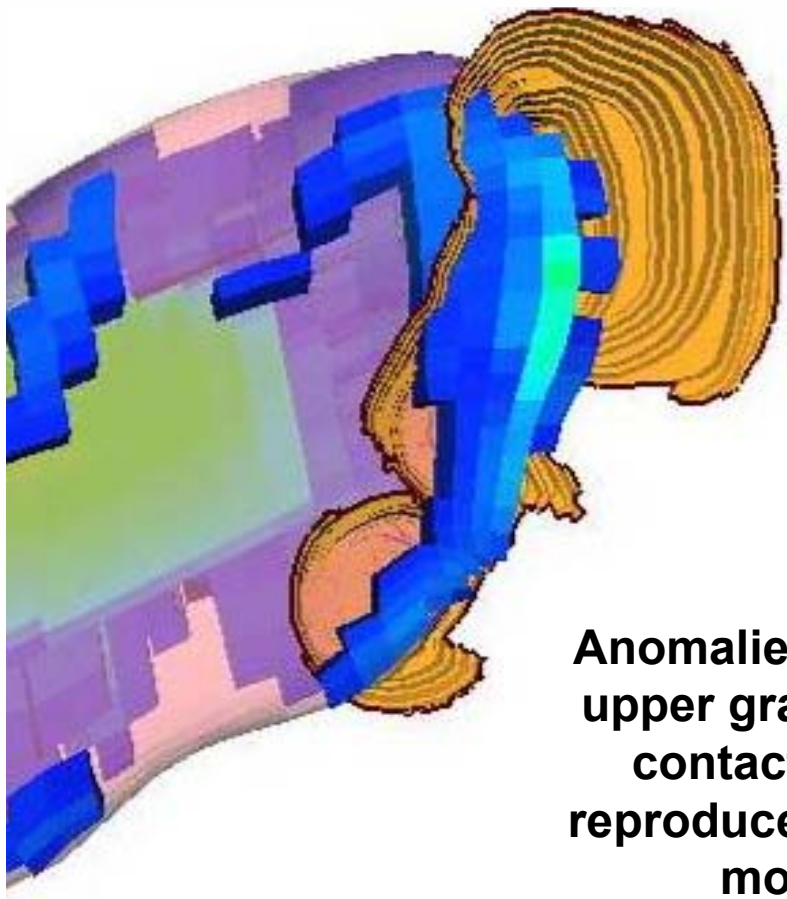


Reverse engineered deposit

Resource Model



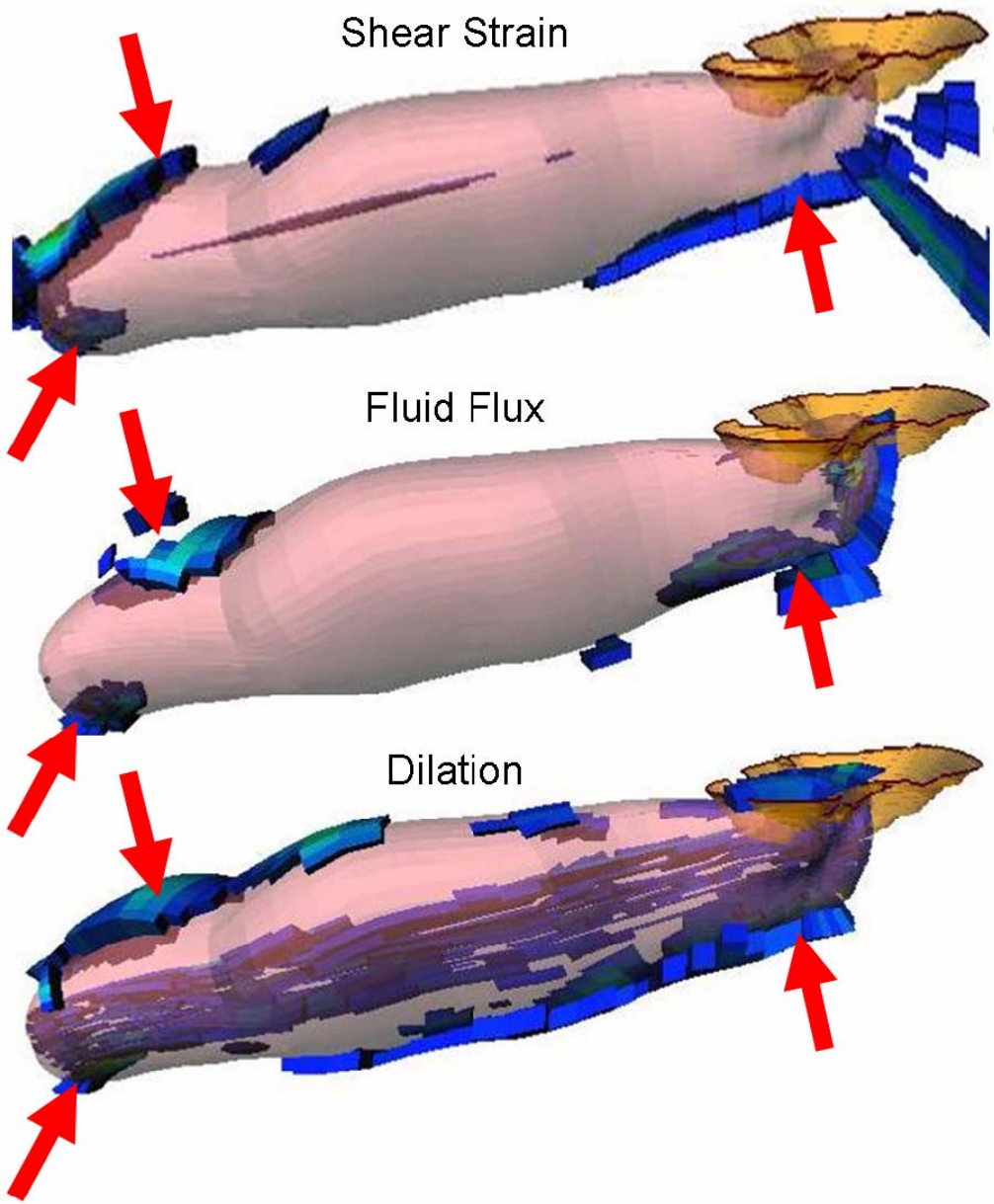
Numerical model: Dilation



Anomalies on upper granite contact are reproduced in models

New targets near mine

3 untested targets represented by coincident modelled anomalies on the margins of the Tarmoola Granodiorite



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New structural targets in Sunrise Dam: adding value to a world-class deposit

Paul Henson and John Miller

Acknowledgements to Mark Doyle and Mike Nugus AngloGold Ashanti

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