

# Integrated Exploration Platform: Software Tools for *Multidata Visualisation* and *Integrated Interpretation*.

*The Centre for Exploration Targeting (CET)*

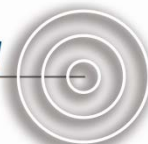
*(Jason C. Wong, Eun-Jung Holden, Peter Kovesi, David Nathan, Daniel Wedge)*

*The Geological Survey of Western Australia (GSWA)*

*(Ian Tyler, Klaus Gessner, Ruth Murdie)*



Centre for **EXPLORATION  
TARGETING**



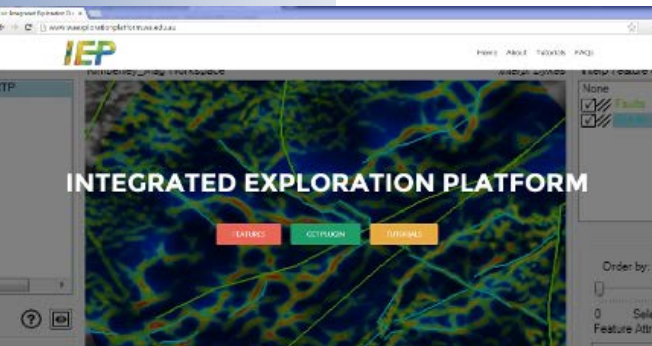
**Geological Survey of  
Western Australia**

# Talk Outline

- i. Launch: Integrated Exploration Platform.
- ii. Overview of the IEP.
  - Multidata Visualisation Tools
  - Feature Evidence Feedback Tools
- iii. ArcGIS Workflow with the IEP.
- iv. On-going Work.
- v. Questions.

# The Launch of the IEP

## First Public Version - Free



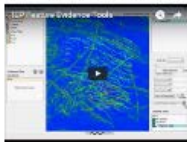
The Integrated Exploration Platform (IEP) is a GIS-based data analytics platform (for ArcGIS) to support mineral explorers operating in Western Australia. The IEP has been built to facilitate an interpreter-driven and computer-assisted approach, to address the challenge of deriving a single coherent interpretation from multiple sources of data, in the presence of uncertainty and human bias.

### PLATFORM FEATURES

Empower mineral explorers in WA with state-of-the-art data analytics to maximise geological insight from GSWA data.

#### Interpretation Support Tools

The IEP utilises image analysis algorithms for feature instance evaluation for statistical interpretation of raster data. Using automated edge, ridge and valley feature extraction algorithms, the IEP produces a number of feature change maps as a representation of feature evolution. The feature evolution model is used to generate a series of feature change maps, and is presented in a series of maps, and is presented in a series of maps.



#### Interactive Multi-Data Visualisation Tools

The IEP visualisation tools use an interactive blending paradigm, simultaneously using multiple datasets, to better facilitate the interpretation of complex information from multiple data sources. A range of different multi-layered blending tools are designed to support different types of data, including 2D data, 3D data, and 4D data.



### REGISTRATION

Please visit the below website to register your interest in the IEP. This free version of the IEP is only for non-commercial use within Western Australia. Please also complete the IEP User Agreement.

- The first public version of the *IEP* is available today <http://www.WAExplorationPlatform.com> (Geolocked to datasets within WA).
- Software toolset for ArcGIS with a novel **computer-assisted and interpreter-driven** approach to integrated multidata interpretation.
- Will continue to evolve based on industry feedback and suggestions, in order to continue in adapting to the needs of the industry.

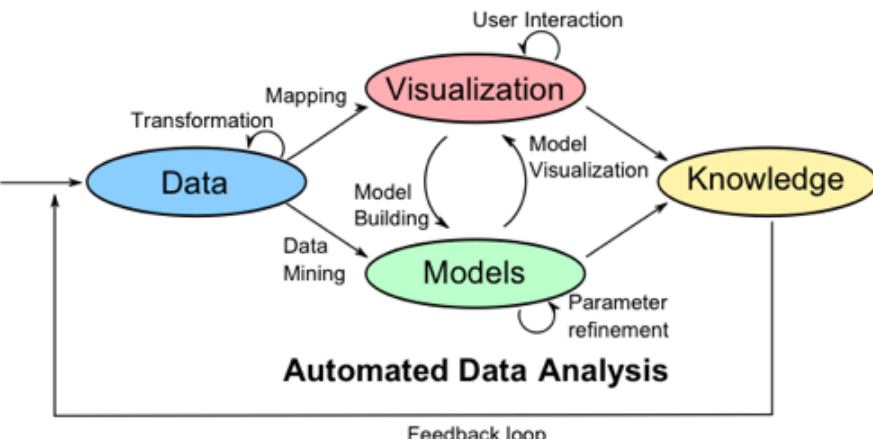
Sponsored by the *Geological Survey of WA (GSWA)* in the *Exploration Incentive Scheme (EIS)*, and *Australian Research Council (ARC) linkage grant (LP140100267)*.

# The Integrated Exploration Platform

1. *Visualisation tools to support multiple 2D and 3D data (A suite of blenders).*

2. *Intelligent interpretation support tools (feature evidence toward quantifying confidence).*

## Visual Data Exploration



Thomas, J., Cook, K.:

*Illuminating the Path: Research and Development Agenda for Visual Analytics. IEEE-Press (2005)*

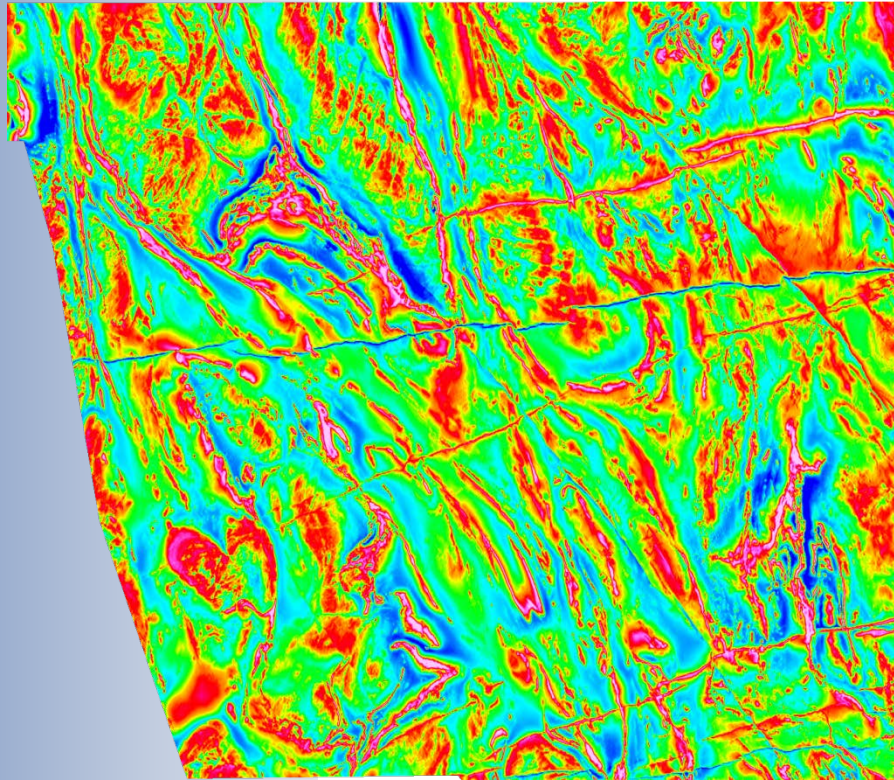
# Multidata Visualisation Tools

1. Human perception sensitive **colour maps**
  - Reduce bias from the human visual system.
2. The Dynamic Range Compression **filter**
  - High pass filtering and data range compression for enhanced display of high-dynamic-range data.
3. A suite of **blending tools**
  - Interactive visualisation of multiple layers of data simultaneously.

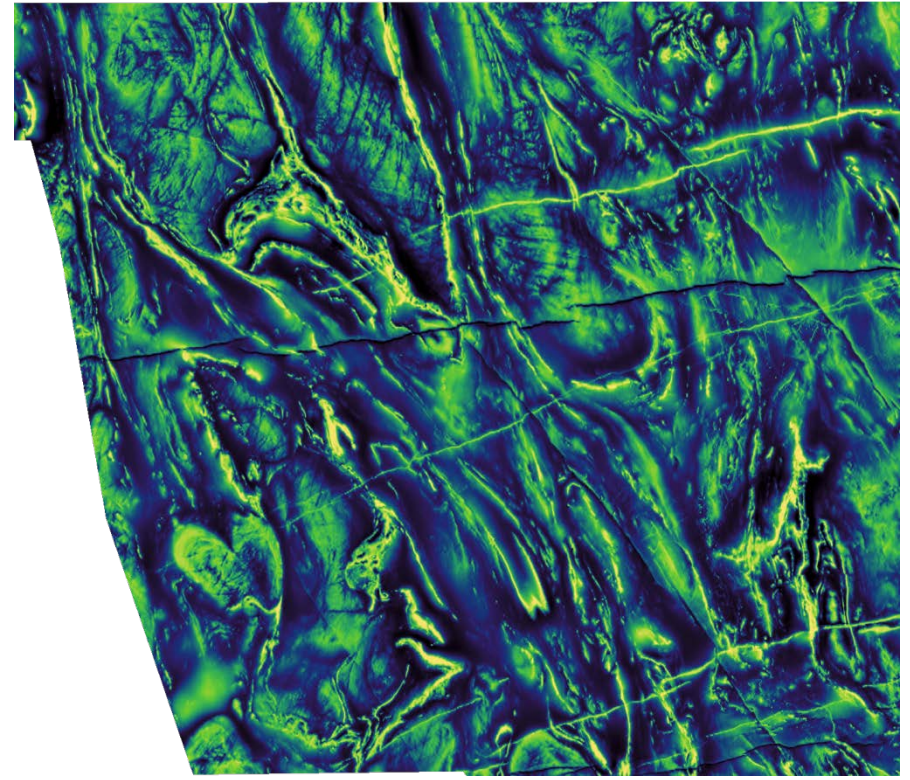


# 1. Visualisation Tools in the IEP

## *Human Perception Sensitive Colour Maps*



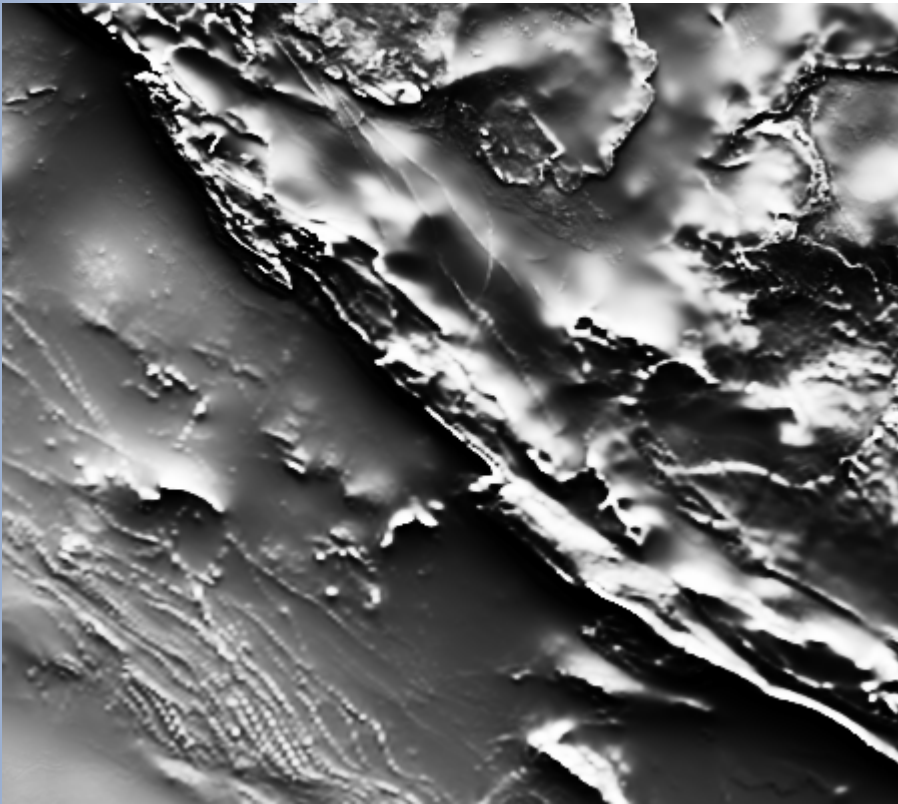
A default rainbow colour map



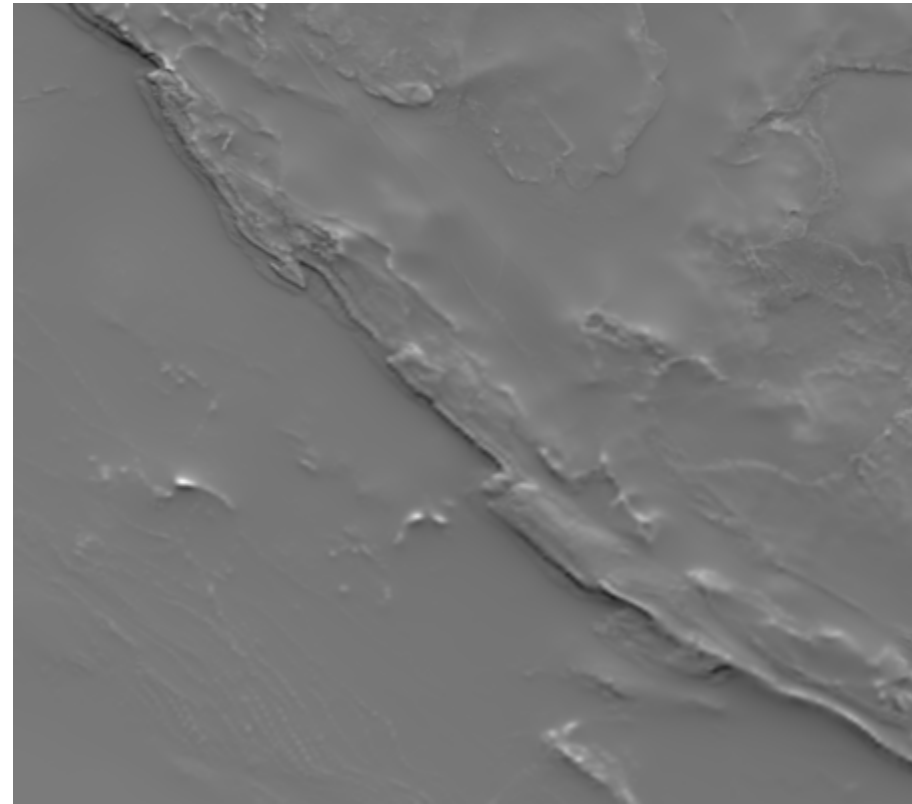
Vs Perceptually uniform map

## 2. Visualisation: Working with Signal Compression

- Geophysical data (e.g. magnetic data), can have a large range of values that cannot be displayed natively on computer screens – *Signal Compression*.



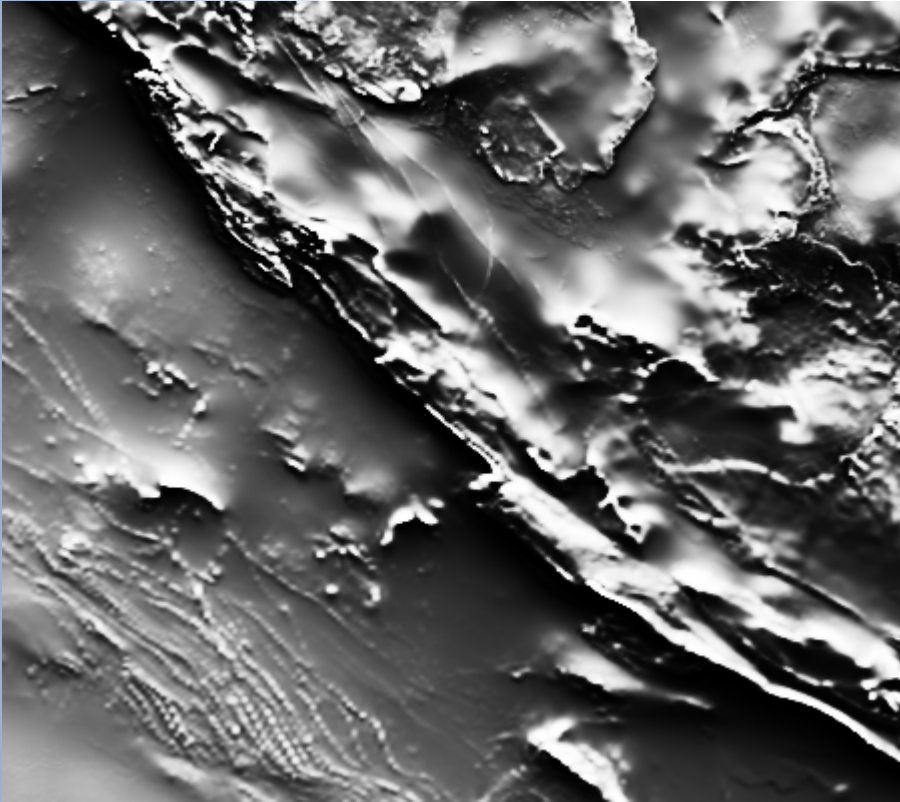
Histogram Equalisation



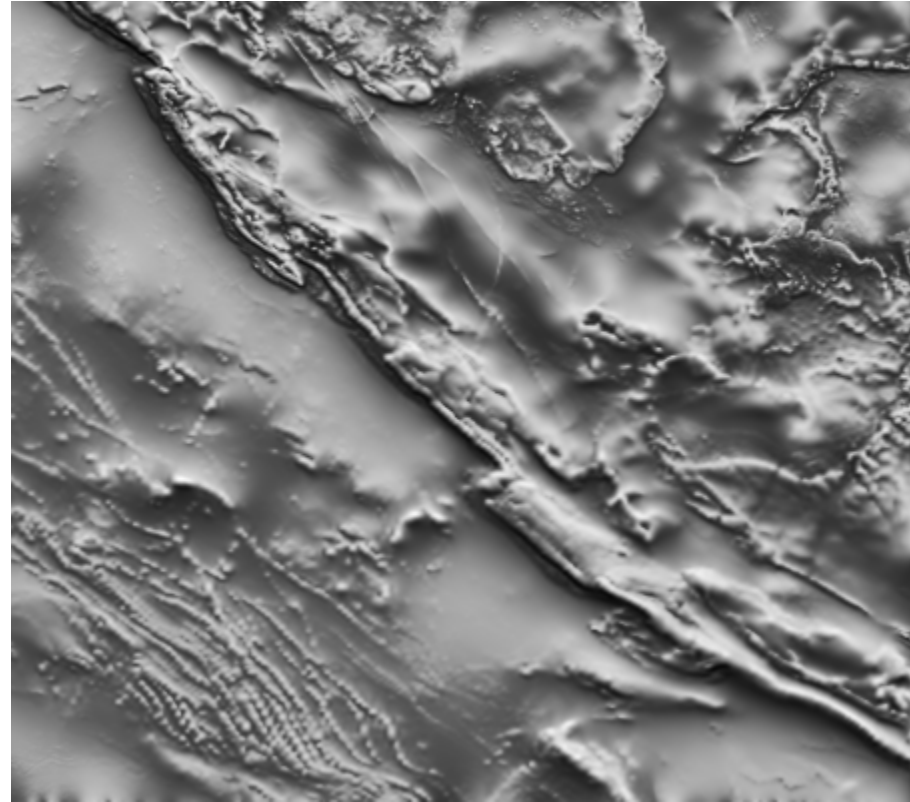
Linear Normalisation



## 2. Visualisation: Working with Signal Compression

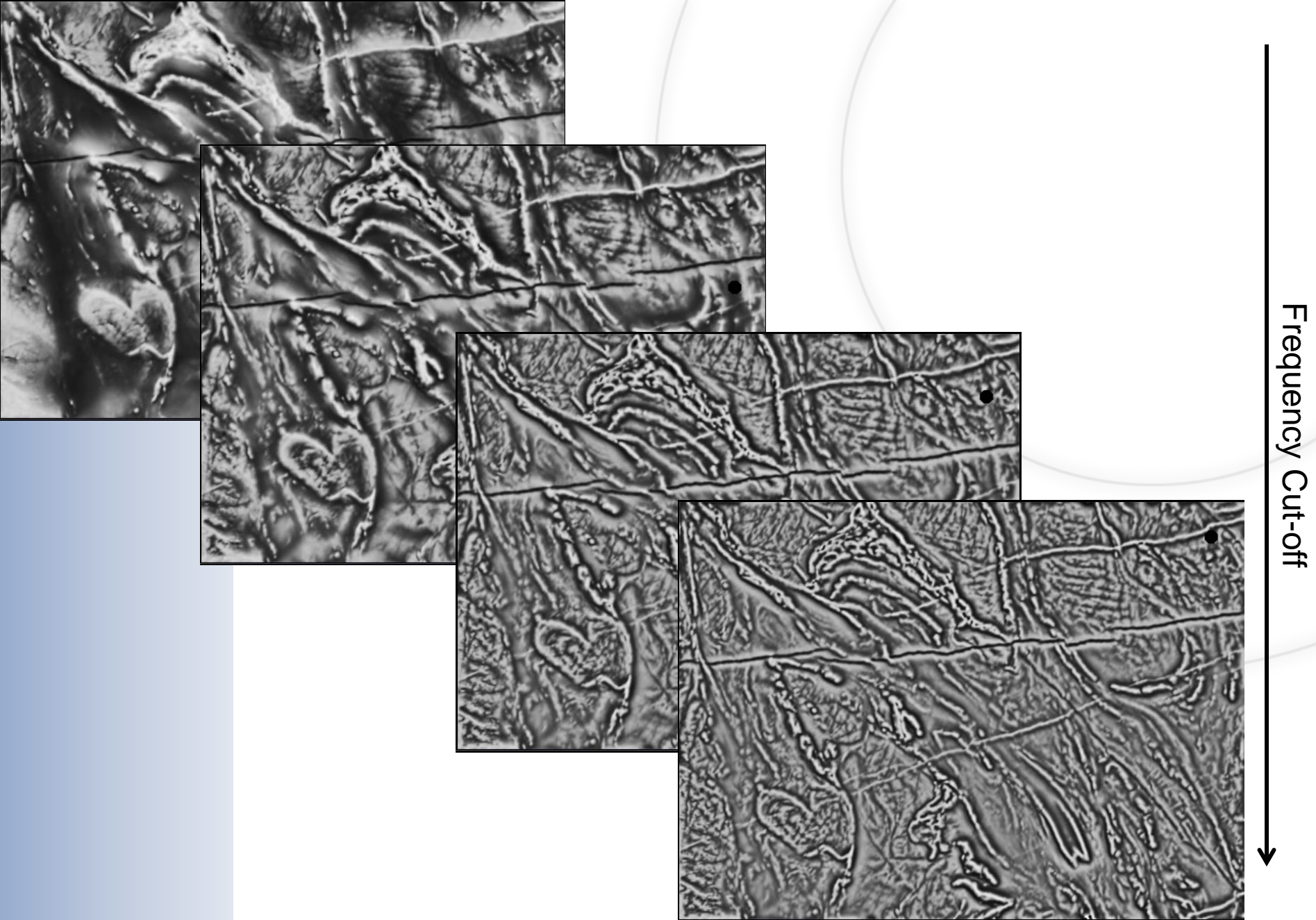


Histogram Equalisation



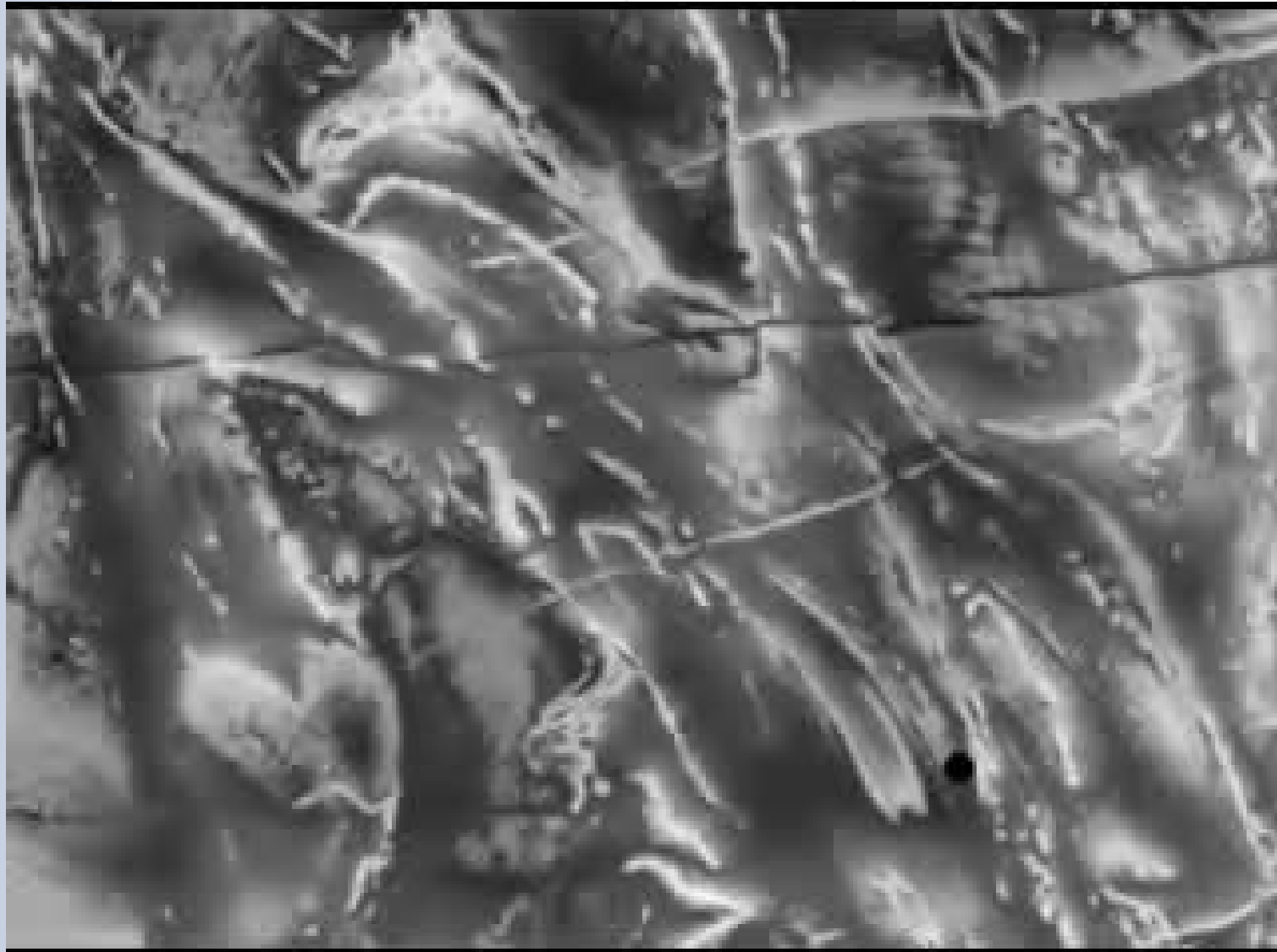
Dynamic Range Compression  
(Kovesi, P. 2012)





### 3. Visualisation Tools in the IEP

#### *Blending DRC Filter Results*



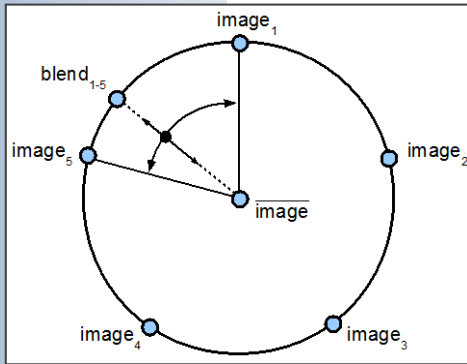
Gravity Data

Magnetic data courtesy of Fugro Airborne Surveys Pty Ltd.

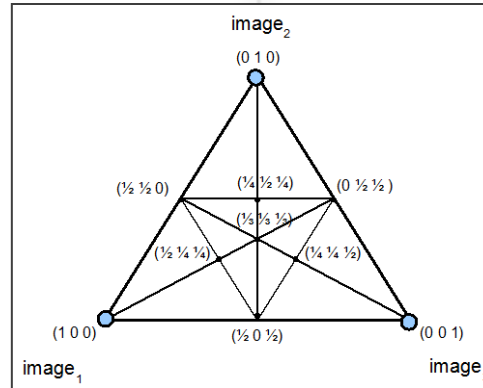
Magnetic Data

# 3. Visualisation Tools in the IEP

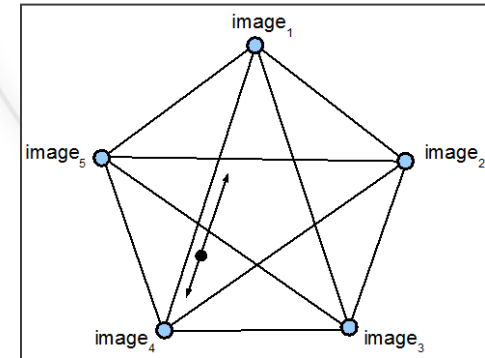
## 2D Data Blenders



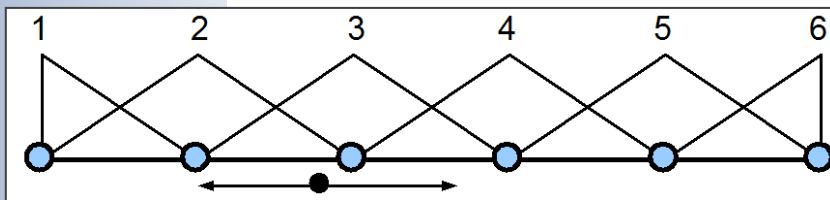
Circle Blender



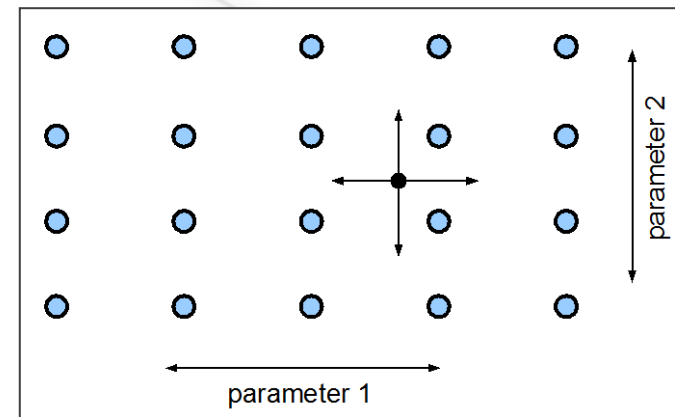
Barycentric Triangle Blender



Clique Blender

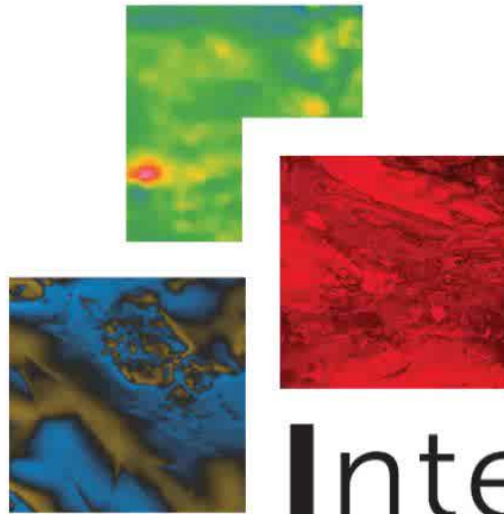


Linear Blender



Bilinear Blender

# 3. IEP 2D Data Blenders



## Integrated Exploration Platform



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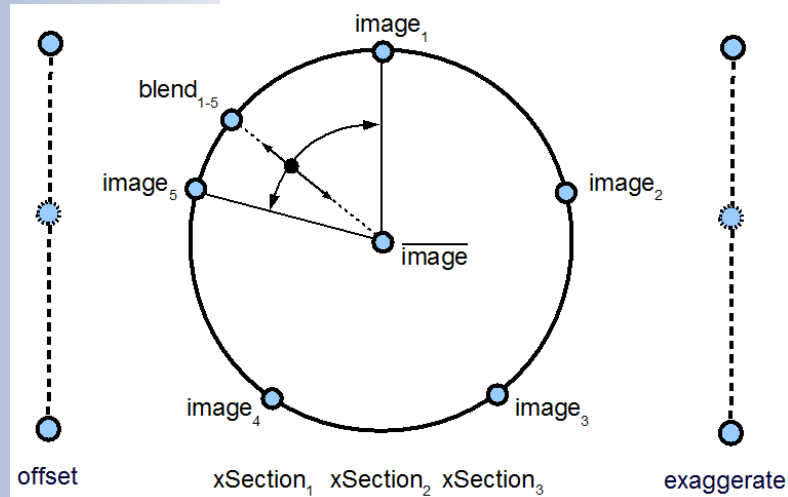


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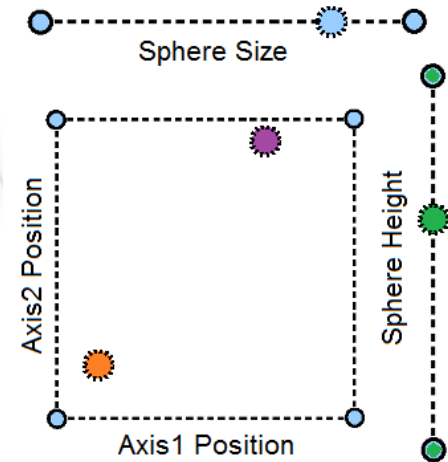


# 3. Visualisation Tools in the IEP

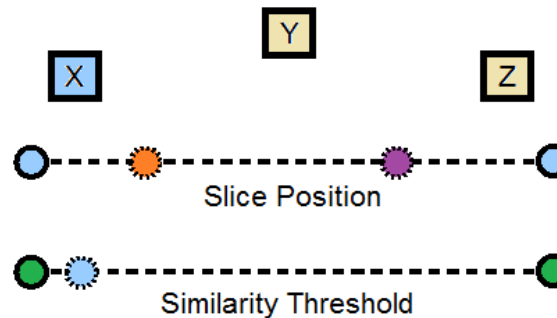
## 3D Data Blenders



Cross-section Data Blender

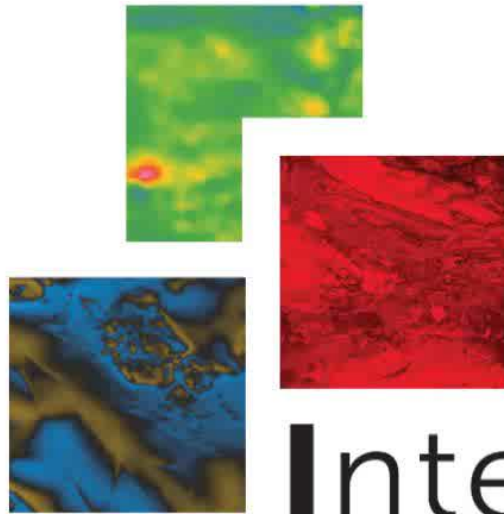


Single Volume Blender:  
Sphere Data Mode



Dual Volume Blender:  
Slice Similarity Mode

# 3. IEP 3D Data Blenders



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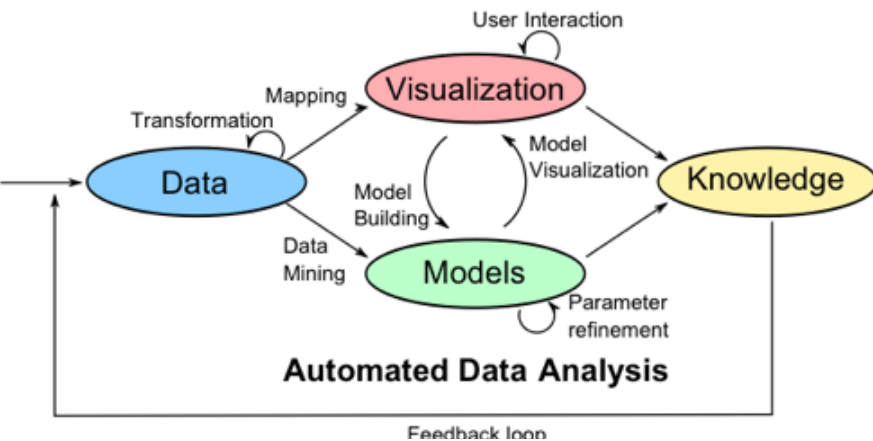
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# The Integrated Exploration Platform

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2. *Intelligent interpretation support tools (feature evidence toward quantifying confidence).*

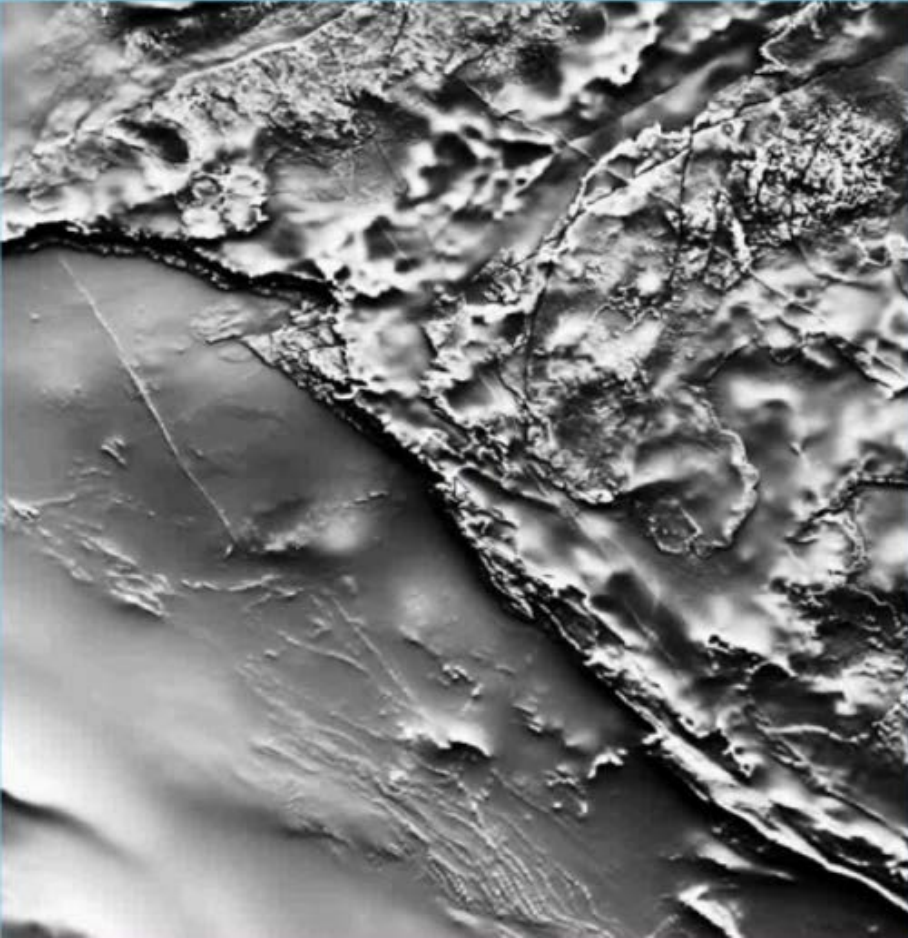
## Visual Data Exploration



Thomas, J., Cook, K.:

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# Structural Interpretation of Magnetic Data

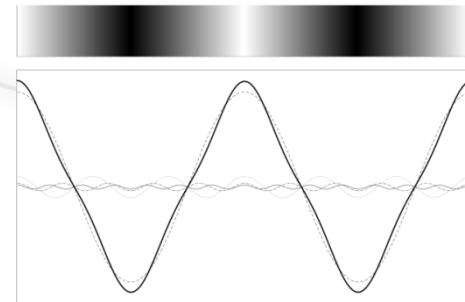


GSWA magnetic data (RTP-DRC) from West Kimberley

- For structural interpretation, interpreter seeks discontinuities (edges, ridges, valleys).



Edge Signal

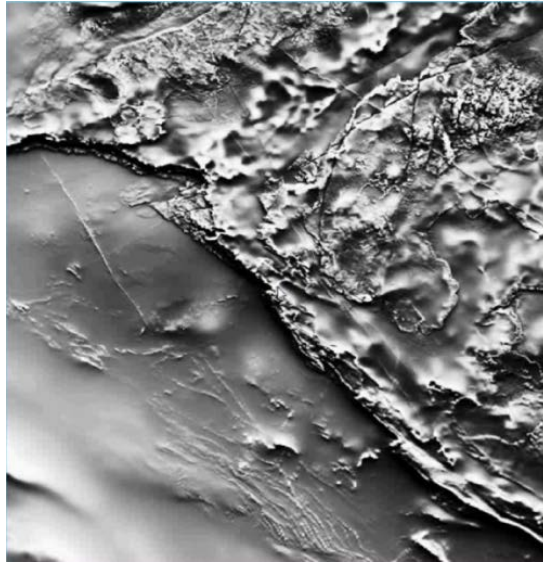


Valley/Ridge Signal

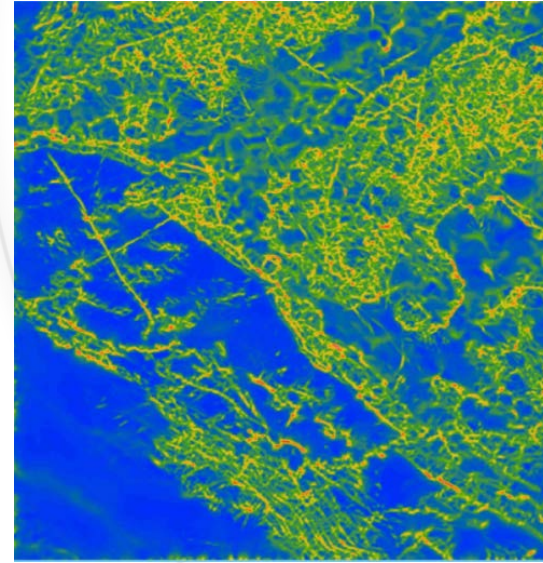


# Feature Evidence Tools in the IEP

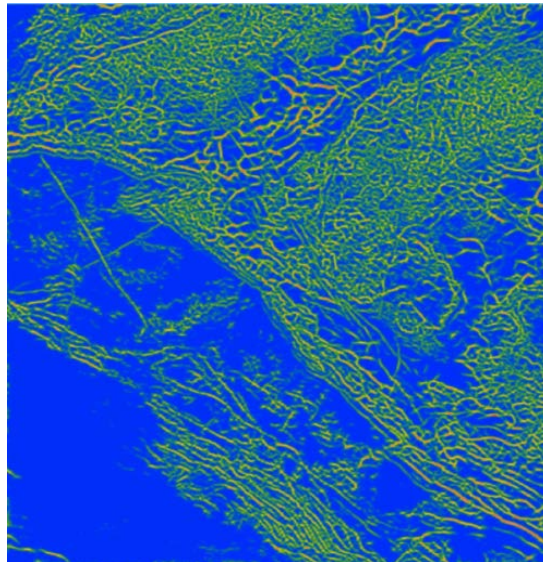
Magnetic data



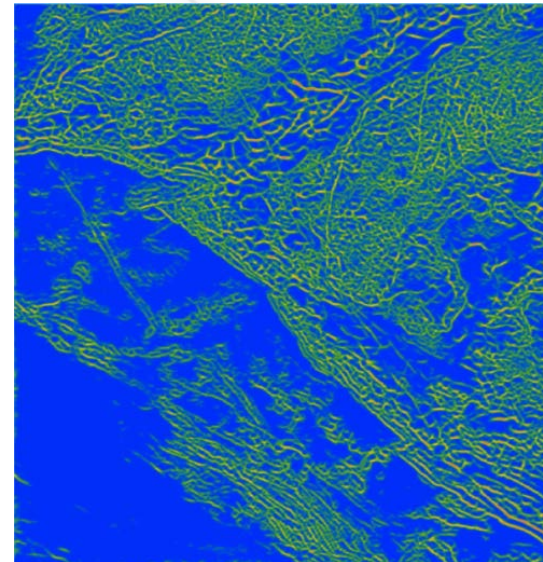
Edge strength map  
(Phase Congruency)



Ridge strength map  
(+ve Phase Symmetry)



Valley strength map  
(-ve Phase Symmetry)

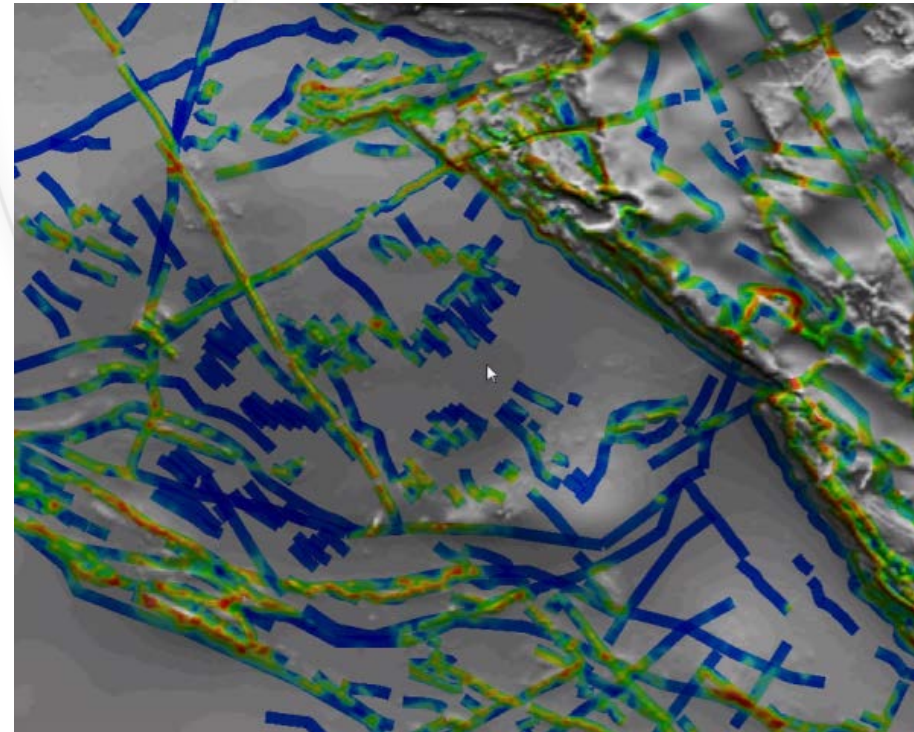
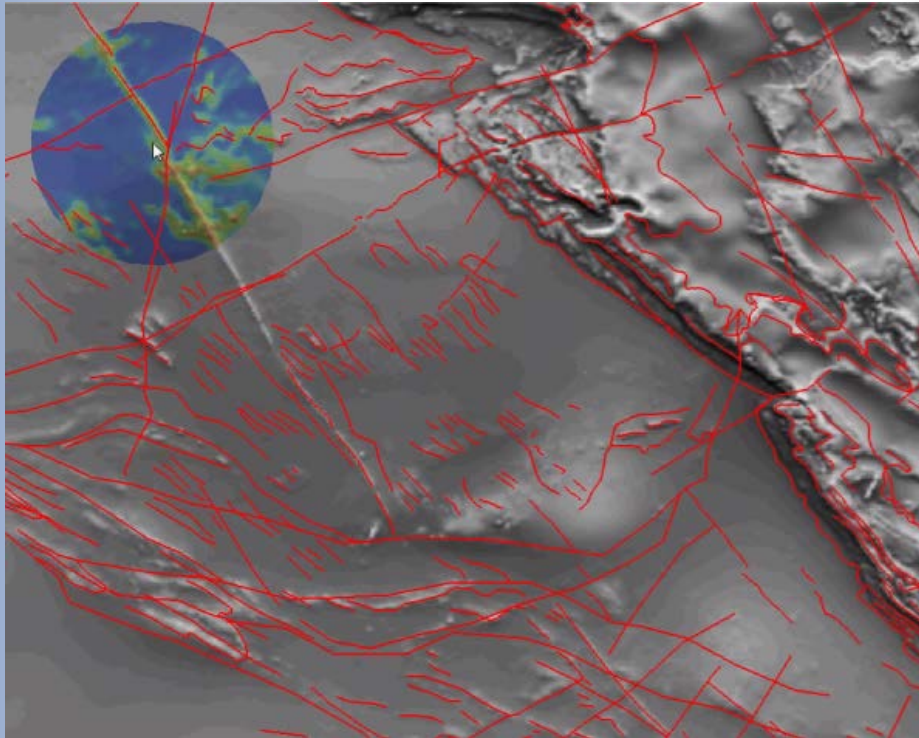


CET Grid Analysis Extension (for Geosoft Oasis Montaj)

<http://www.geosoft.com/pinfo/partners/CETgridanalysis.asp>

# Feature Evidence Tools in the IEP

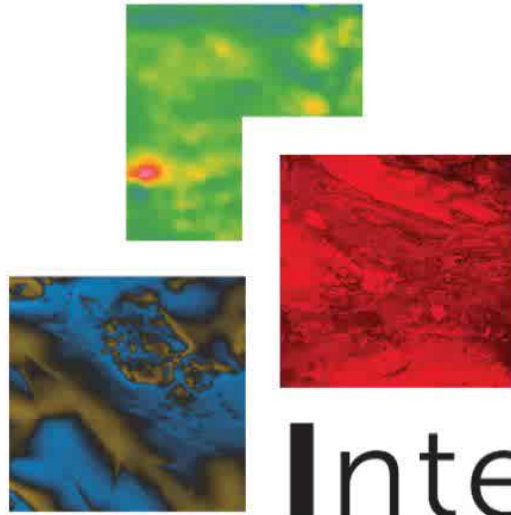
## *Visualising Evidence*



- A spell-checker equivalent for interpretation.
  - Visual feedback on data evidence.
  - Quantitative measure of feature evidence.



# IEP Feature Evidence Tools



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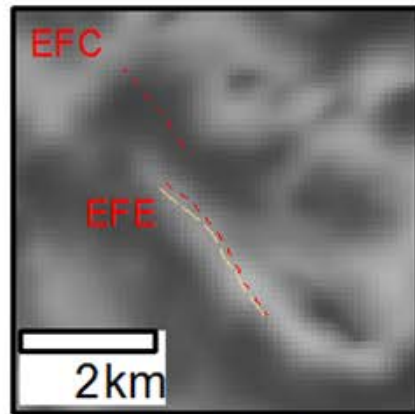
**EXPLORATION**  
INCENTIVE SCHEME



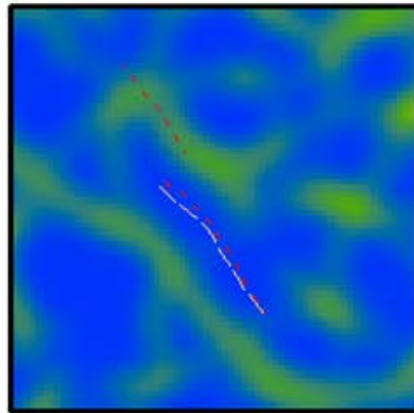
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# Feature Evidence Tools in the IEP

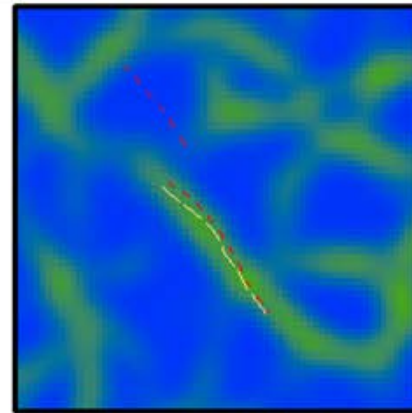
## *Using Evidence*



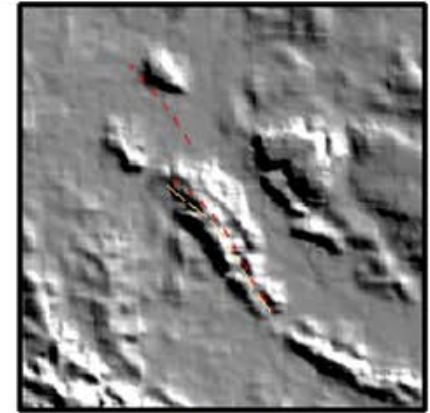
DRC7500



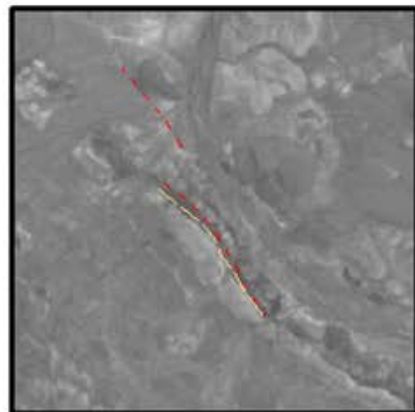
Valley DRC7500



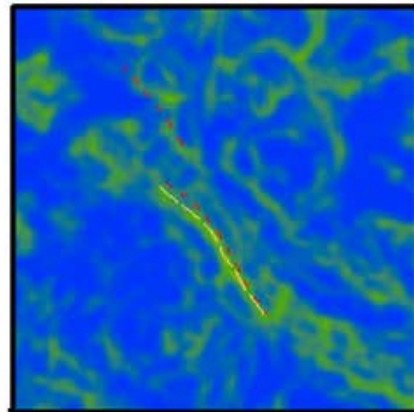
Ridge DRC7500



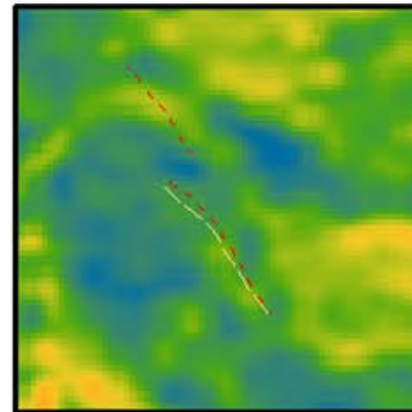
SRTM



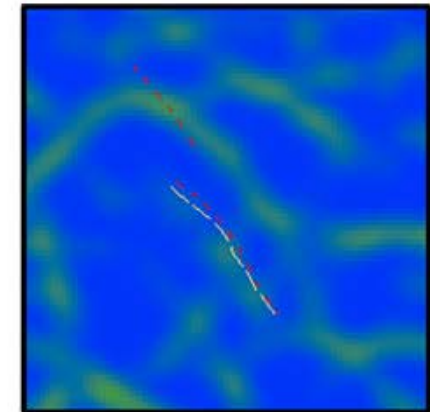
Landsat



Edge Landsat



GRS K

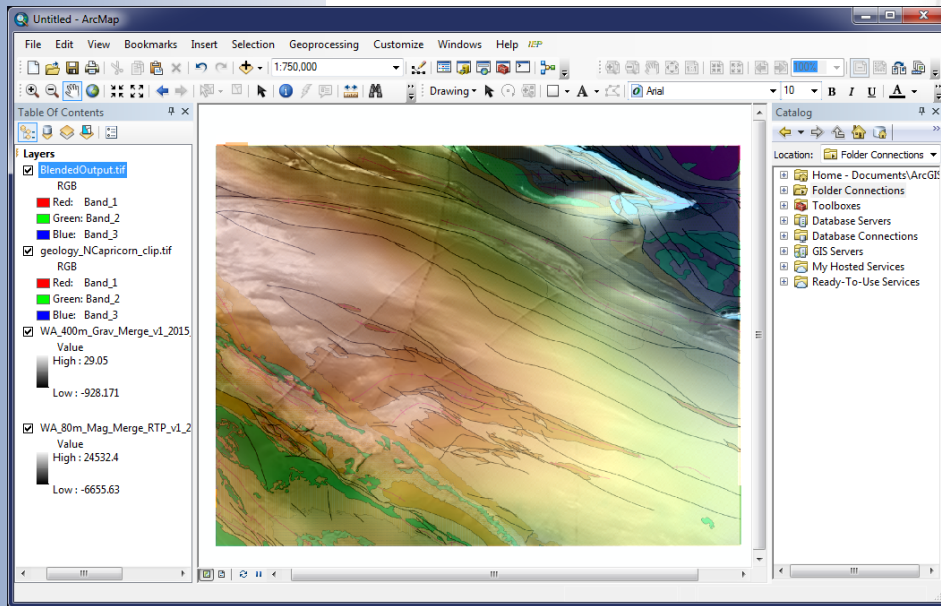


Ridge GRS K

An example of using multidata evidence to realign (in yellow) one of the original structural interpretation (red dashed lines).



# ArcGIS Workflow with the IEP

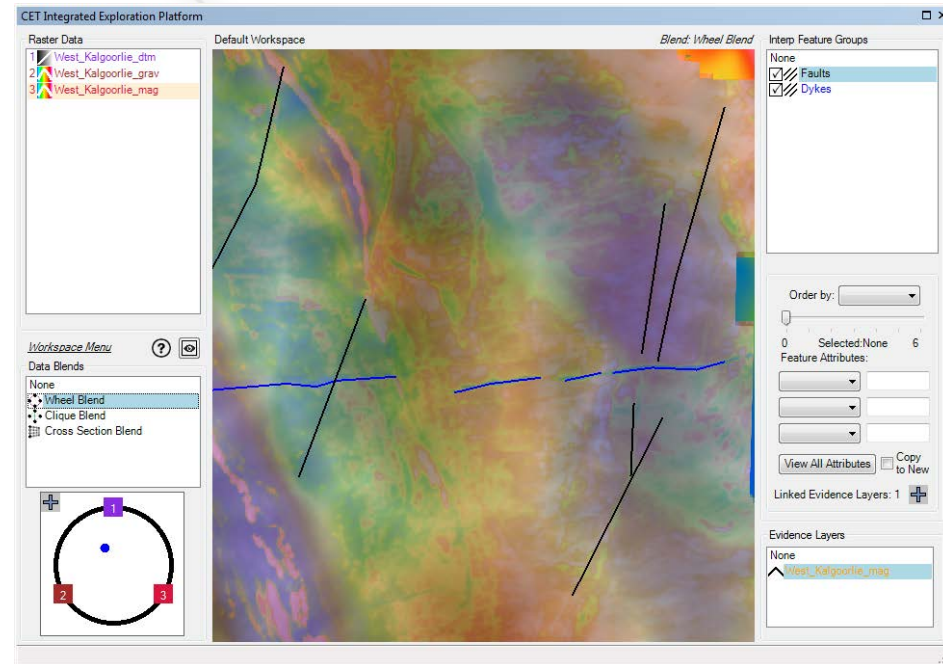


IEP

- Load GeoTIFF and grid datasets
- Load Interpretation Shapefiles

ArcMap

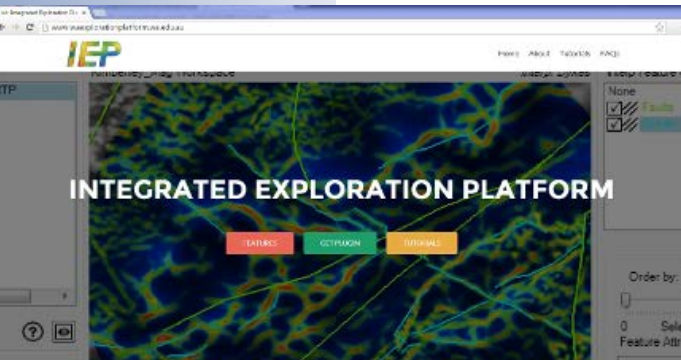
- Export Blends as GeoTIFFs
- Save Interpretations as Shapefiles



# On-going Work

- Improving the interface for better useability and flexibility to different workflows.
- Next phase of interpretation support tools.
  - Lithology and texture analysis.
- More advanced tools dealing with 2D and 3D datasets (for example):
  - Exporting voxel subsets.
  - Importing 3D surfaces.
  - Custom colour maps.
  - Custom data stretches.

# The Integrated Exploration Platform



- Register and download the IEP at <http://www.WAExplorationPlatform.com>
- Demo space with the IEP on the show floor.
- Two posters on the IEP tools for visualisation and feature evidence.

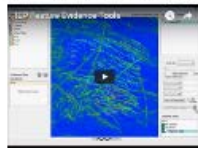
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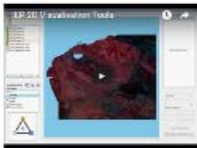
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### Interactive Multi-Data Visualisation Tools

The IEP visualisation tools use an interactive blending paradigm, simultaneously using multiple datasets, to better facilitate the interpretation of complex information from multiple data sources. A number of different multi-image blending tools are designed to support different types of data visualisation for mineral exploration, including 2D data such as geophysical data, radiometric data, and ASTER data, as well as 3D data such as 3D seismic data.



*Thank you.*

*Questions?*

Special thanks to Jon Hronsky

and to all Beta testers, especially:

Vaclav Metelka, Mark Armstrong, Mark Lindsay.

De Beers Canada.

Southern Geoscience Consultants.

Anglo American Canada.

Rio Tinto Australia.

## REGISTRATION

Please contact the Geoscience Australia (GA) website for more information on the IEP. This is a member of the IEP and only has access to the IEP in Western Australia. Please refer to the IEP website for more information.



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