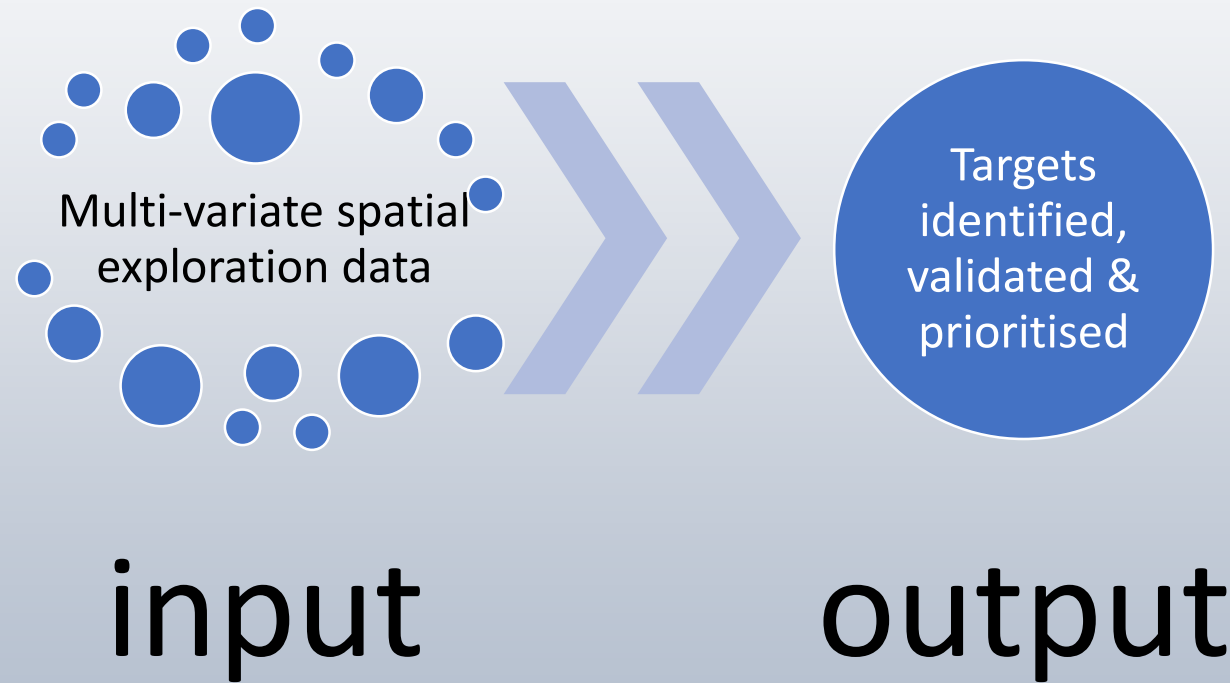


# Machine Learning in Exploration Target Generation

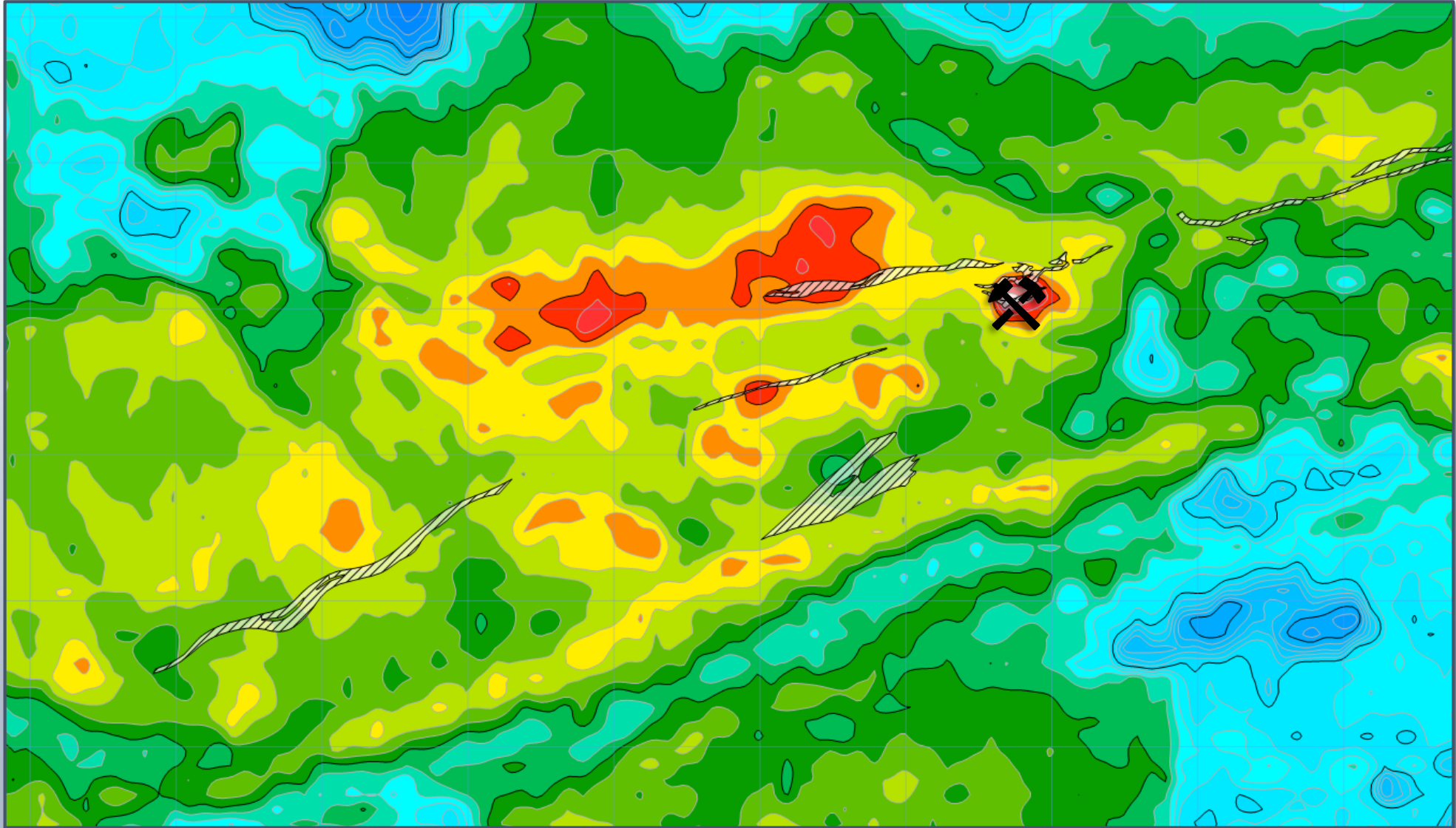
Ross Corben (GEOWiZ Consulting)  
Gavin Daneel (Gavin Daneel & Associates)



# Paradigm



# Degrussa brown-field prospectivity?



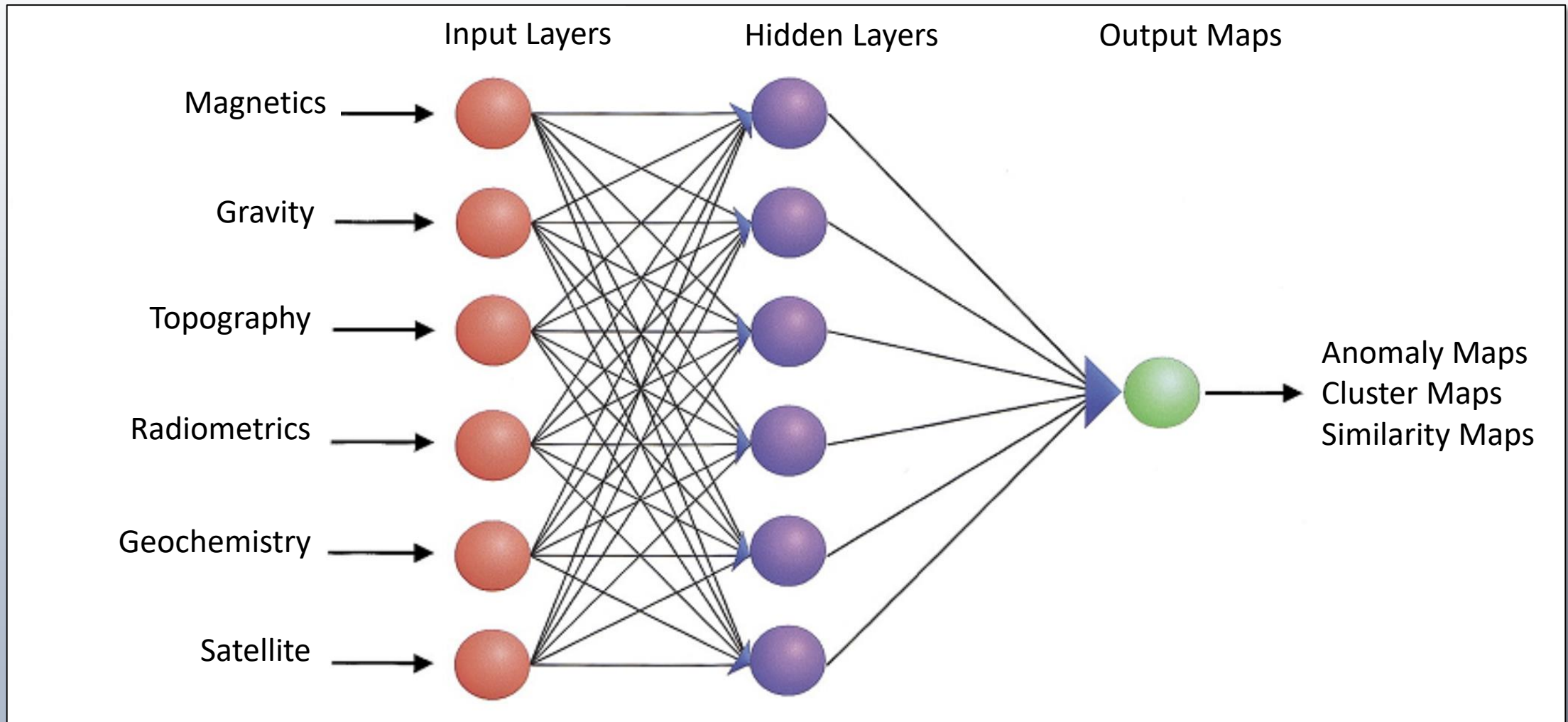
# Artificial Neural Networks (ANNs)

- ANNs are one set of algorithms used in machine learning
- They are inspired by the biological processes of the brain
- ANNs are good at:
  - Analysing large amounts of complex data
  - Identifying relationships between data layers
  - Recognising patterns and associations
  - Making predictions automatically
- Powerful analysis tool that can explore the complete set of data layers
- Decision support for the Geologist
- Orders of magnitude more time efficient than conventional methods





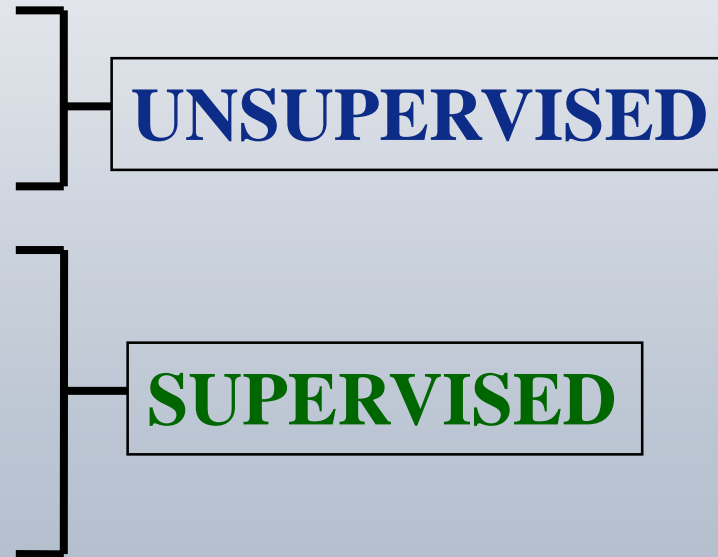
# Artificial Neural Networks



# ANN Analysis Techniques

Five types of neural network analysis can be used for target generation in mineral exploration:

- Anomaly Detection
- Cluster Identification
- Correlation Analysis
- Relationship Analysis
- Fuzzy Searching



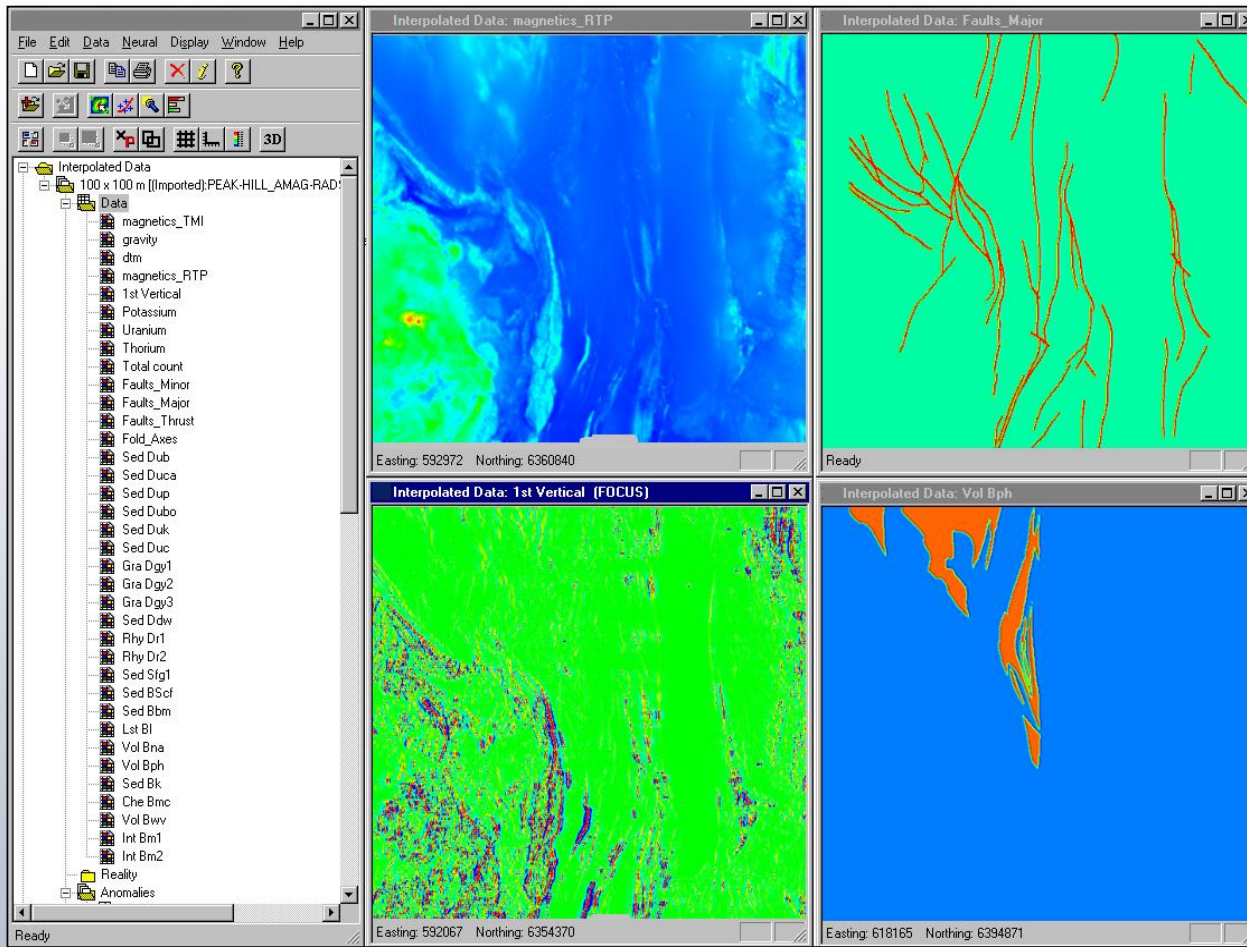
# Data Input & Output

Analysis can be at any scale.

Can handle 2D or 3D data.

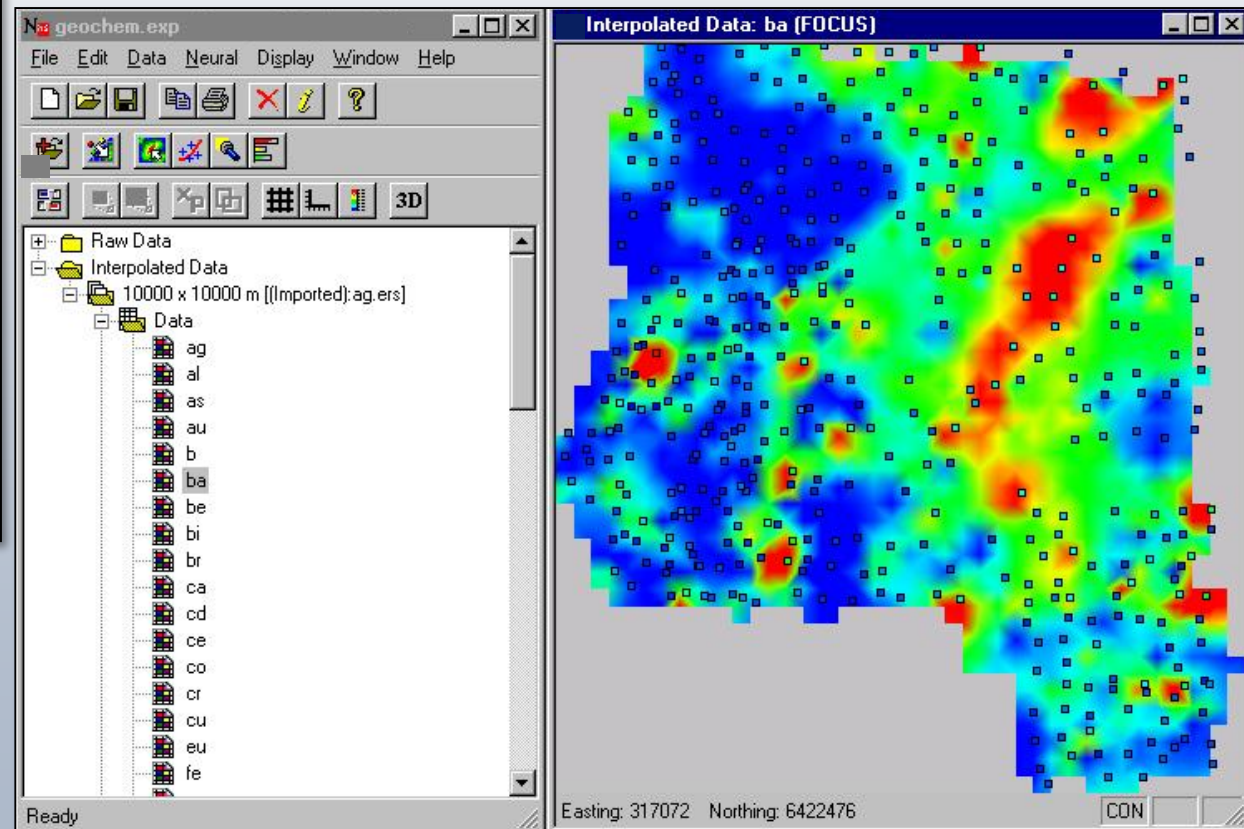
Prospect scale:

soil samples – 50 elements



Regional scale data layers:

- Airborne magnetics
- Structural – 1st order faults,
- Processed magnetics - 1vd
- Geology layers



# ANN Anomaly Analysis

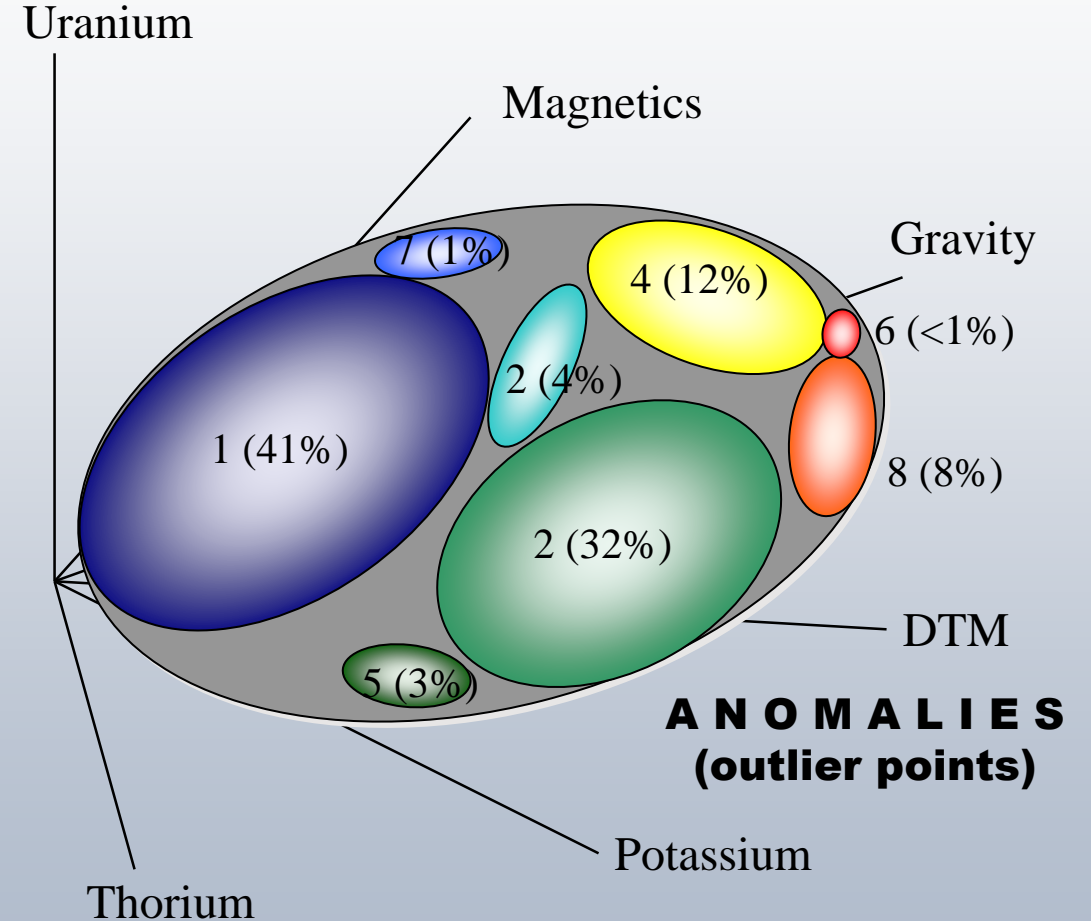
- Features:
  - Identifies regions that are anomalous
  - Evaluates *how* anomalous these regions are
  - Relates anomalies back to the data with the ability to interrogate each anomaly
  - Fully automatic operation
- Control by:
  - Selection of survey layers
  - Region of interest
  - Training duration

# Anomaly & Cluster Identification

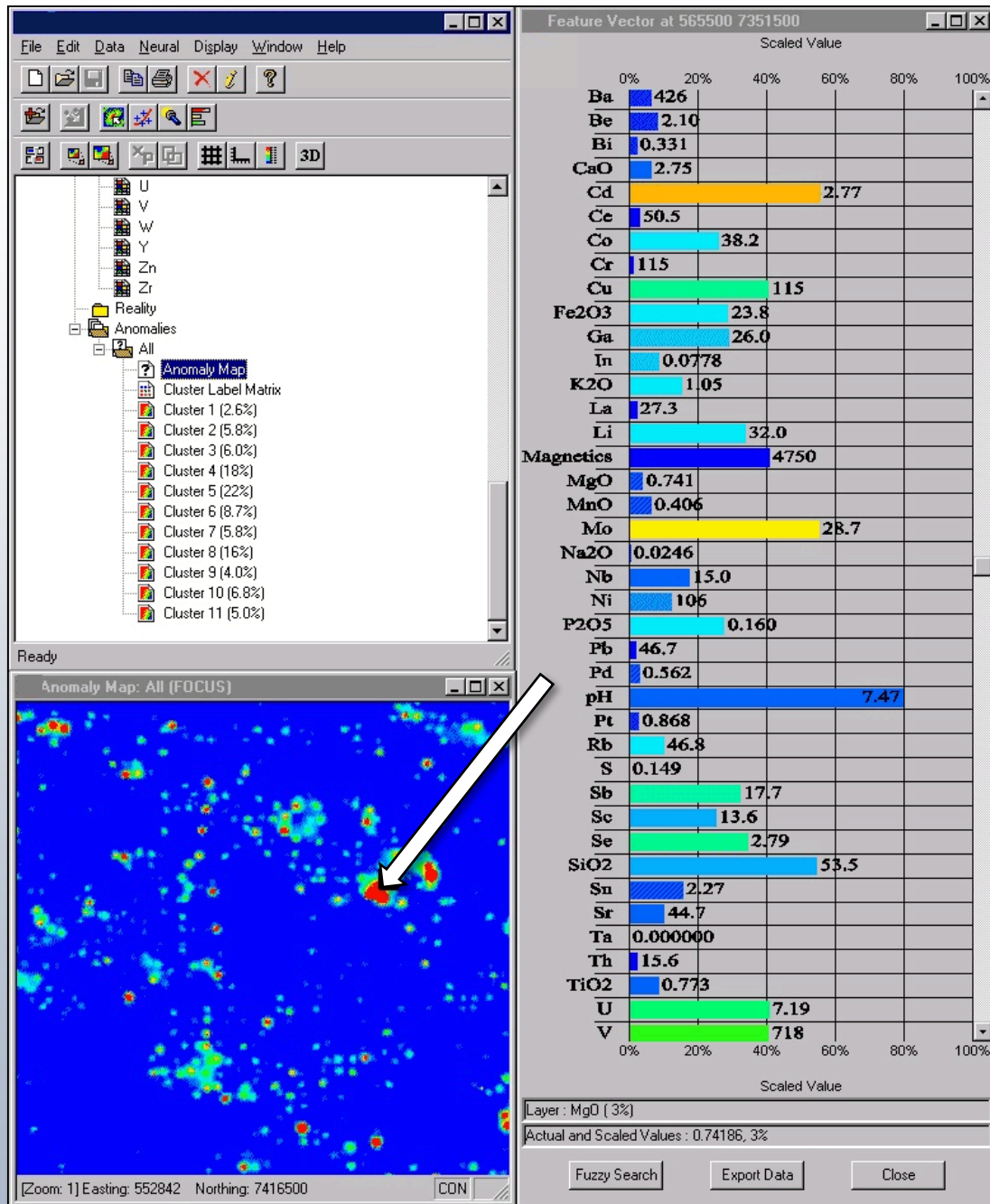
An unsupervised neural analysis search results in a map of anomalies highlighting instances where the data do not fit the range of values of common patterns (or clusters).

After identifying the anomalies, the unsupervised search defines areas of commonly recurring patterns and then groups these into clusters.

Essentially the group of anomalous points (defined by the anomaly map) are those points that fall outside the set of common patterns (or clusters) recognised by the unsupervised ANN.







## Anomaly analysis

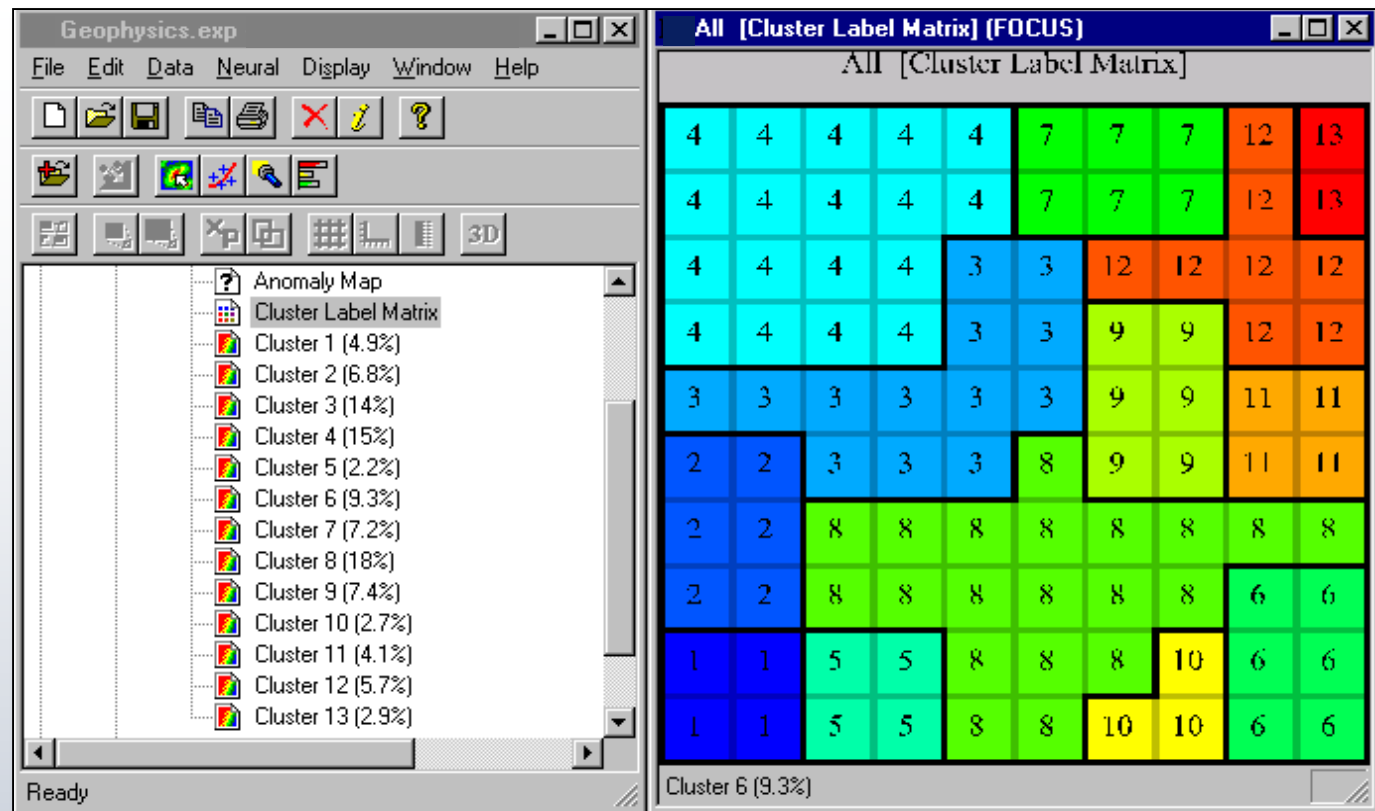
The Feature Vector Plot (FVP) shows the values at particular anomalies.

The colour of the histogram indicates the variability of that layer with its neighbours.

Moving the cursor over the anomaly map dynamically changes the FVP values.

# Cluster Label Matrix

13 clusters have been identified in this example



The Cluster Label Matrix represents the association between individual clusters. Each cluster is represented by several coloured and numbered squares:

- The number of squares assigned to a cluster indicates its relative proportion of the total data coverage or area
- The proximity of two clusters indicate their similarity e.g. cluster 1 is similar to cluster 5 but dissimilar to cluster 4. A geological setting where this sort of association might occur is in a granitic terrain with minor basaltic flows. In this instance clusters 3 and 4 might represent the outcrops of the dominant granitic lithologies whereas clusters 1 and 5 might well represent the basaltic flows and their weathering products.



# Neural Fuzzy Search

- Specify search items
  - search for a selected pattern eg. anomaly
  - search from a particular location eg. a known mineral deposit
  - search for a “created” pattern - look for a particular deposit type signature
  - searches for a correlation signature
- Control by:
  - choose data layers to include
  - set the data threshold for each layer
  - control the weighting of each layer

# Neural Fuzzy Search

**Neural Fuzzy Search** - link from known mineral deposit to look for areas with a similar geochemical signature

The screenshot shows the Prospect Explorer 2.1 software. The main window displays an 'Anomaly Map' with a color scale from blue (low) to red (high). A white arrow points from a specific location on the map to the 'Neural Fuzzy Search Creator' window. The search parameters are set to 'Link from FVP (432001, 644860)'. The 'Weight' is 5, and the 'Fuzzy Search' is set to 'Equiv.'. The search results are displayed as a color-coded map with various elements listed on the left:

Element	Percentage
ag	0%
al	26%
as	36%
au	0%
b	53%
ba	49%
be	0%
bi	0%

The screenshot shows the 'Neural Fuzzy Search Creator' and 'Fuzzy Search: [Editing] (FOCUS)' windows. The search parameters are set to 'Link from FVP (597701, 635810)'. The 'Weight' is 5, and the 'Fuzzy Search' is set to 'Equiv.'. The search results are displayed as a color-coded map with various elements listed on the left:

Element	Percentage
magnetics_TM	41%
gravity	34%
dtm	8%
magnetics_RTI	49%
1st Vertical	62%
Potassium	50%
Uranium	6%
Thorium	5%

The 'Fuzzy Search: [Editing] (FOCUS)' window shows a zoomed-in view of the anomaly map with several locations marked with '+' and labeled: E22, E27, E32, E48, E51N, E51, E36, and E26S. A white arrow points from the search results in the 'Neural Fuzzy Search Creator' window to the corresponding location on the 'Fuzzy Search: [Editing] (FOCUS)' map.

**Neural Fuzzy Search** using the North Parkes Endeavour 27 deposit as the search location

# Neural Fuzzy Search

## Customised (Porphyry) *Fuzzy Search*

- elevated Ag, Au, Cu, K, Mo
- low Cr, Ni

**Neural Fuzzy Search Creator**

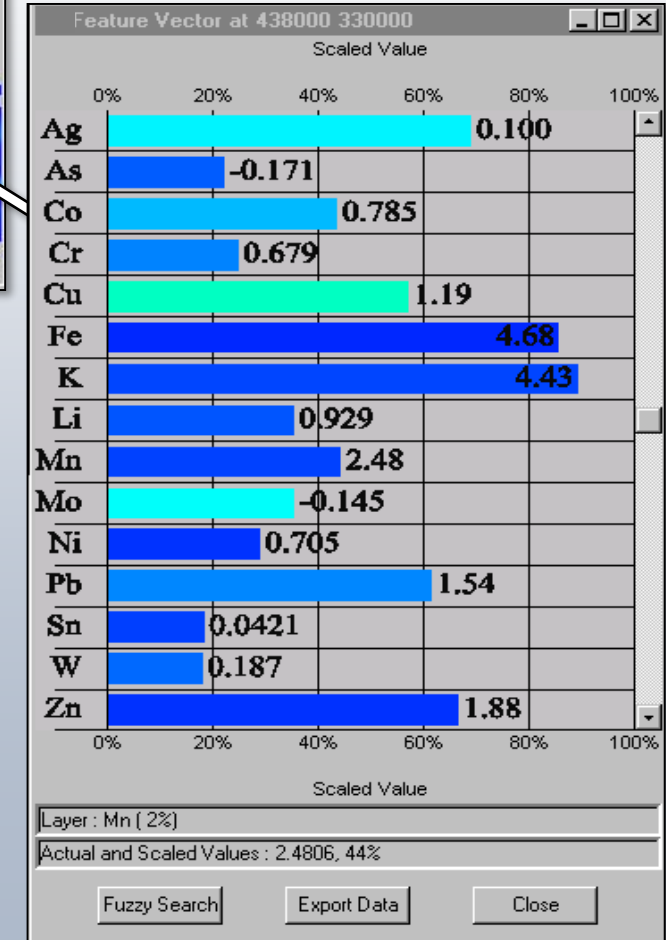
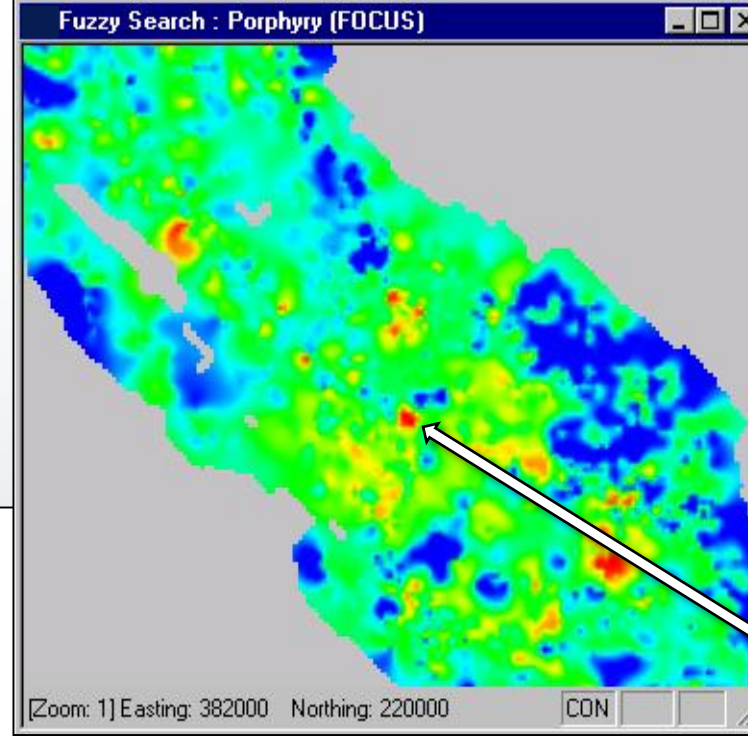
Neural Fuzzy Search Parameters

Fuzzy Search: **Porphyry**

Li: 50%      Weight: 5       Lower  
 Upper  
 Equiv.  
 Not used

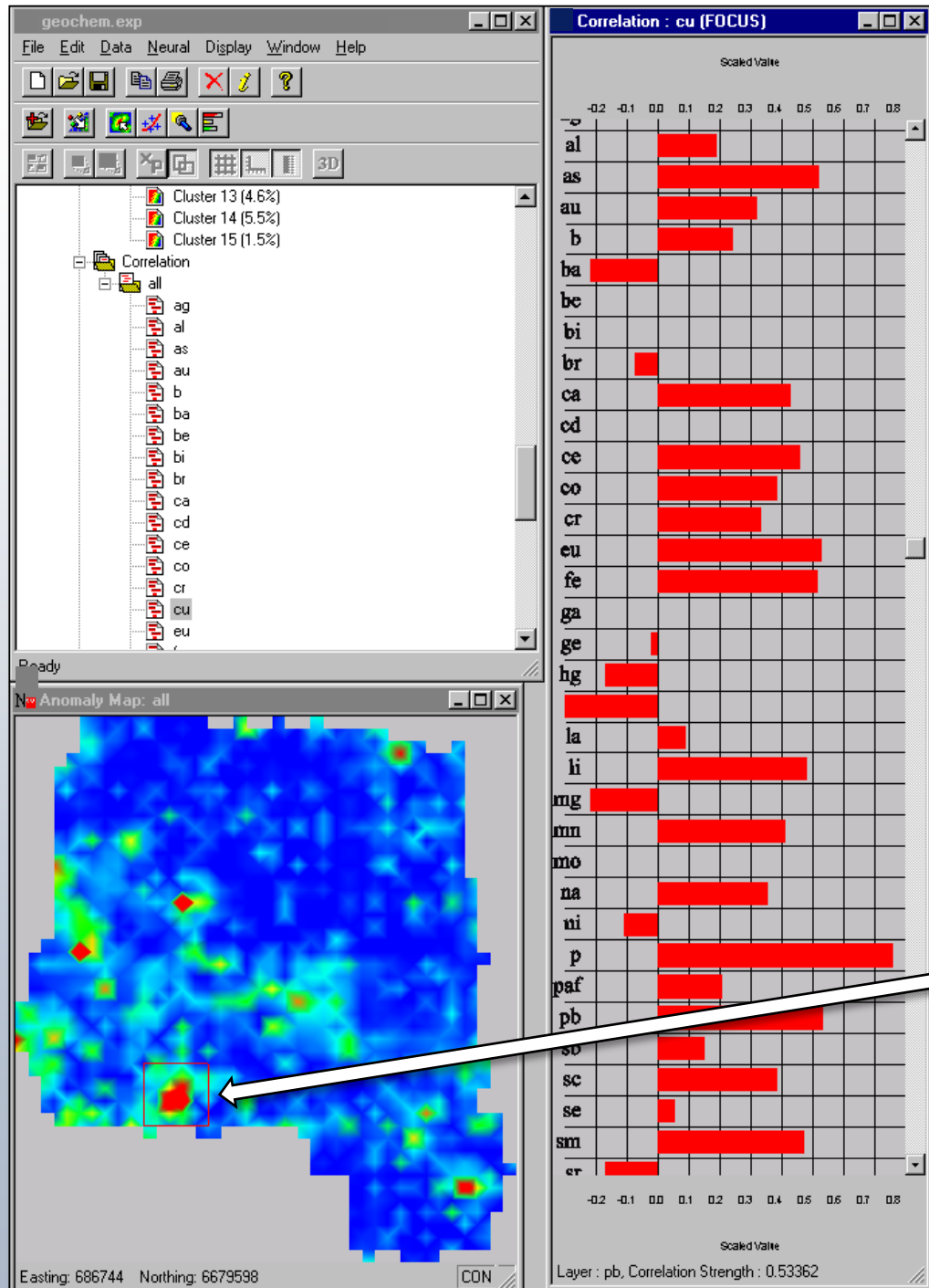
Ag	50%
As	32%
Cu	50%
Fe	50%
K	50%
Li	50%

Buttons: Save, Save As, **Fuzzy Search**, Close



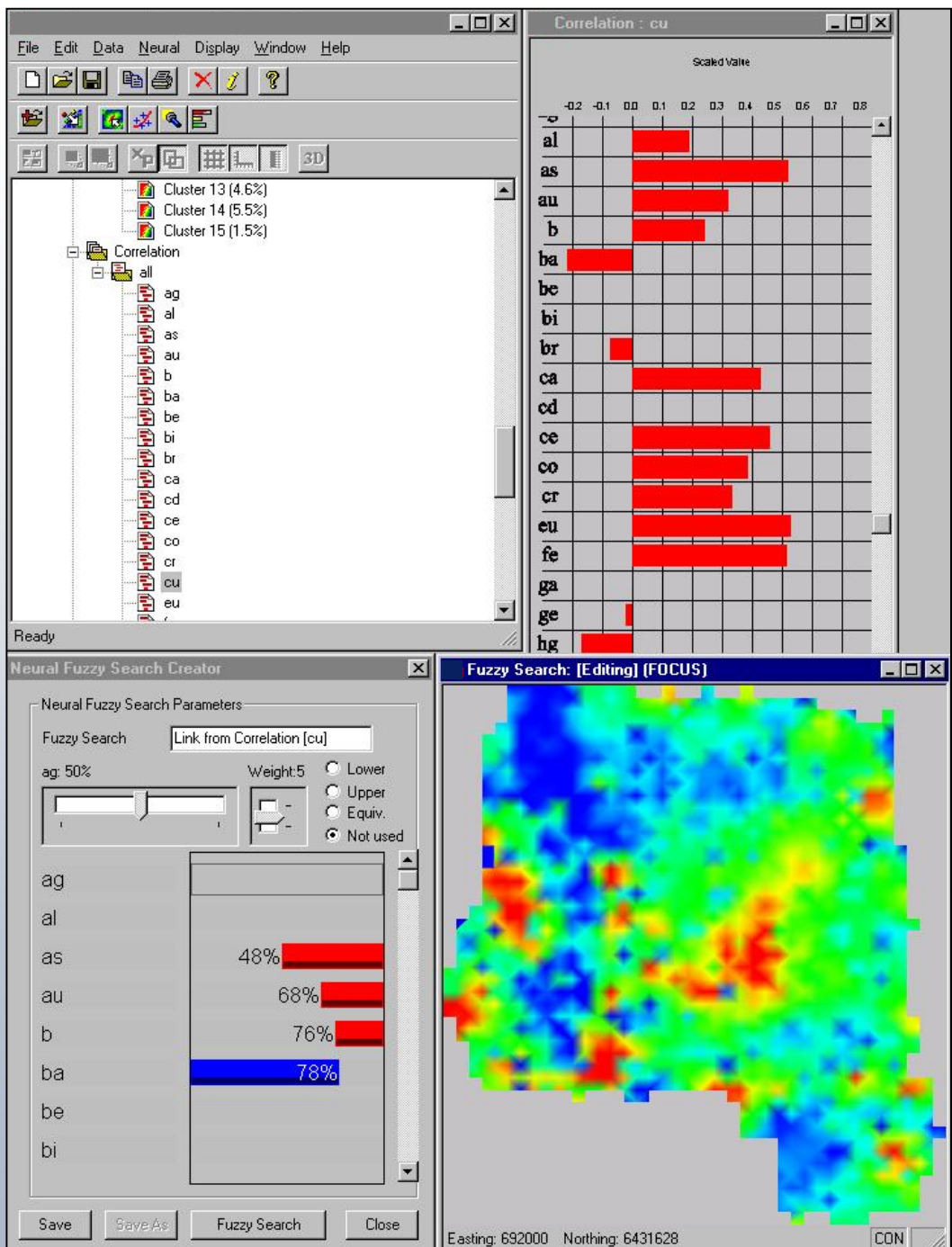
# Neural Correlation Analysis

- Looks at the relationships between the data layers
- Relational Knowledge
- Correlation signatures can be determined
- Search for areas with similar correlation signature ie. search for similarities in relationships for population identification
- Correlation analysis provides a means of searching for signatures of the relationship between layers, independent of the amplitude values of the layers
- The subtle relationship between elements can be of more importance than the observed rank outlier values that are easily observed



Correlation of each element with respect to Cu within a specified region of interest

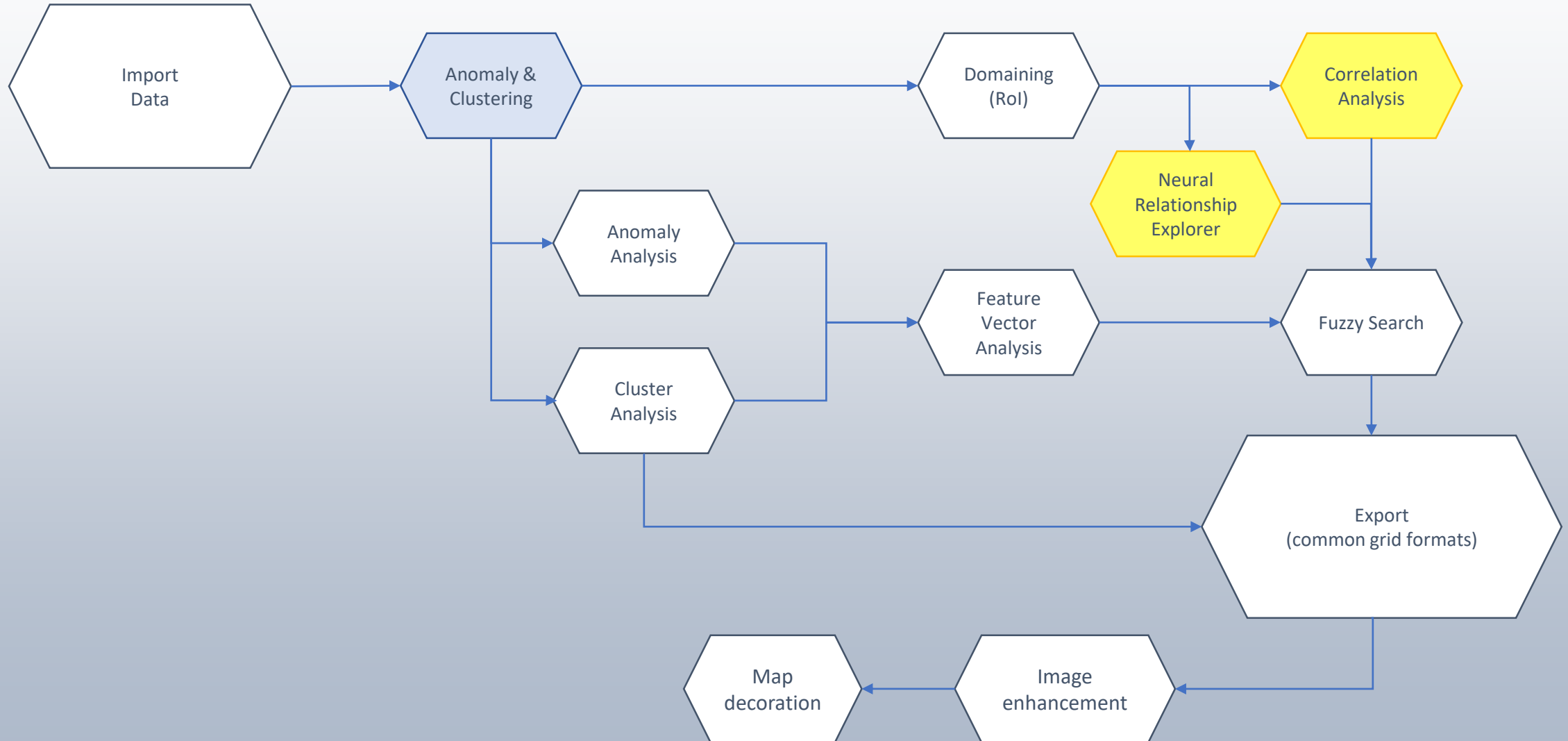




# Correlation link to fuzzy search

This searches for signatures of the relationships between layers, independent of the amplitude values of the layers and so may detect anomalies in areas where the raw values are close to the detection limit but the associations are the same as the higher values in the region of interest.

# Workflow - Neural Network Analysis

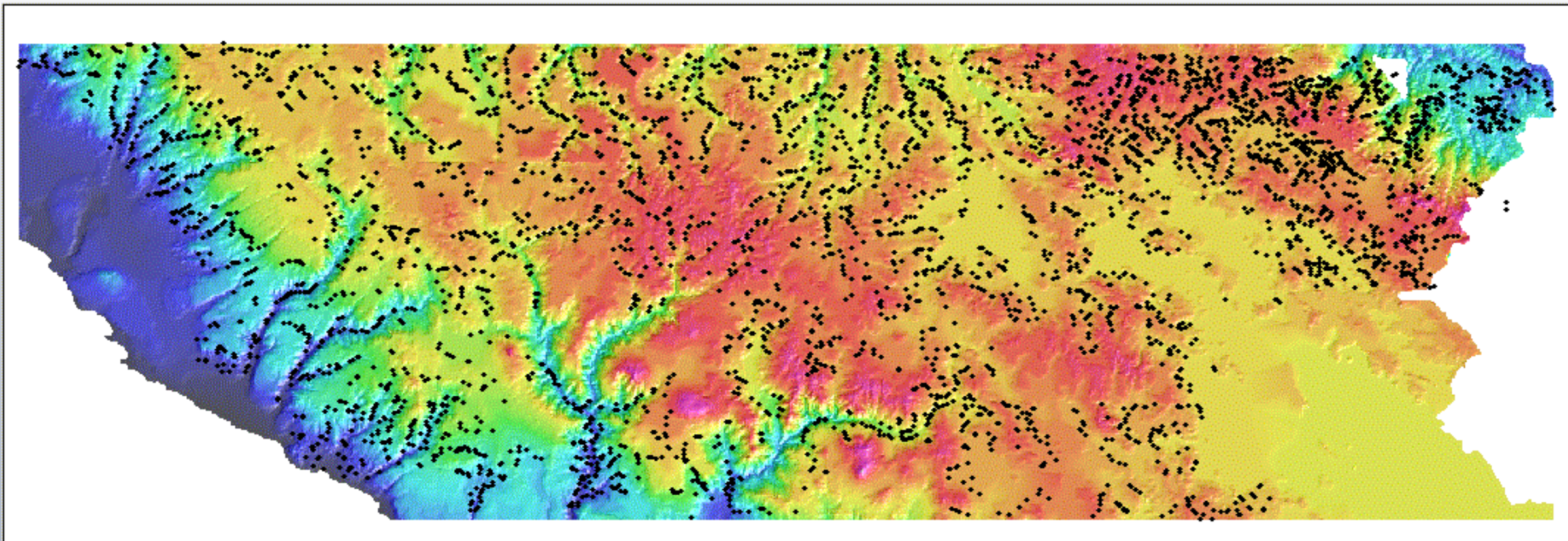




# Rio Tinto – Southern Peru

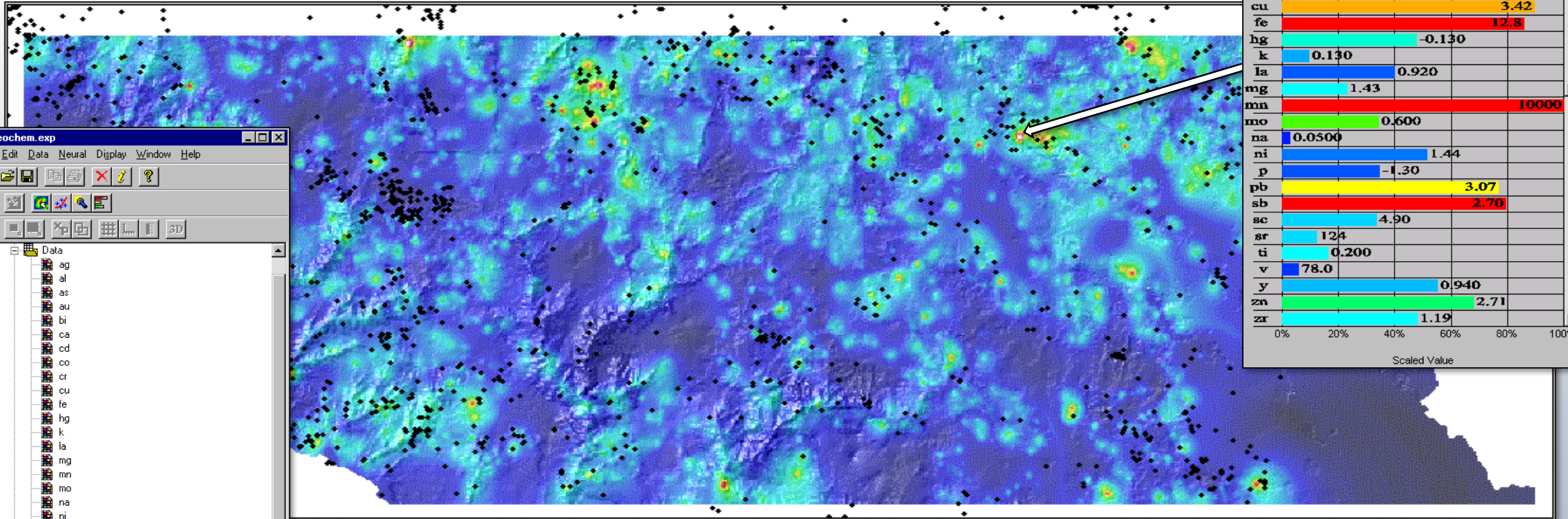
- Peru Mines Department (Ingemet) Southern Peru Data Package
- Geochemistry - 30 layers of stream sediment geochemical samples
- Mineral Occurrences Database
- Surface geology
- Anomaly detection, cluster analysis, fuzzy search and correlation analysis tools used

# Stream Sediment Sample Points





# Anomaly Analysis

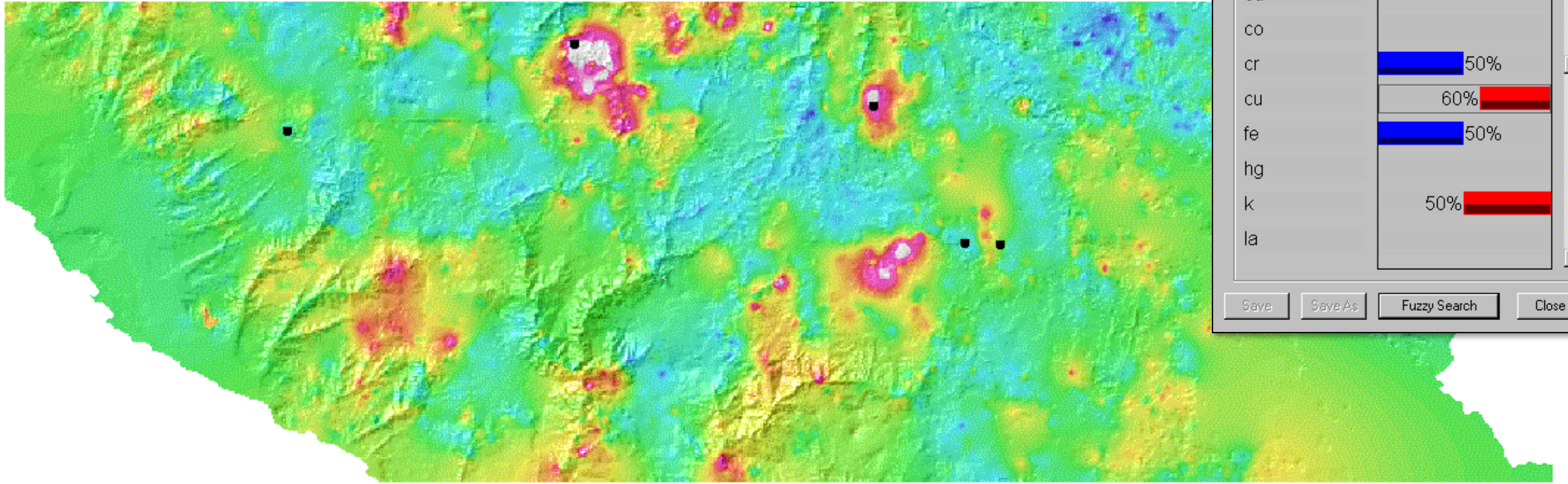


## Unsupervised Anomaly Analysis

all elements used in search shown with known mineral occurrences



# Porphyry Fuzzy Search Results



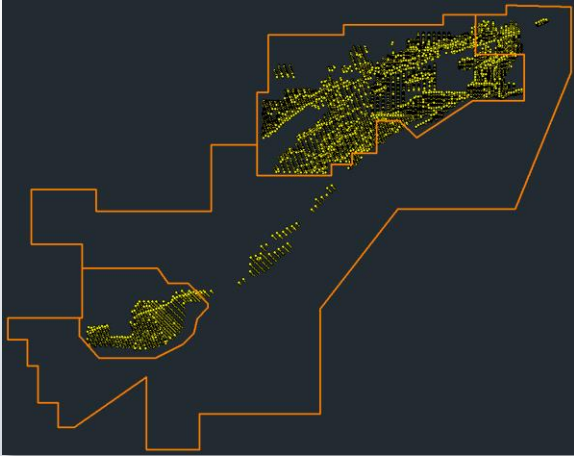
**Porphyry search:** > 50% Ag-Au-Cu-K-Mo-Pb-Zn

< 50% Cr-Fe-Ni

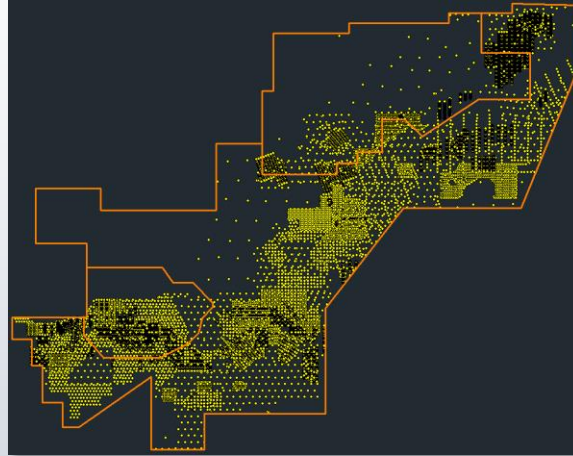
Known major porphyry mines and deposits

# Degrussa VMS Deposit - WA

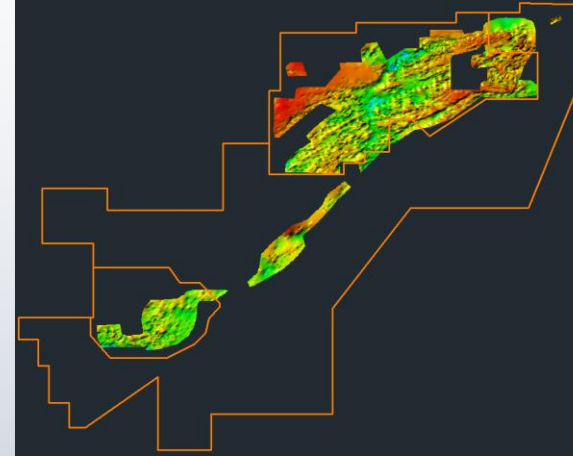
Boh geochem (83)



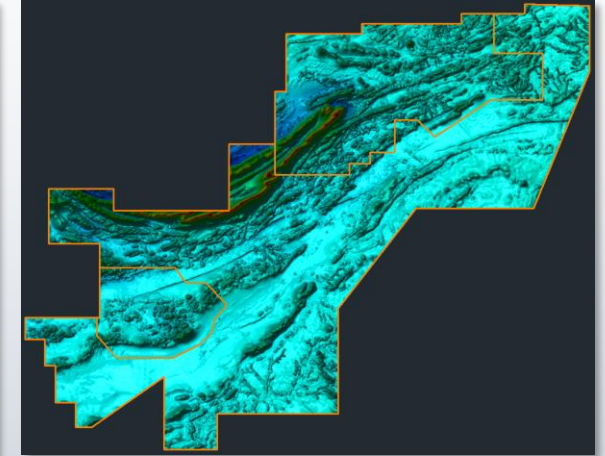
Soil geochem (67)



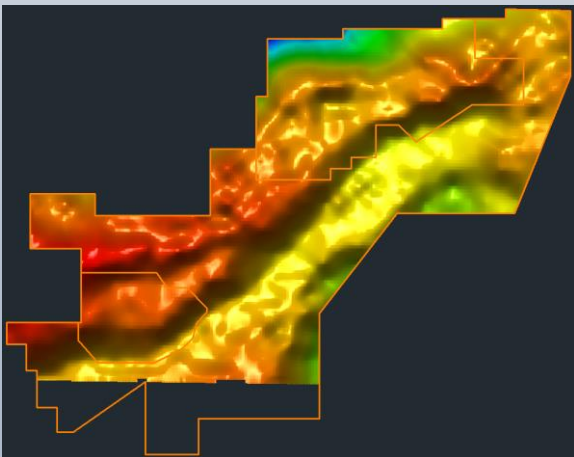
Depth to basement (1)



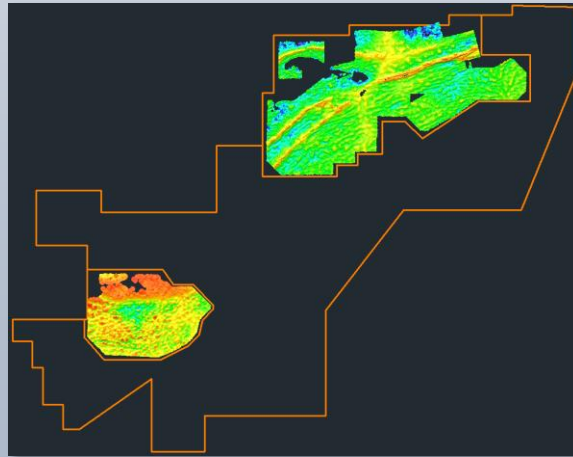
Aeromagnetics (1)



Gravity (1)



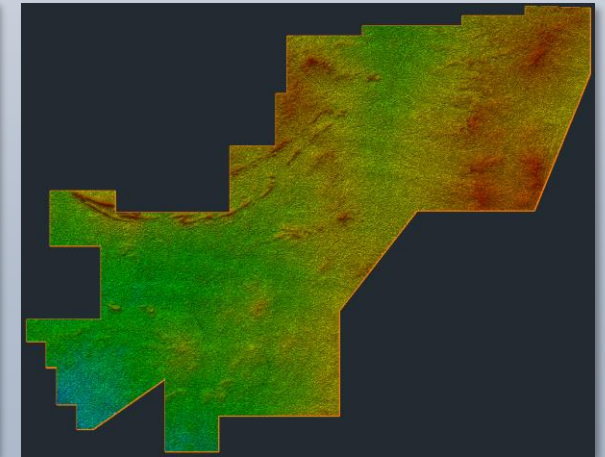
AEM (32)



Satellite (24)



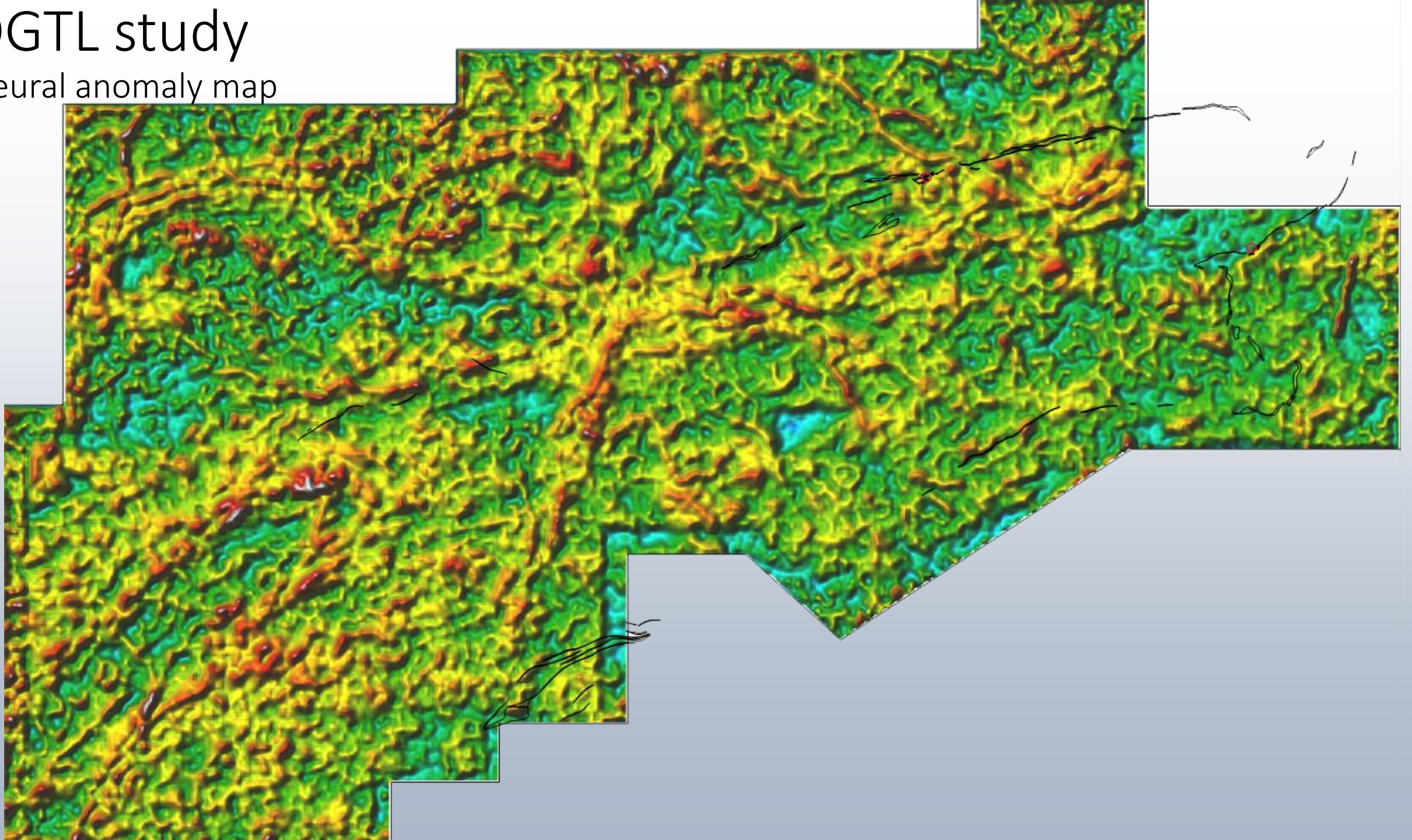
DEM (1)





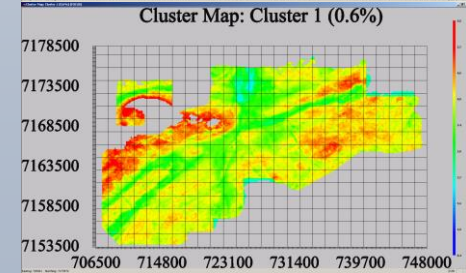
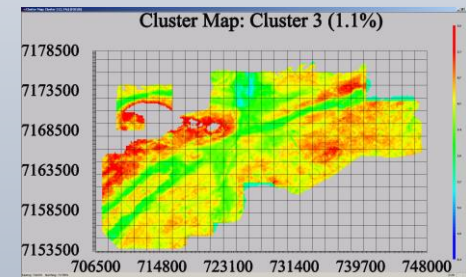
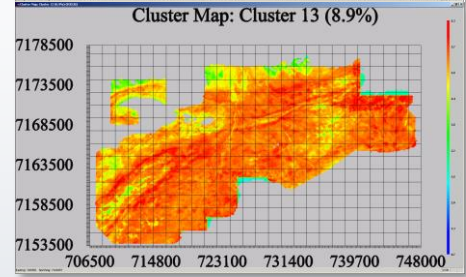
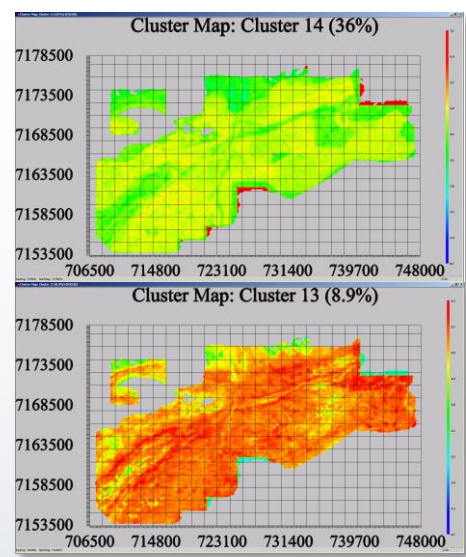
# DGTL study

Neural anomaly map

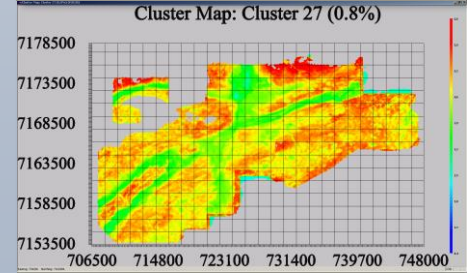
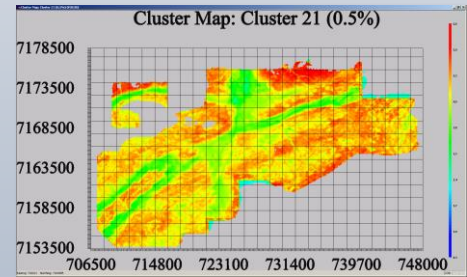
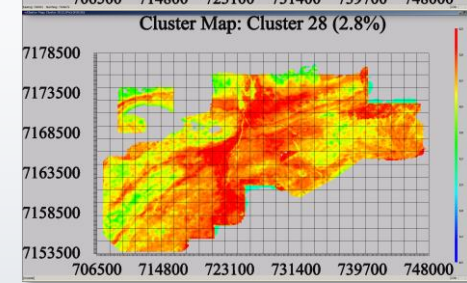
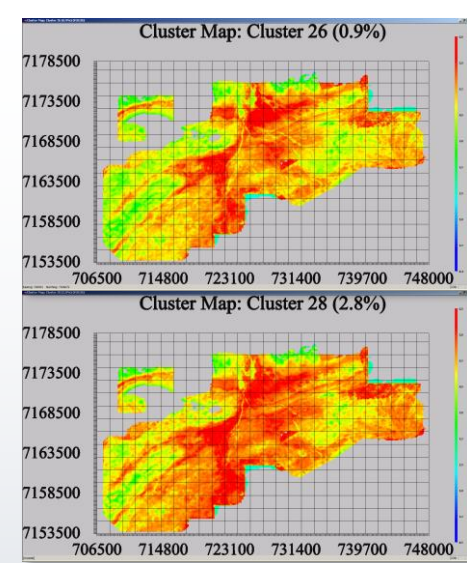




# DGTL Study- Cluster Label Matrix



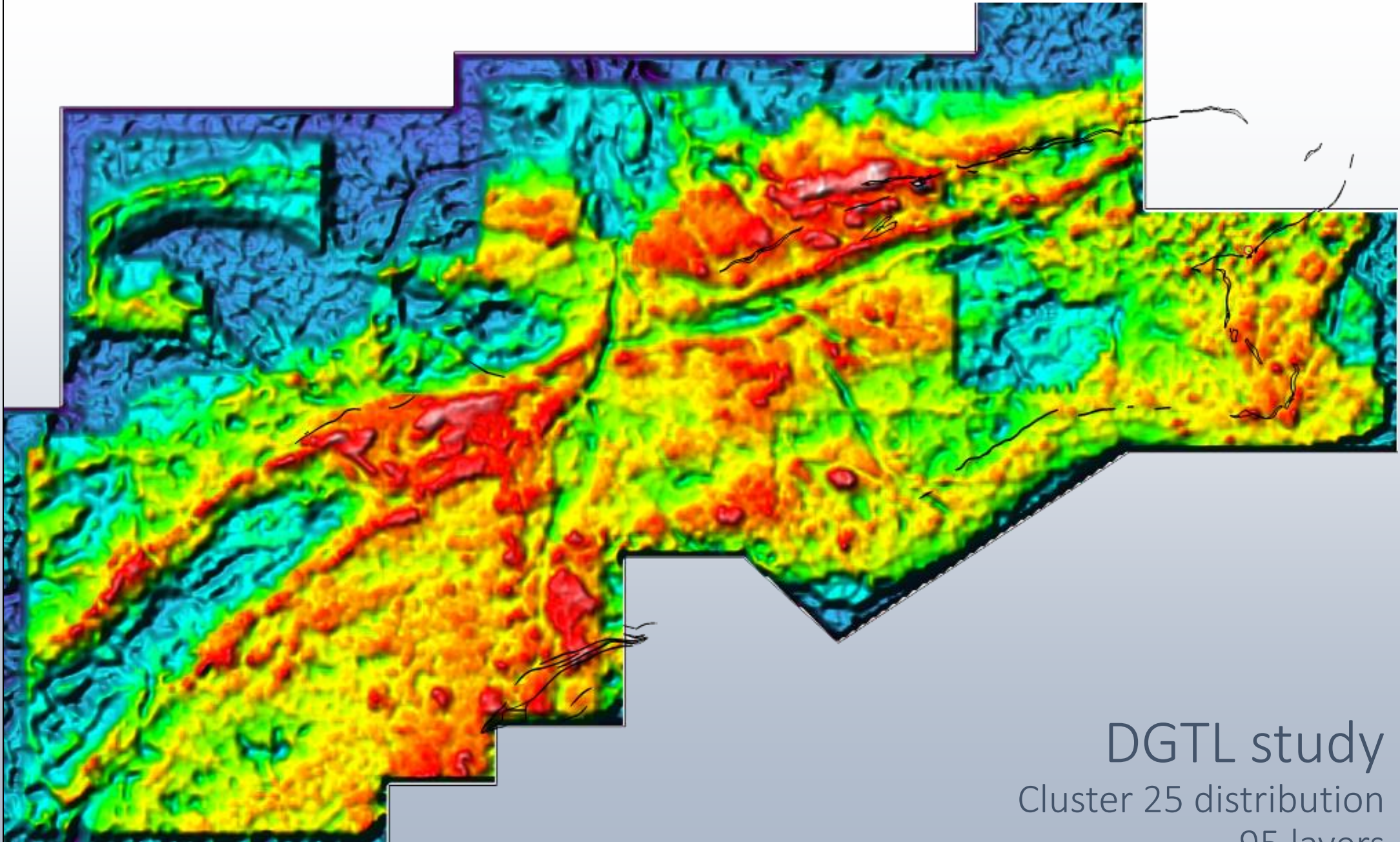
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Feature Vector at 733700 7173100

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- DB\_clipped\_Ao1\_PEGRD
- AI\_DEM\_Ao1\_PEGRD
- LANDSAT\_B2\_AO1\_PEGRD
- LANDSAT\_B4\_AO1\_PEGRD
- LANDSAT\_B7\_AO1\_PEGRD
- Rad\_Koc\_Ao1\_PEGRD
- AI\_DoseRate\_Ao1\_PEGRD
- Mag\_Ansig\_Ao1\_PEGRD
- Mag\_RTP\_Ao1\_PEGRD
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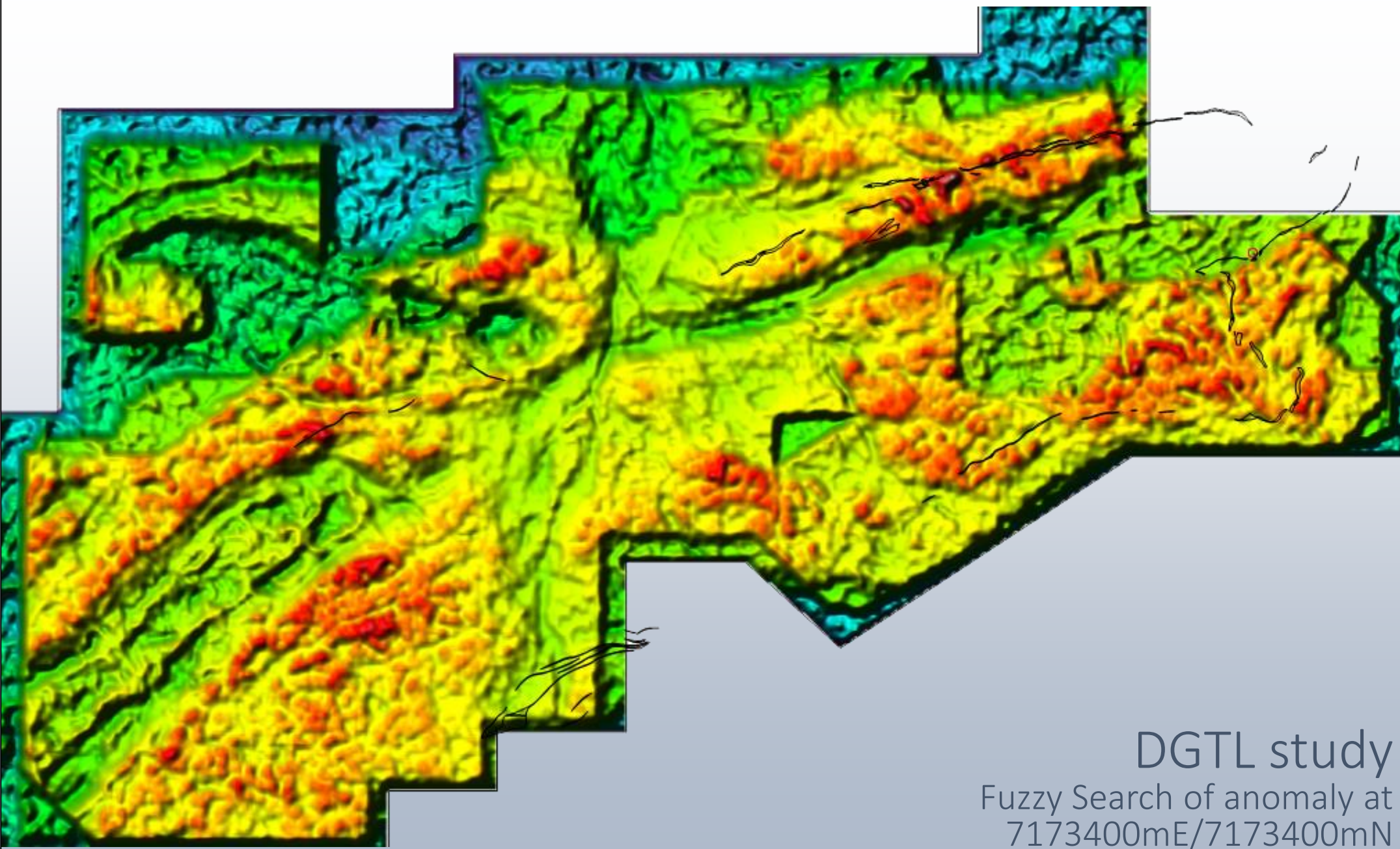


DGTL study  
Cluster 25 distribution  
95 layers



Feature Vector at 734700 7173400

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- bah\_Ao1\_SiO2ppm\_PEGRD
- bah\_Ao1\_Spppm\_PEGRD
- bah\_Ao1\_Spct\_PEGRD
- bah\_Ao1\_Teppm\_PEGRD
- bah\_Ao1\_Tioppm\_PEGRD
- bah\_Ao1\_Zrppm\_PEGRD
- Ao1l\_030m\_040m\_PEGRD
- Ao1l\_000m-005m\_PEGRD
- Ao1l\_005m-010m\_PEGRD
- Ao1l\_010m-015m\_PEGRD
- Ao1l\_015m\_020m\_PEGRD
- Ao1l\_020m\_030m\_PEGRD
- Ao1l\_030m\_040m\_PEGRD
- Ao1l\_040m\_050m\_PEGRD
- Ao1l\_050m\_060m\_PEGRD
- Ao1l\_060m\_070m\_PEGRD
- Ao1l\_070m\_080m\_PEGRD
- Ao1l\_080m\_090m\_PEGRD
- Ao1l\_090m\_100m\_PEGRD
- Ao1l\_100m\_120m\_PEGRD
- Ao1l\_120m\_140m\_PEGRD
- Ao1l\_140m\_160m\_PEGRD
- Ao1l\_160m\_180m\_PEGRD
- Ao1l\_180m\_200m\_PEGRD
- Ao1l\_200m\_220m\_PEGRD
- Ao1l\_220m\_240m\_PEGRD
- Ao1l\_240m\_260m\_PEGRD
- Ao1l\_260m\_280m\_PEGRD
- Ao1l\_280m\_300m\_PEGRD
- Ao1l\_300m\_340m\_PEGRD
- Ao1l\_340m\_400m\_PEGRD
- Ao1l\_400m\_420m\_PEGRD
- Ao1l\_420m\_460m\_PEGRD
- Ao1l\_460m\_500m\_PEGRD
- Ao1l\_500m\_540m\_PEGRD
- Ao1l\_540m\_580m\_PEGRD
- Ao1l\_660m\_700m\_PEGRD
- Ao1l\_620m\_660m\_PEGRD
- Reg\_RTP\_12q5m\_Foc\_Ao1l\_PEGRD
- Atlas\_Combined\_Dool\_bouq2q57\_Ao1l\_PEGRD
- Atlas\_Combined-Collier\_Bouguer\_Ao1l\_PEGRD
- ASTER\_FEOHGRPCONT\_AO1l\_PEGRD
- ASTER\_ALOHGRPCONT\_AO1l\_PEGRD
- ASTER\_ALOHGRPCONT\_AO1l\_PEGRD
- ASTER\_FC\_B1\_AO1l\_PEGRD
- ASTER\_FC\_B2\_AO1l\_PEGRD
- ASTER\_FC\_B3\_AO1l\_PEGRD
- ASTER\_KAOLINRPCONT\_AO1l\_PEGRD
- ASTER\_FERRICOXCOMP\_AO1l\_PEGRD
- ASTER\_FERRICOXCONT\_AO1l\_PEGRD
- ASTER\_FERROUSFPCONTMGOHCO3\_AO1l\_PEGRD
- ASTER\_FERROUSFENDEX\_AO1l\_PEGRD
- ASTER\_GRVEG\_AO1l\_PEGRD
- ASTER\_REGRAT\_B3\_AO1l\_PEGRD
- ASTER\_MGOHGRPCOMP\_AO1l\_PEGRD
- ASTER\_MGOHGRPCONT\_AO1l\_PEGRD
- ASTER\_OPAQUES\_AO1l\_PEGRD
- ASTER\_REGRAT\_B1\_AO1l\_PEGRD
- ASTER\_REGRAT\_B2\_AO1l\_PEGRD
- DEM\_clipped\_Ao1l\_PEGRD
- Ar\_DEM\_Ao1l\_PEGRD
- LANDSAT\_B2\_AO1l\_PEGRD
- LANDSAT\_B4\_AO1l\_PEGRD
- LANDSAT\_B7\_AO1l\_PEGRD
- Rad\_Kqct\_Ao1l\_PEGRD
- Ar\_DoseRate\_Ao1l\_PEGRD
- Mag\_AvSig\_Ao1l\_PEGRD
- Mag\_RTP\_Ao1l\_PEGRD
- Mag\_RTPIR\_Ao1l\_PEGRD
- Mag\_TMI\_Ao1l\_PEGRD
- Rad\_Thoppm\_Ao1l\_PEGRD
- Rad\_Uppm\_Ao1l\_PEGRD



DGTL study  
Fuzzy Search of anomaly at  
7173400mE/7173400mN  
95 layers



# STARRA Hymap Analysis

Input layers:

Geophysics (2 layers)

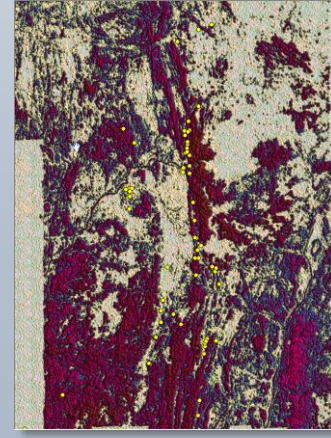
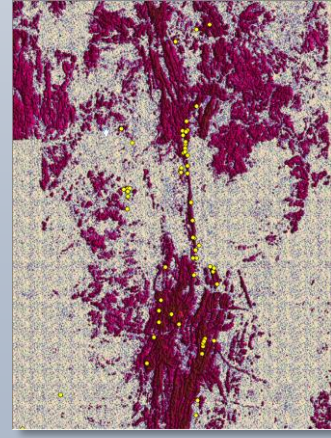
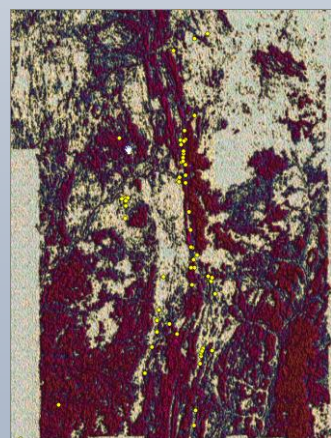
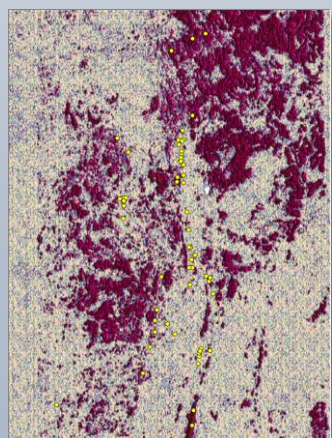
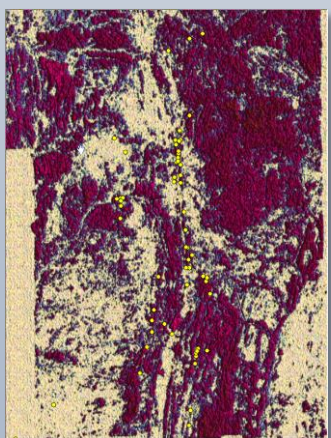
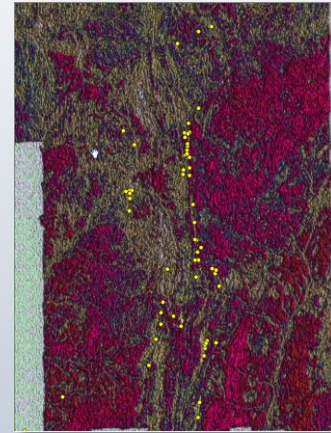
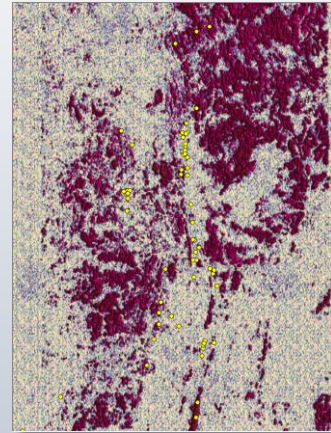
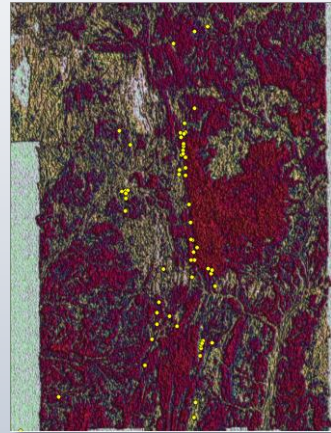
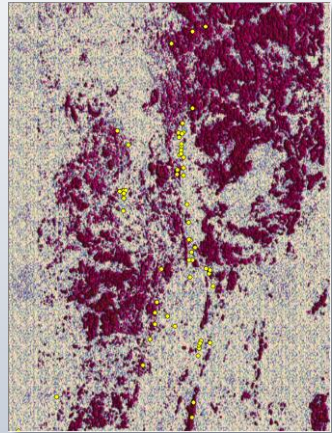
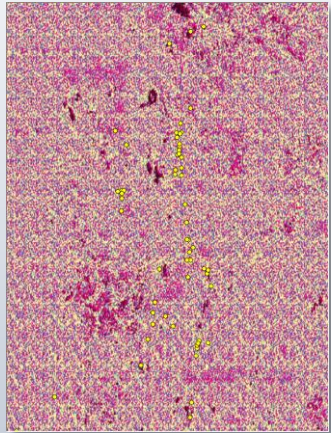
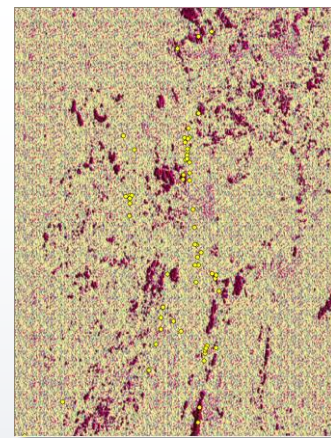
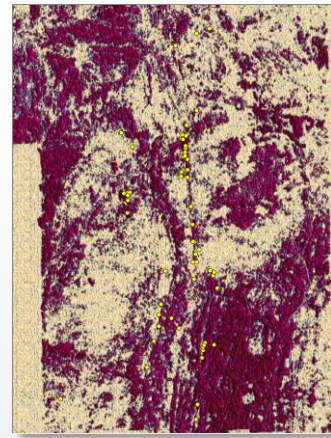
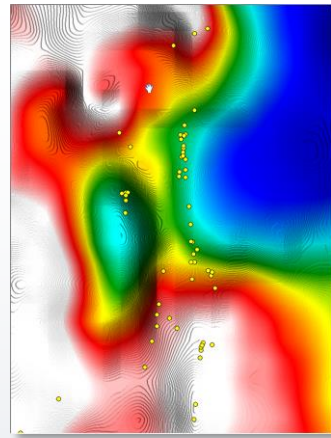
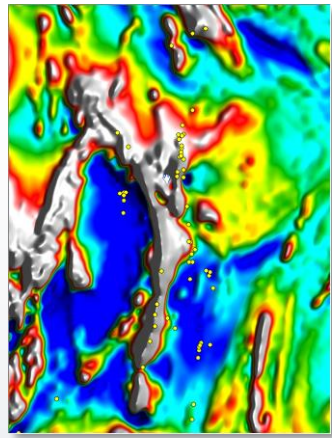
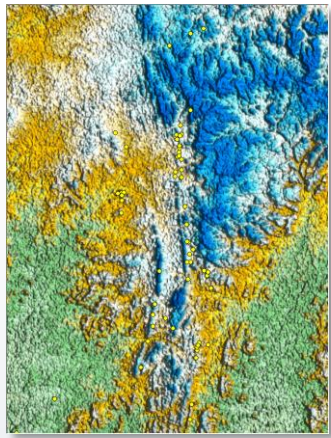
- Gravity
- Magnetics

Terrain (1 layer)

- DTM

Spectral (12 layers)

- Variety of modelled mineral abundance maps



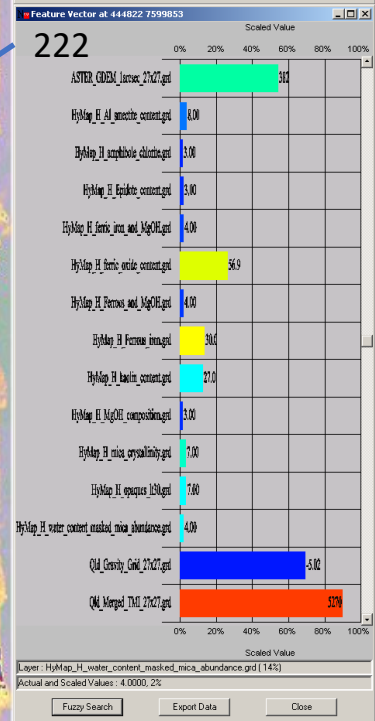
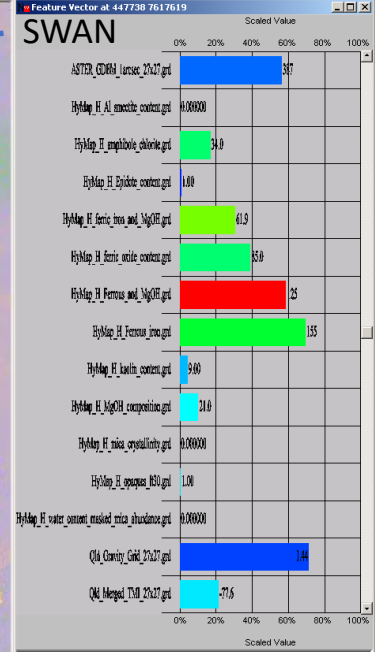
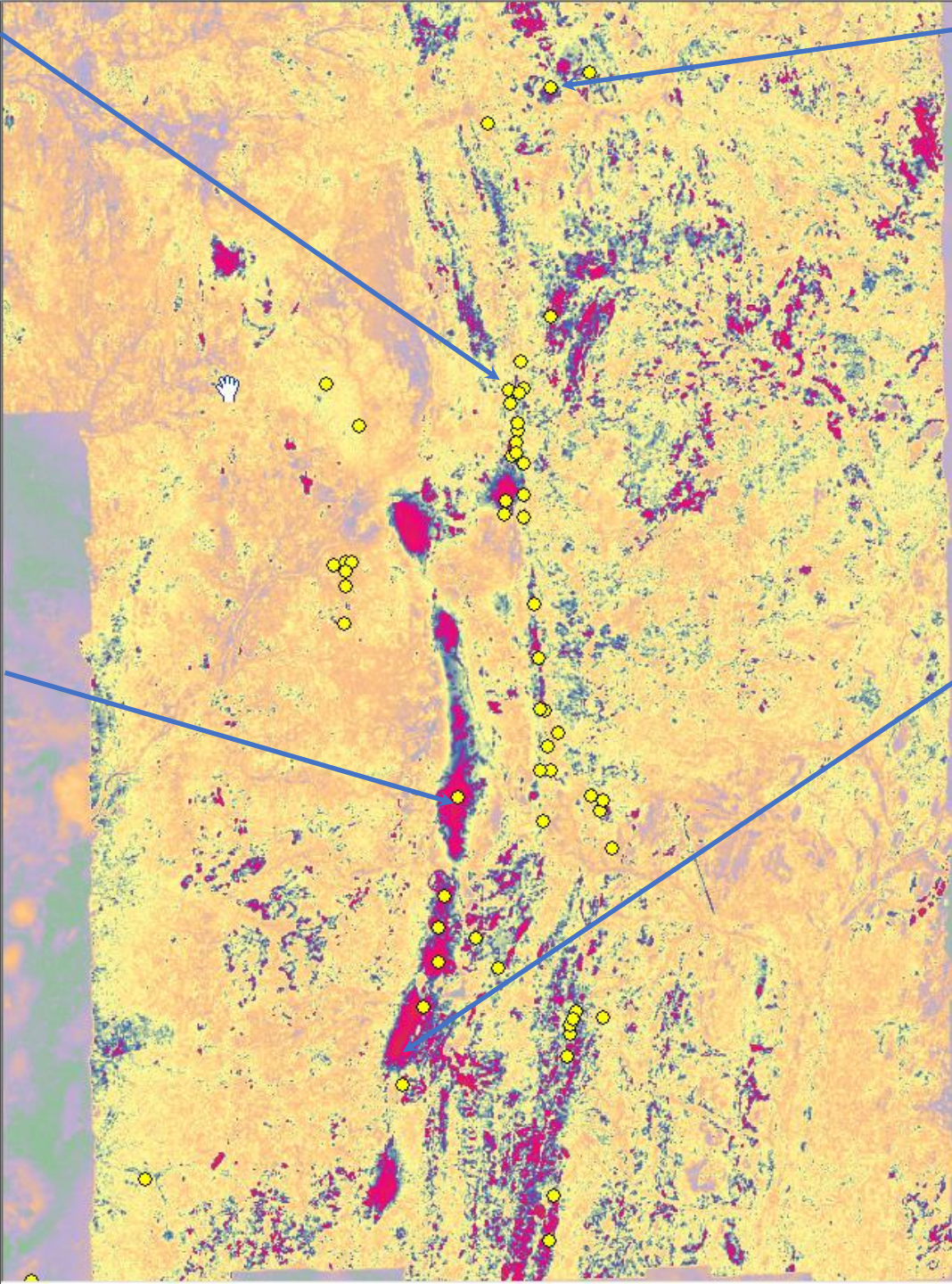
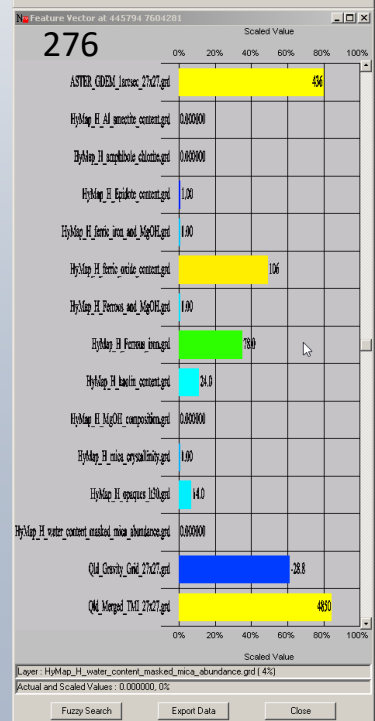
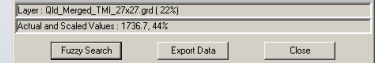
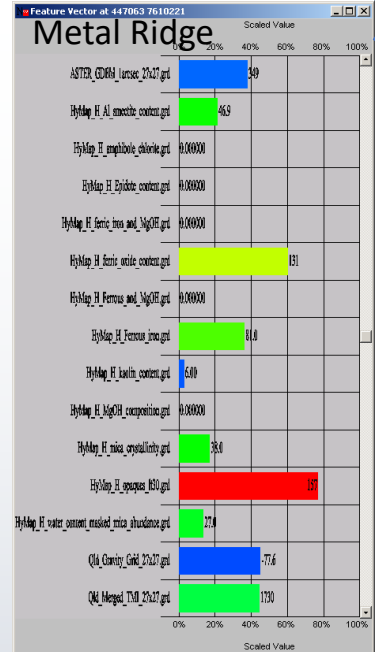


# Anomaly Map Unsupervised ANN

Highlighted colours signify cells having rare input layer associations

Mineralising systems:

- generally have a much smaller footprint relative to geological & geomorphological regions
- Unusual physical metrics (geophysical, geochemical, spatial etc.) relative to region
- Unlikely to be defined by a cluster or class of more frequently occurring input layer associations





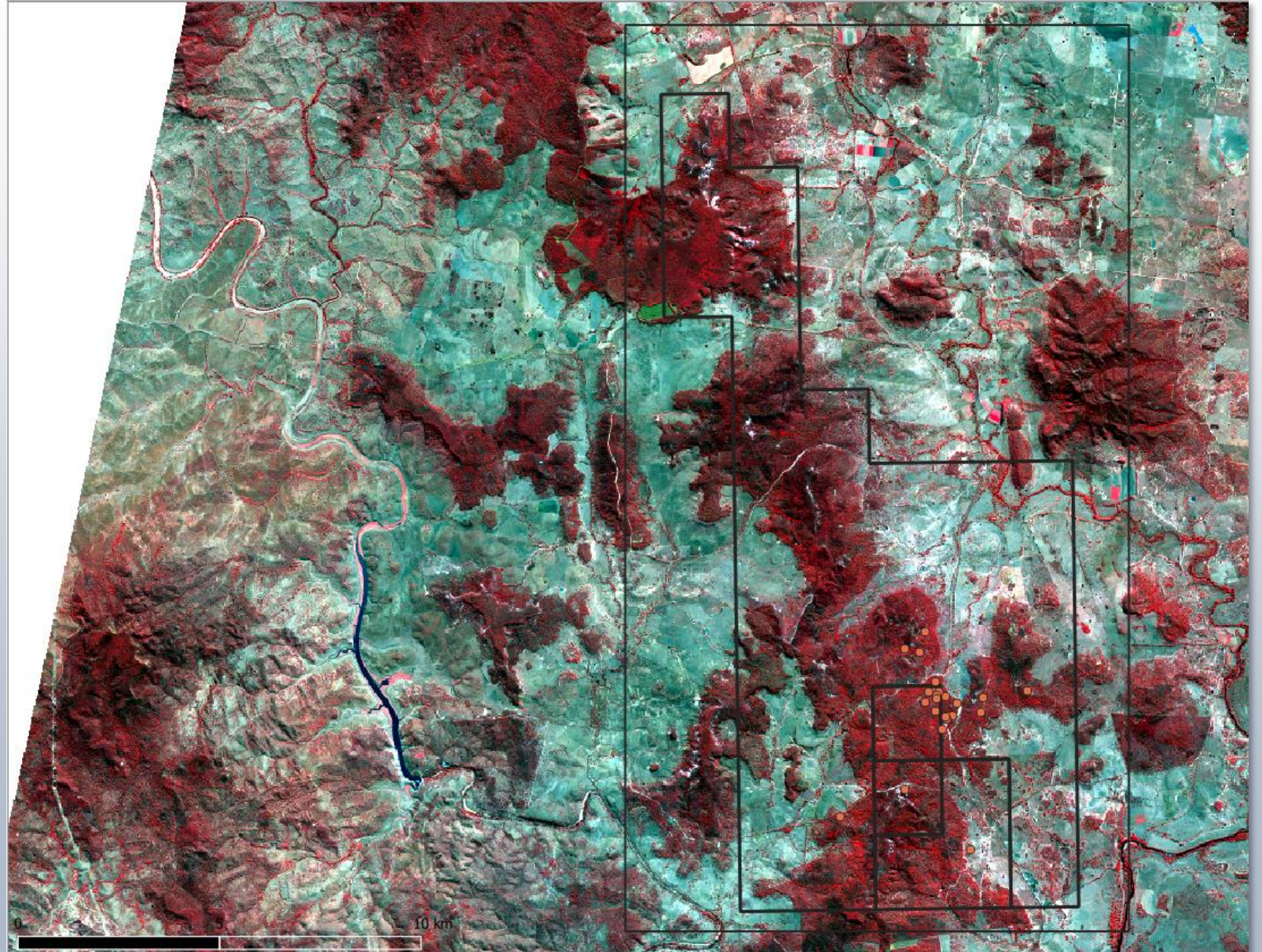




# Neural Analysis Project Using ASTER Data

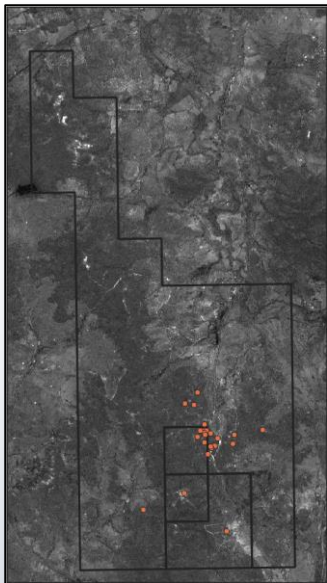
## AREA OF INTEREST

UPPER LEFT X=302500.000  
UPPER LEFT Y=7230000.000  
LOWER RIGHT X=315000.000  
LOWER RIGHT Y=7207500.000  
WEST LONGITUDE=151° 02' 21.4472" E  
NORTH LATITUDE=25° 01' 57.8340" S  
EAST LONGITUDE=151° 09' 58.9343" E  
SOUTH LATITUDE=25° 14' 14.6504" S  
UL CORNER LONGITUDE=151° 02' 33.1153" E  
UL CORNER LATITUDE=25° 01' 57.8340" S  
UR CORNER LONGITUDE=151° 09' 58.9343" E  
UR CORNER LATITUDE=25° 02' 03.5222" S  
LR CORNER LONGITUDE=151° 09' 48.0034" E  
LR CORNER LATITUDE=25° 14' 14.6504" S  
LL CORNER LONGITUDE=151° 02' 21.4472" E  
LL CORNER LATITUDE=25° 14' 08.9097" S  
PROJ\_DESC=UTM Zone -56 / WGS84 / meters  
PROJ\_DATUM=WGS84  
PROJ\_UNITS=meters  
EPSG\_CODE=EPSG:32756  
COVERED AREA=281.25 sq km

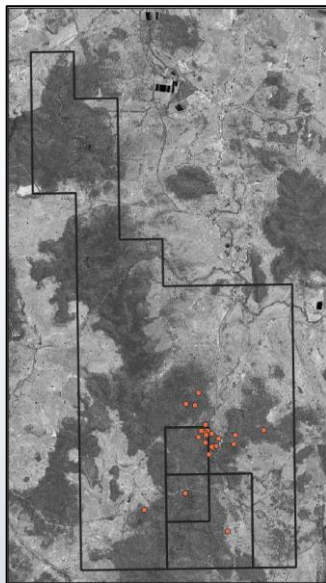




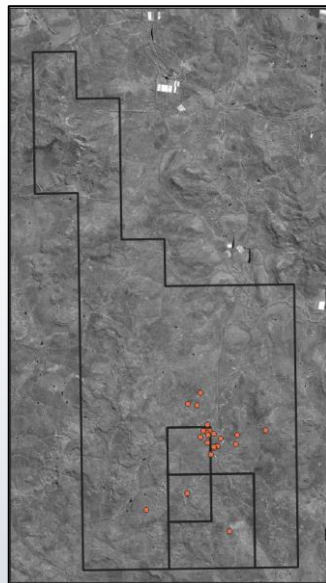
VNIR\_Band\_1\_DS



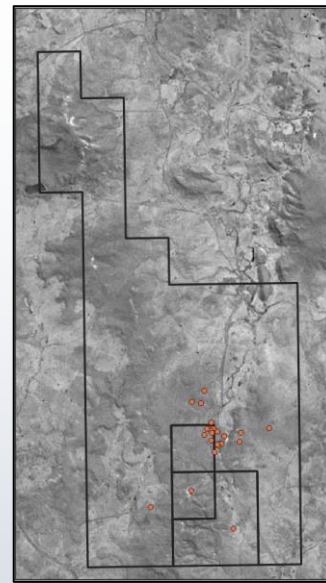
VNIR\_Band\_2\_DS



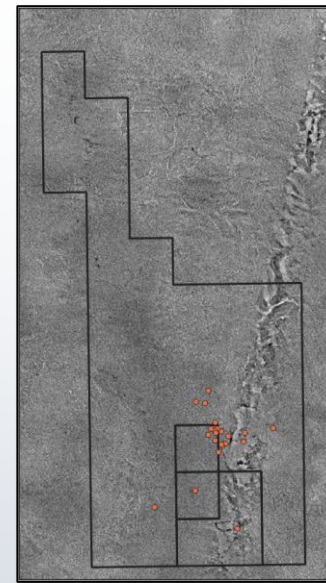
VNIR\_Band\_3\_DS



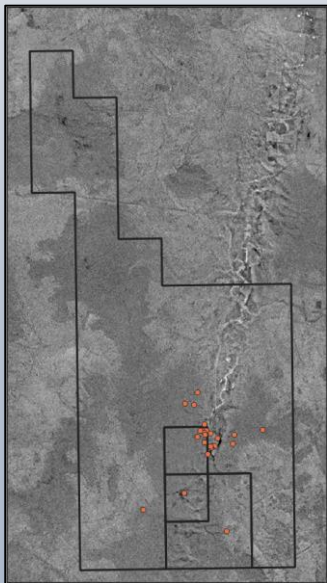
SWIR\_Band\_4\_DS



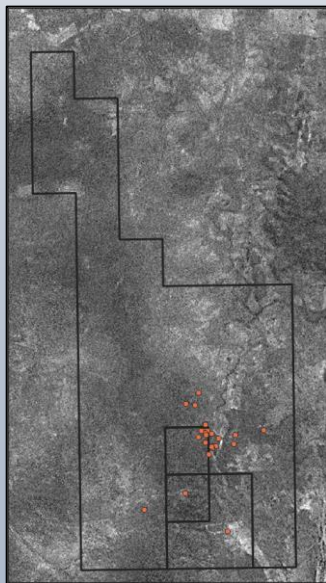
SWIR\_Band\_5\_DS



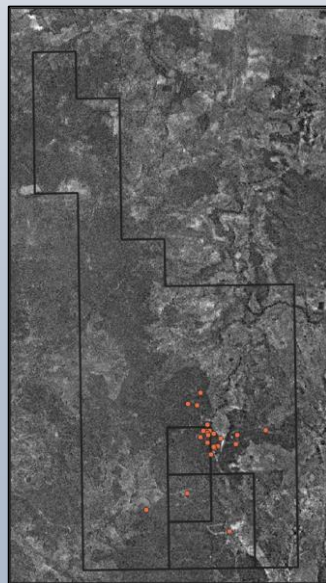
SWIR\_Band\_6\_DS



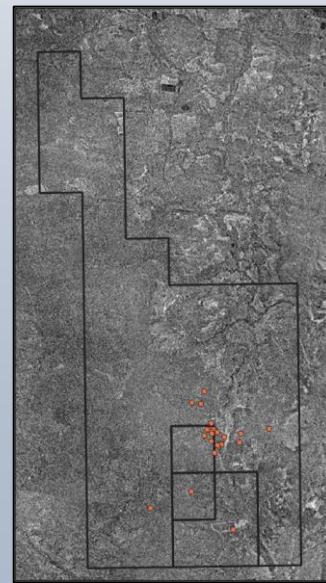
SWIR\_Band\_7\_DS



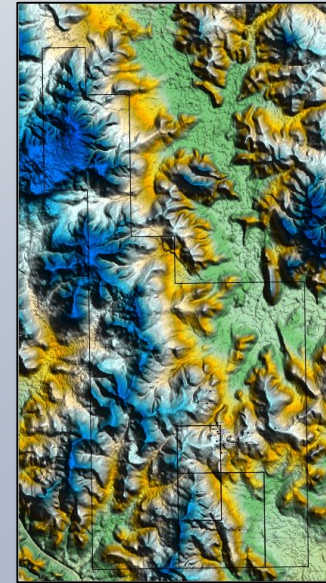
SWIR\_Band\_8\_DS



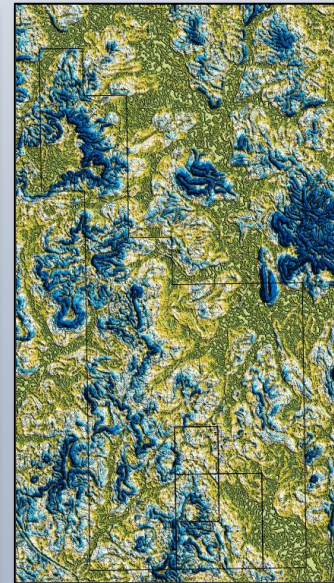
SWIR\_Band\_9\_DS



DEM

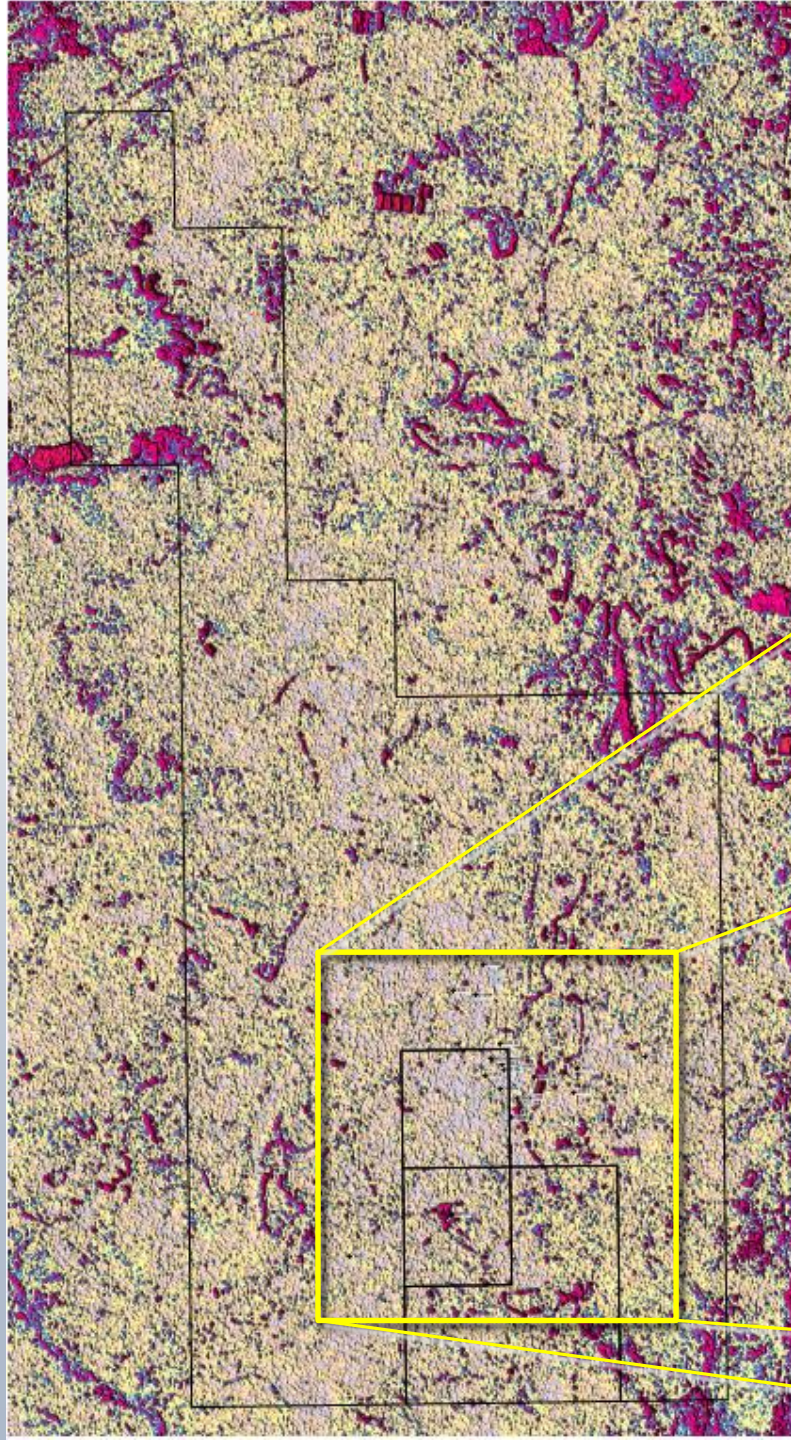
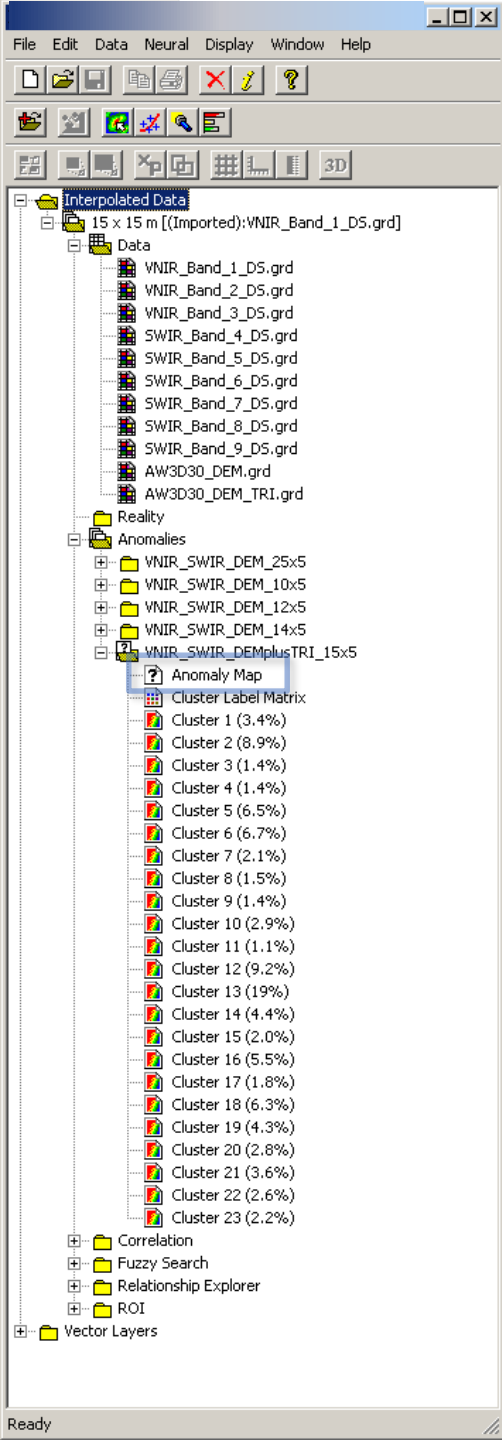


DEM – Terrain Ruggedness Index (TRI)



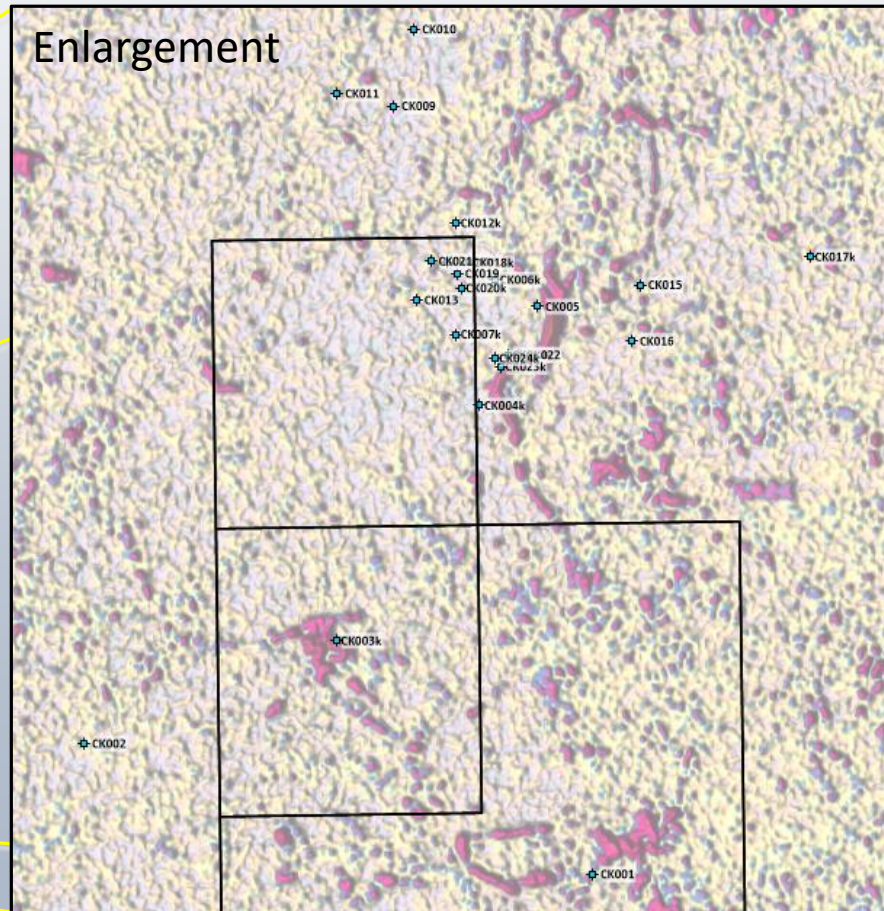
**ASTER&  
DEM Layers  
Used  
In Analysis**



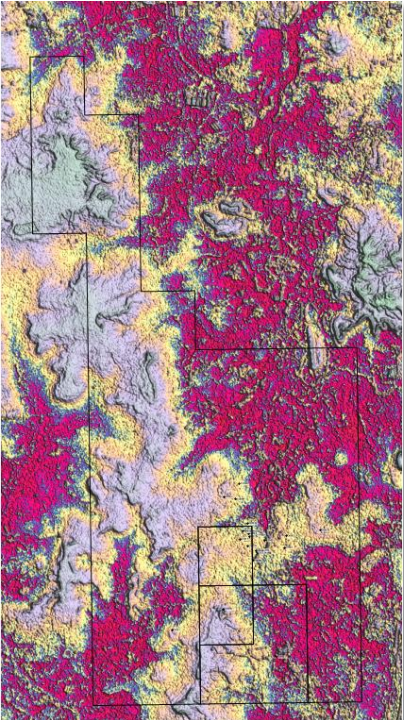


# Anomaly Map

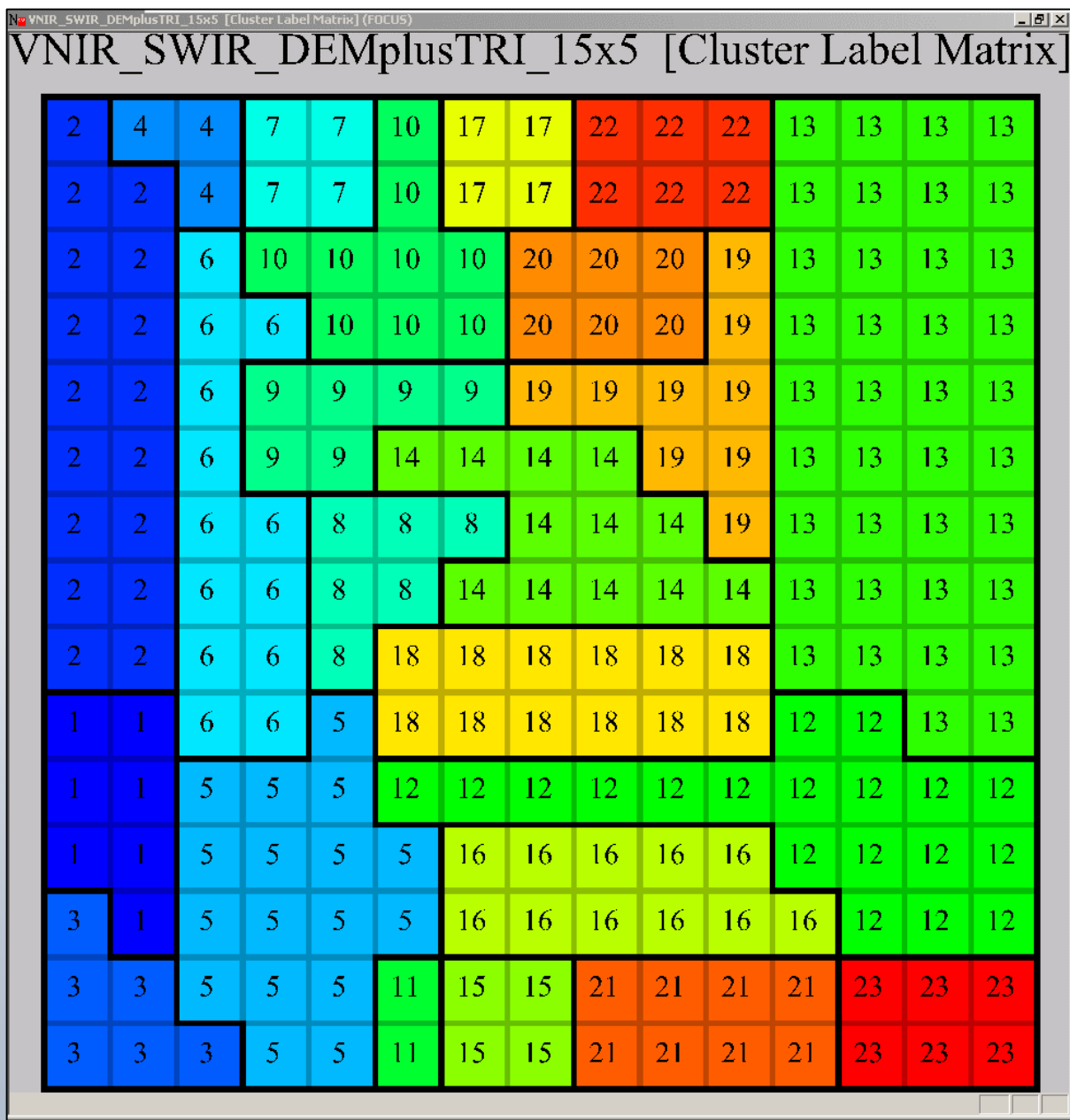
- Magenta colours signify points with unique input layer associations too rare to comprise a cluster
- Anomalous points may be unique for different reasons
- The only drill hole coinciding with an anomaly is CK003



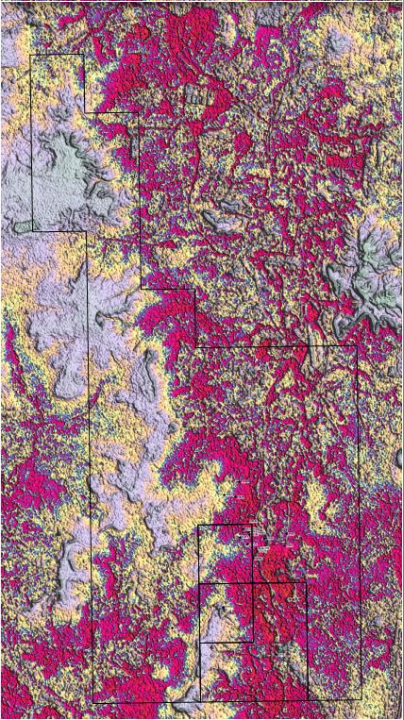
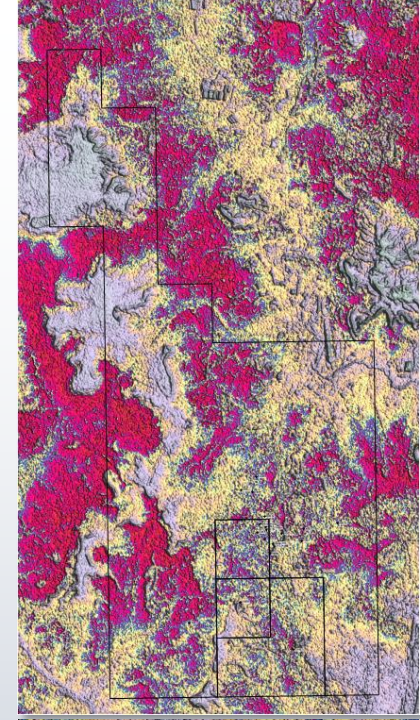




Cluster 2

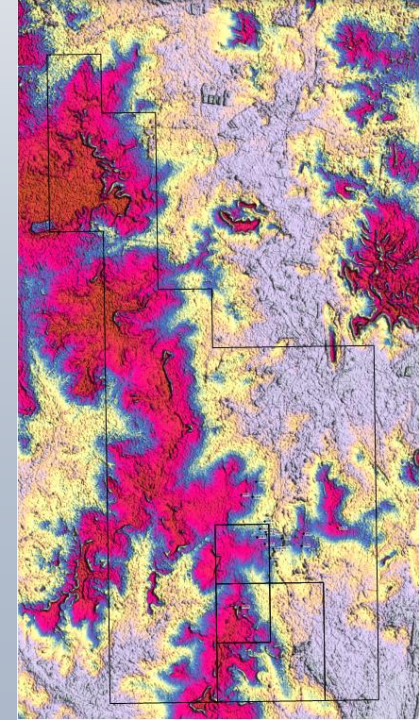


Cluster 13



Cluster 3

Cluster 23



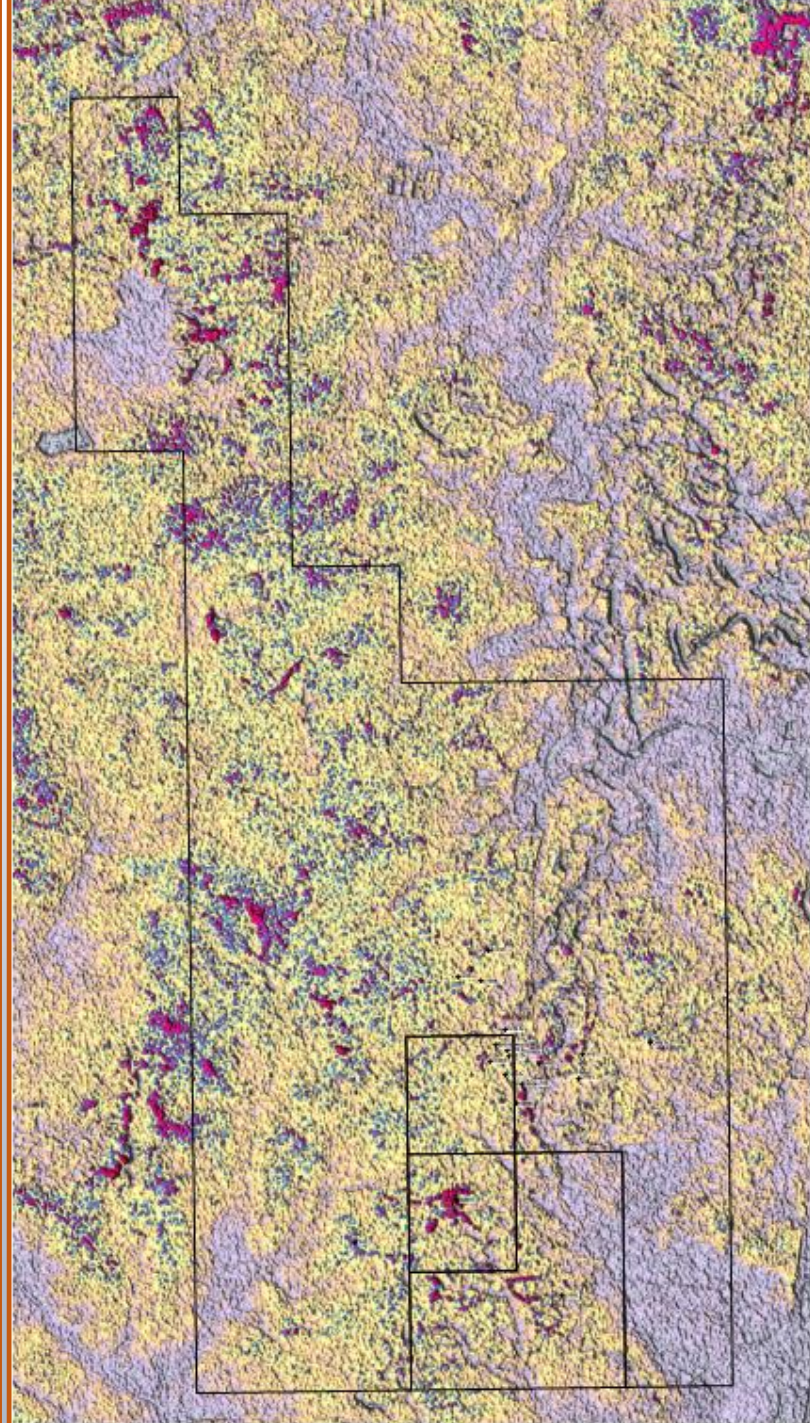
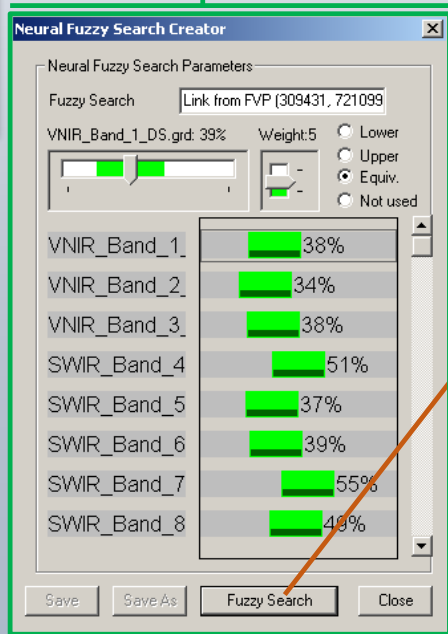
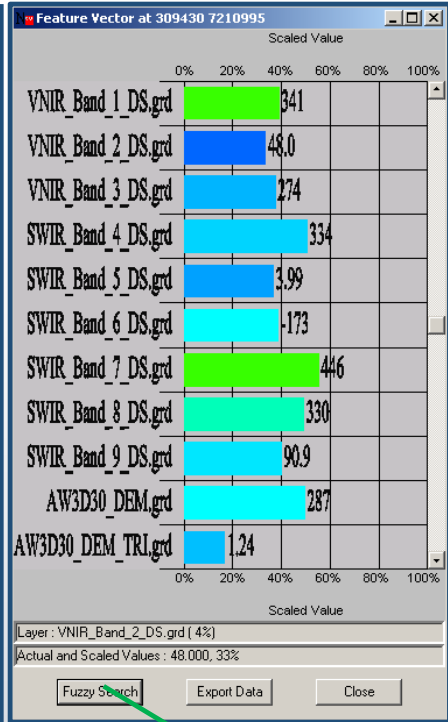
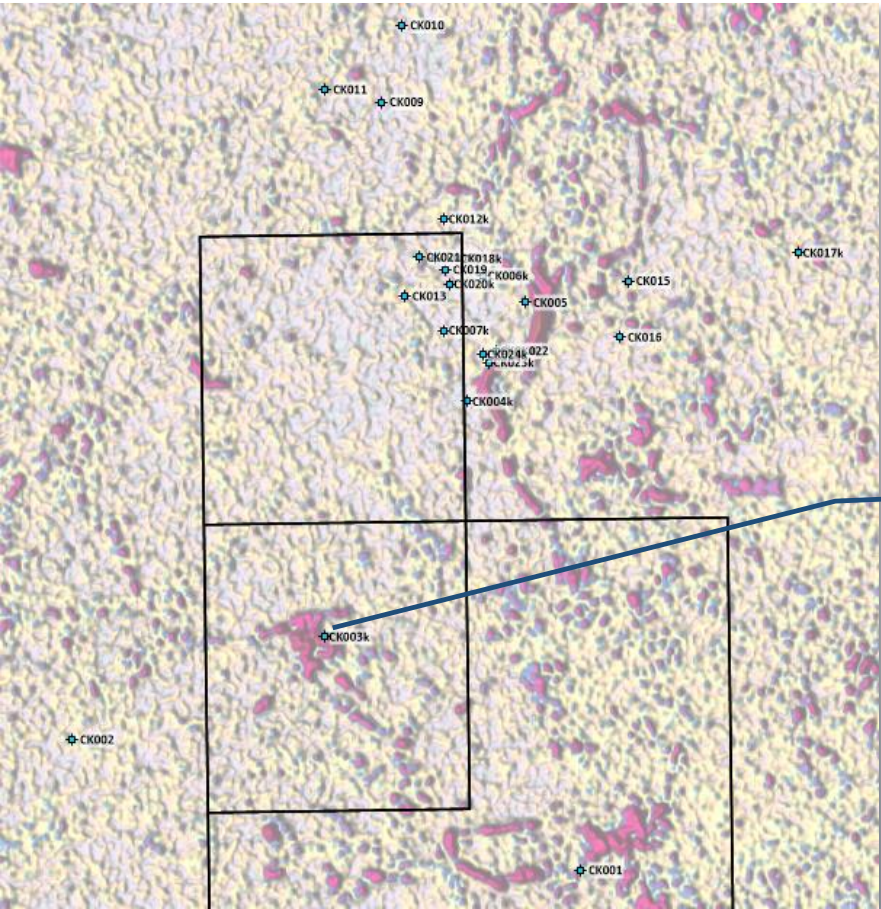
Cluster Label Matrix – neural matrix indicating the relationship between clusters defined by the unsupervised ANN



## Workflow

1. Generate feature vector plot at point of interest (CK003)
2. Create a Neural Fuzzy Search profile. Form auto-populated by relevant search profile
3. Initiate a fuzzy search to generate a similarity map showing points more closely sharing the same input layer association as CK003 in magenta.

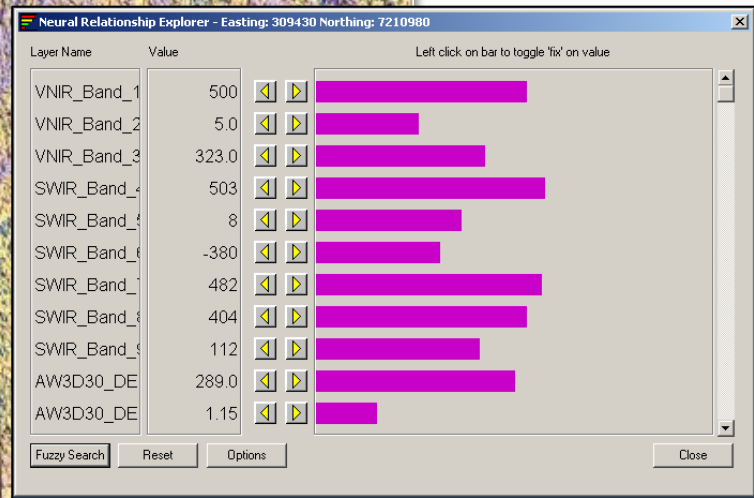
## Drill hole Prospectivity Map



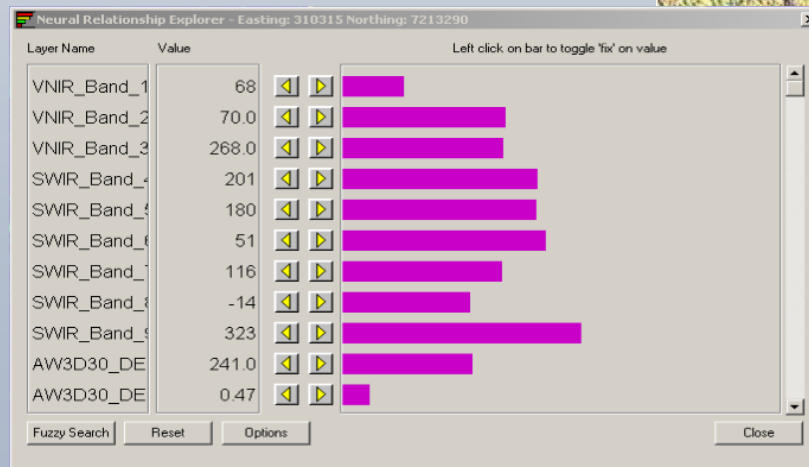


# CK003

## ROI supervised learning NRE pattern & distribution



## Densest drill location ROI correlation search NRE pattern & distribution

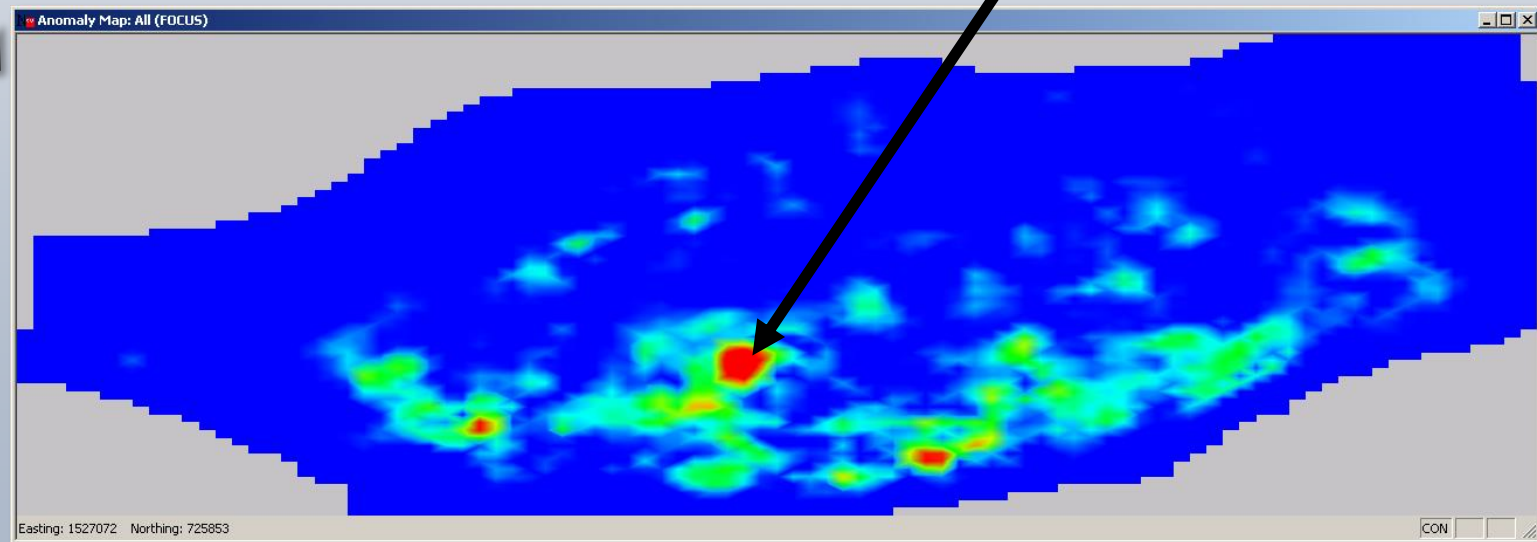
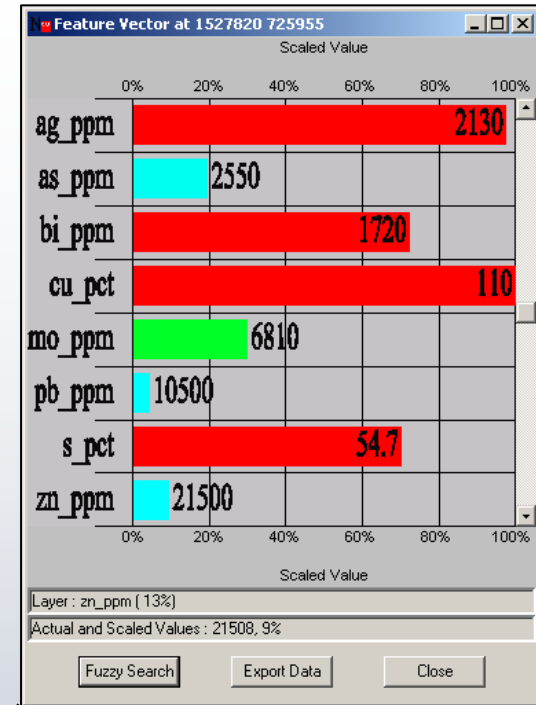
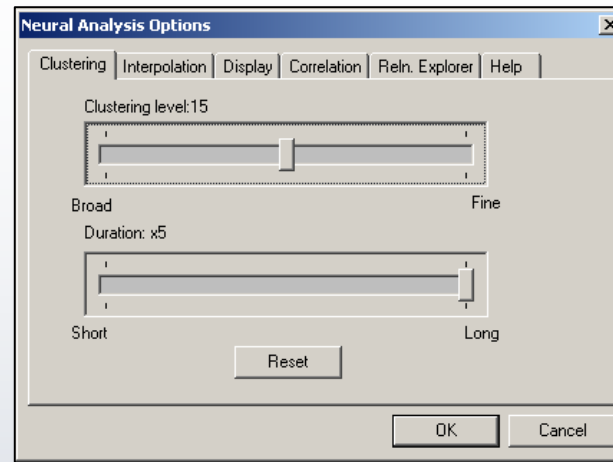
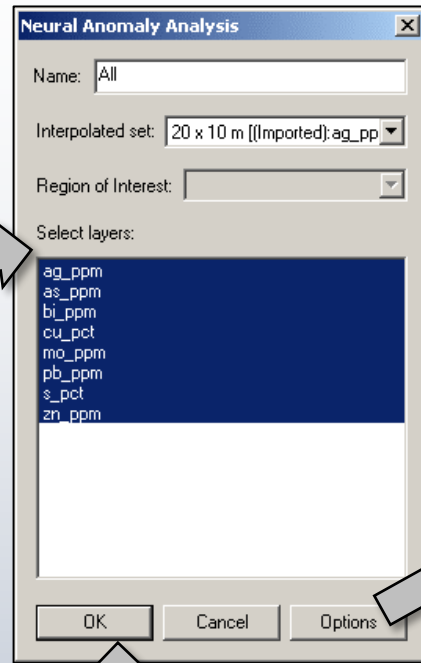
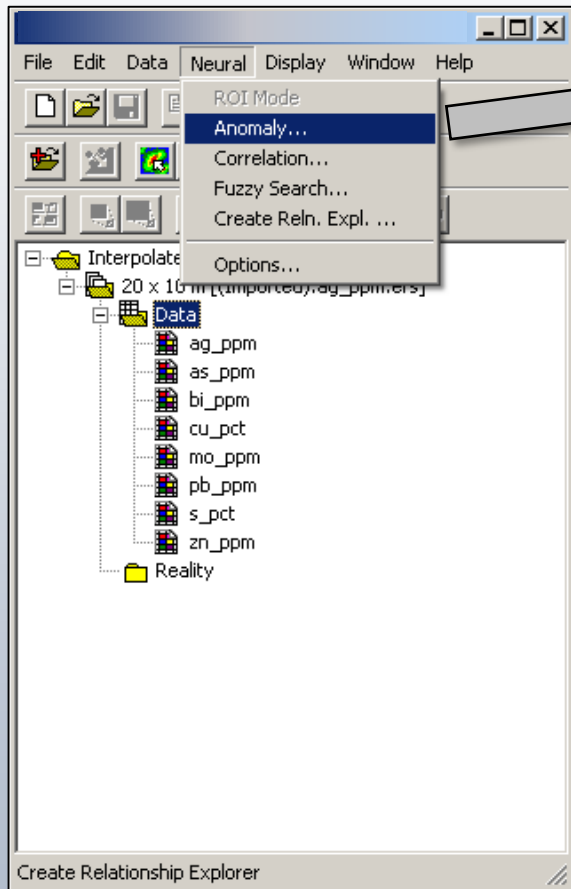




# 3D Neural Network Analysis Project

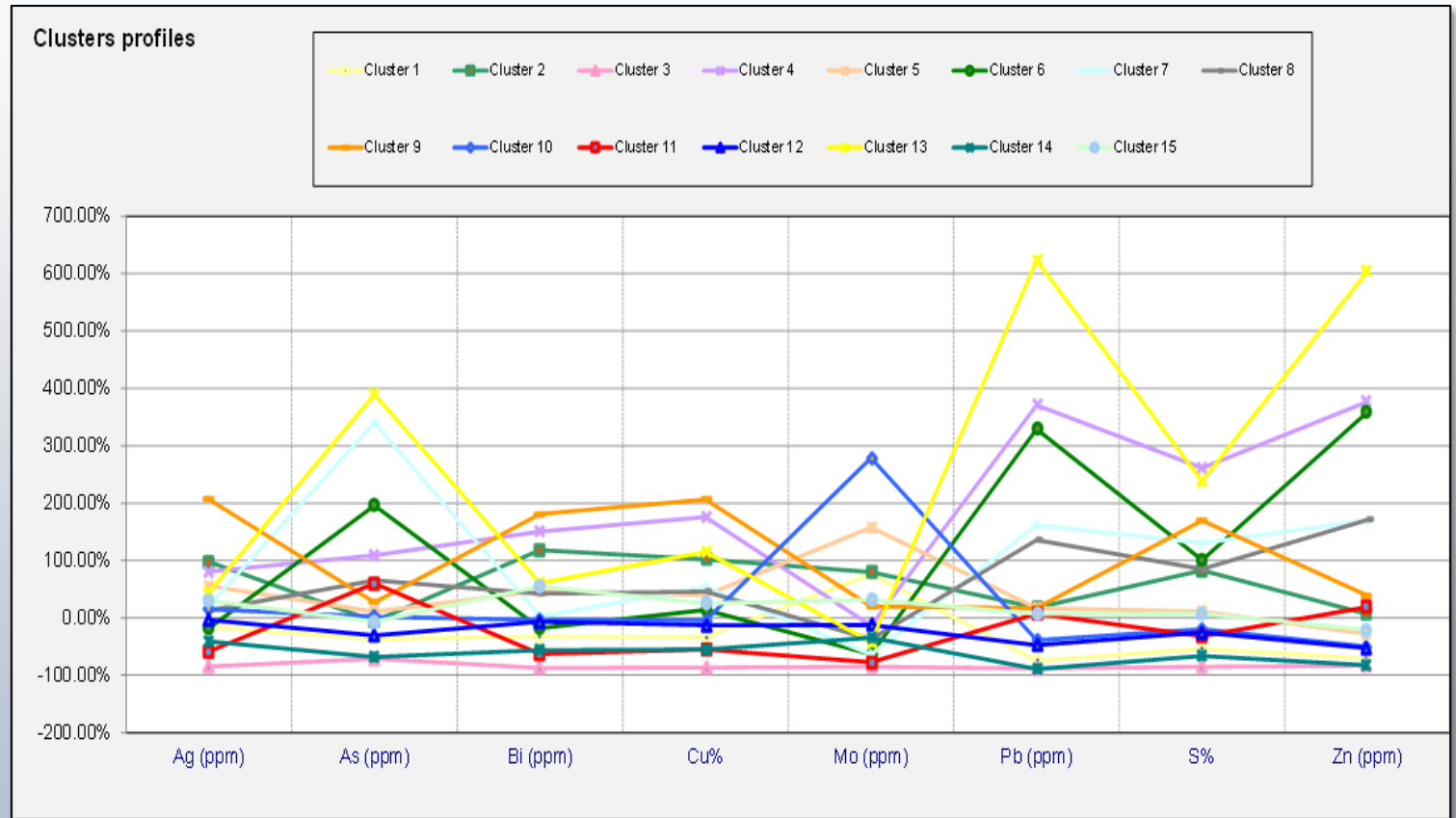
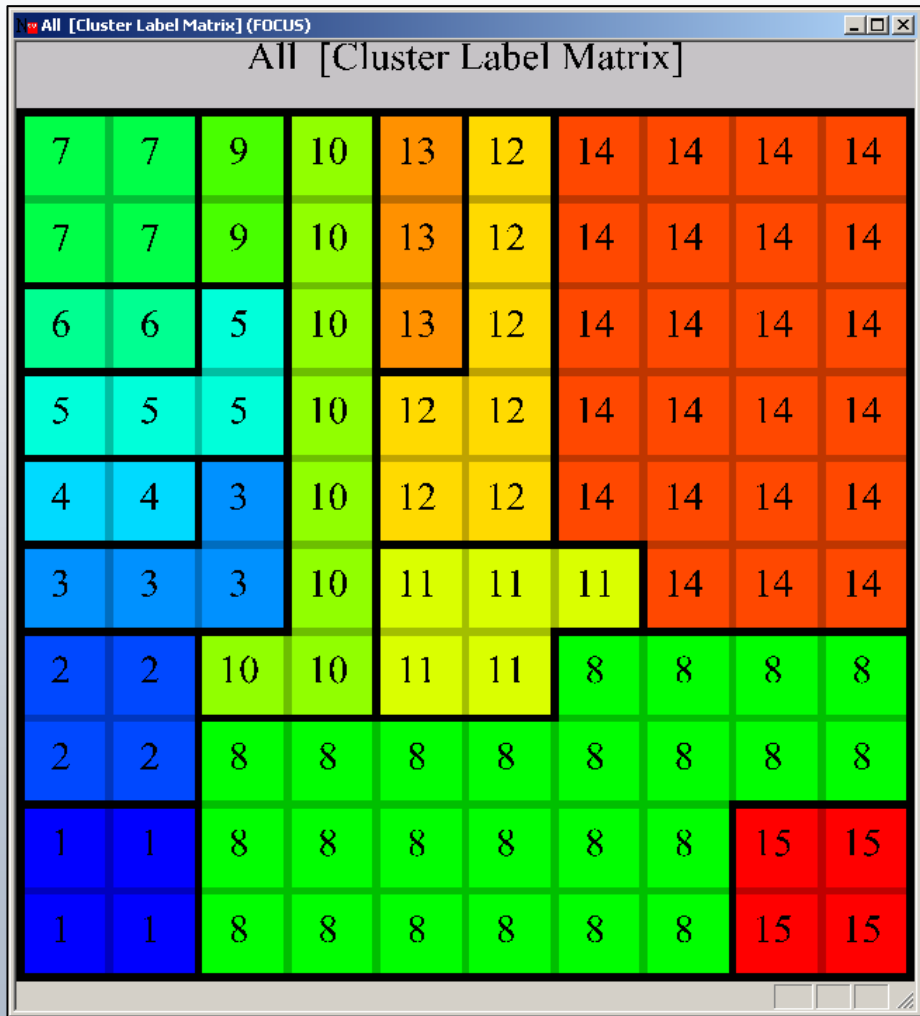
- Geochemical-geometallurgical domains can be identified using multivariate data analysis combined with machine learning pattern-recognition techniques (Keeney, 2010; Montoya et al. 2011).
- Geochemical domains can reflect mineralogy to a degree that might be difficult or impossible to produce using geological mapping, visual logging, or considering geochemical data in conventional ways (Berry et al., 2011; Cobeñas et al., 2015).
- Example project – 3D block model of a strata bound Cu deposit with 8 elements modelled: Ag, As, Bi, Cu, Mo, Pb, S, Zn
- Over 150 RC and diamond drill holes defining the resource

# Unsupervised Anomaly Map

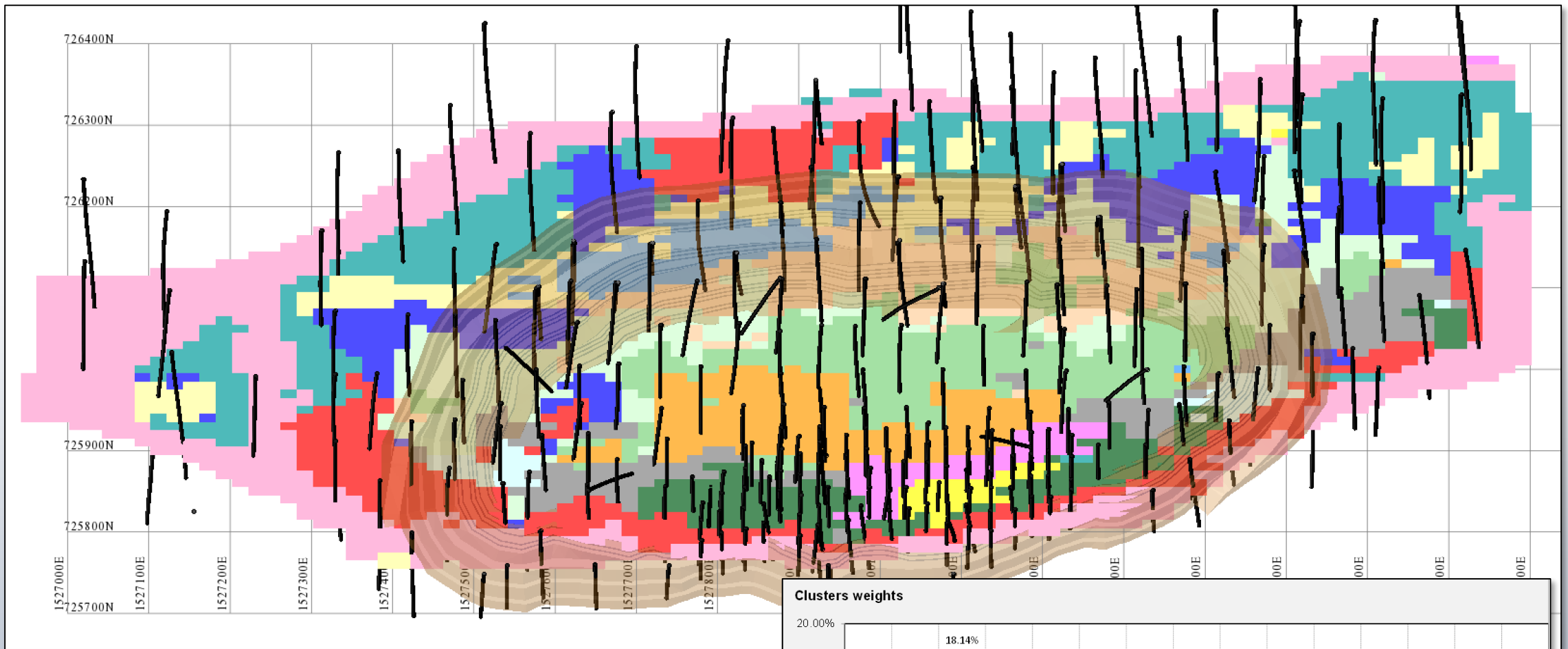




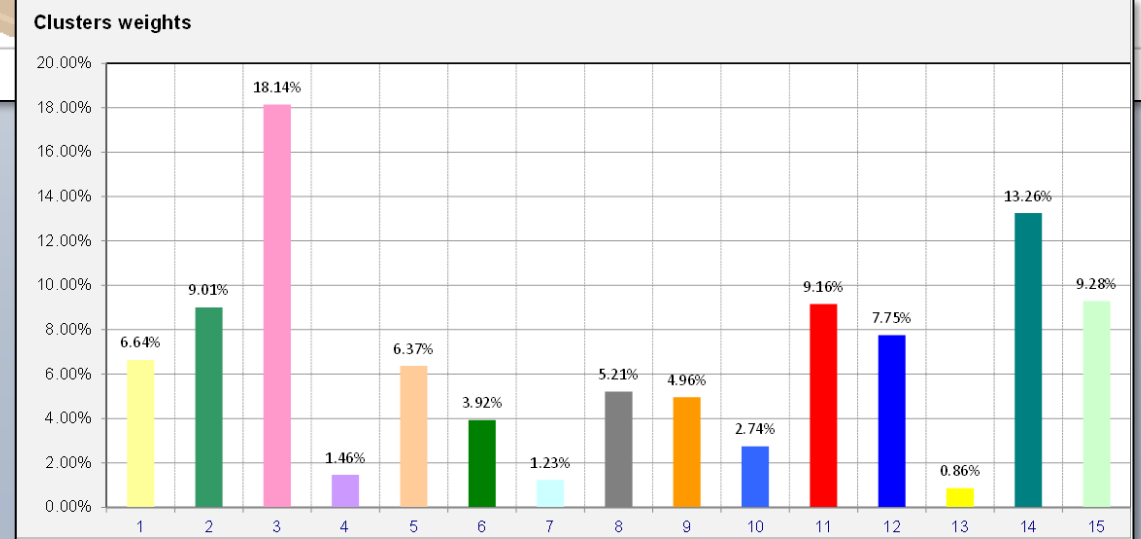
# Unsupervised Cluster Identification



Cluster profiles for 15 clusters generated. The peaks represent the relative strength of their contribution of the element to the cluster in which they are associated.



Clusters exist in spatially coincident groups suggesting that they have meaning in terms of the geological process.





# Fuzzy Search for High As, Bi and Cu

File Edit Data Neural Display Window Help

- ROI Mode
- Anomaly...
- Correlation...
- Fuzzy Search...**
- Create Reln. Expl. ...
- Options...

Interpolated  
20 x 10 m (Campocody/ag\_ppm/orig)

- Data
  - ag\_ppm
  - as\_ppm
  - bi\_ppm
  - cu\_pct
  - mo\_ppm
  - pb\_ppm
  - s\_pct
  - zn\_ppm
- Reality
- Anomalies
  - All
    - Anomaly Map
    - Cluster Label Matrix
    - Cluster 1 (3.9%)
    - Cluster 2 (2.8%)
    - Cluster 3 (5.0%)
    - Cluster 4 (4.1%)
    - Cluster 5 (5.1%)
    - Cluster 6 (5.5%)
    - Cluster 7 (16%)
    - Cluster 8 (20%)
    - Cluster 9 (3.8%)
    - Cluster 10 (3.3%)
    - Cluster 11 (3.9%)
    - Cluster 12 (5.0%)
    - Cluster 13 (3.7%)
    - Cluster 14 (15%)
    - Cluster 15 (3.3%)
- Fuzzy Search
- Point Prospects

Ready

Neural Fuzzy Search Creator

Neural Fuzzy Search Parameters

Fuzzy Search: Hi As Bi Cu

bi\_ppm: 50% Weight: 7

Lower  
Upper  
Equiv.  
Not used

ag_ppm	
as_ppm	50%
bi_ppm	50%
cu_pct	50%
mo_ppm	
pb_ppm	
s_pct	
zn_ppm	

Save Save As Fuzzy Search Close

Increase As weighting

Feature Vector at 1528080 725845

Scaled Value

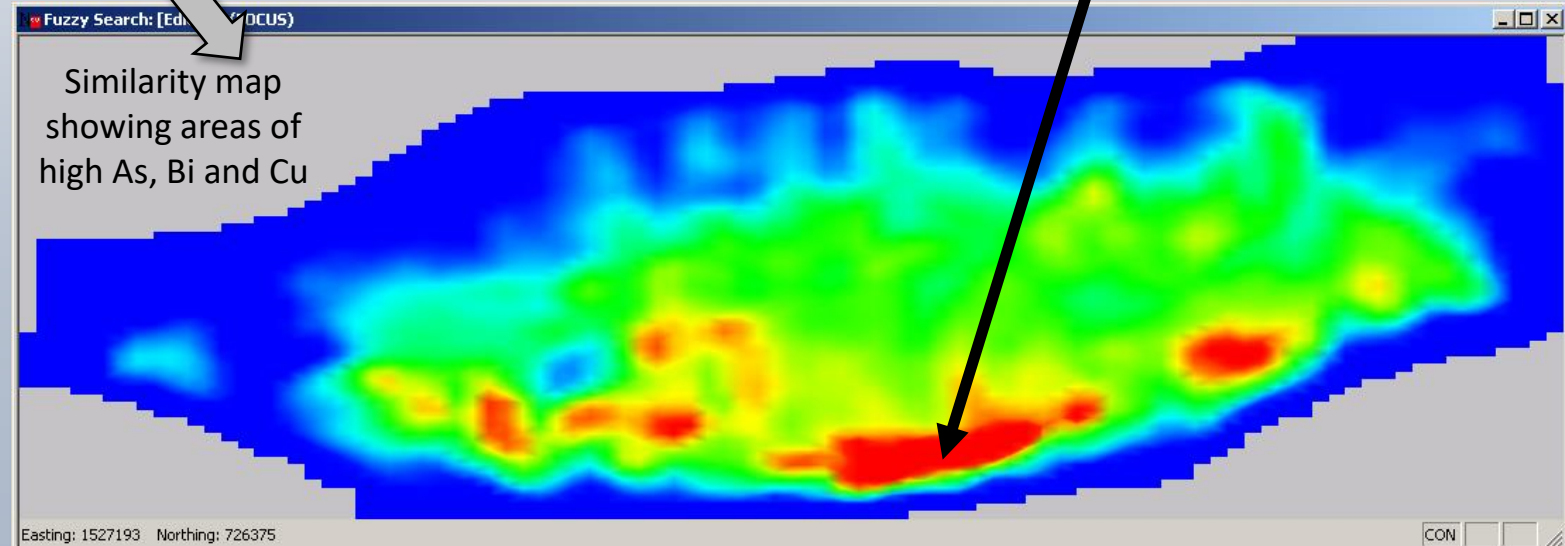
	0%	20%	40%	60%	80%	100%
ag_ppm						761
as_ppm						8280
bi_ppm						1450
cu_pct						69.8
mo_ppm						4020
pb_ppm						191000
s_pct						70.4
zn_ppm						194000

Scaled Value

Layer: pb\_ppm ( 71%)

Actual and Scaled Values: 191160, 80%

Fuzzy Search Export Data Close

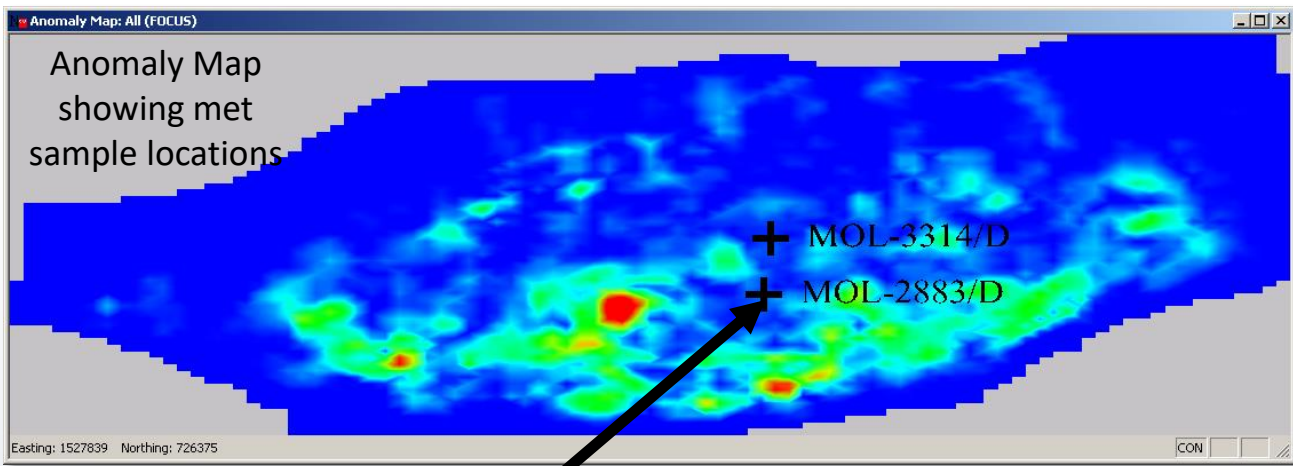


File Edit Data Neural Display Window Help

Interpolated Data

- 20 x 10 m [(Imported):ag\_ppm.ers]
  - Data
    - ag\_ppm
    - as\_ppm
    - bi\_ppm
    - cu\_pct
    - mo\_ppm
    - pb\_ppm
    - s\_pct
    - zn\_ppm
  - Reality
  - Anomalies
    - All
      - Anomaly Map
      - Cluster Label Matrix
      - Cluster 1 (3.9%)
      - Cluster 2 (2.8%)
      - Cluster 3 (5.0%)
      - Cluster 4 (4.1%)
      - Cluster 5 (5.1%)
      - Cluster 6 (5.5%)
      - Cluster 7 (16%)
      - Cluster 8 (20%)
      - Cluster 9 (3.8%)
      - Cluster 10 (3.3%)
      - Cluster 11 (3.9%)
      - Cluster 12 (5.0%)
      - Cluster 13 (3.7%)
      - Cluster 14 (15%)
      - Cluster 15 (3.3%)
    - Fuzzy Search
    - Point Prospects

Ready



Feature Vector at 1528020 725975

Scaled Value

Element	Value
ag_ppm	588
as_ppm	1040
bi_ppm	1380
cu_pct	46.2
mo_ppm	3850
pb_ppm	28700
s_pct	30.0
zn_ppm	26400

Scaled Value

Layer: bi\_ppm [43%]

Actual and Scaled Values: 1382.3, 57%

Fuzzy Search Export Data Close

FVP showing geochemical characteristics of a particular met sample

Fuzzy Search Creator using met sample search criteria

Neural Fuzzy Search Creator

Neural Fuzzy Search Parameters

Fuzzy Search Link from FVP (1528021, 72597)

ag\_ppm: 27% Weight: 5  Lower  Upper  Equiv.  Not used

ag\_ppm 26%

as\_ppm 8%

bi\_ppm 58%

cu\_pct 42%

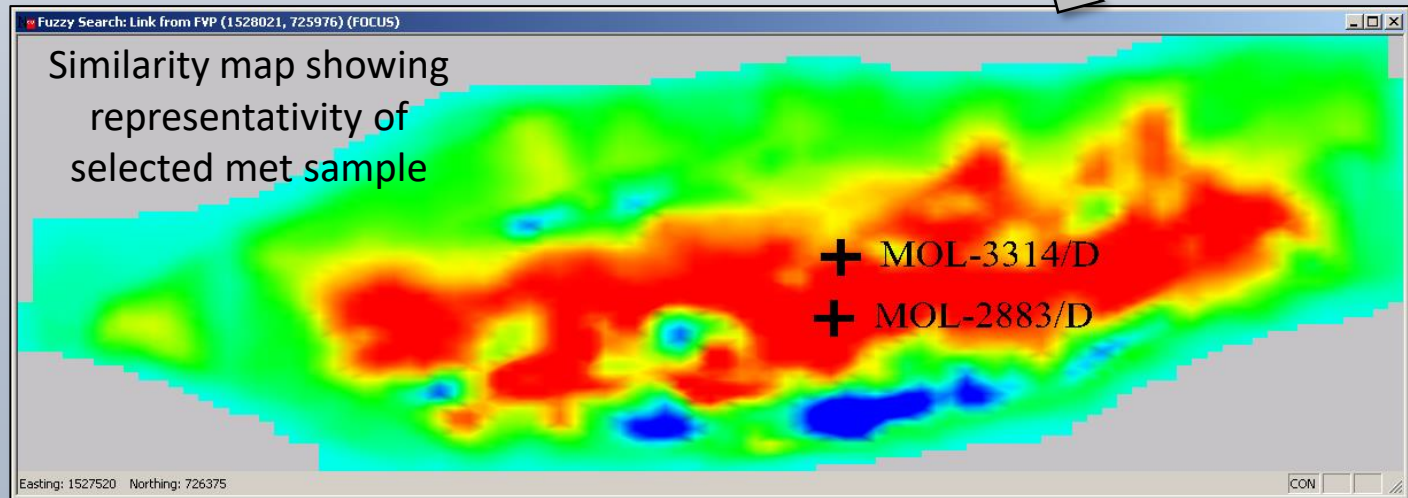
mo\_ppm 17%

pb\_ppm 12%

s\_pct 39%

zn\_ppm 12%

Save Save As Fuzzy Search Close



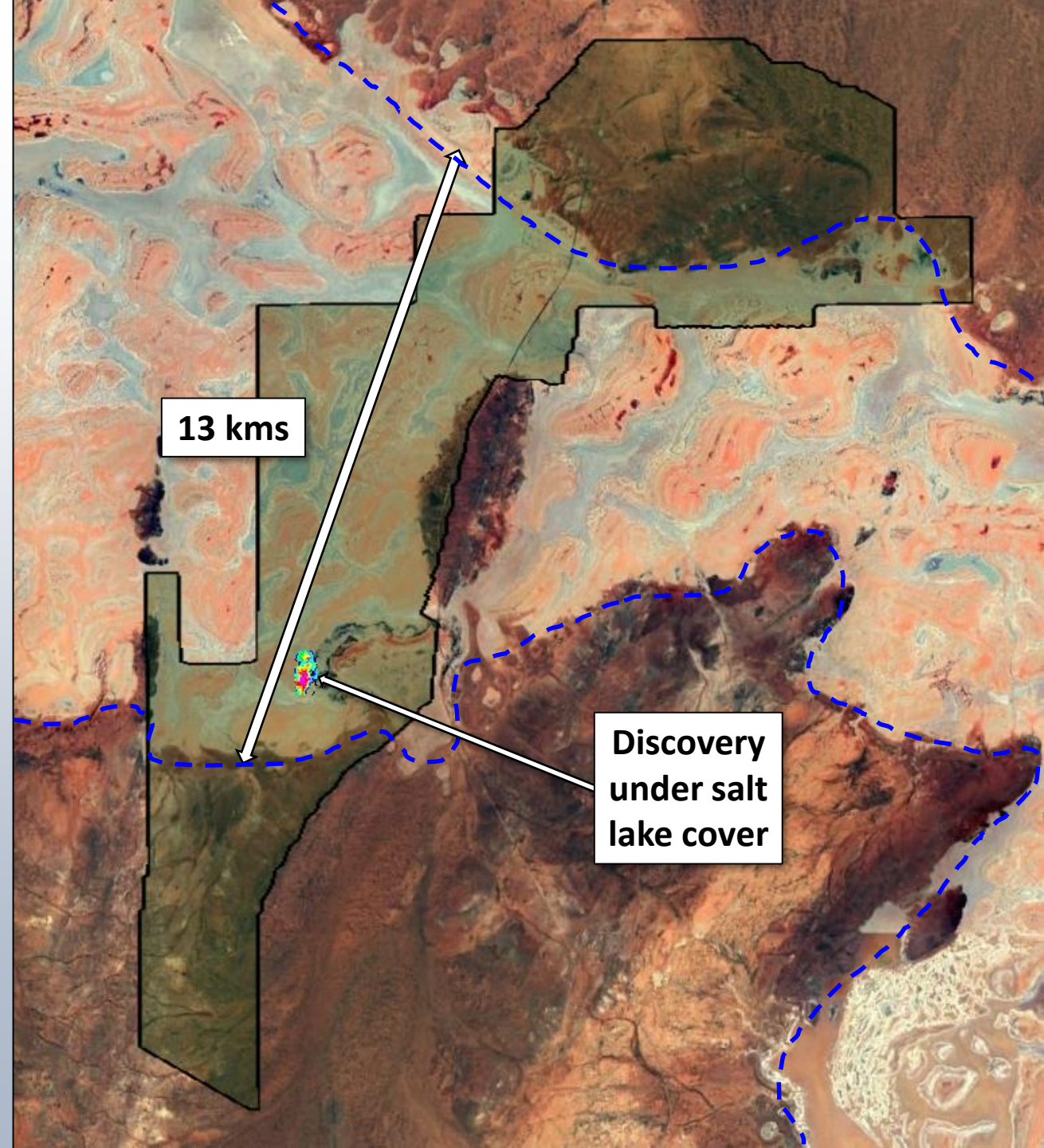


# Under Cover Western Australian Archean Gold Project

This project was recently completed for a company exploring for gold beneath a salt lake in Western Australia.

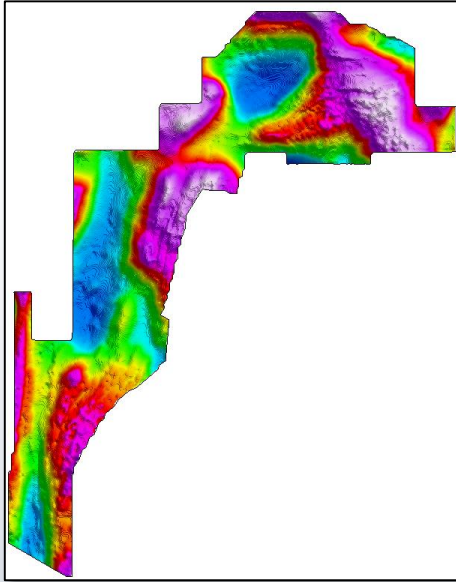
The company had made a significant discovery and had completed an initial drilling program with some outstanding intersections.

The cost of drilling on the lake was very high so they were looking for ways to minimize the drilling by locating targets under cover using machine learning.

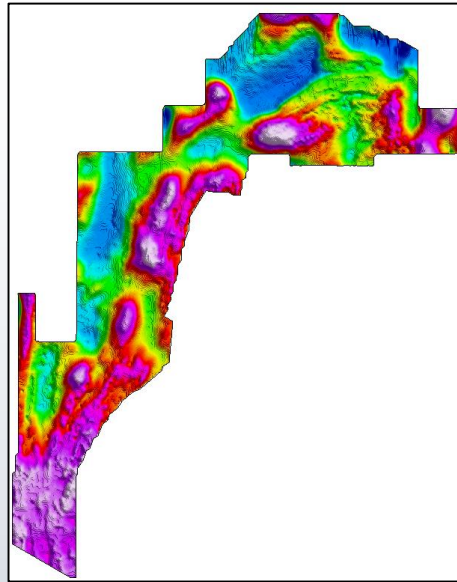


**Gravity  
layers**

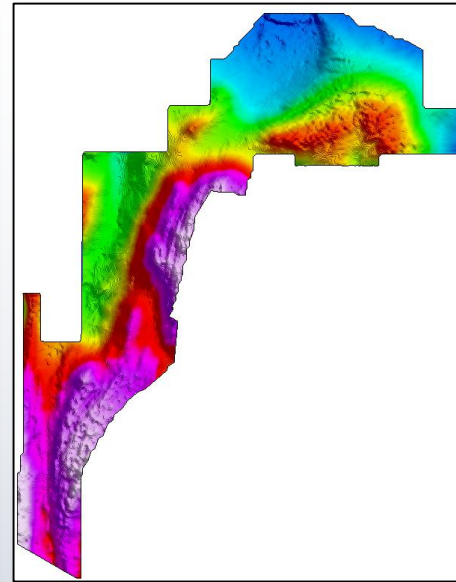
BA\_3<sup>rd</sup>\_Order\_Res



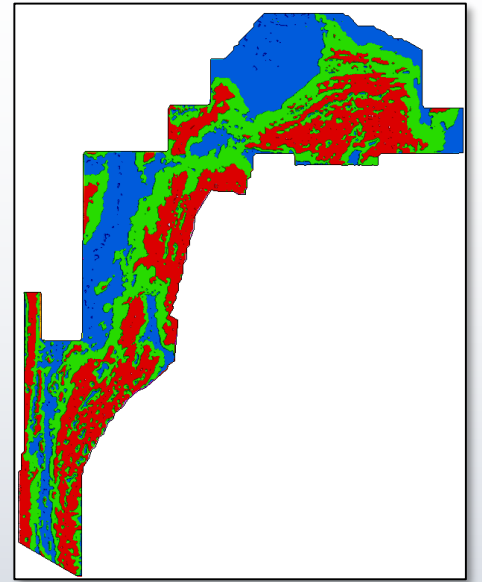
BA\_Res\_5km



SCBA267GU

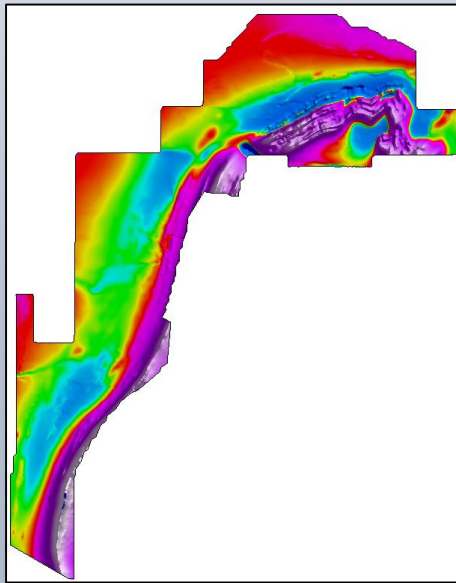


SCBA267GU-tilt

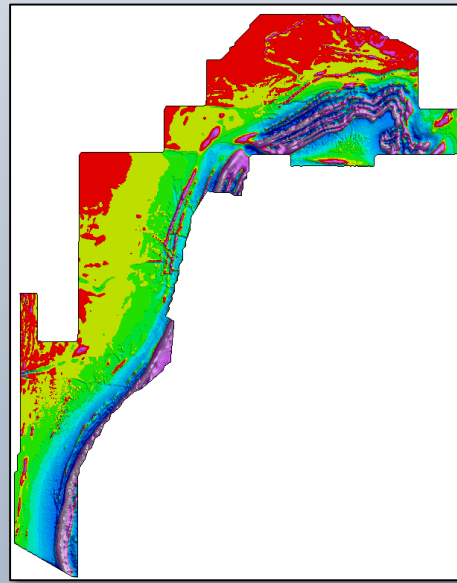


**Magnetics  
layers**

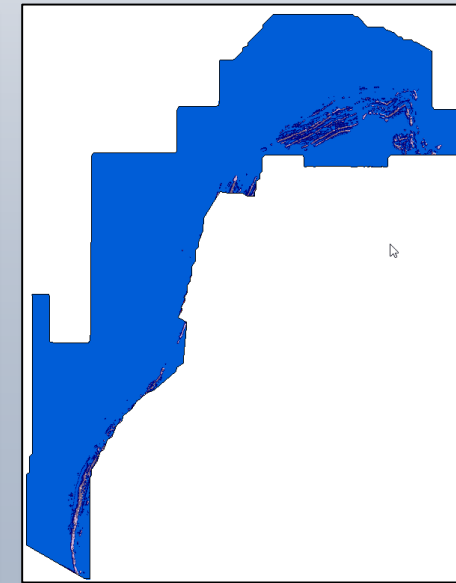
TMI\_RTP



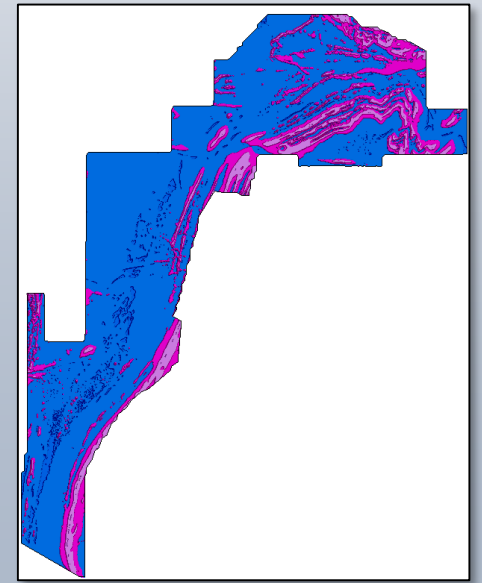
TMI\_TRP-1VD



TMI\_RTP-2VD

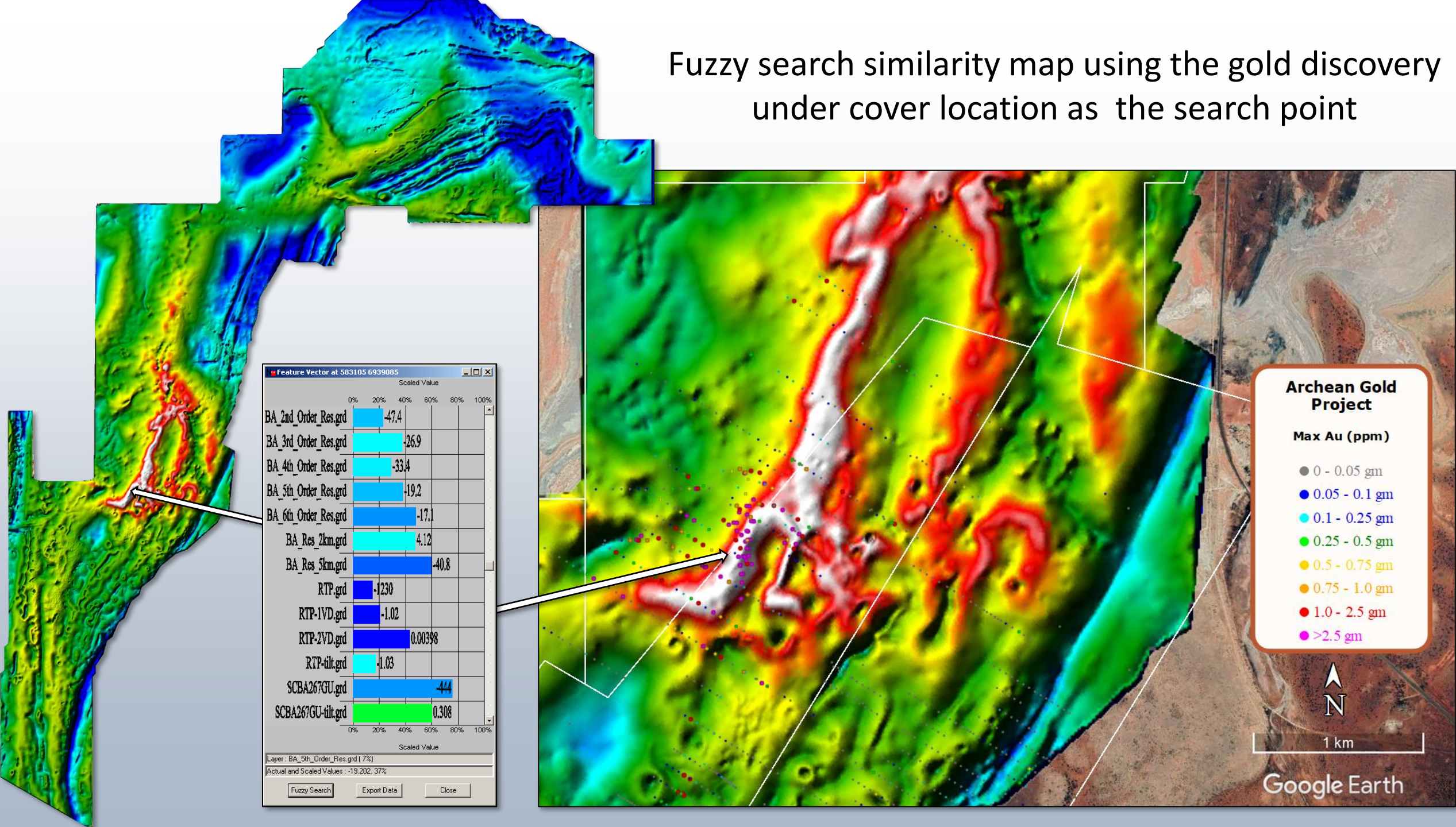


TMI\_RTP-tilt



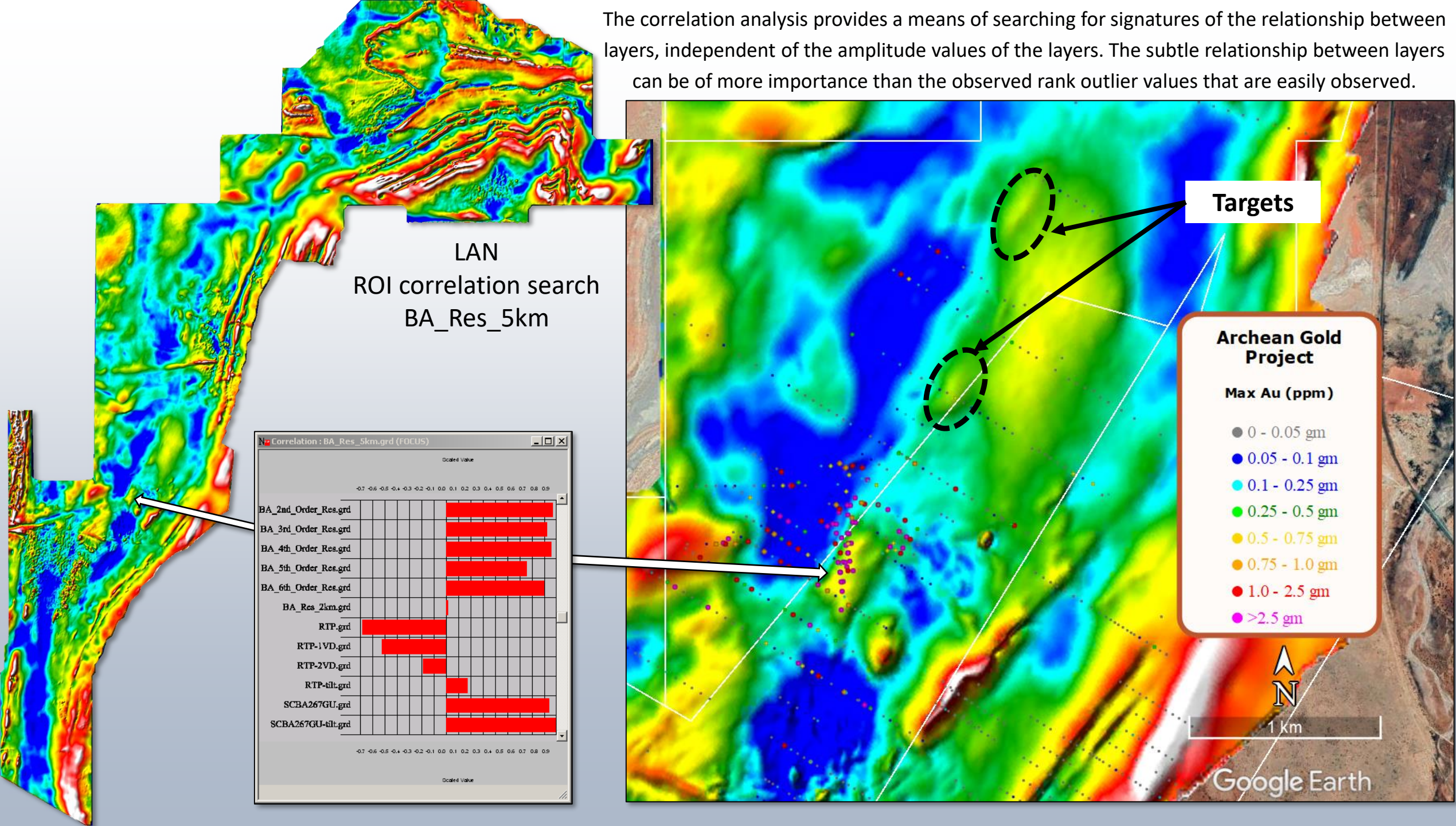


# Fuzzy search similarity map using the gold discovery under cover location as the search point





The correlation analysis provides a means of searching for signatures of the relationship between layers, independent of the amplitude values of the layers. The subtle relationship between layers can be of more importance than the observed rank outlier values that are easily observed.







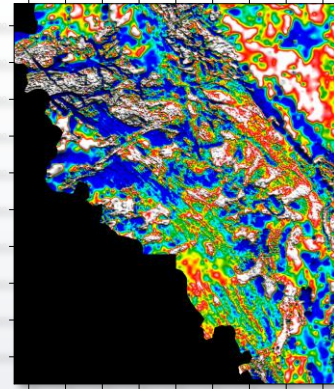
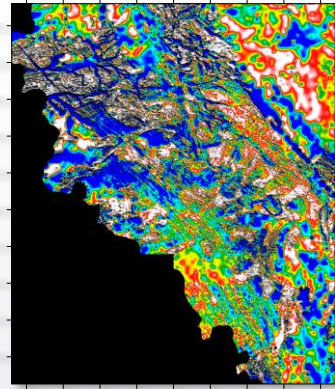
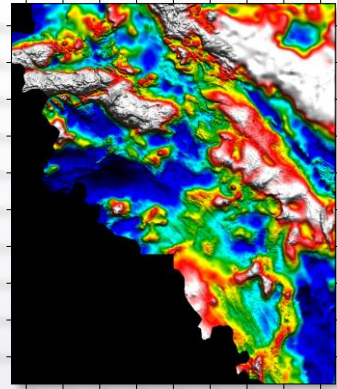
GeoWizards have utilized the exploration data supplied by Oz Minerals, as well as sourcing other data, to perform detailed Neural Network processing using unsupervised neural analysis tools to automatically identify anomalies, and supervised analysis tools using data relationships at known mineral deposits such as Olympic Dam and Prominent Hill to search for “lookalikes”. The resulting anomaly and similarity maps have then been integrated with geology and drill hole data to develop a feature selection matrix that has been used to prioritise targets for further investigation.

gravity

gravity

1VD

UC1000 residual

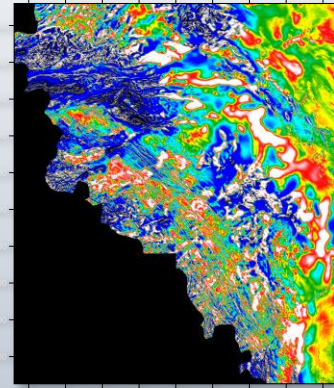
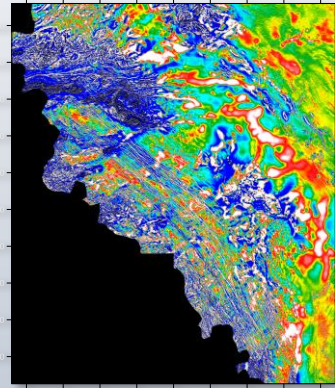
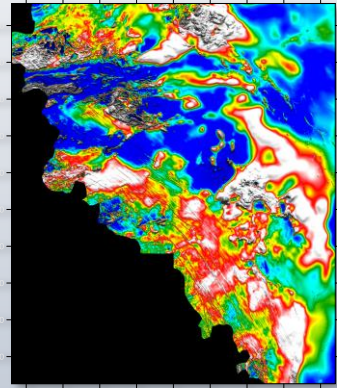


magnetics

RTP

RTP 1VD

UC1000 residual



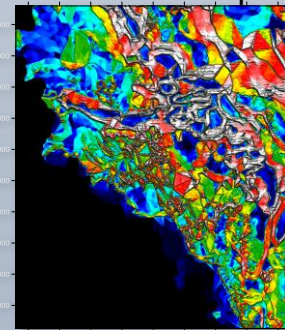
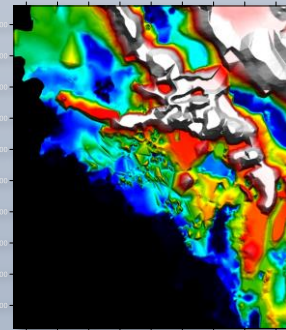
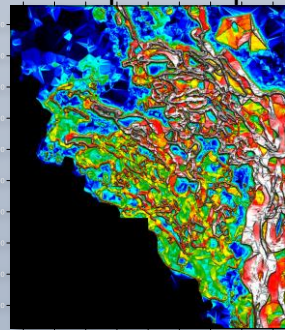
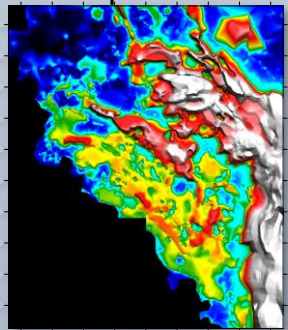
cover thickness

Neoproterozoic

Neoprot. slope

Phanerozoic

Phan. slope



# REGIONAL STUDY INPUT LAYERS

North Eastern Gawler IOCG Province

Machine Learning Analysis Input layers

gridded to a common 200m x 200m





# REGIONAL STUDY SEARCH RESULTS

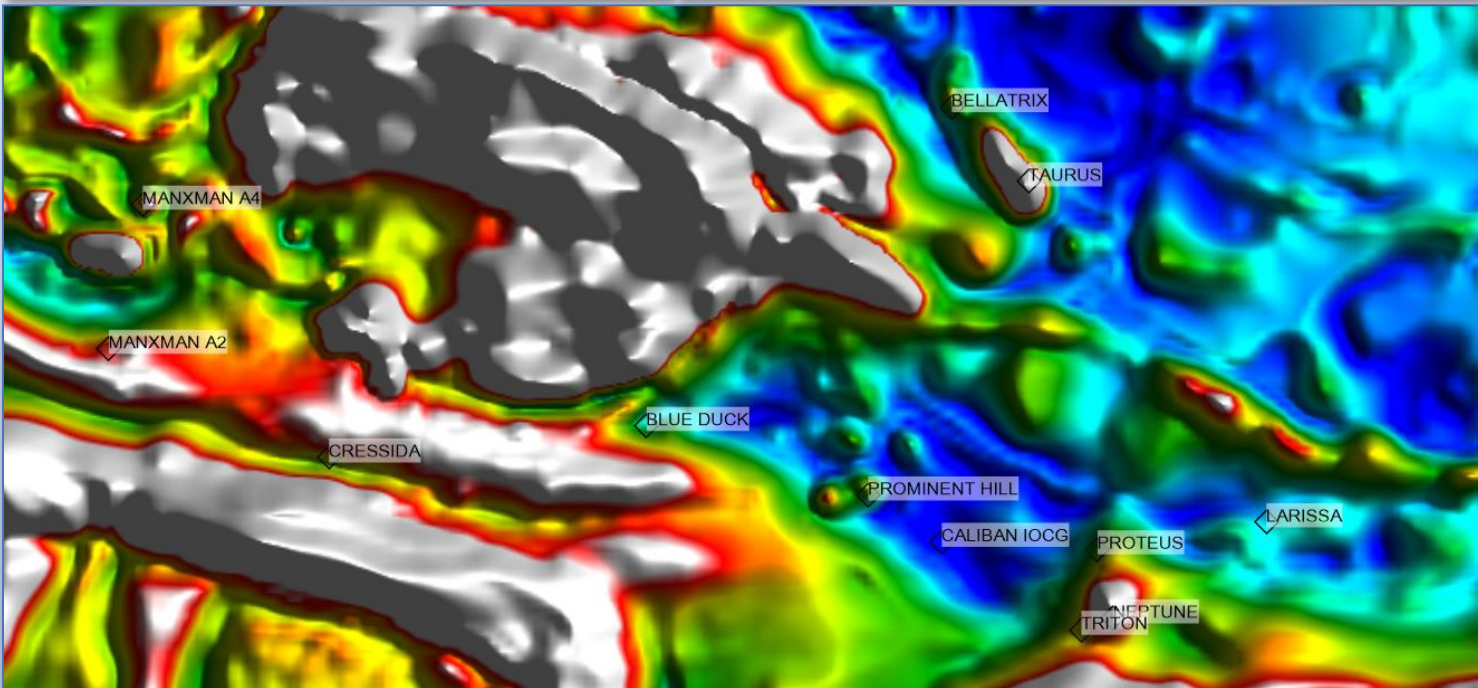
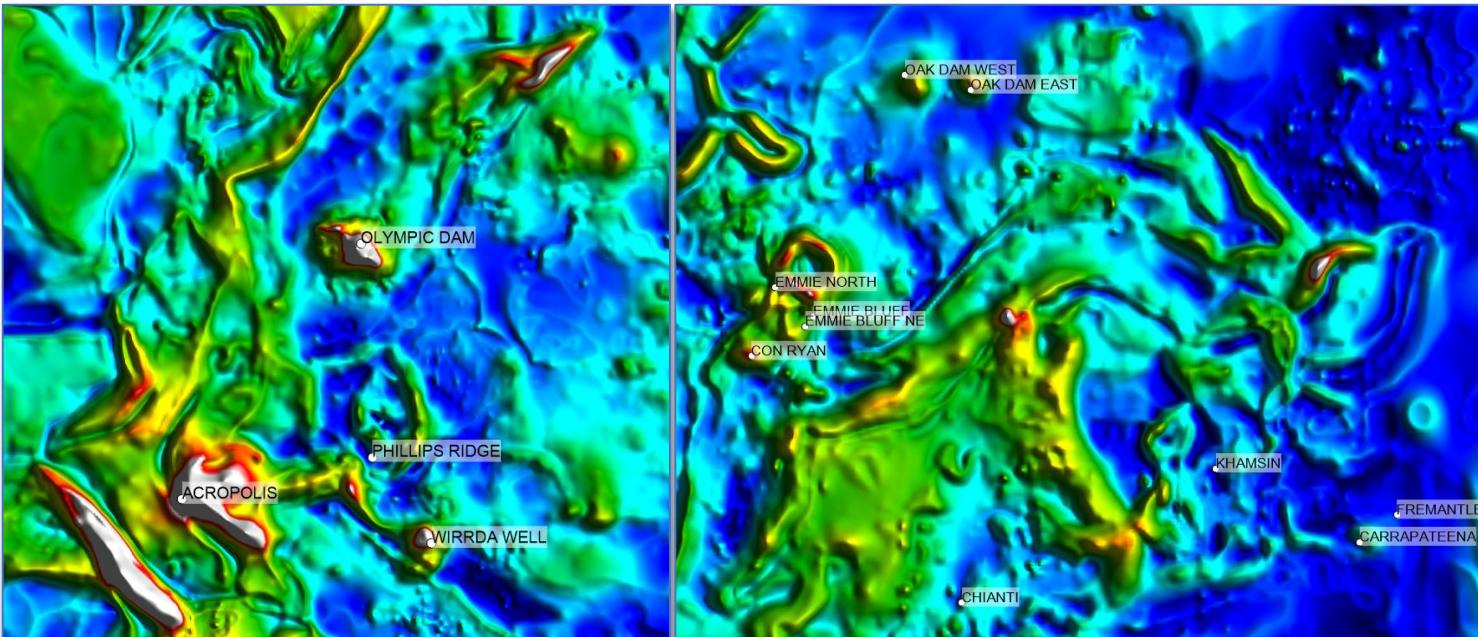
North Eastern Gawler IOCG Province

Unsupervised ANN

**Detected relatively unique input-layer  
association (anomalies) over all major  
IOCG deposits and discoveries**

Note:

warmer colours signify relative  
uniqueness and each feature is not  
unique for the same input-layer  
association





# REGIONAL STUDY SEARCH RESULTS

North Eastern Gawler IOCG Province

Unsupervised ANN

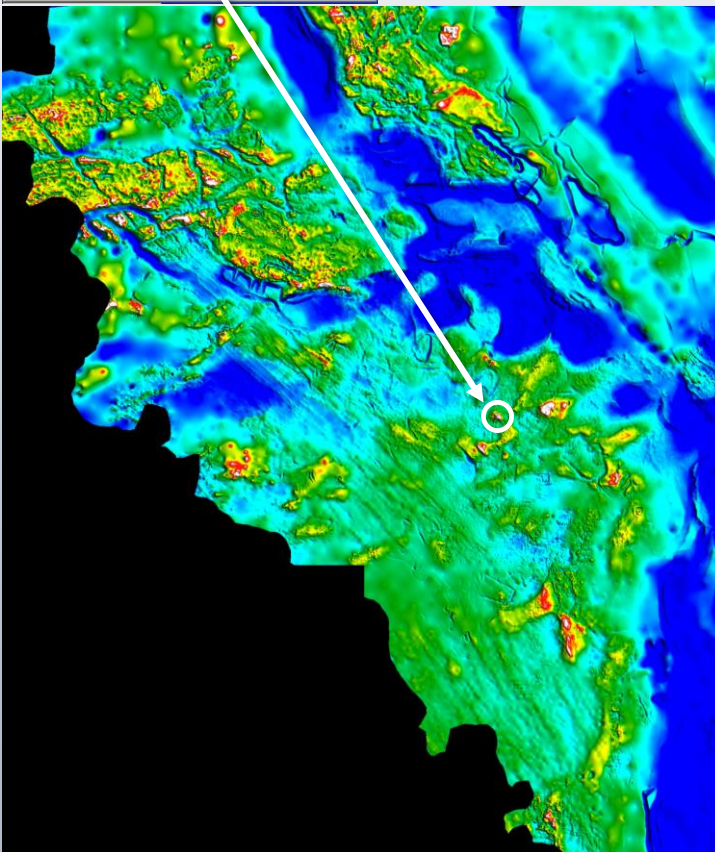
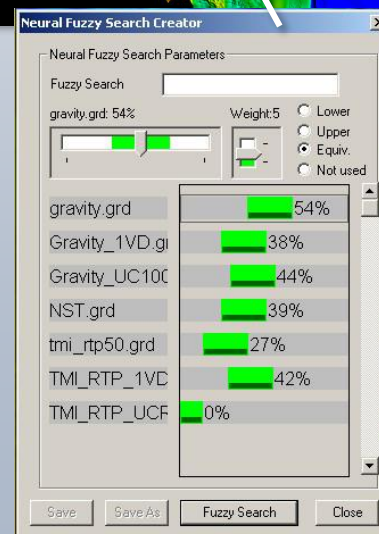
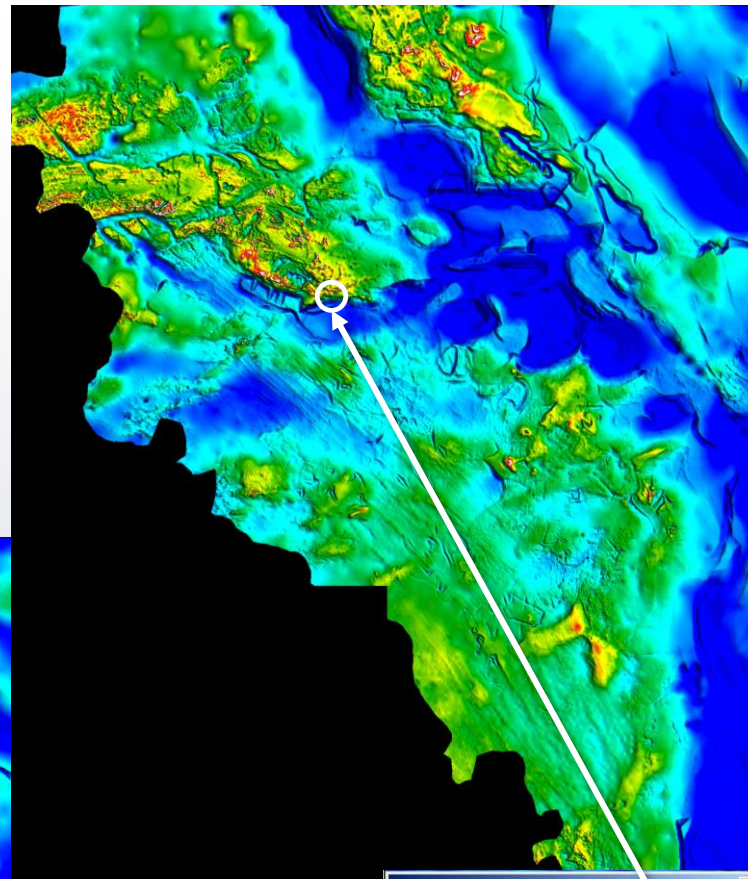
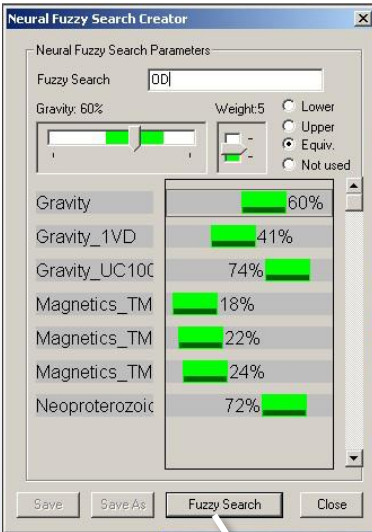
**Numerous features sharing similar input-layer associations for Olympic Dam (Left) and Prominent Hill (Right) as highlighted by the auto-generated fuzzy search creator parameters for each deposit**

Note:

1. warmer colours signify relative similarity and each feature highlighted shares similar input-layer association
2. "character" of Olympic Dam is not the same as for Prominent Hill

NUMEROUS MAJOR IOCG

TARGETS IDENTIFIED





Thank you

If you would like more info,  
please contact us at:

[www.geowiz.com.au](http://www.geowiz.com.au)

[www.gdaneel.consulting](http://www.gdaneel.consulting)