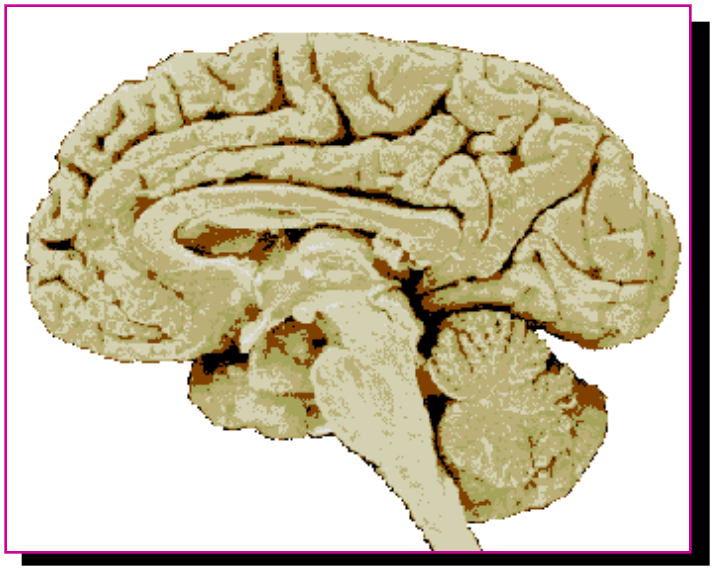
PROSPECT EXPLORER

Neural Network Analysis

- Neural computers can:
  - Analyse large amounts of complex data
  - Identify relationships
  - Recognise patterns and associations
  - Make predictions automatically
- Powerful analysis tool
- Decision Support for the Geologist
- Orders of magnitude more time efficient than conventional methods

Neural Computing



- Inspired by the biological processes of the brain
- Learns by example
- Generalises from experience
- Automatically produce predictions

Types of Neural Networks

- Supervised:
  - Back propogation
  - Training data set provided and neural net learns from available data
- Unsupervised:
  - Feedforward
  - No training data and neural net required to learn and group from whole data set

Neural Analysis Techniques

Five types of neural analysis performed:

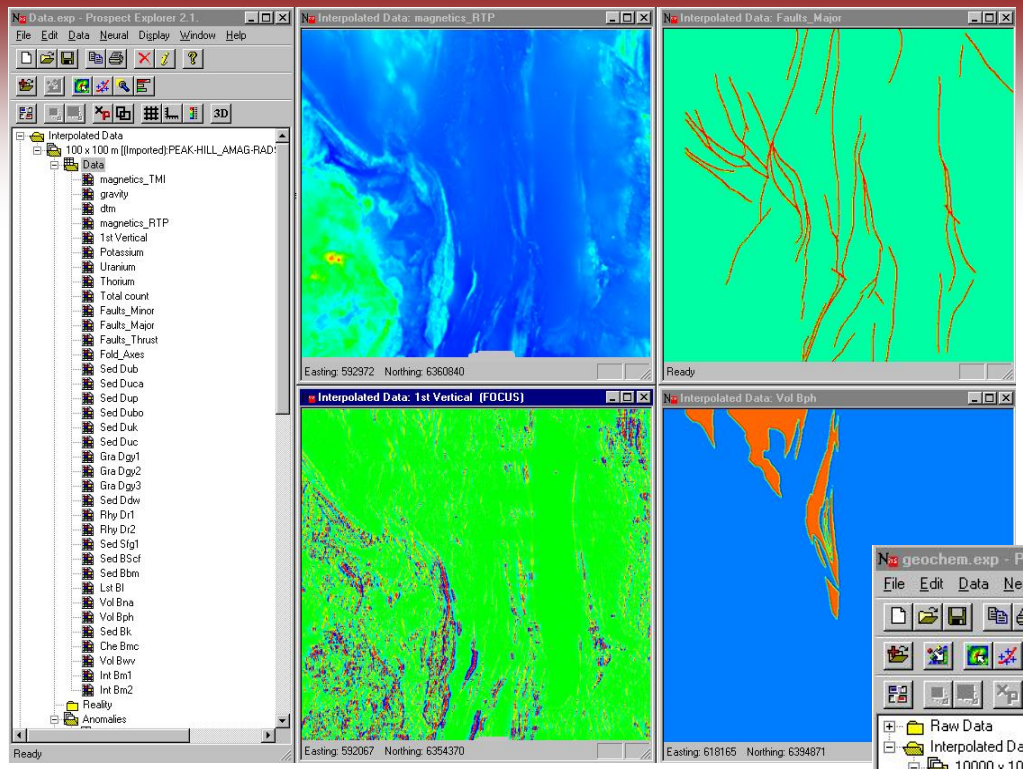
- Anomaly Detection
- Cluster Identification
- Correlation Analysis
- Relationship Analysis
- Fuzzy Searching

UNSUPERVISED

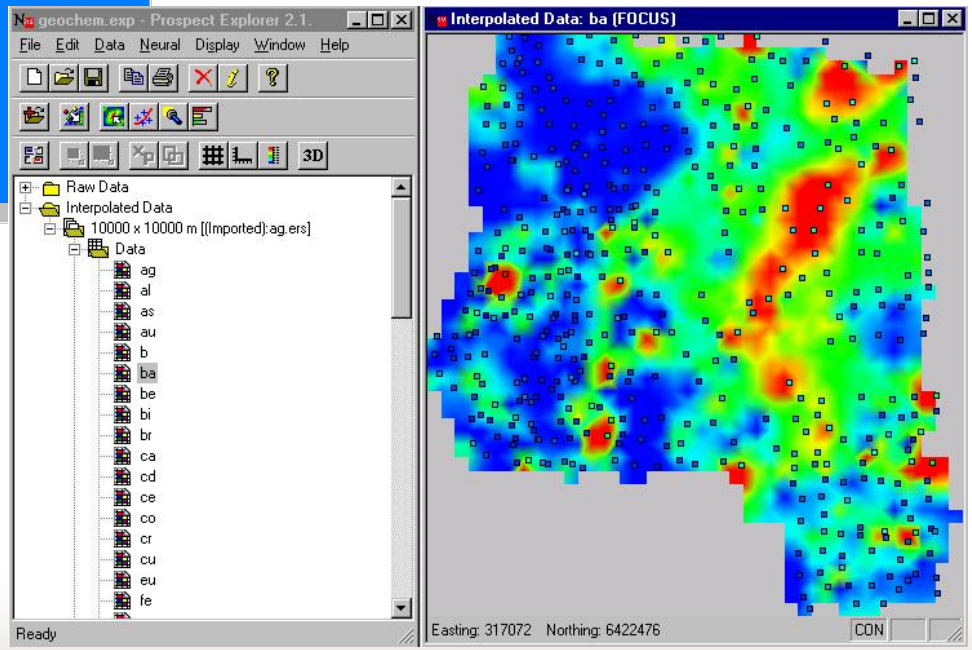
SUPERVISED

Data Input

- Data Input
  - Gridded data – ascii, ER mapper, Geosoft, GIS
  - Geochemical, geological, geophysical, topgraphical, satellite etc.
  - Multiple DXF overlays
- Analysis Output
  - Image files
  - ER Mapper, Geosoft, MapInfio, ArcView



Prospect scale soil sample data – 46 elements

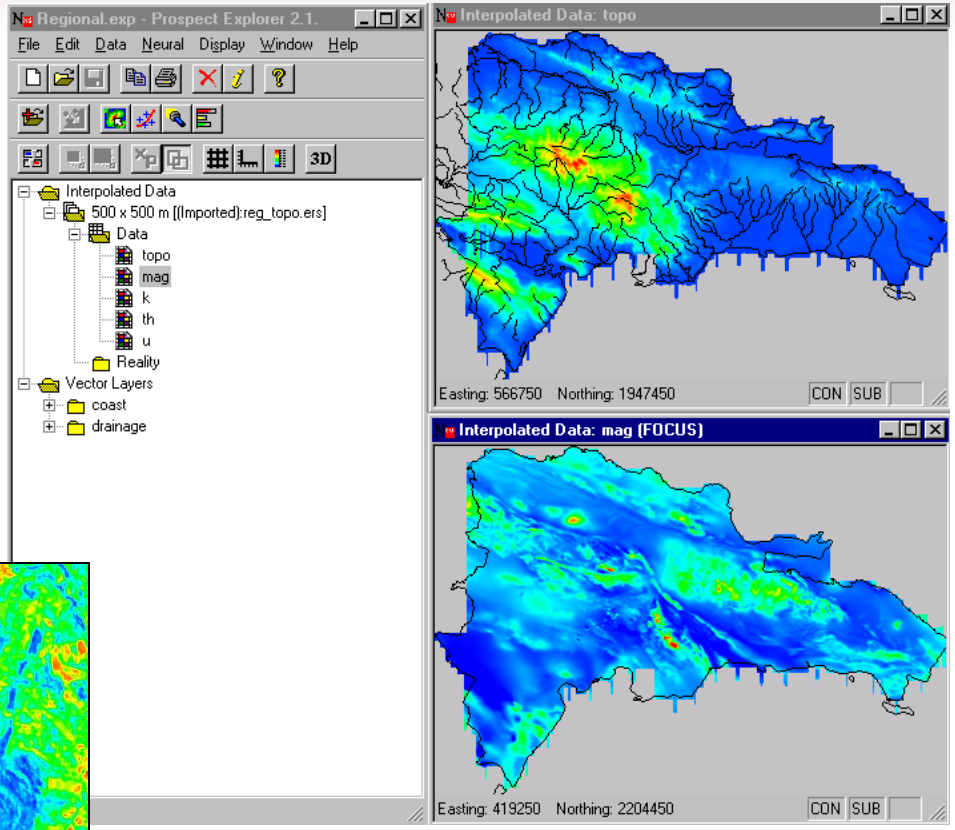


Regional scale data layers:

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

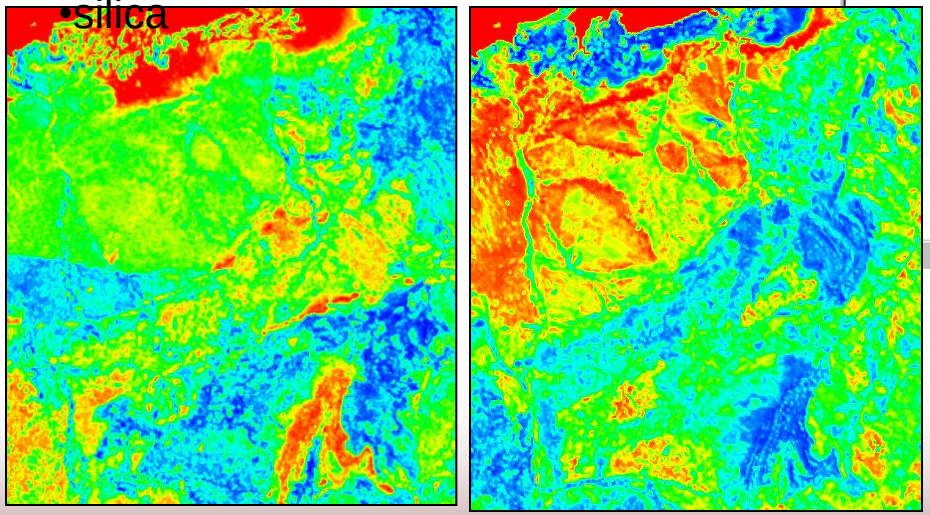
Country scale data

- Topography
- Airborne magnetics
- DXF overlays



Regional scale hyperspectral data

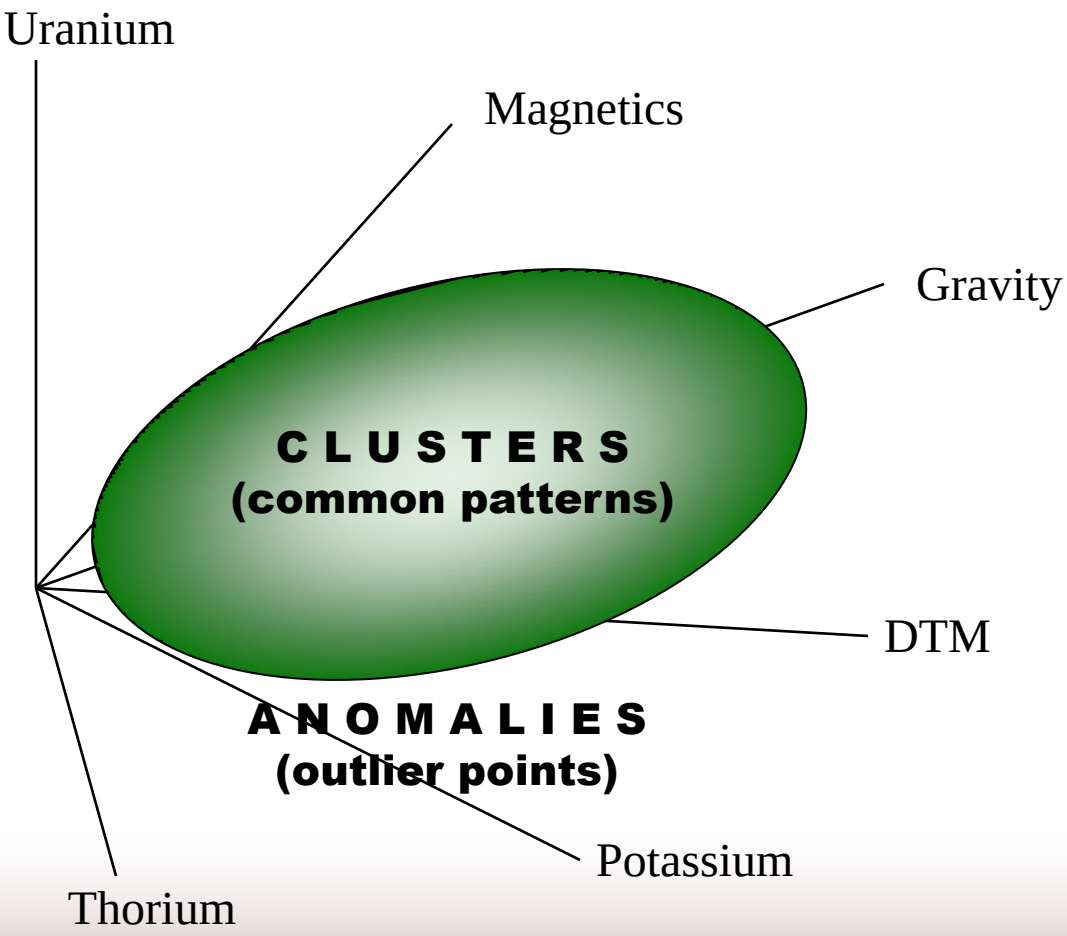
- clay
- silica

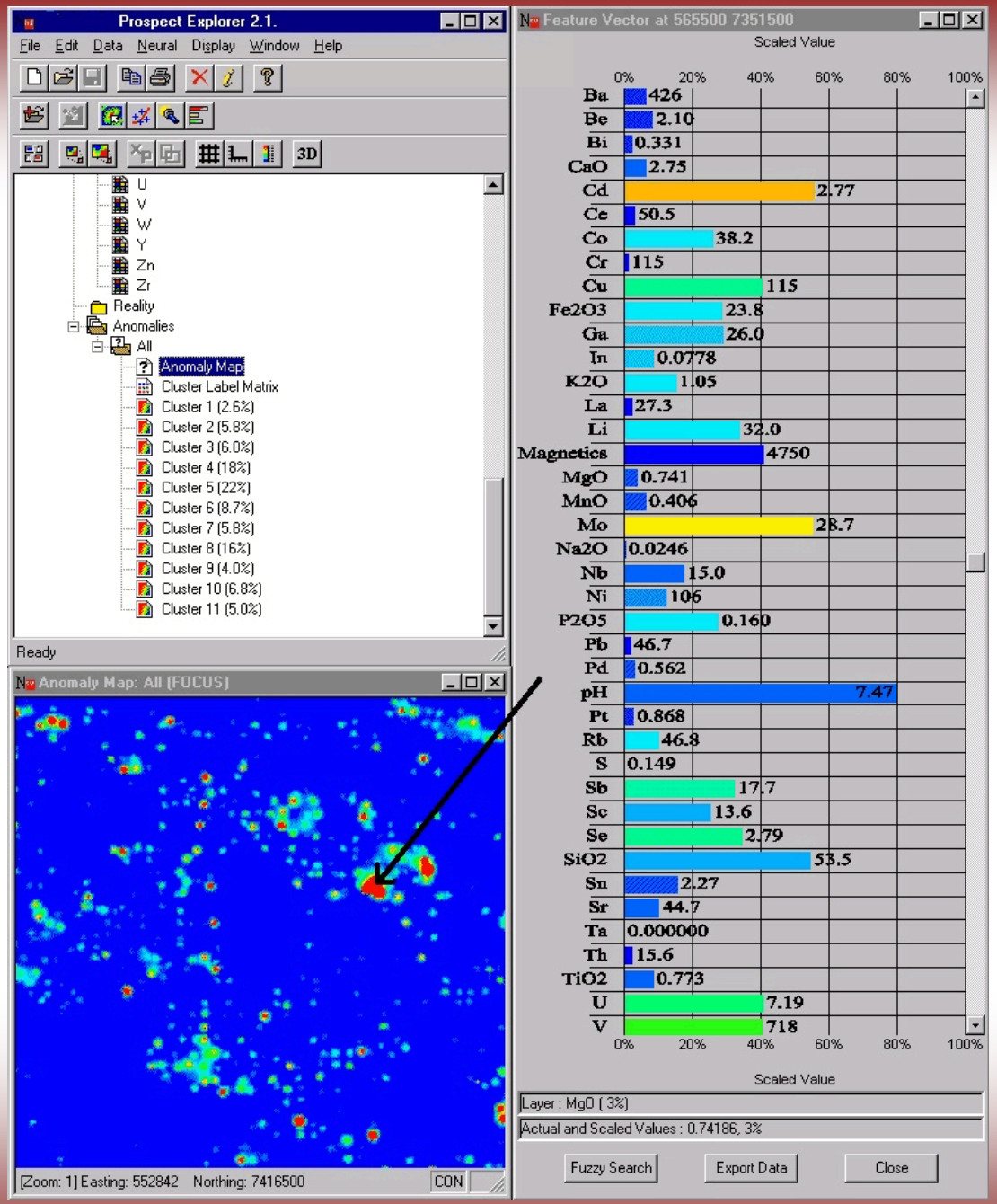


Neural Anomaly Analysis

- 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 Detection





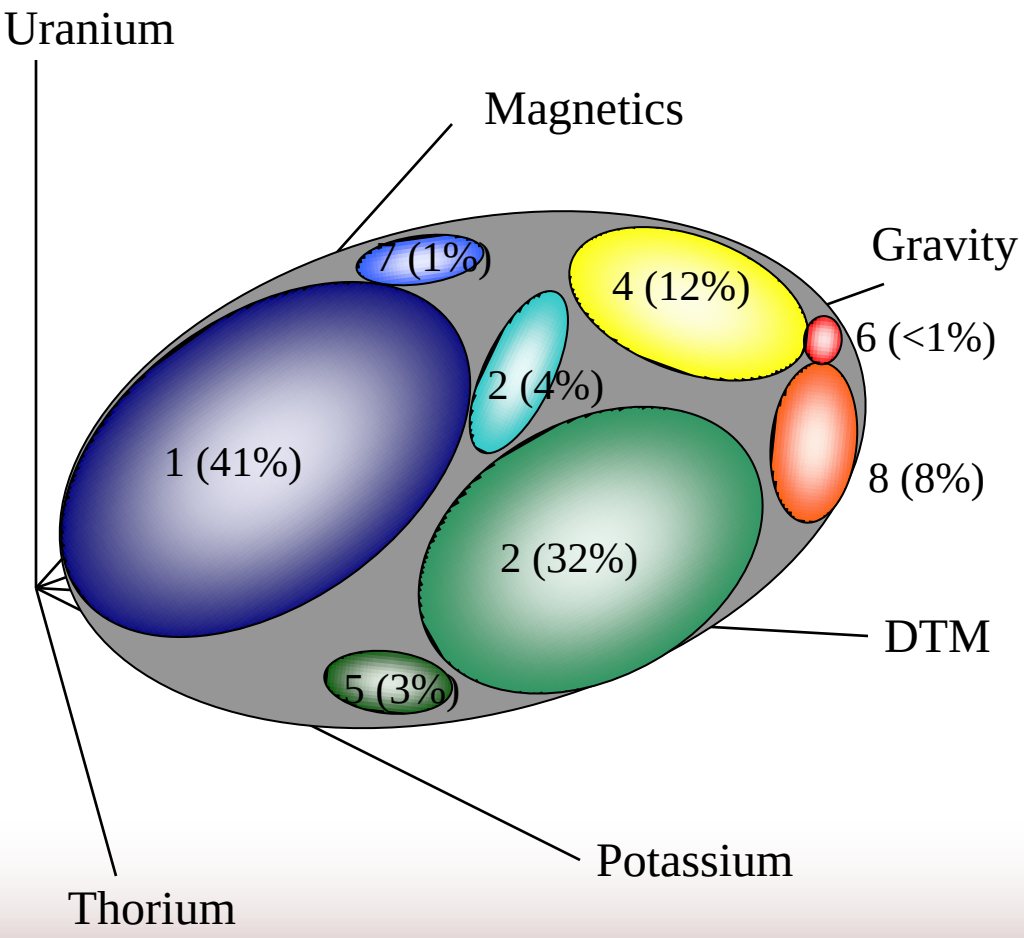
Anomaly analysis

Feature vector plot shows the values at particular anomalies. The colour of the histogram indicates which data layers are the most significant in determining the anomaly.

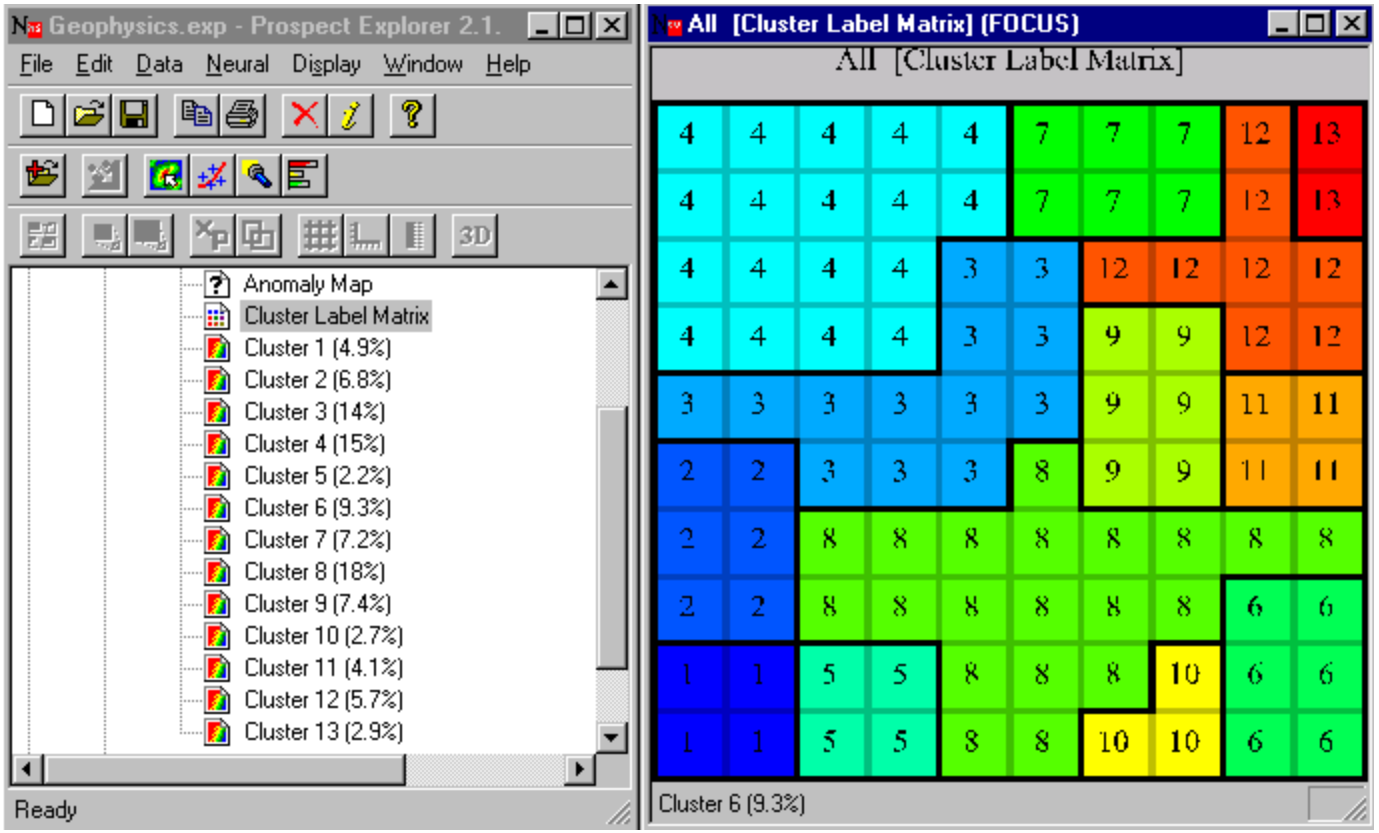
Cluster Analysis

- Extraction of pattern groups
  - common pattern types eg lithology
  - character of each cluster type
- Aids geologist:
  - Visualising geoscience data
  - Evaluating types of patterns within survey site
  - Geoscientist can interpret clusters according to the geological setting e.g. lithology and alteration zones

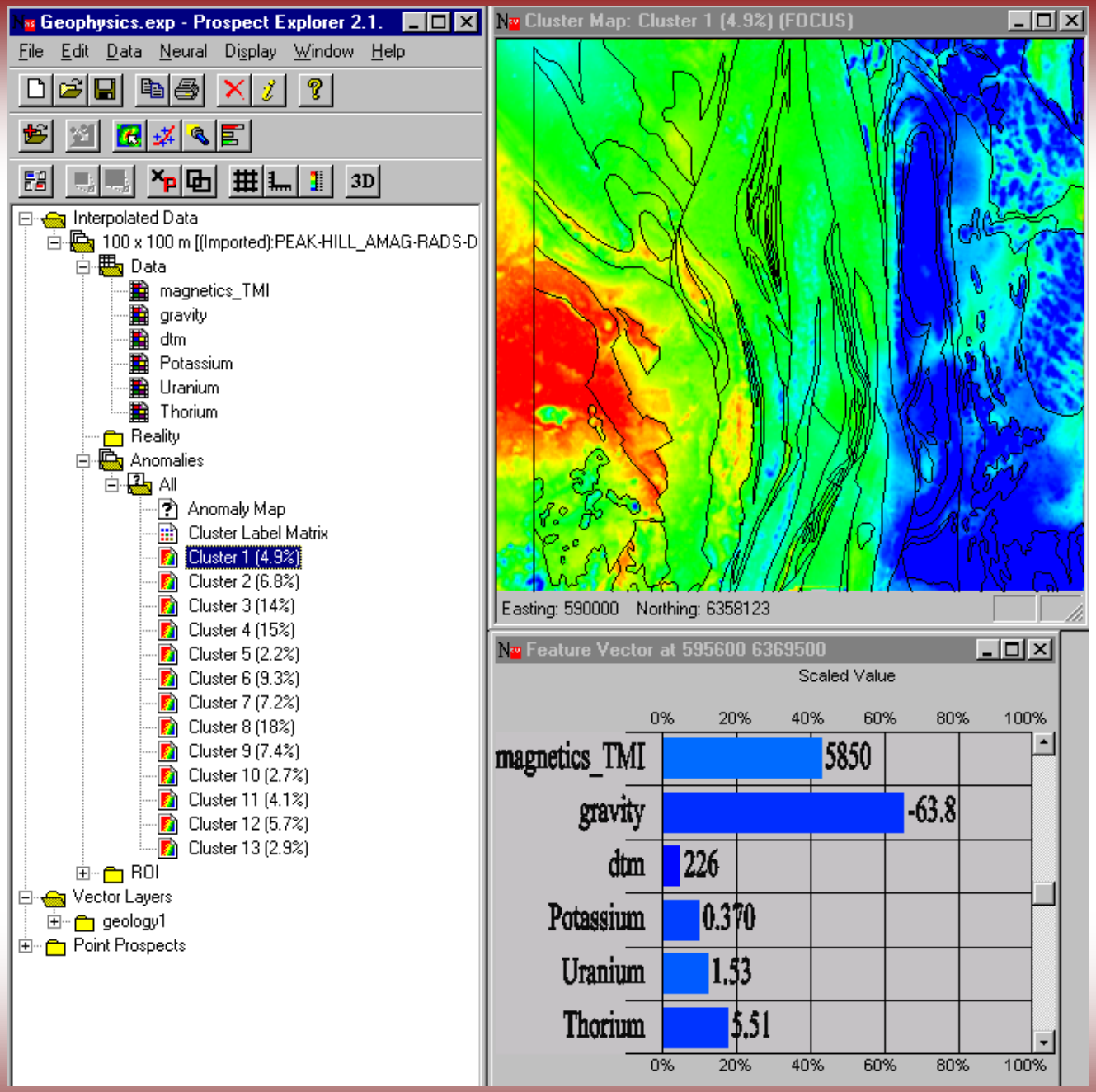
Cluster Identification



Cluster Identification

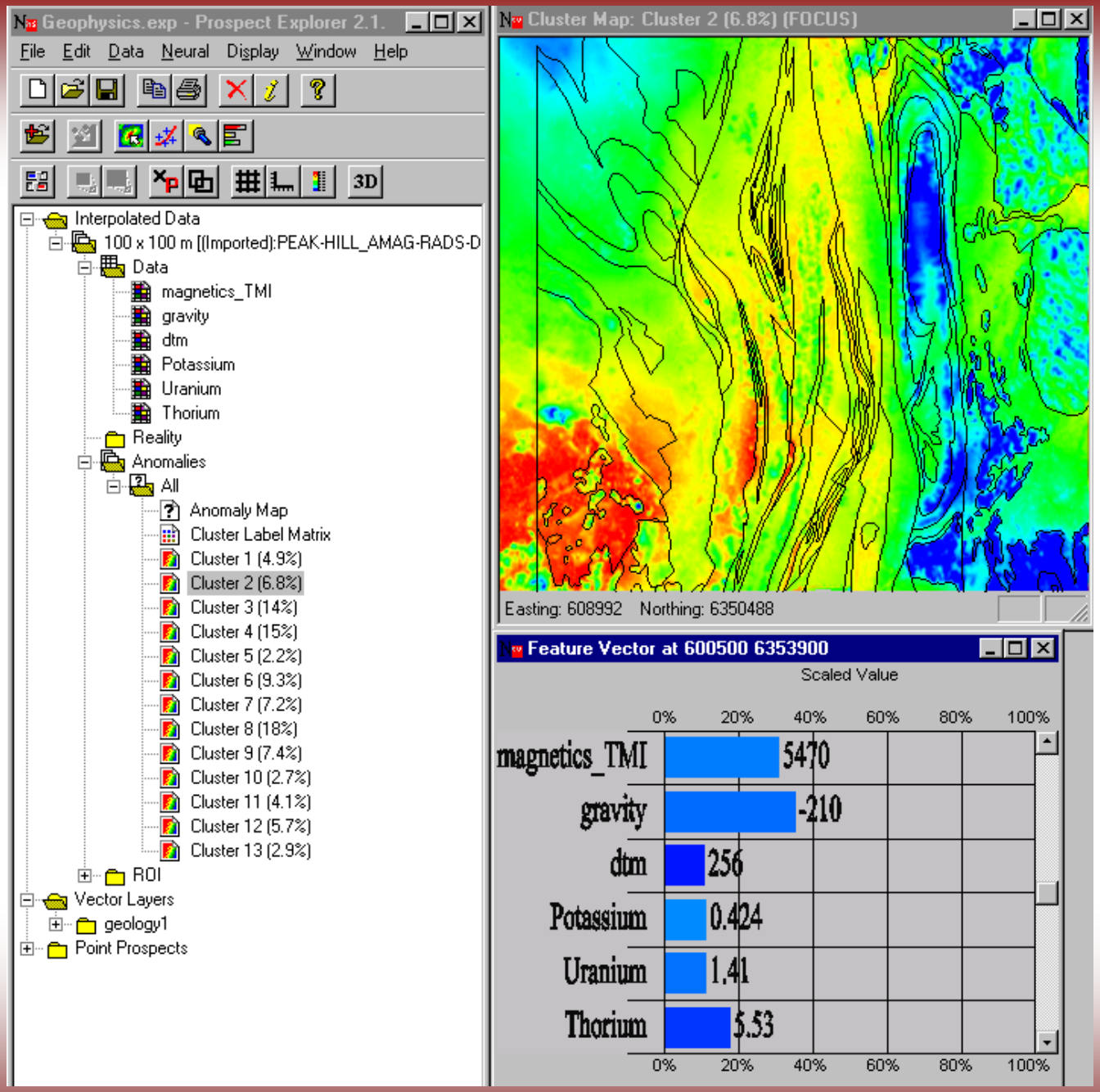


13 clusters identified in geophysical data

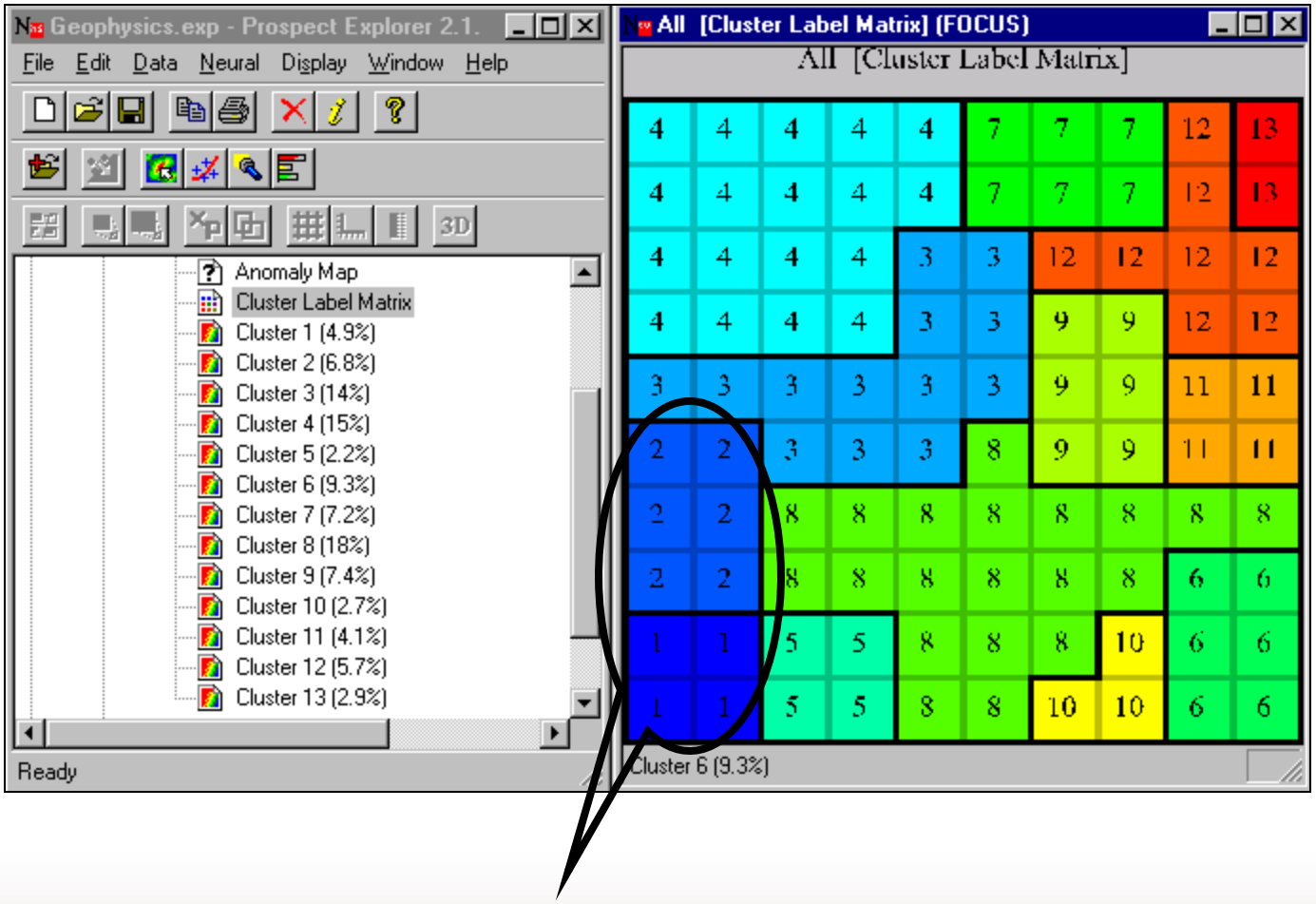


Cluster 1

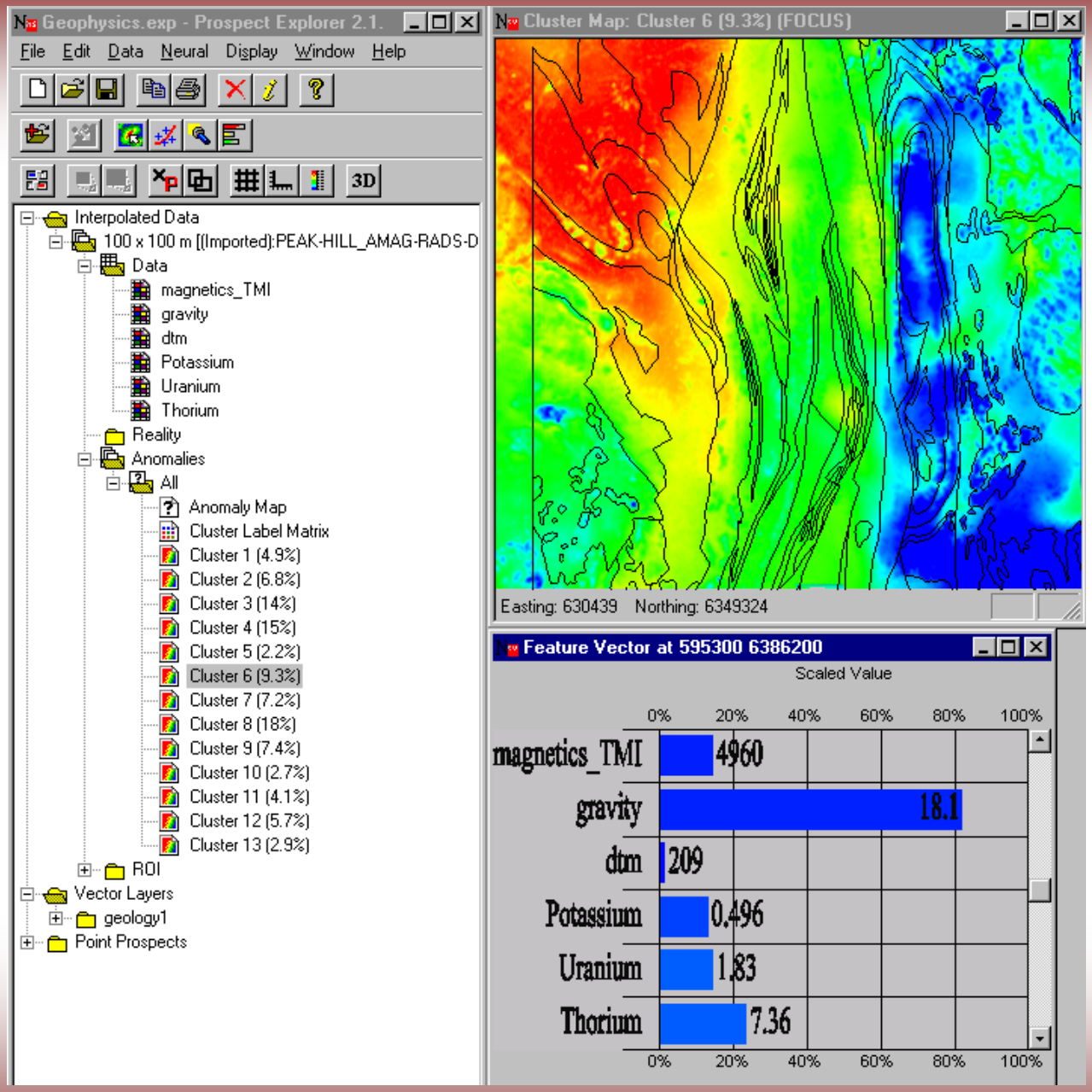
Feature Vector Plot shows the geochemical signature of this particular cluster. This may be mapping out a lithological boundary.


Geophysics.exp - Prospect Explorer 2.1.
File Edit Data Neural Display Window Help
3D
Interpolated Data
100 x 100 m [(Imported):PEAK-HILL_AMAG-RADS-D
Data
magnetics_TMI
gravity
dtm
Potassium
Uranium
Thorium
Reality
Anomalies
All
Anomaly Map
Cluster Label Matrix
Cluster 1 (4.9%)
Cluster 2 (6.8%)
Cluster 3 (14%)
Cluster 4 (15%)
Cluster 5 (2.2%)
Cluster 6 (9.3%)
Cluster 7 (7.2%)
Cluster 8 (18%)
Cluster 9 (7.4%)
Cluster 10 (2.7%)
Cluster 11 (4.1%)
Cluster 12 (5.7%)
Cluster 13 (2.9%)
ROI
Vector Layers
geology1
Point Prospects
Cluster Map: Cluster 2 (6.8%) (FOCUS)
Easting: 608992 Northing: 6350488
Feature Vector at 600500 6353900
Scaled Value
0% 20% 40% 60% 80% 100%
magnetics_TMI 5470
gravity -210
dtm 256
Potassium 0.424
Uranium 1.41
Thorium 5.53
0% 20% 40% 60% 80% 100%

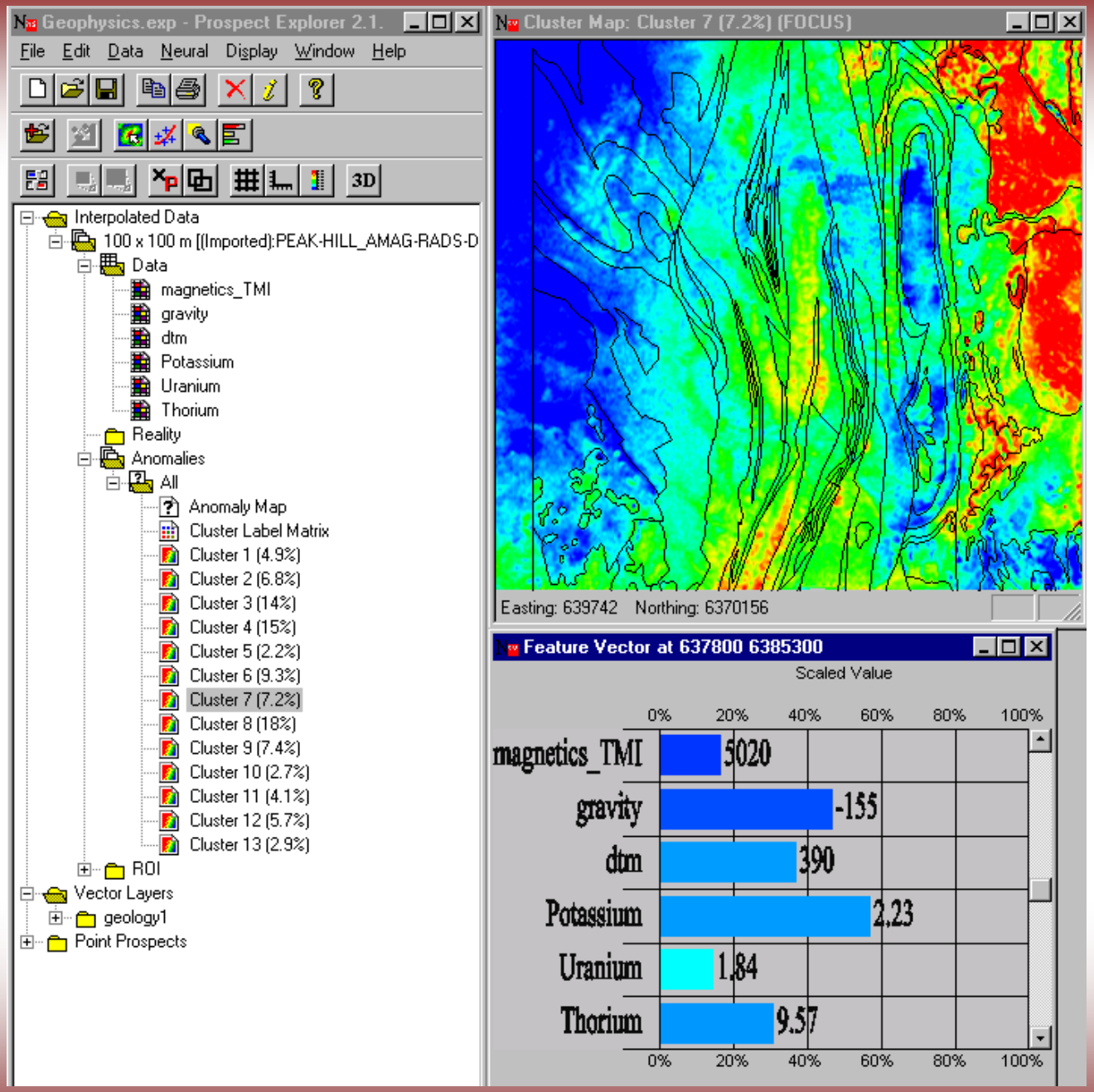
Cluster 2



Cluster 1 and 2 are contain similar data

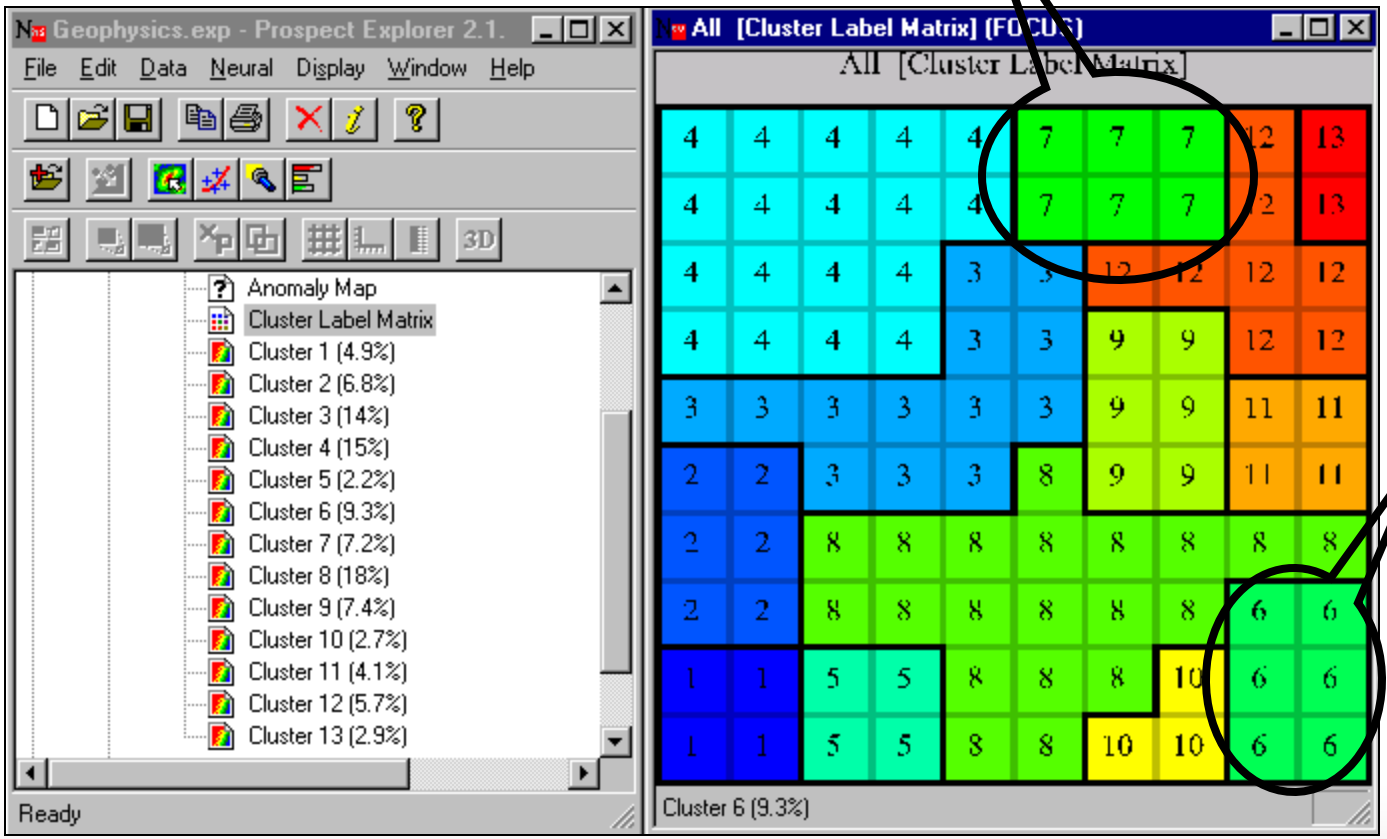

Geophysics.exp - Prospect Explorer 2.1.
File Edit Data Neural Display Window Help
3D
Interpolated Data
100 x 100 m [(Imported):PEAK-HILL_AMAG-RADS-D
Data
magnetics_TMI
gravity
dtm
Potassium
Uranium
Thorium
Reality
Anomalies
All
Anomaly Map
Cluster Label Matrix
Cluster 1 (4.9%)
Cluster 2 (6.8%)
Cluster 3 (14%)
Cluster 4 (15%)
Cluster 5 (2.2%)
Cluster 6 (9.3%)
Cluster 7 (7.2%)
Cluster 8 (18%)
Cluster 9 (7.4%)
Cluster 10 (2.7%)
Cluster 11 (4.1%)
Cluster 12 (5.7%)
Cluster 13 (2.9%)
ROI
Vector Layers
geology1
Point Prospects
Cluster Map: Cluster 6 (9.3%) (FOCUS)
Easting: 630439 Northing: 6349324
Feature Vector at 595300 6386200
Scaled Value
0% 20% 40% 60% 80% 100%
magnetics_TMI 4960
gravity 18.1
dtm 209
Potassium 0.496
Uranium 1.83
Thorium 7.36
0% 20% 40% 60% 80% 100%

Cluster 6


Geophysics.exp - Prospect Explorer 2.1.
File Edit Data Neural Display Window Help
3D
Interpolated Data
100 x 100 m [(Imported):PEAK-HILL_AMAG-RADS-D
Data
magnetics_TMI
gravity
dtm
Potassium
Uranium
Thorium
Reality
Anomalies
All
Anomaly Map
Cluster Label Matrix
Cluster 1 (4.9%)
Cluster 2 (6.8%)
Cluster 3 (14%)
Cluster 4 (15%)
Cluster 5 (2.2%)
Cluster 6 (9.3%)
Cluster 7 (7.2%)
Cluster 8 (18%)
Cluster 9 (7.4%)
Cluster 10 (2.7%)
Cluster 11 (4.1%)
Cluster 12 (5.7%)
Cluster 13 (2.9%)
ROI
Vector Layers
geology1
Point Prospects
Cluster Map: Cluster 7 (7.2%) (FOCUS)
Easting: 639742 Northing: 6370156
Feature Vector at 637800 6385300
Scaled Value
0% 20% 40% 60% 80% 100%
magnetics_TMI 5020
gravity -155
dtm 390
Potassium 2.23
Uranium 1.84
Thorium 9.57
0% 20% 40% 60% 80% 100%

Cluster 7

Cluster 7 - Sandstone & Conglomerate



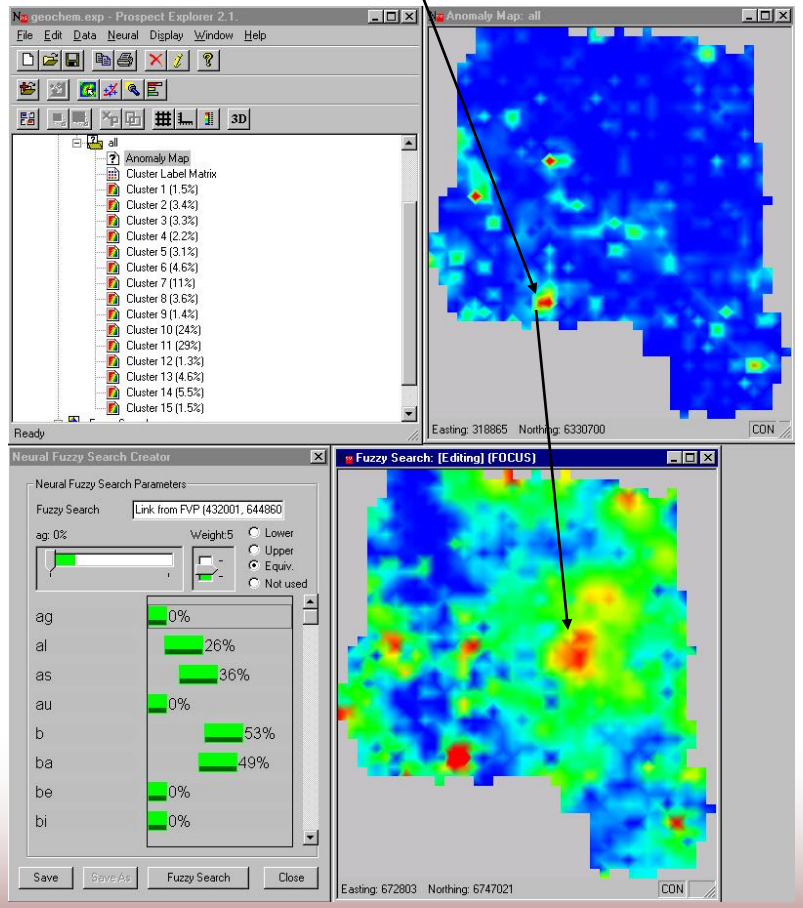
Cluster 6

Granite Batholith

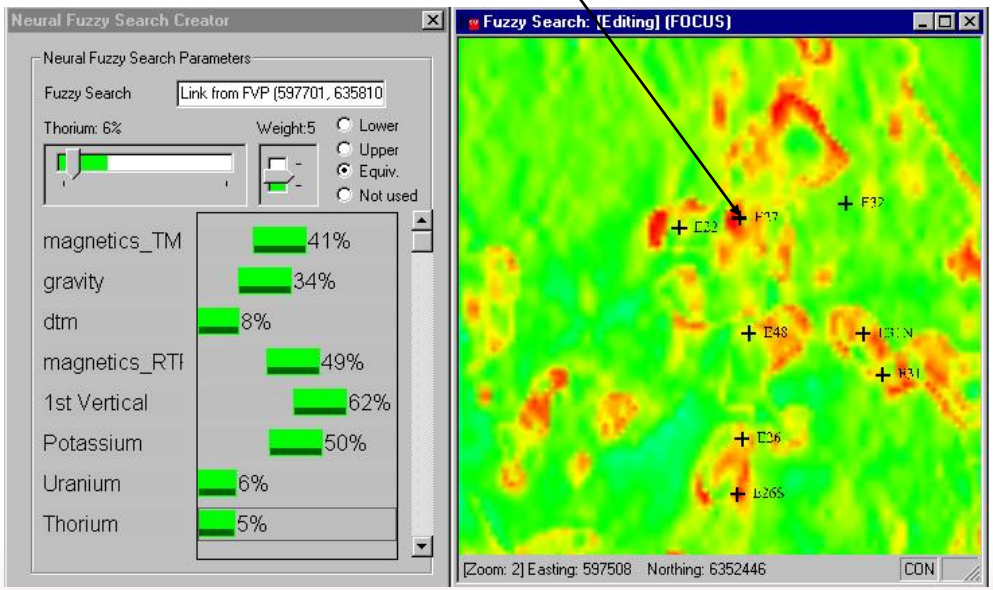
Neural Fuzzy Search

- Specify search items
  - search a selected pattern eg. anomaly
  - search a particular location eg. known 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

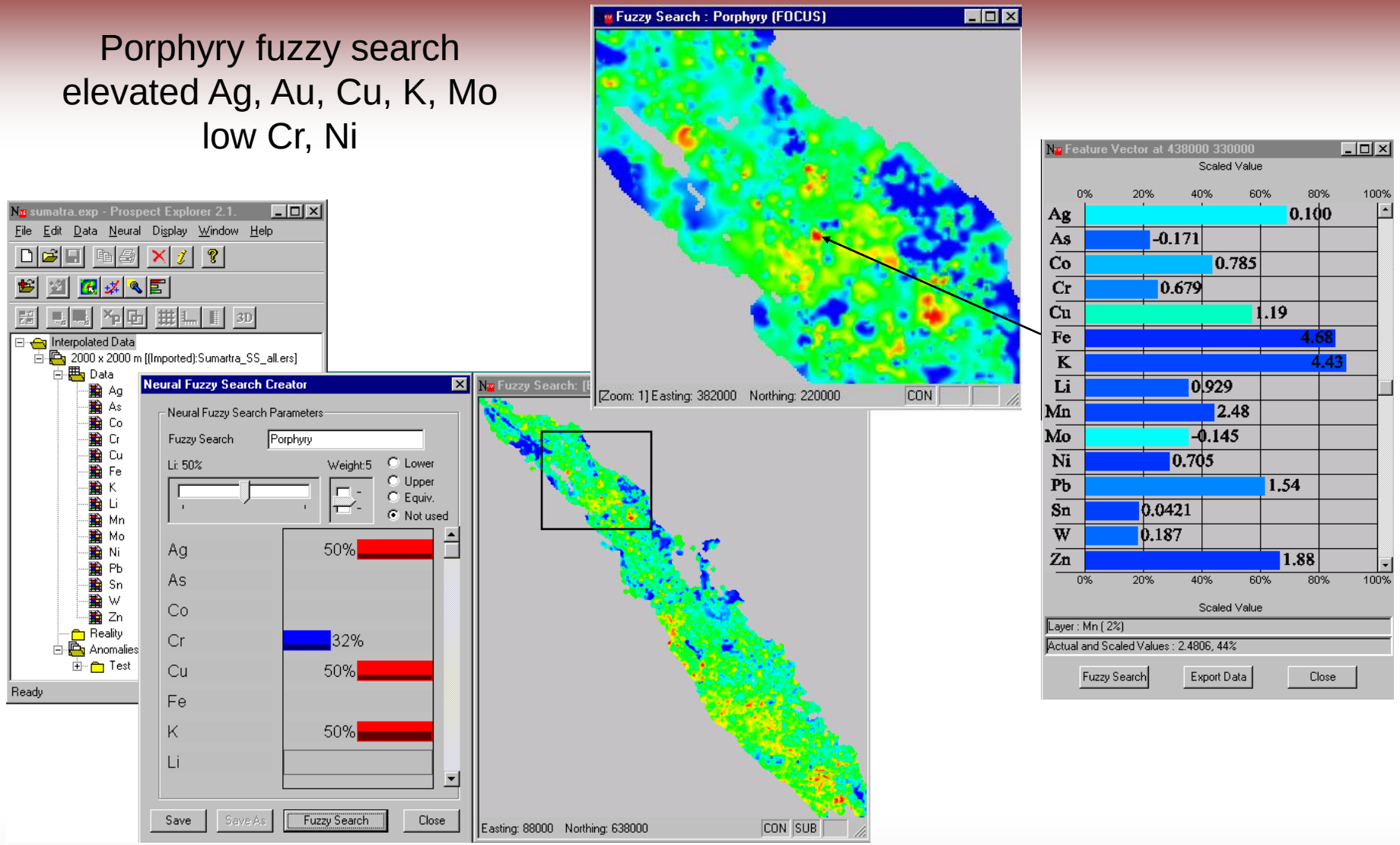
Fuzzy search link from known mineral deposit to look for areas with a similar geochemical signature



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

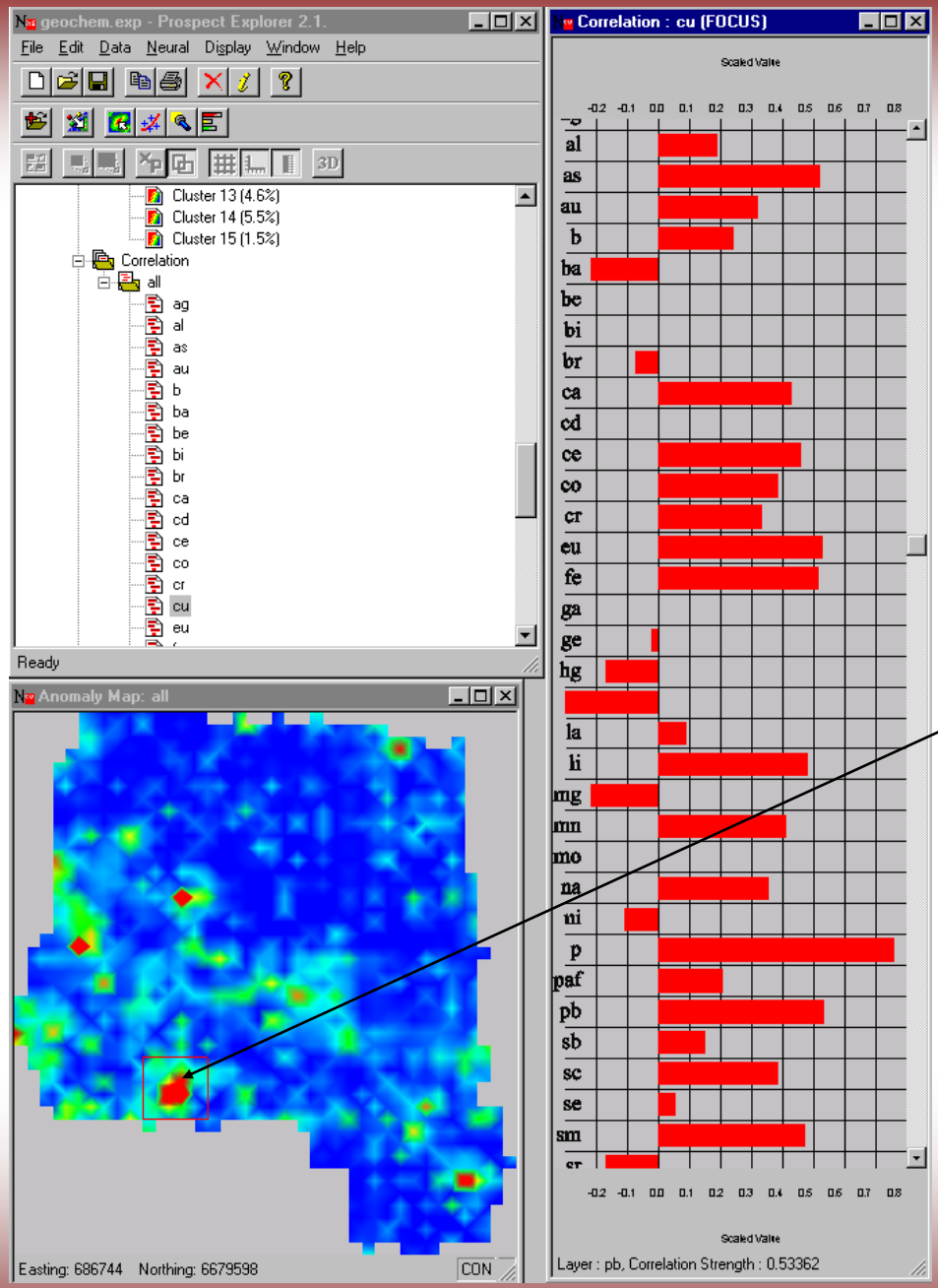


Porphyry fuzzy search elevated Ag, Au, Cu, K, Mo low Cr, Ni

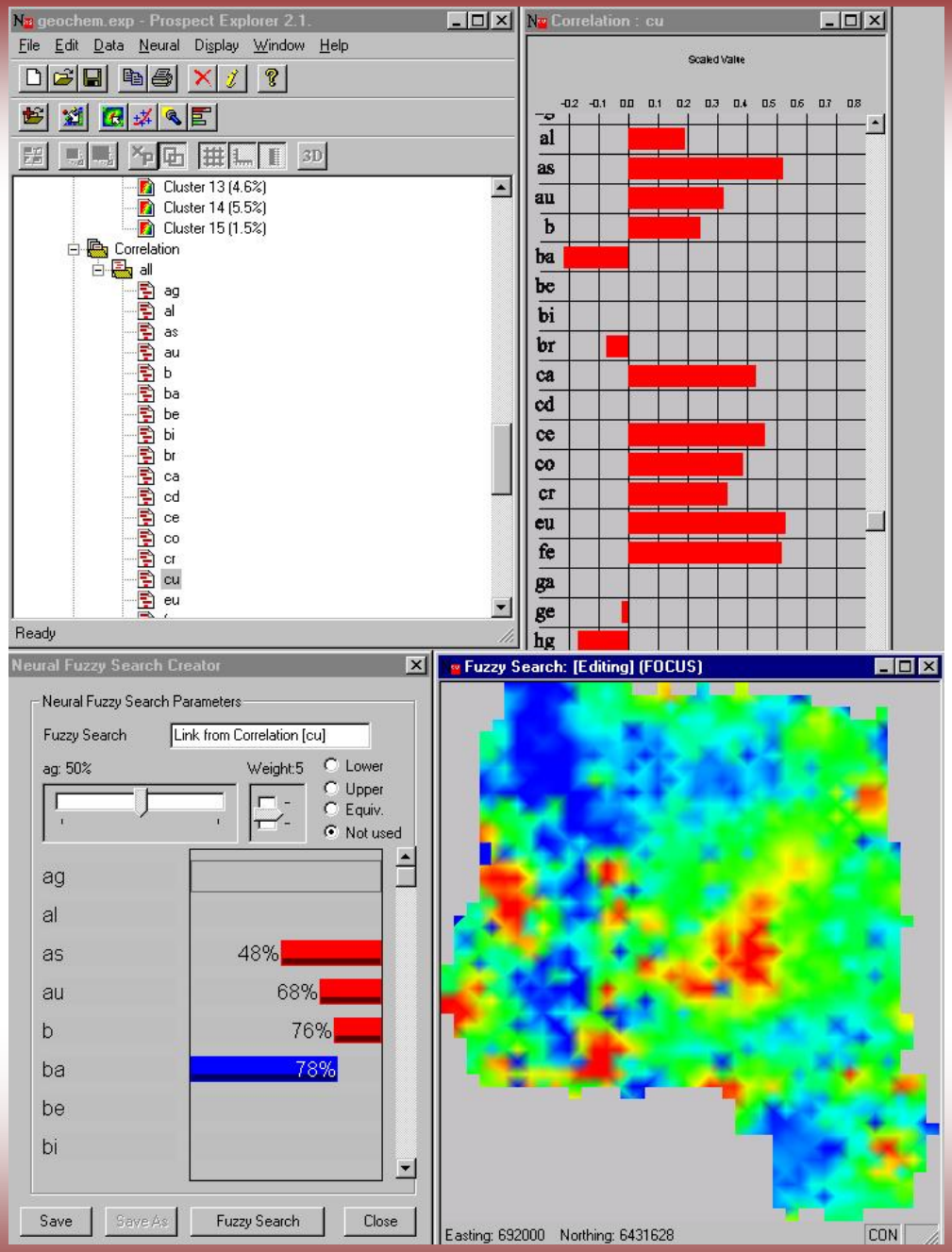


Correlation Analysis

- Relationships between survey results
- Relational Knowledge
- Correlation signatures can be determined
- Search for areas with similar correlation signature ie search for similarities in relationships for population identification



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

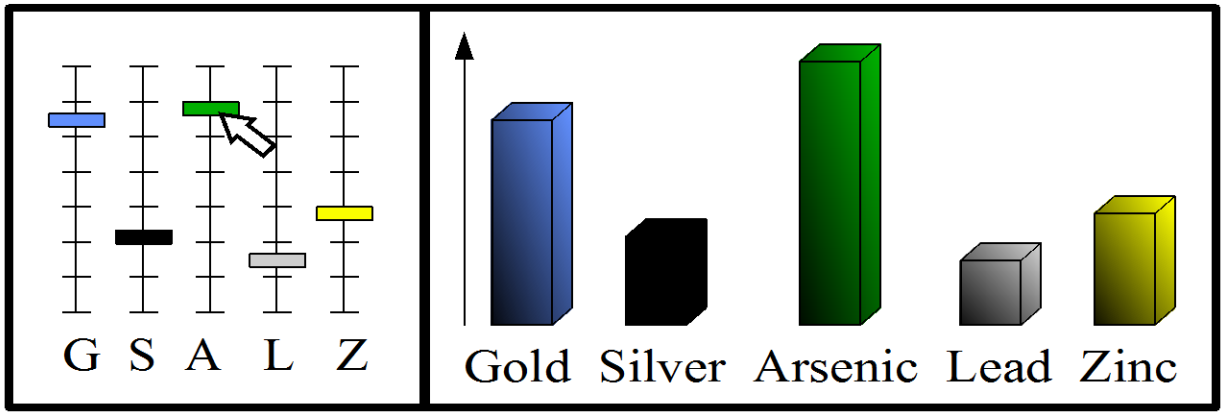


Correlation link to fuzzy search

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.

Relationship Explorer

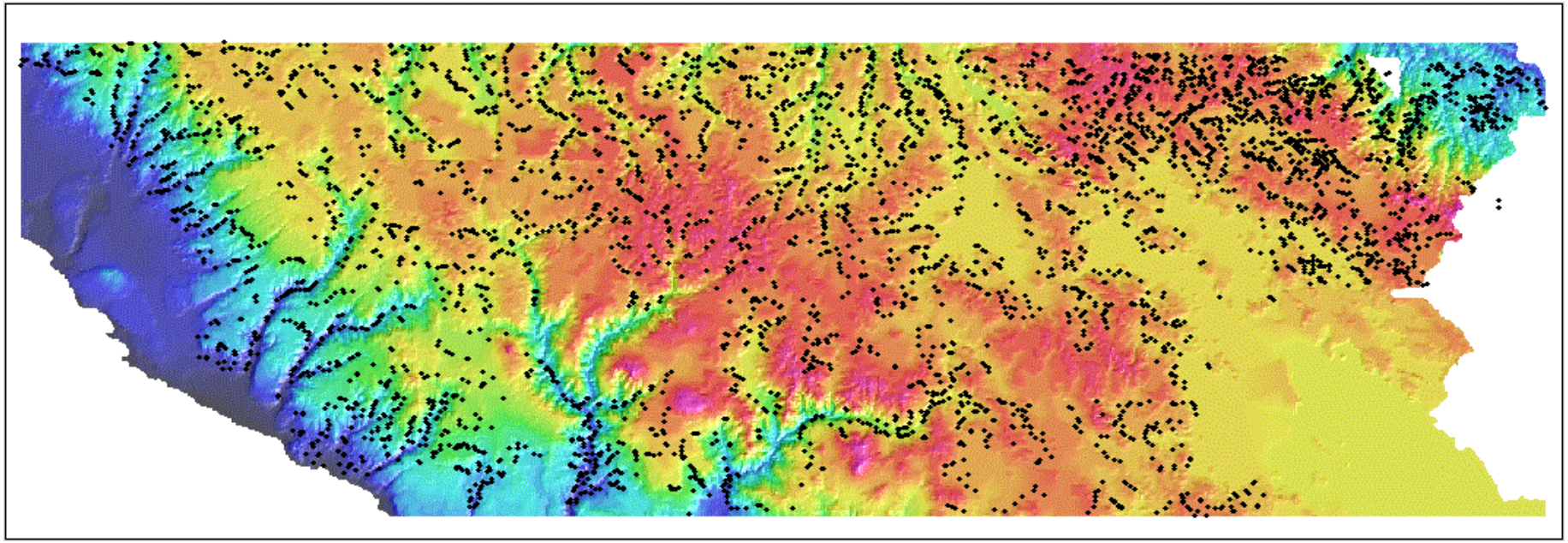
- Visual “Graphic Equaliser”
  - enables analysis of inter-channel responses as one channel varies
  - ***allows more qualitative analysis of data***



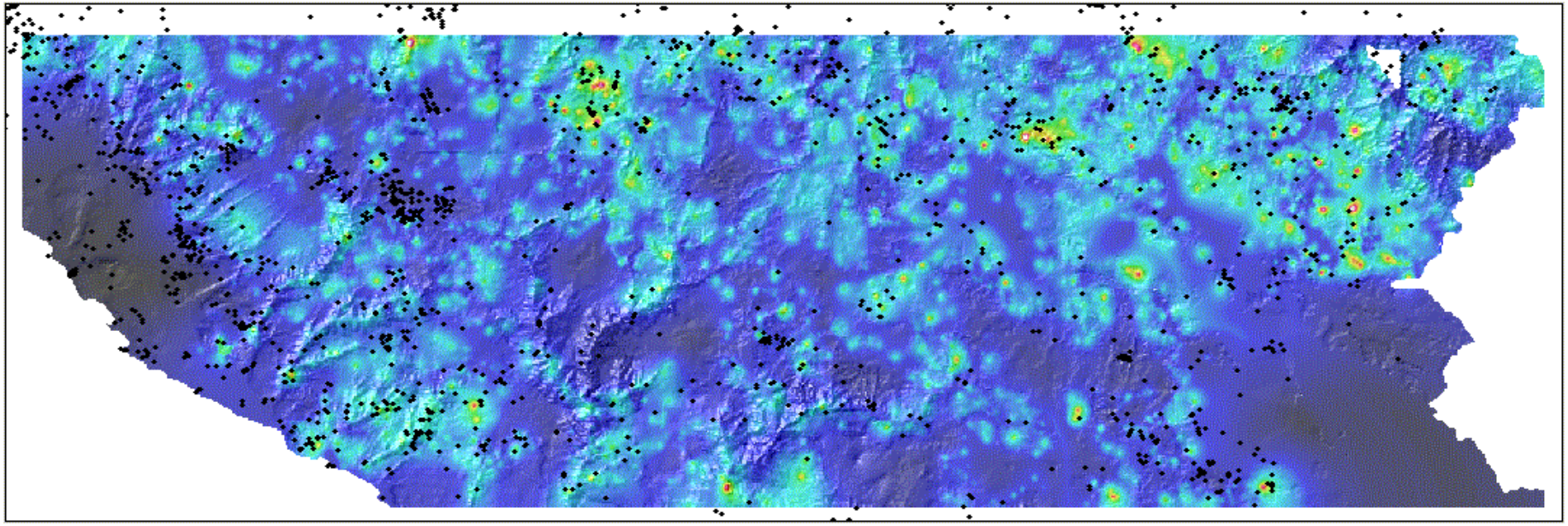
Rio Tinto Neural Analysis

- Ingemet Southern Peru Data Package
- Geochemistry - 30 layers of stream sediment samples
- Mineral Occurences Database
- *Prospect Explorer* software
- Anomaly detection, cluster analysis, fuzzy searches and correlation analysis

Sample Points

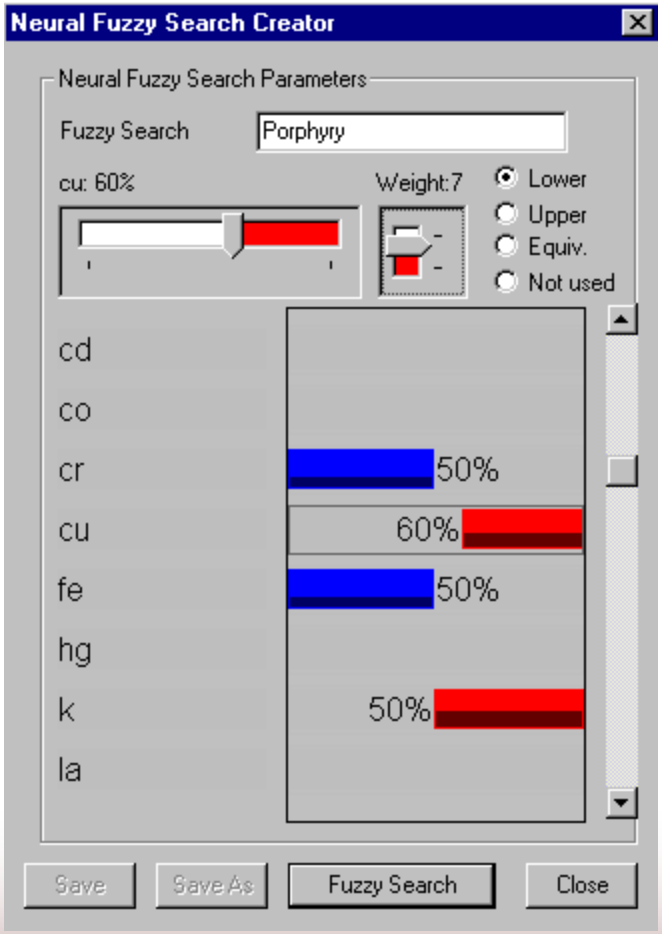


Anomaly Analysis



Neural Anomaly Analysis – all elements with known mineral occurences

Fuzzy Search Creator



Porphyry search

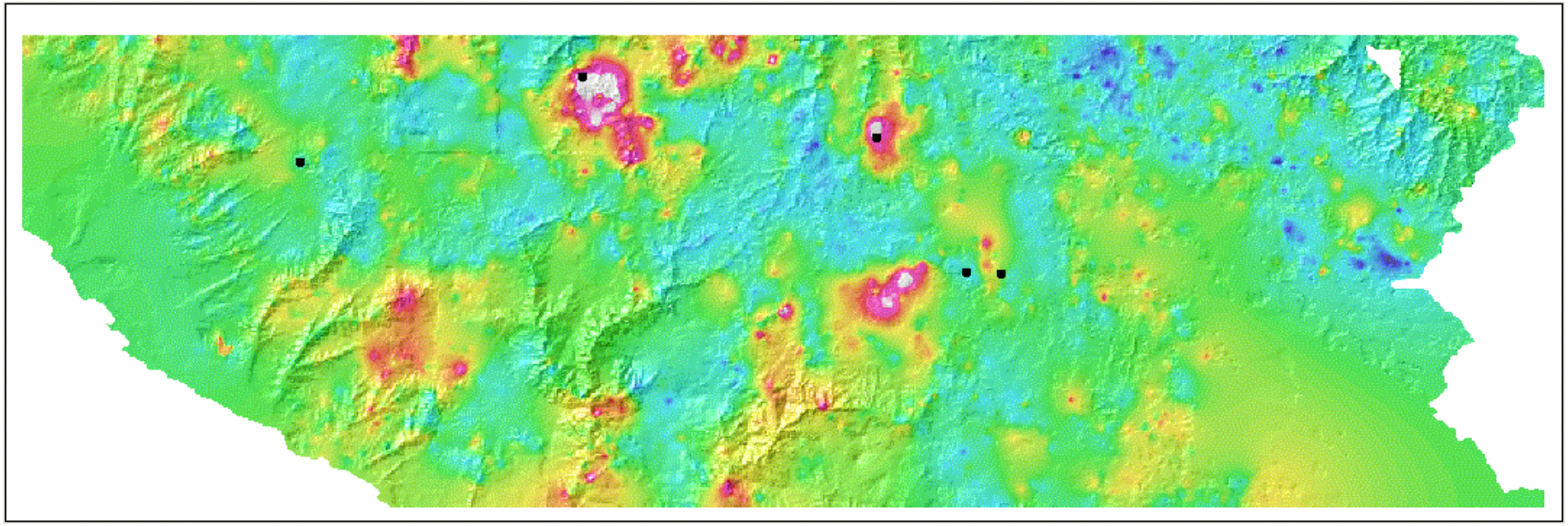
>50% Ag-Au-Mo-Pb-Zn

>60% Cu high weighting

>50% K high weighting

<50% Cr-Fe-Ni

Fuzzy Search Results

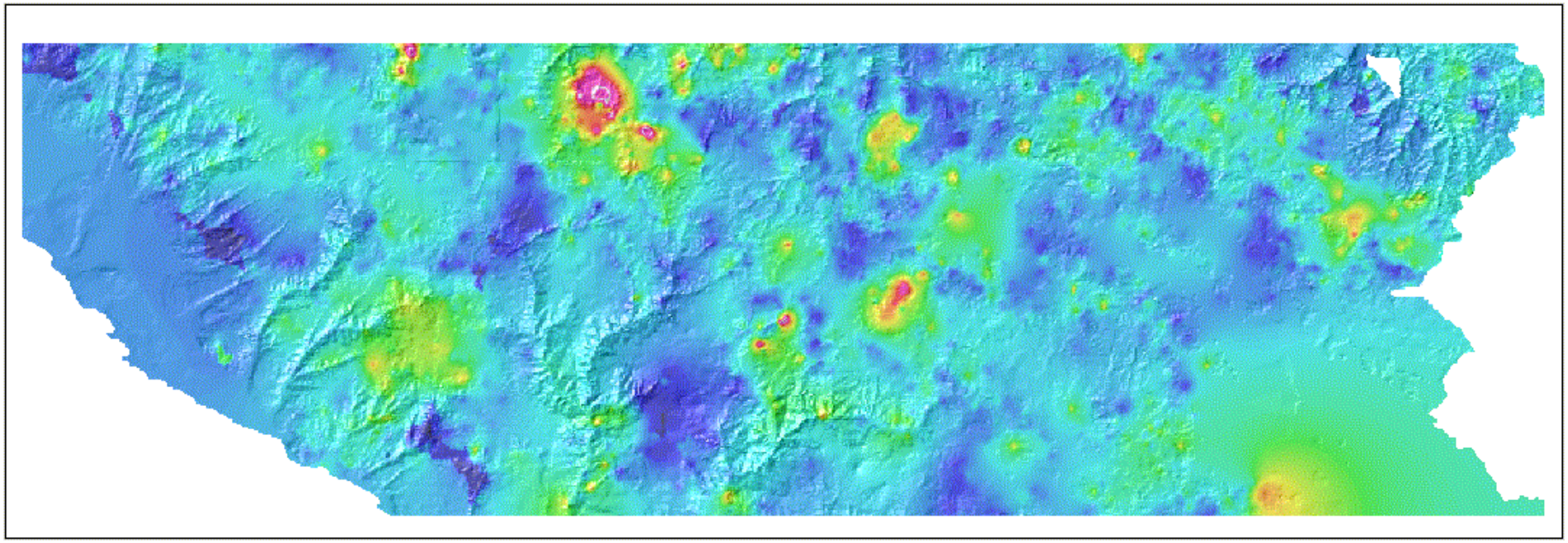


Porphyry search: >50% Ag-Au-Cu-K-Mo-Pb-Zn

<50% Cr-Fe-Ni

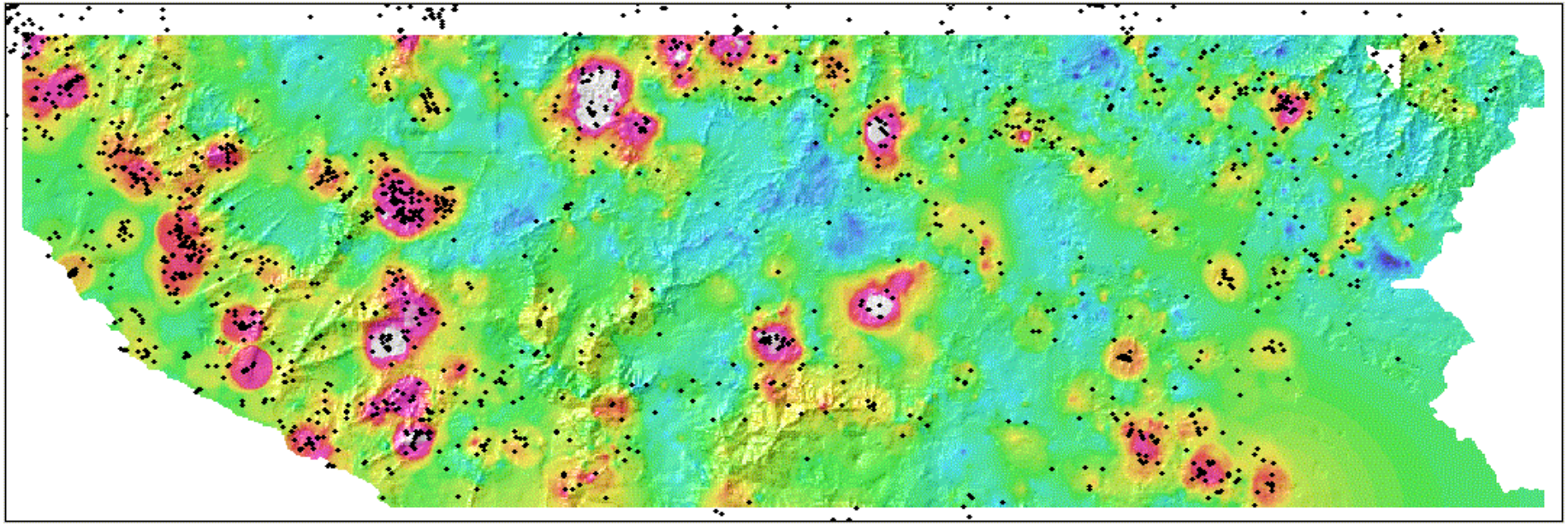
Known major porphyry mines and deposits

Fuzzy Search Results



Epithermal search: >50% Ag-Au-As-Sb

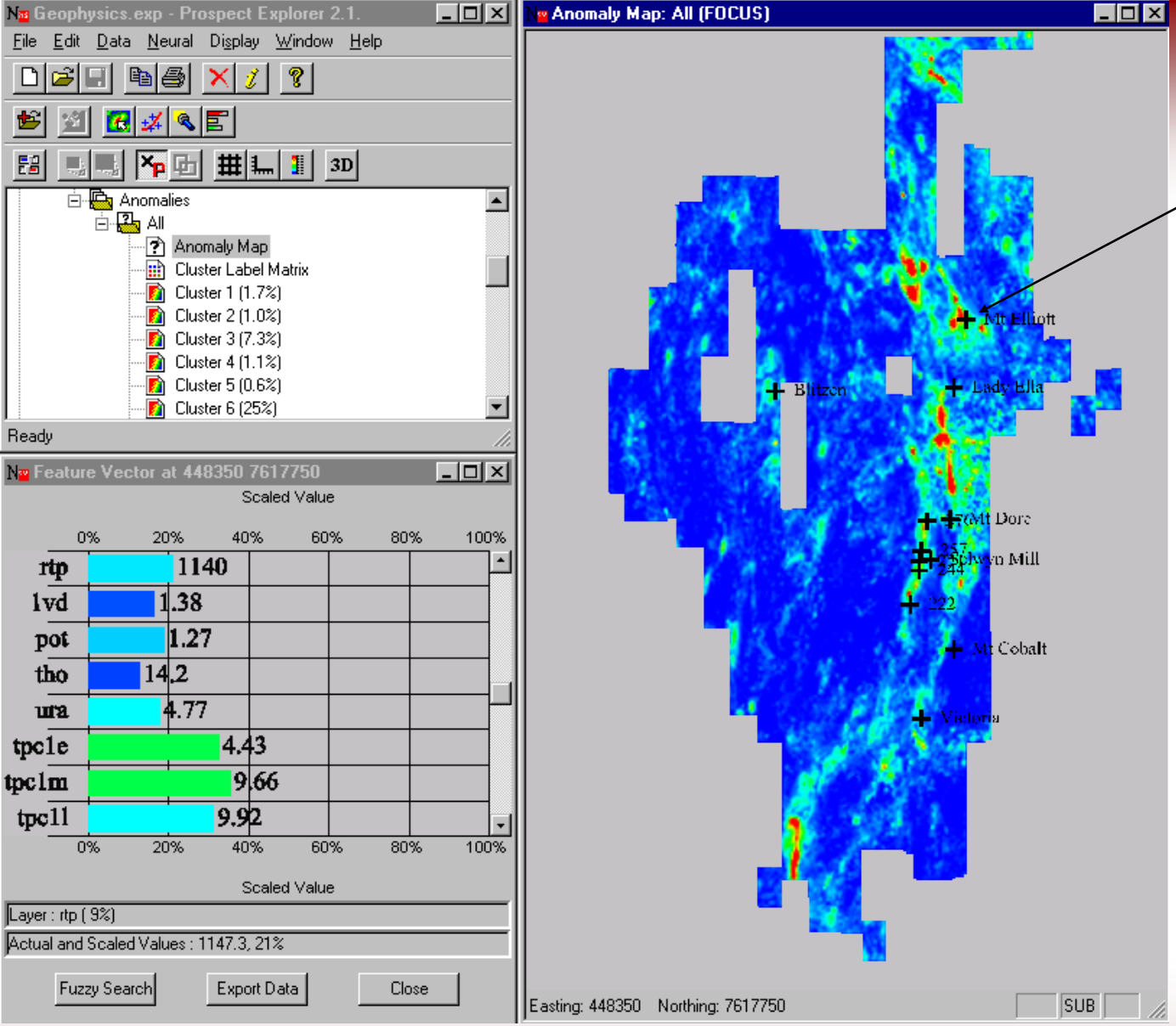
Fuzzy Search Results



Mineralisation search: >50% Ag-Au-Cu-K-Mo-Pb-Zn
>50% mineral occurences

Selwyn Neural Analysis

- Geophysics - 8 data layers
- Geochemistry - 5 layers of soil samples
- *Prospect Explorer* software
- Anomaly detection, cluster analysis, fuzzy searches and correlation analysis

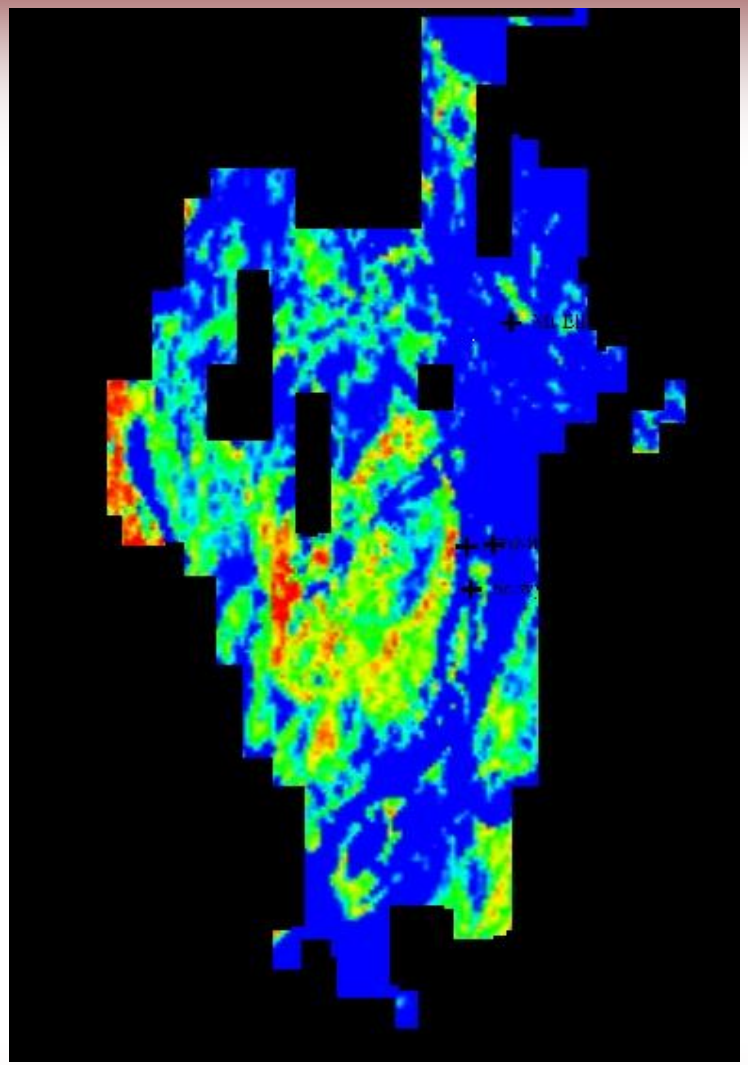


Mt Elliott

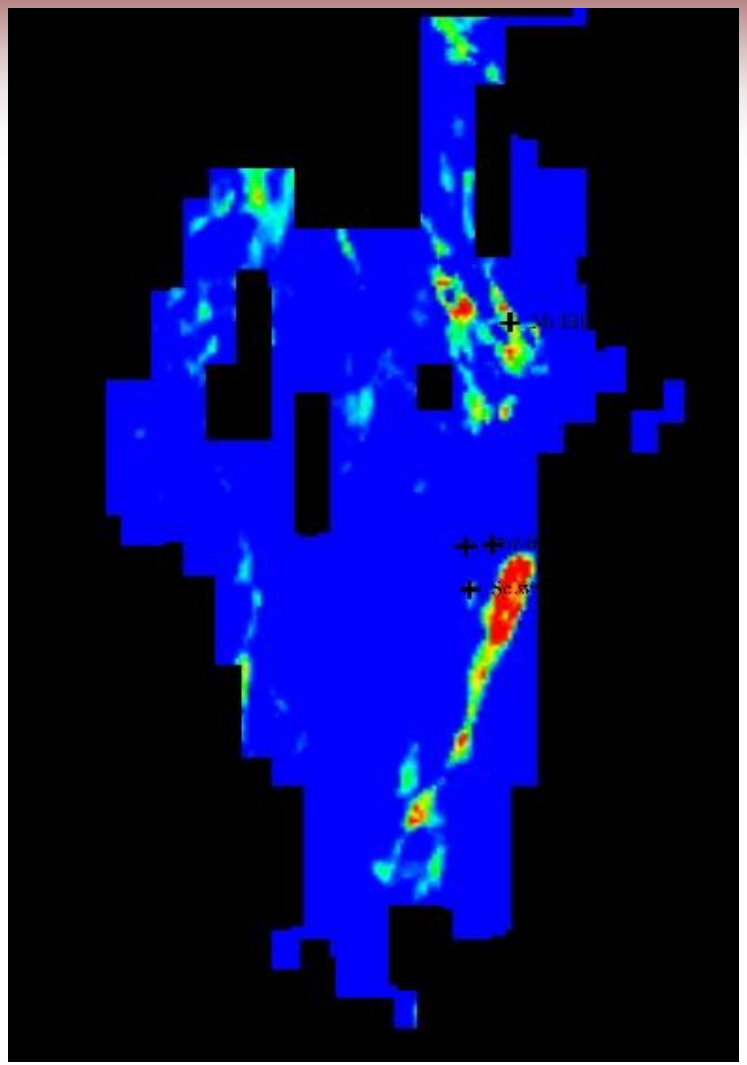
Anomaly analysis

Feature vector plot shows the values at particular anomalies.

The colour of the histogram indicates which data layers are the most significant in determining the anomaly.

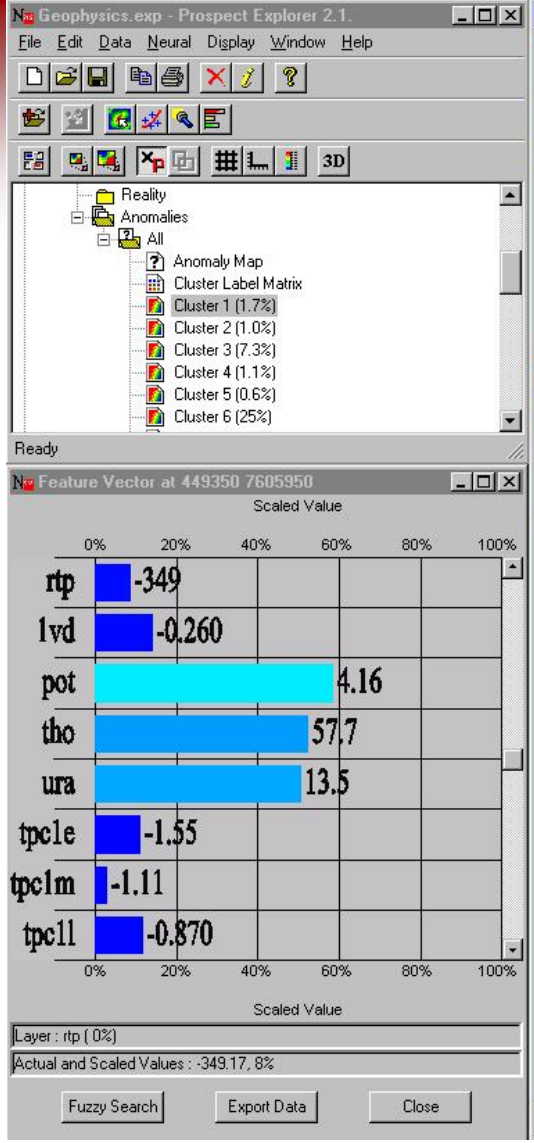


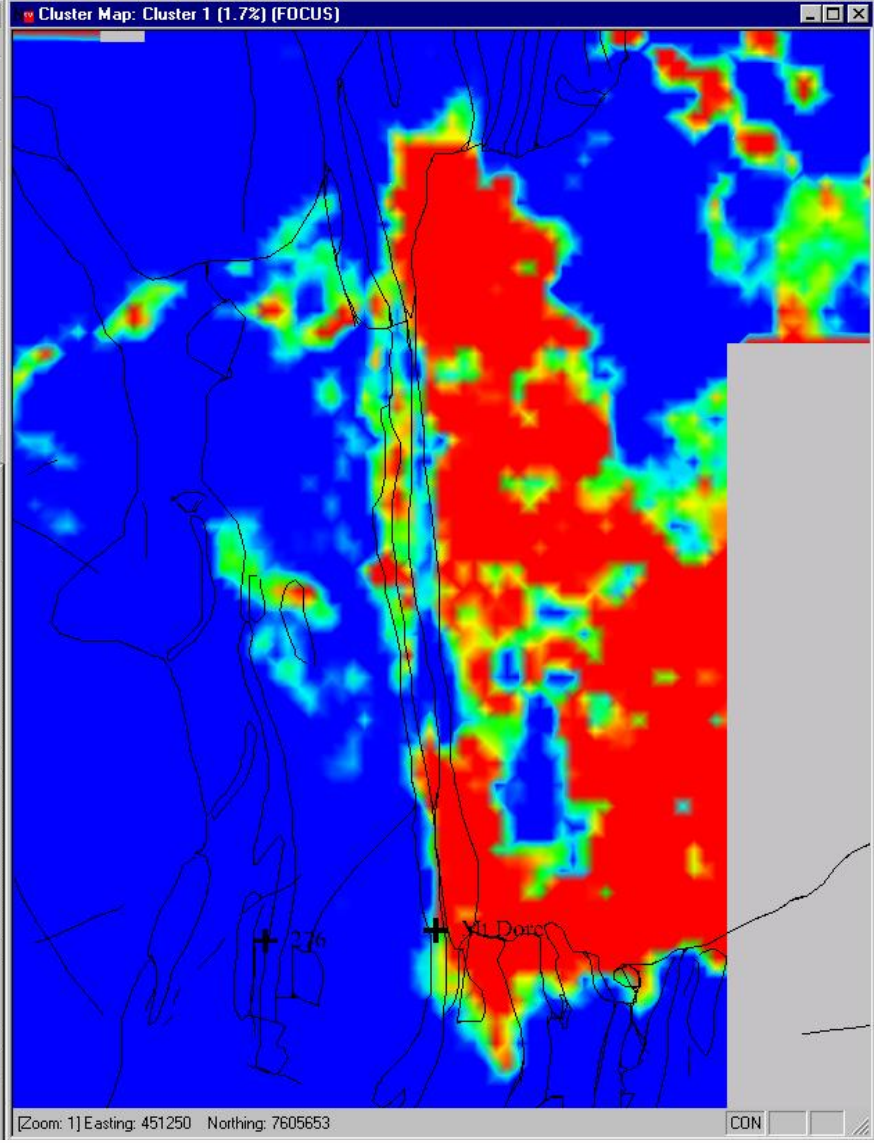
Cluster 21 - Argylla Formation



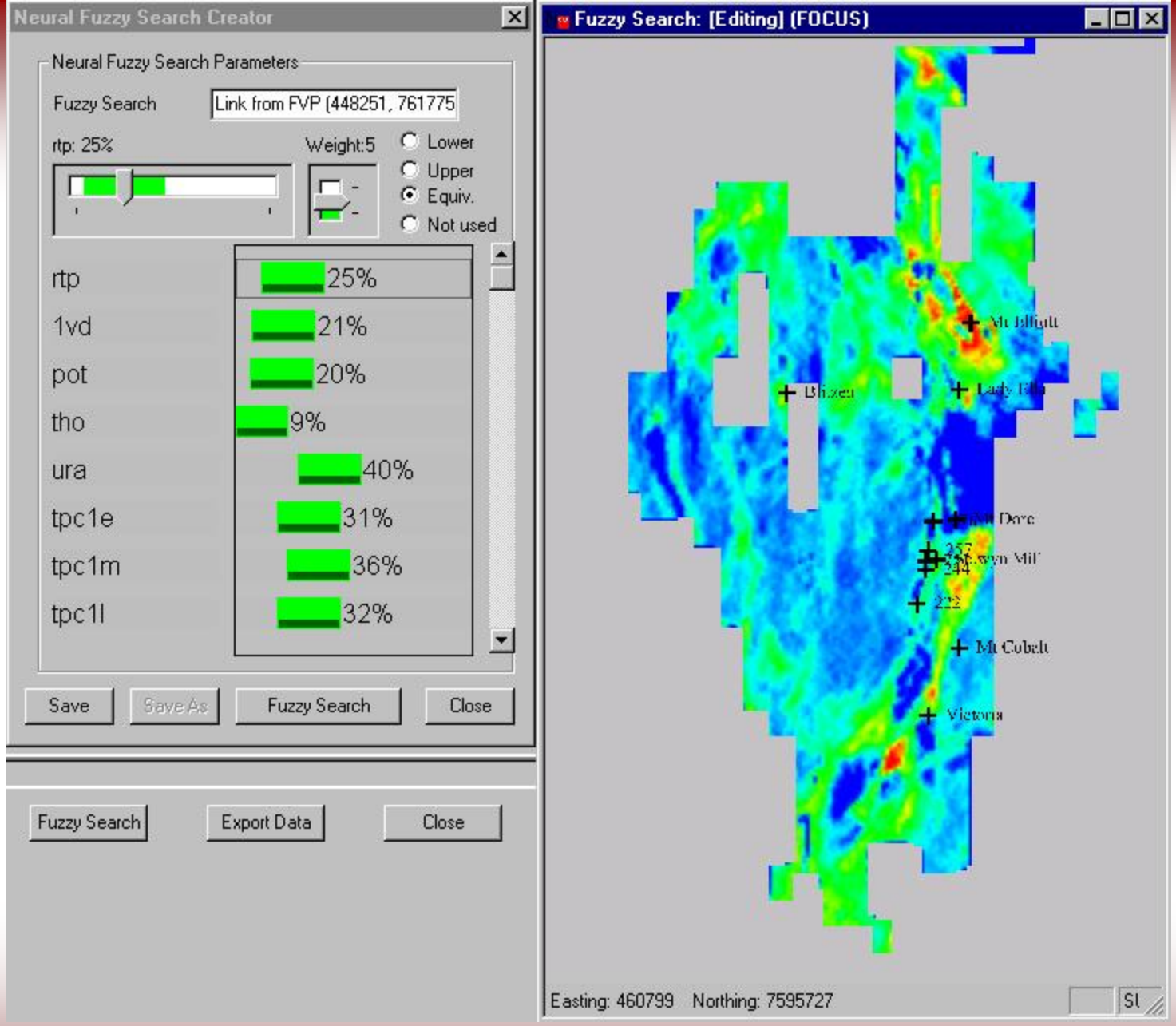
Cluster 24 - Black Shales

Feature Vector Plot shows the geophysical signature of this particular cluster. This may be mapping out a lithological boundary.





Cluster 1 - Mt Dore/Yellow Waterhole Granites



Mt Elliott Fuzzy Search