UNEARTHING TARGETS IN SOIL / STREAM GEOCHEMISTRY USING NOVEL DATA MINING

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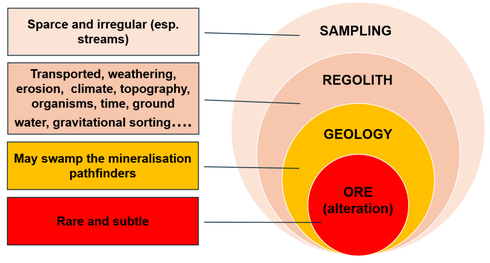


TARGET: rare and hidden by background

Soil and stream sediment geochemistry play a crucial role in exploration, however, mineralisation can be scarce and concealed by regolith effects, particularly in instances of limited sampling, extensive surveys, and complex geological conditions. To improve targeting, data mining techniques can leverage multi-element information. A critical step is normalising the data to account for background cover (regolith and lithology), which enhances the detection of anomalies prior to statistical characterisation, prospectivity analysis, and targeting. In this greenfield area, where no bedrock deposits exist, prospectivity analysis depended on matching the characteristics of a significant alluvial deposit.

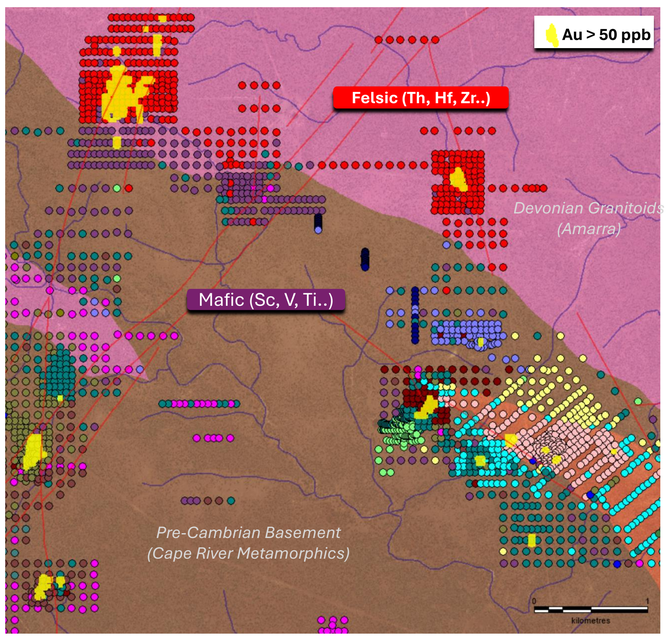
INITIAL PREPARATION AND EVALUTION

- Dataset: ~5,000 UltraFine+® soils and stream sediments > 50 elements (courtesy of Rockland Resources Pty Ltd) from the Pentland area situated 100 km west of Charters Towers (Queensland – Australia)
- A complete and near gaussian dataset was created for statistical evaluation using Log-ratio Expectation Maximisation and CLR - Centred Log Ratio
- Exploratory Data Analysis (EDA) helped to understand how the data structure and Intrusion Related Gold System (IRGS) framework: e.g. univariate methods, visualisation methods (e.g. violin plots), Principal Component Analysis (PCA) and Correlation Analysis to identify background levels and data statistics, controls, patterns and possible pathfinders

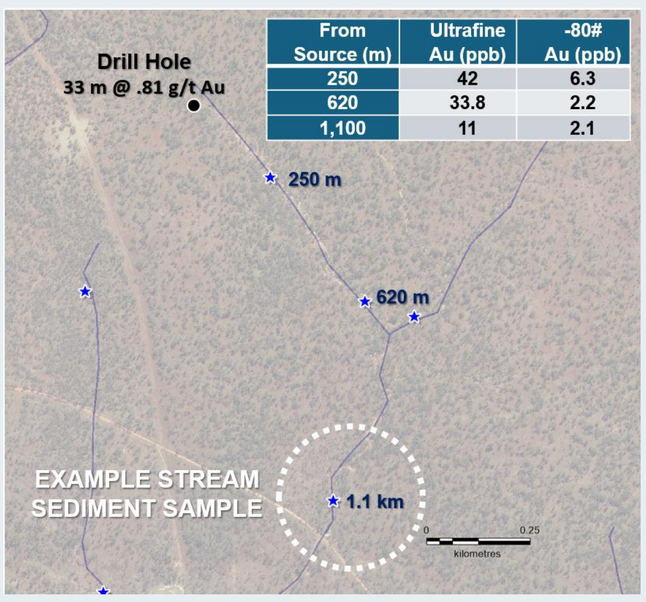
COVER DOMAIN CLUSTERING

The geochemistry cover domain refers to the regolith response which hopefully reflects the local lithology (e.g. felsic Th-Hf-Zr vs Mafic Sc-V-Ti) and should be independent of localised mineralisation (and alteration)

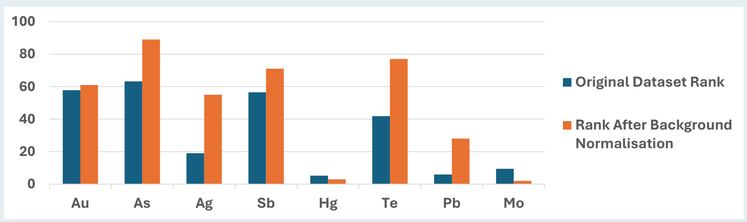
- The input options are as follows:
  - Regolith maps, airborne radiometrics and satellite imagery, however, the actual geochemistry is preferred here to maintain consistency of the sampling regime including the size fraction (could be a small proportion of the surface volume)
  - Using non-pathfinder geochemistry elements helps to avoid alteration affects (e.g. CLR of Al, Ca, Fe, Ga, Hf, K, La, Mn, Nb, Sc, Sr, Th, Ti, U, Zr also key regolith ratios may be useful)
  - PCA (non-pathfinders): may enhance the geology discrimination and clustering speed, whilst avoiding noise (especially if there are levelling issues)
- The best cover domain is assigned after visually comparing the results of unsupervised clustering algorithms: K-Means, Louvian, K-Means of Self Organising Map (SOM) and DB-Scan of t-SNE



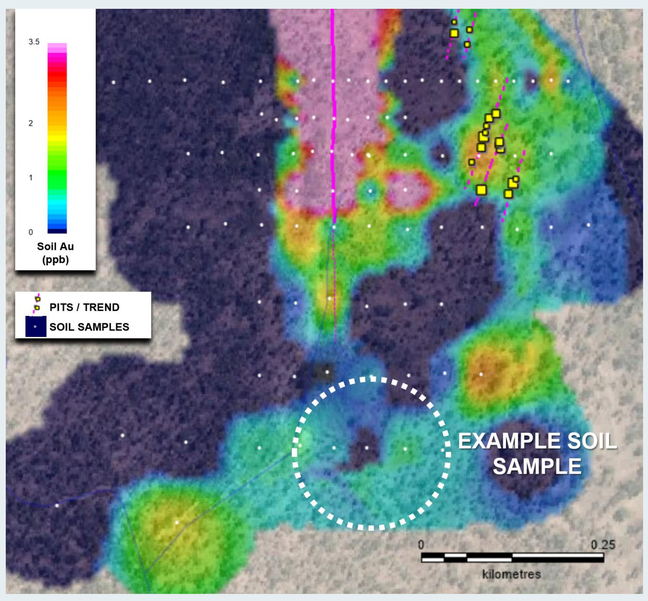
Louvian (PCA 1-5) soil cover clusters (coloured dots) and Gold (>50 ppb Au) Overlying 1:100,000 Solid Geology (Geological Survey of Queensland)

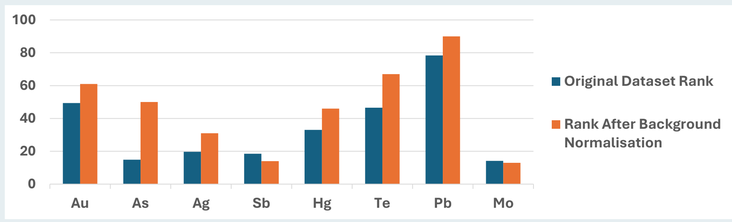


From Source (m)	Ultrafine Au (ppb)	-80# Au (ppb)
250	42	6.3
620	33.8	2.2
1,100	11	2.1



This **stream sediment sample** is located 1.1 km down-stream from bedrock gold mineralisation (33 m @ .81 g/t Au) and has only weak gold (11 ppb Au) which is not anomalous in pathfinders. Normalisation allows pathfinders to be recognised: As (Te-Sb. The -80# Au is much weaker than the UltraFine+® counterpart.





This **soil sample** is located 300 m along strike (south) from bedrock gold mineralisation (chips to 2.2 g/t Au and up to 178 ppb Au in soils) but is obscured by cover and has weak gold (8.5 ppb Au) with elevated Pb. Normalisation allows pathfinders to be recognised: Pb (Te).

BACKGROUND NORMALISATION

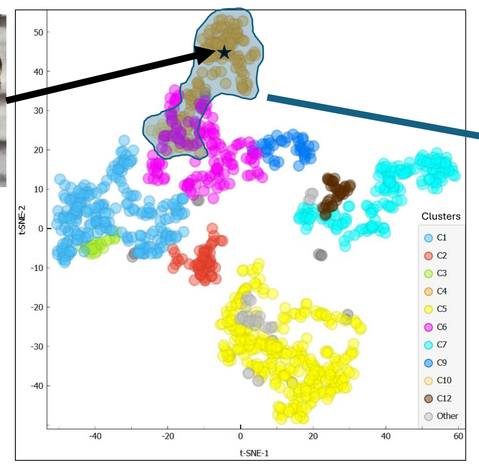
- Cover normalisation is applied to highlight anomalous elements compared to the background regolith and create comparable ranges for comparing and combining the results (e.g. index)
- This step is often ignored by explorers but could be crucial for revealing hidden / subtle patterns and mineralisation – especially for broad sampling, large surveys and complex geology
- The MAD (Median Absolute Deviation) has been used in this study (otherwise known as the median-MAD and modified Z-Score) since it is relatively robust to skewed data with outliers
- MAD can be applied based on the cover subsets (e.g. CMAD) but here we also restricted the statistics to background (e.g. BCMAD) by excluding samples with high gold (above > 8.6 ppb Au ~ dataset median)
- Impact on Spearmen Correlation for gold is a strengthening of 120% (median) and >200% for Pb and Sb
- Stream and soil pathfinder elements often have significant promotion of percentile rank shown here for two examples proximal to mineralisation

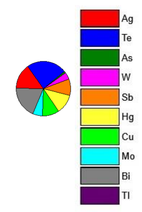
CHARACTERISATION AND PROSPECTIVITY

- Matching a deposit pathfinder signature can help focus prospectivity rankings for targeting
- For this green-field study the only deposit is the Pentland Deep Lead, which produced >60,0000 Oz Au of alluvial gold, however, the bedrock source has not been located. In this instance, mineralised float samples were analysed to approximate the multielement signature (soil values were guessed by halving the rock chip values and adopting typical background levels)
- To reveal soil pathfinder groups, t-SNE was used to reproject samples with anomalous gold into 3D space (shown here as a scatter plot of t-SNE 1 vs t-SNE 2)
- This has highlighted a soil cluster with similar signature to the deposit: high in Au-Bi-Te-Ag (Sb-Hg-Cu) and low in As-Tl

Deposit Float

t-SNE (3D) of Mineralised Soil Subset (BCMAD normalised) Plus Deposit Sample





Cluster Signature Containing Deposit
High Au-Bi-Te-Ag (Sb-Hg-Cu) and Low: As-Tl

Geoff Beckitt

Beckittgeoff@gmail.com

+61 458 930 000

Scan to view an AIG presentation in Brisbane 13/8/2024

Rockland Resources Pty Ltd is thanked for permission to use and show the data in this study