NWQ Geochemistry Toolkit

Meeting the challenge of finding buried and blind ore deposits

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The Challenge:
Ernest Henry before…

…and after

How can we best use time and money to optimise the identification of drill targets?

Background

- Mount Isa Inlier is one of the world's most significant base metal provinces
- The region has been systematically explored for base metals since 1950s mainly within the exposed domain
- Large areas of prospective rocks are under-explored for blind/concealed deposits
- Geochemistry is pivotal in future ore discovery
- Optimised multi-element geochemical data is required in all settings – outcropping/exposed and covered areas
- Detection and recognition of distal ore signals via coordinated and progressive acquisition in all media and exploration settings

Geochemistry Toolkit (GTK) Project

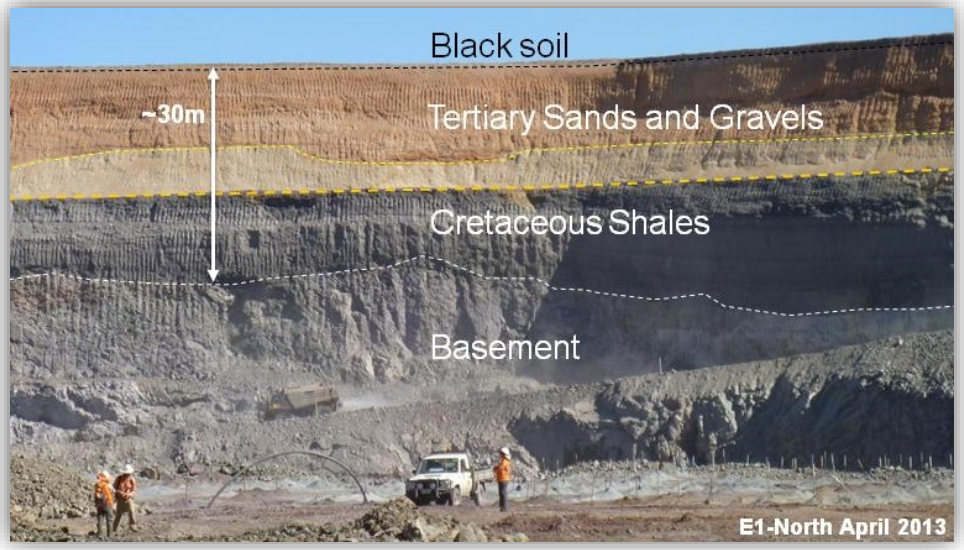
- GTK is a handbook of practical guidelines and pictorial illustration for optimising pre-discovery geochemical exploration in NW Queensland
- GTK handbook will be available to all explorers (online and hardcopy)
- Accompanied by updated thickness of cover maps and GIS data links (GSQ)
- GTK geochemistry workshops will be delivered regionally and in Brisbane *(Cloncurry, 12th March, Brisbane TBC)*

Geochemistry Toolkit (GTK) Project

- Provides overviews of each sampling method or analytical technique for deeper deposits in both outcropping and covered areas
- Provides guidelines to appropriate data processing, presentation and interpretation
- Project will be completed before mid-2018

Geochemistry Toolkit (GTK) Project

- The GTK is structured on the basis of 4 exploration settings (“domains”), corresponding to differences in type and thickness of transported or ‘post-mineral’ cover.
  - **Exposed** (<1m)
  - **Unconsolidated**: 1-25 m
  - **Unconsolidated**: 25-100m+
  - **Consolidated**



Example of post-mineral cover

Geochemistry Toolkit (GTK) Project

Chapters

Exposed

1. Conventional surface geochemistry and data

Unconsolidated cover

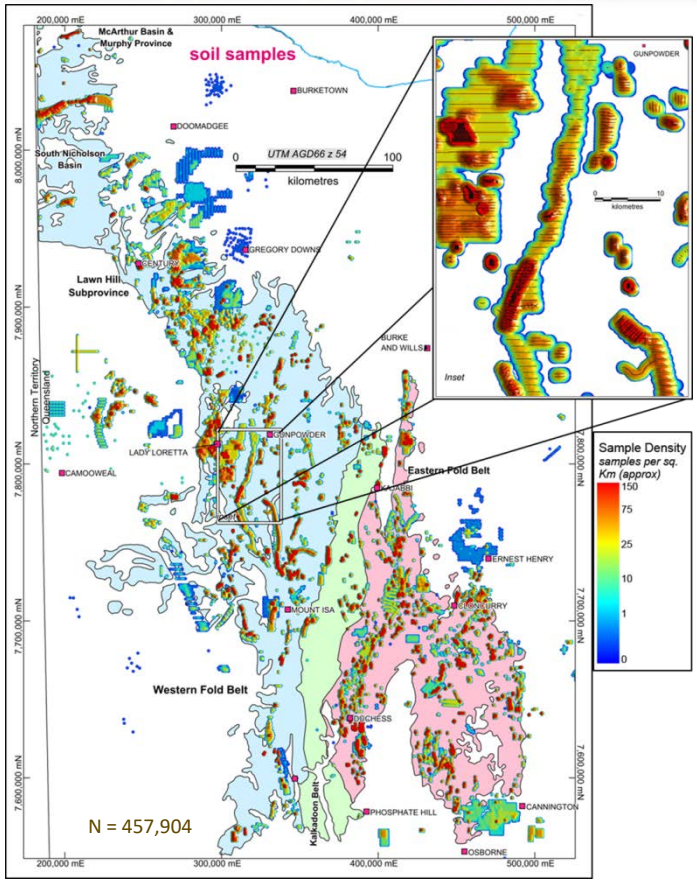
2. Surface and within cover expressions of known ore deposits
3. Exploration case studies/orientations
4. Sampling methods, target media, transport mechanisms, analytical overview
5. Hydrochemistry

Bedrock methods

6. Pb isotopes, Stable isotopes

All supported by GSQ updated thickness of cover GIS, data links.

Bedrock Domain: Conventional Geochemistry



Sample type	Sub-total	Mesh classes
Soil Conventional	359,111	52
BCL	40,693	17
Other	58,100	
Total	457,904	

Element	Number of readings	Proportion (of 458,000) %
Pb	388,300	85
Zn	328,000	72
Ag	278,000	61
As	193,000	42
Au	184,000	40
Cu	172,000	38
Bi	114,000	25
Mo	95,500	21
Sb	39,300	8.5
Tl	33,800	7.4
Sn	26,600	5.8
U	22,900	5
La	16,300	3.6
Lu	3,200	0.7

- Historical data sets for all media examined in terms of overall coverage and data effectiveness
- Especially with respect to common “pathfinders” (including trace metals)

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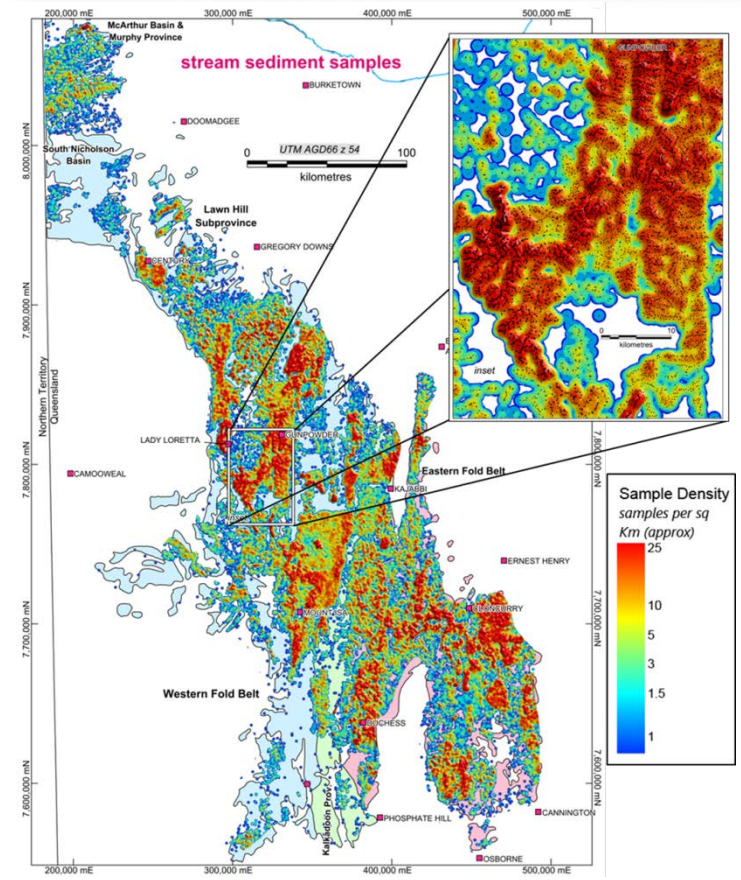
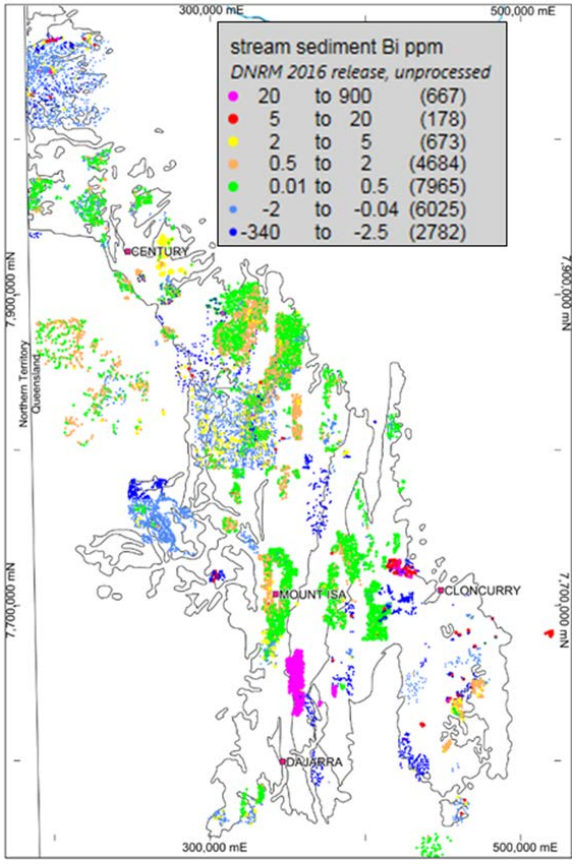
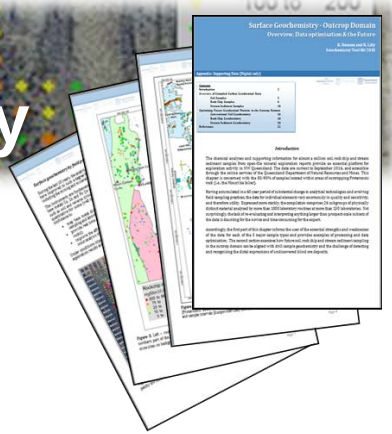
Bedrock Domain: Conventional Geochemistry







- Recommended elemental suites & analytical schemes for stream sediments, rock chips and soil

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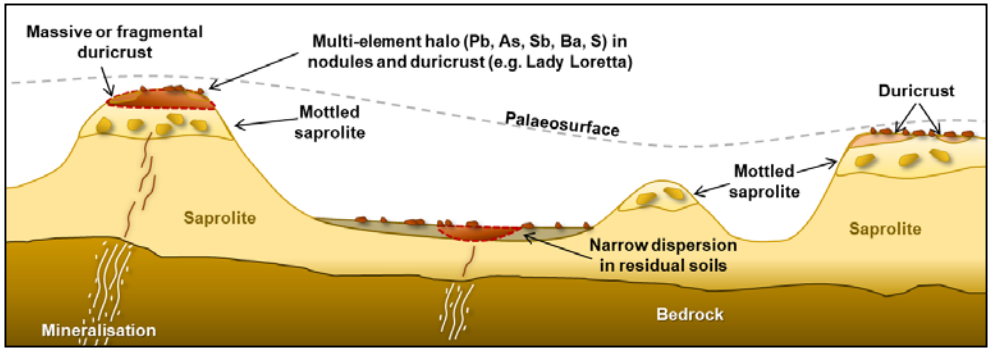
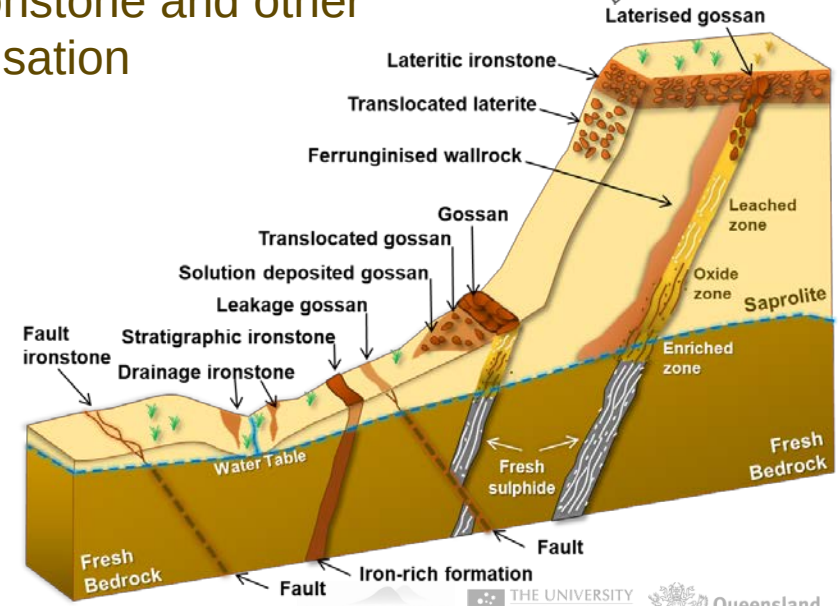
Bedrock Domain: Gossan and Ironstones

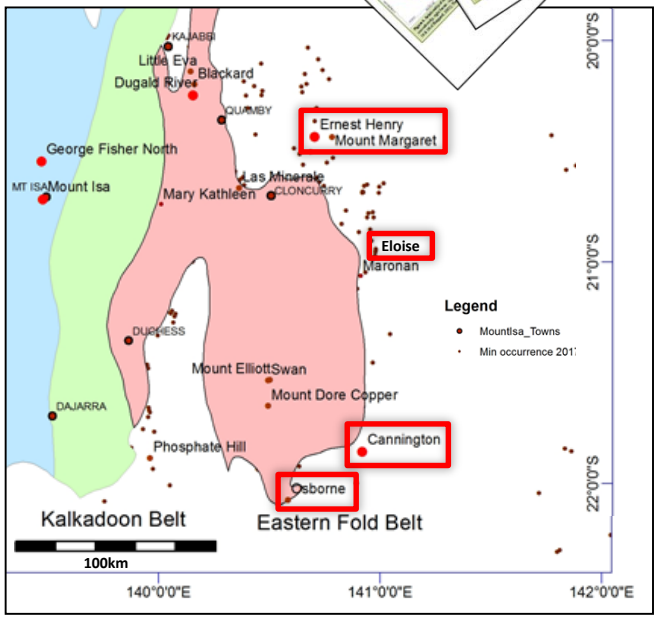
- Review of gossan and ironstone geochemical characteristics
- Identifies simple geochemical criteria (and thresholds) to recognise gossan, as distinct from variants of bedrock ironstone and other ferruginous materials *not* derived from mineralisation





Covered Domain: Ore Deposit Case Studies

- Brings together historical studies and provision of key maps and results for known deposits in covered domain:
  - Ernest Henry and Mount Margaret (E1)
  - Osborne
  - Eloise
  - Cannington
- All case studies have some evidence of geochemical anomalism above projected ore *(including potential for gas mediated anomalies)*

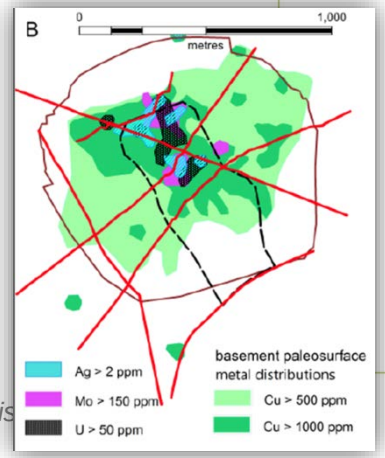


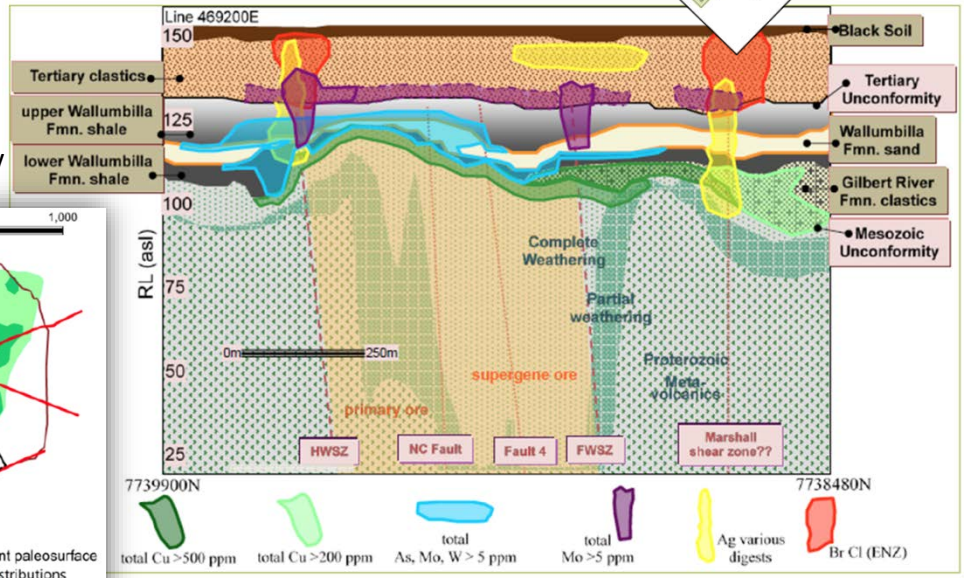
Covered Domain: Ore Deposit Case Studies

- Each of the case studies offer different insights into controls of chemical anomalies to deeper sources and in some cases, the likeliest transport mechanisms.

- The results of ‘failed’ surveys are also discussed, as guidance for the challenge, inherent to all applied technologies, of distinguishing negative and null exploration results.

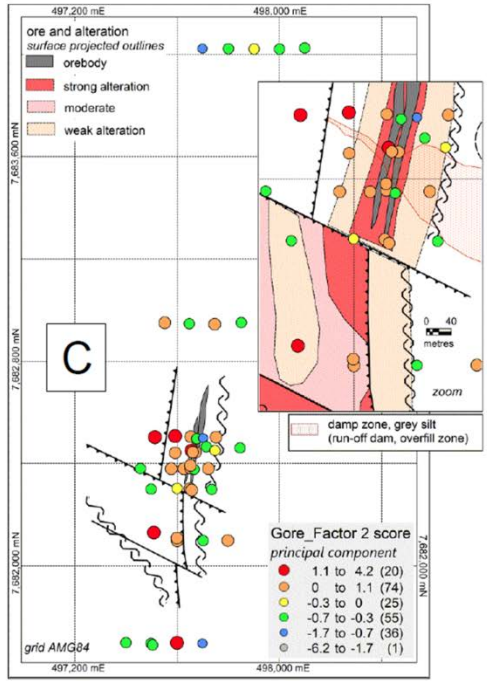
Ernest Henry Case Study

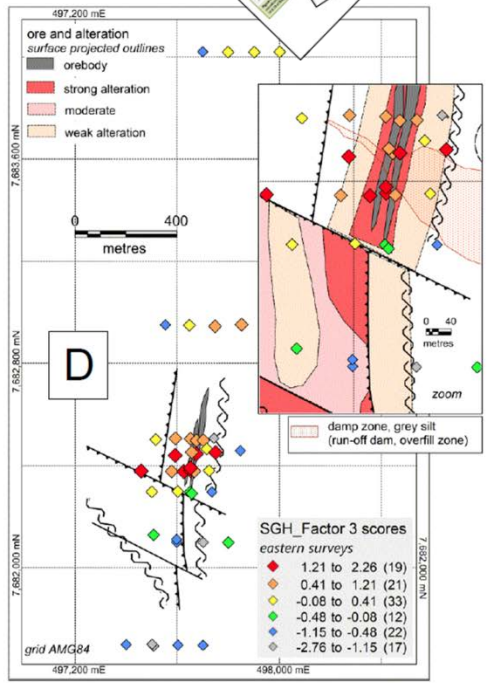




Covered and Consolidated Domain: Ore Deposit Case Studies

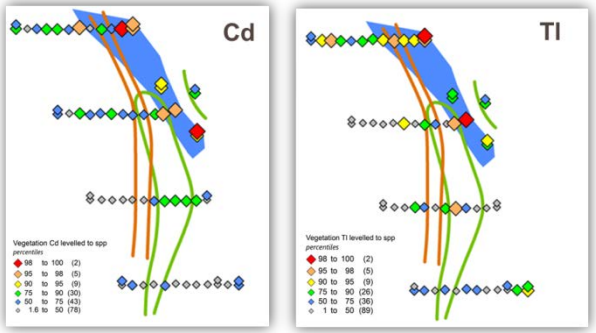
- Several gas-in-soil methods have been trialled at Ernest Henry, Osborne and Eloise
- Methods include:
  - **pSirogas (CSIRO)** at Osborne and Ernest Henry
  - **Soil desorption pyrolysis (SGH)** and **GORE soil gas** at Eloise
  - **Metal Soil Gas** at Eloise
- The promising results are reviewed to raise awareness of the potential of gas-in-soil methods





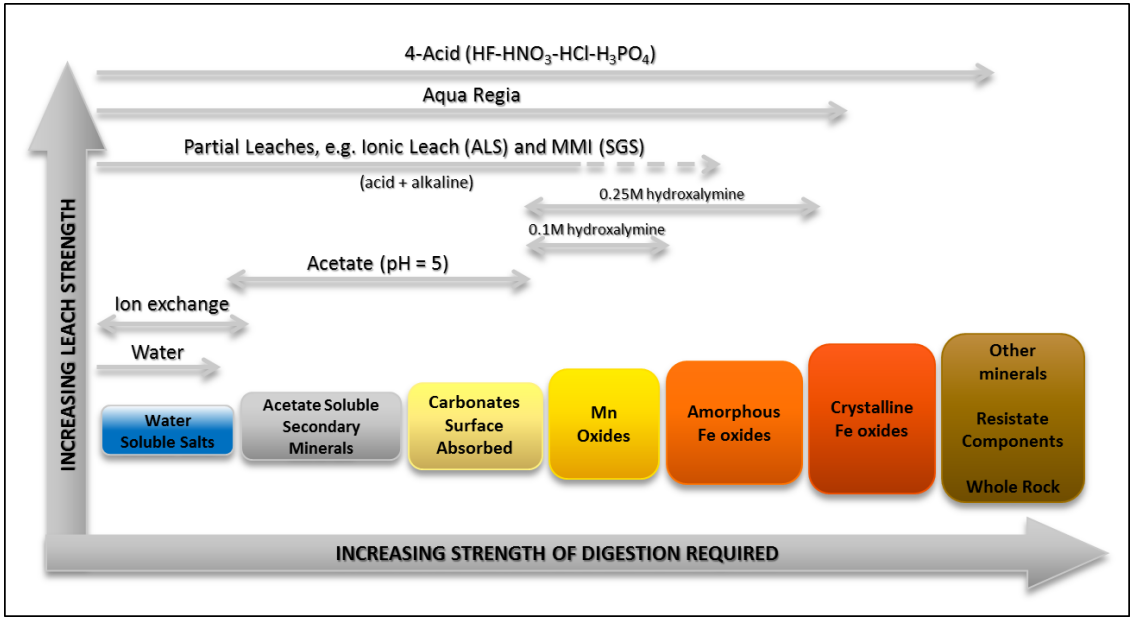
Covered Domain: Orientation surveys and Biogeochemistry

- Vegetation sampling (leaves/grasses) offers potential sample medium in all cover settings
- Case studies (e.g. *Geochemistry Through Cover project, 2016*), orientation surveys and sampling methodologies discussed



Covered Domain: Sampling methods

- GTK project will detail:
  - Sampling methods
  - Target media
  - Transport mechanisms
  - Analytical overview



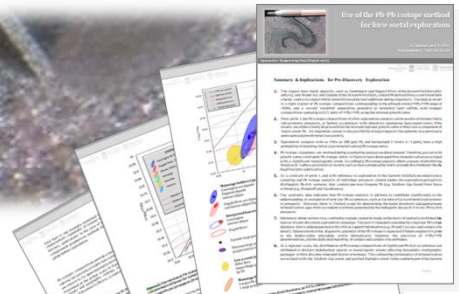
Covered and Consolidated Domain: Hydrogeochemistry

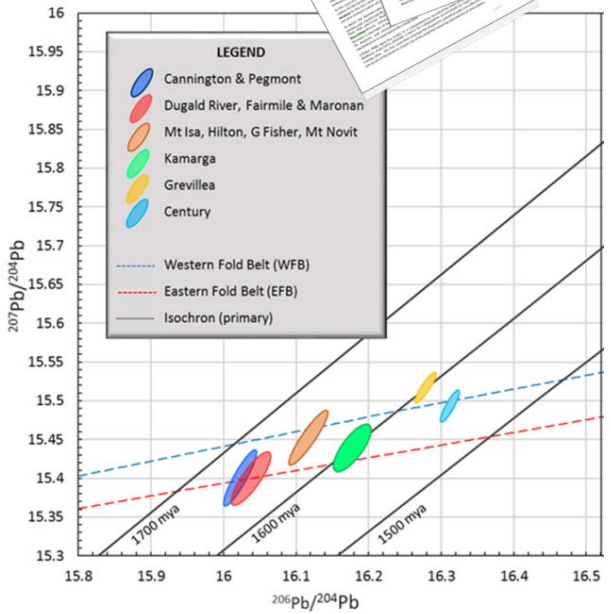
- Under-utilised and under-estimated methodology? No shortage of “successful” case studies in the literature
- GTK documents Ernest Henry deposit area investigations, results are promising but not robust - the dataset is a mix of aquifers and “process” uncertainties….
- GA and CSIRO groundwater chemistry compilations for the Mount Isa region lack metal data
- A rigorous and methodical regional sampling and analysis initiative would provide a long term data resource with multiple end-users

Bedrock Domain: Pb Isotopes

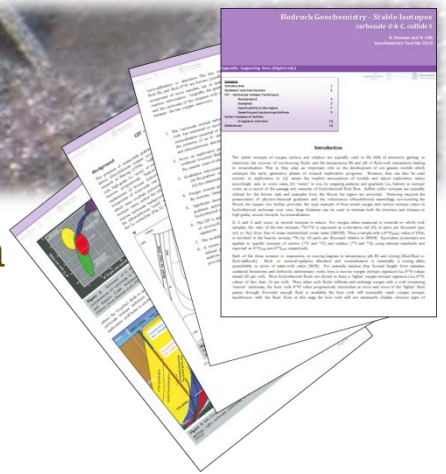
- Thorough review of well-established Pb isotope method with relevance for the search for Pb-Zn systems e.g. Sediment hosted (Mount Isa, G.Fisher, L.Loretta) and Cannington-type

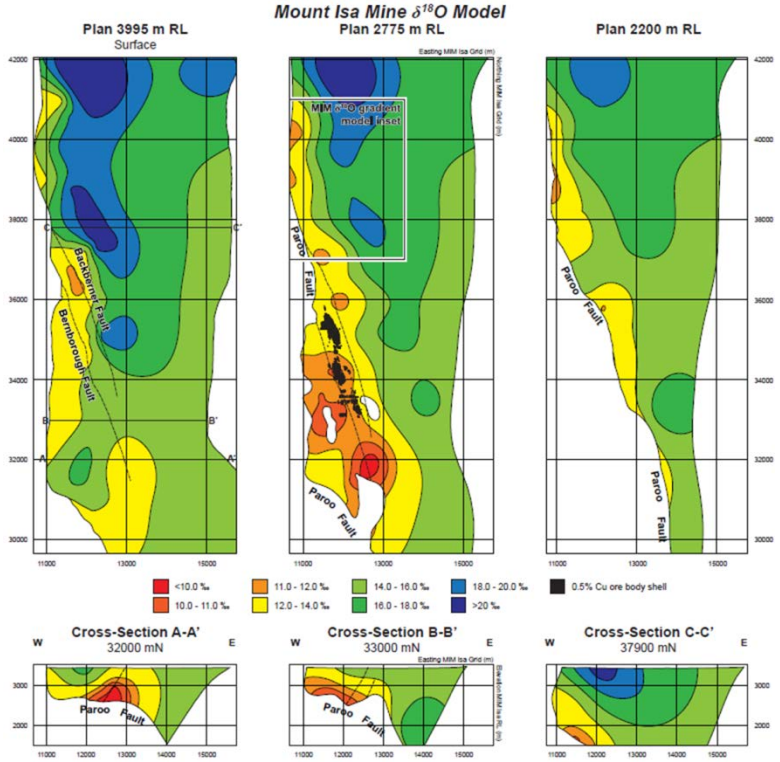
- Pb isotope compositions of a few exploration samples can be used to eliminate likely sub-economic prospects
- Pb isotope signatures are even retained during weathering and gossan development





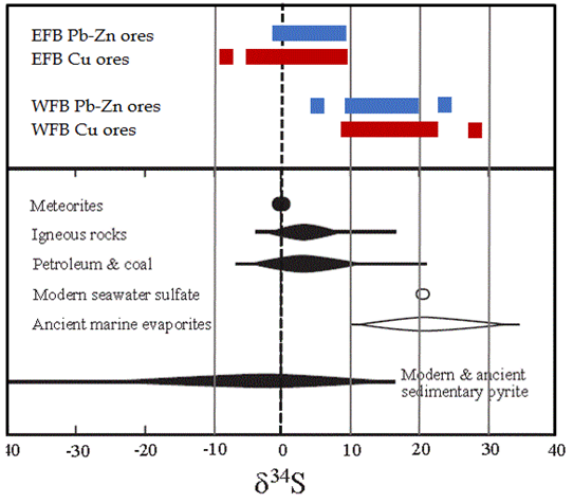
Bedrock Domain: Stable Isotopes





- Carbonate O & C isotoptic data reviewed for the region and conclude Carbonate Isotope Technique (CIT) relevant to the wider WFB/McArthur Basin.

- S isotopes – limited to petrogenetic and metallogenetic characterisation with no evidence for zonations relevant to exploration



Stable isotope data from B. Andrew, 2016.
Current collaborative PhD, MIM - Waikato Uni

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GTK: What next?

- Planning and execution of multiple surveys at different scales using the geochemical exploration techniques established by the GTK
  (excluding hydrochemical – a distinct additional program)
- Surveys will target prospective areas identified by prior structural, fluid-flow and/or geophysical modelling
- Aim is to produce atlas of prospective areas in Mt Isa inlier to assist explorers

GTK: Summary

- Geochemistry is pivotal to future ore discovery in Mount Isa Inlier
- Large areas of prospective rocks are under-explored for concealed deposits
- The GTK project aims to summarise the ‘state-of-knowledge’ for geochemical exploration in NWQ using all available techniques
- GTK provides geochemical case studies of known ore bodies
- Project to be finished by mid-2018 (online/hard copy with accompanying workshops)

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Thank you!

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