



Regional hydrogeochemistry

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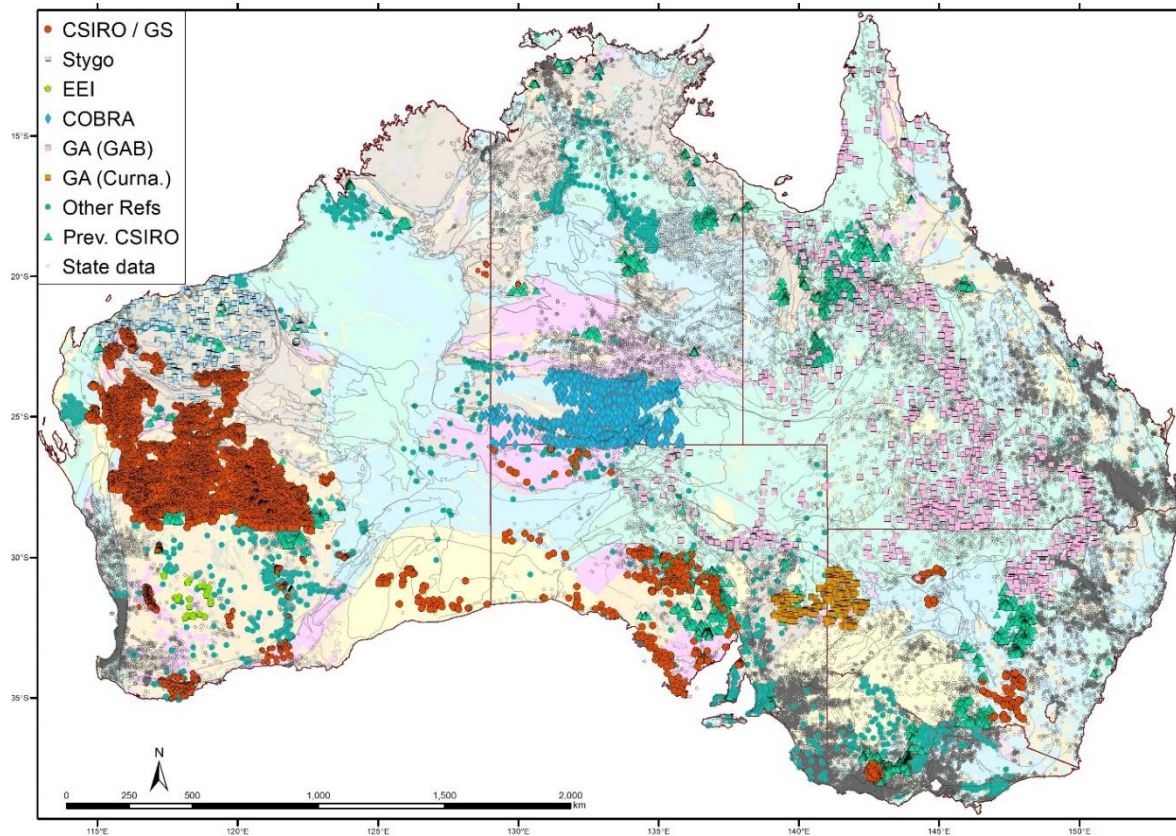
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Value of hydrogeochemistry

- Greenfields exploration & development of *Regional* targets
 - Potential for low (> km sample density)
 - Moving into basins (drilling for large targets)
- Indication of alteration signatures
 - S-alteration and various alteration haloes (As, W ...)
 - Uranium – “Yeelirrie” type targets in northern Yilgarn (elsewhere?)
 - Archaean lode Gold – Au, As, Mo, Rb for northern groundwaters
 - SO₄ anomalism show sulphides
 - NiS targeted using Ni, Co, Pt
 - VMS targeted using Cu, Zn, Pt, Ag
 - Lithology mapping through cover (very successful)
- Integrate with baseline environmental studies

Compiling Australia-wide data



- Many data sources
- Not just compilation!
QA/QC and validation
- Greatest number of samples from State Government datasets (grey circles), though with lesser element suites
- Other datasets have more extensive element suites – *different data densities*
- Our goal is to make as much of this data readily available

Online Resources

- CSIRO Publications
- <https://publications.csiro.au/r/>
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- CSIRO Data
- <https://data.csiro.au/dap/search>
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- Sampling log books, training
- Email david.gray@csiro.au

The screenshot shows the CSIRO Research Publications Repository search results page. The header includes the CSIRO logo, navigation links for 'Contact Us' and 'Help', and a 'CSIRO Login' section with fields for 'Username' and 'Password' and a 'LOGIN' button. Below the header are navigation tabs: 'SEARCH PUBLICATIONS', 'ADVANCED SEARCH', 'BROWSE PUBLICATIONS', and 'SELECTED RECORDS (0)'. The main content area is titled 'Search Results' and shows a search for 'Hydrogeochemistry' with 42 results. The results are listed with their titles, authors, and publication dates. A left sidebar contains 'REFINE RESULTS' options for 'Year of Publication' (set to 'All') and 'Show ONLY these Publication Types' (including Conference Material, Report, Journal Article, and Book Chapter). Another section shows 'Show ONLY these Authors' with a list of names and their respective result counts.

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- Book Chapter (1)

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Show ONLY these Authors:

- gray, david (15)
- gray, d.j. (9)
- bardwell, nicki (6)
- reid, nathan (6)
- noble, ryan (5)
- andrew, a. s. (4)
- carr, g. r. (4)
- crewell, rg (4)
- giblin, a. m. (4)
- whitford, d. j. (4)

Clear More

Search Results

Showing results for: Hydrogeochemistry

SEARCH

Found: 42 results Display: 10 | 25 | 50 results Sort by: Date

Select all on page indicates that full text is available.

- Hydrogeochemistry dataset obtained from Stygofauna Sampling, Pilbara Region, Western Australia - Data Release: Accompanying Notes
Author: Gray, David
Date of Publication: 2016-06
Full text
- Hydrogeochemistry of New South Wales - Data Release: Accompanying Notes
Author: Gray, David; Bardwell, Nicki
Date of Publication: 2016-06
Full text
- Hydrogeochemistry from Victoria - Data Release: Accompanying Notes
Author: Gray, David; Bardwell, Nicki
Date of Publication: 2016-06
Full text
- Hydrogeochemistry of Queensland - Data Release: Accompanying Notes
Author: Bardwell, Nicki; Gray, David
Date of Publication: 2016-06
Full text
- Hydrogeochemistry from Northern Territory - Data Release: Accompanying Notes
Author: Bardwell, Nicki; Gray, David
Date of Publication: 2016-06
Full text
- Hydrogeochemistry of Western Australia - Data Release: Accompanying Notes
Author: Bardwell, Nicki; Gray, David
Date of Publication: 2016-06
Full text
- Hydrogeochemistry of South Australia - Data Release: Accompanying Notes
Author: Gray, David; Bardwell, Nicki

Online Reso



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Published date: All

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- Geochemistry not elsewhere classified (8)
- Isotope Geochemistry (1)

Clear

Show ONLY these Projects:

- Strategic - WA Hydrochemistry Database (8)
- 1212.3 Goyder FLOWS2 -T2 GW flow syst (1)

Clear

Show ONLY these People:

- Gray, David (8)
- Bardwell, Nicki (6)
- Giffedder, Mat (1)
- Noble, Ryan (1)
- Reid, Nathan (1)
- Taylor, Andrew (1)

Clear

Search Results

Showing results for: Hydrogeochemistry **SEARCH**

Found: 9 results 5 Display: 10 | 25 | 50 results Sort by: **Relevance** | Recent | Title

indicates that access to files within this collection is restricted

[Hydrogeochemistry of Queensland: Data Release](#)
This is the revised groundwater data from the Queensland Department of Natural Resources and Mines. The data release is based on data downloaded from www.data.qld.gov.au. By combining data into one file... [more](#)
Strategic - WA Hydrochemistry Database - Hydrogeochemistry dataset analysis - Published 10 Jun 2016

[Hydrogeochemistry of Victoria: Data Release](#)
This is the revised groundwater data originally downloaded from the Visualising Victoria's Groundwater Web Portal: <http://www.vvg.org.au/>. By combining data sets into one file, with consistent detect... [more](#)
Strategic - WA Hydrochemistry Database - Hydrogeochemistry dataset analysis - Published 12 Jun 2016

[Hydrogeochemistry of Western Australia: Data Release](#)
This is the revised groundwater data from the Government of Western Australia (WA). Data was supplied by Lindsay Preece and Robert Lavis from Water Information Management at the Department of Water, W... [more](#)
Strategic - WA Hydrochemistry Database - Hydrogeochemistry dataset analysis - Published 12 Jun 2016

[Hydrogeochemistry of Northern Territory: Data Release](#)
This is the revised groundwater data originally supplied by Department of Land Resource Management ©, Northern Territory of Australia, courtesy of Anna Sheridan. By combining data into one file, with... [more](#)
Strategic - WA Hydrochemistry Database - Hydrogeochemistry dataset analysis - Published 10 Jun 2016

[Hydrogeochemistry of New South Wales: Data Release](#)
This is the revised groundwater data originally supplied by the NSW Office of Water, courtesy of Greg Russell. By combining data into one file, with consistent detection limits, correcting for analyt... [more](#)
Strategic - WA Hydrochemistry Database - Hydrogeochemistry dataset analysis - Published 07 Jun 2016

[Hydrogeochemistry of South Australia: Data Release](#)
This is the revised hydrogeochemical data from the SA_Geodata groundwater database, courtesy of Lloyd Sampson of the Department of Environment, Water and Natural Resources, South Australia (SA). By c... [more](#)
Strategic - WA Hydrochemistry Database - Hydrogeochemistry dataset analysis - Published 07 Jun 2016

[Hydrogeochemistry of north Yilgarn Craton \(M414\): Data Release](#)
This regional hydrogeochemical dataset combines the NE Yilgarn (2007-9), Byro-Belele (2011-12) and NW Yilgarn Hydrogeochemistry (2012-14) Project datasets, along with previous mine-site based sampling... [more](#)
Strategic - WA Hydrochemistry Database - Hydrogeochemistry dataset analysis - Published 07 Jun 2016

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- Water management
- Hydrology
- Hydro/Geology
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Selectable layer: All bores

Canberra

Legend

Search

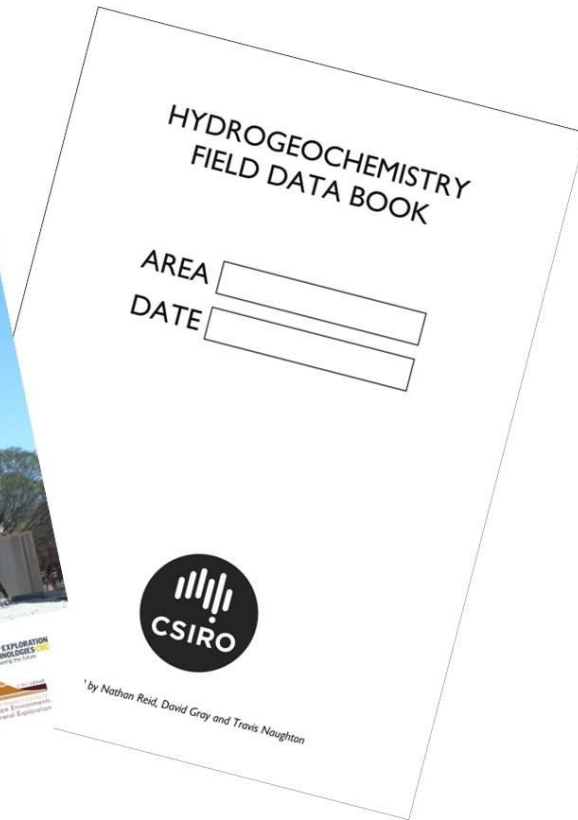
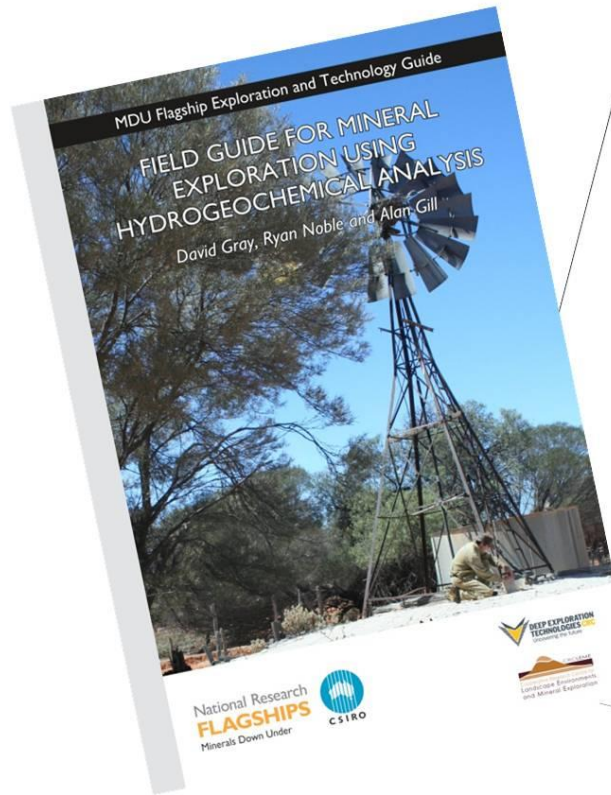
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Current Scale: 50,000,000

SEARCH RESULTS

98.76231, -9.61934

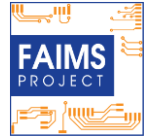
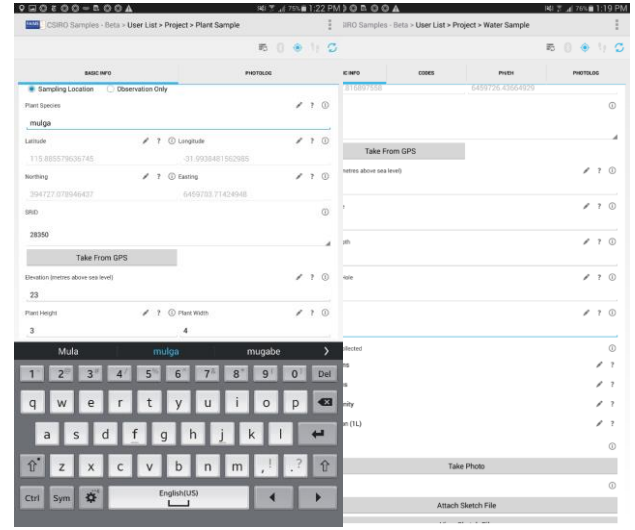
Selection Size: 0



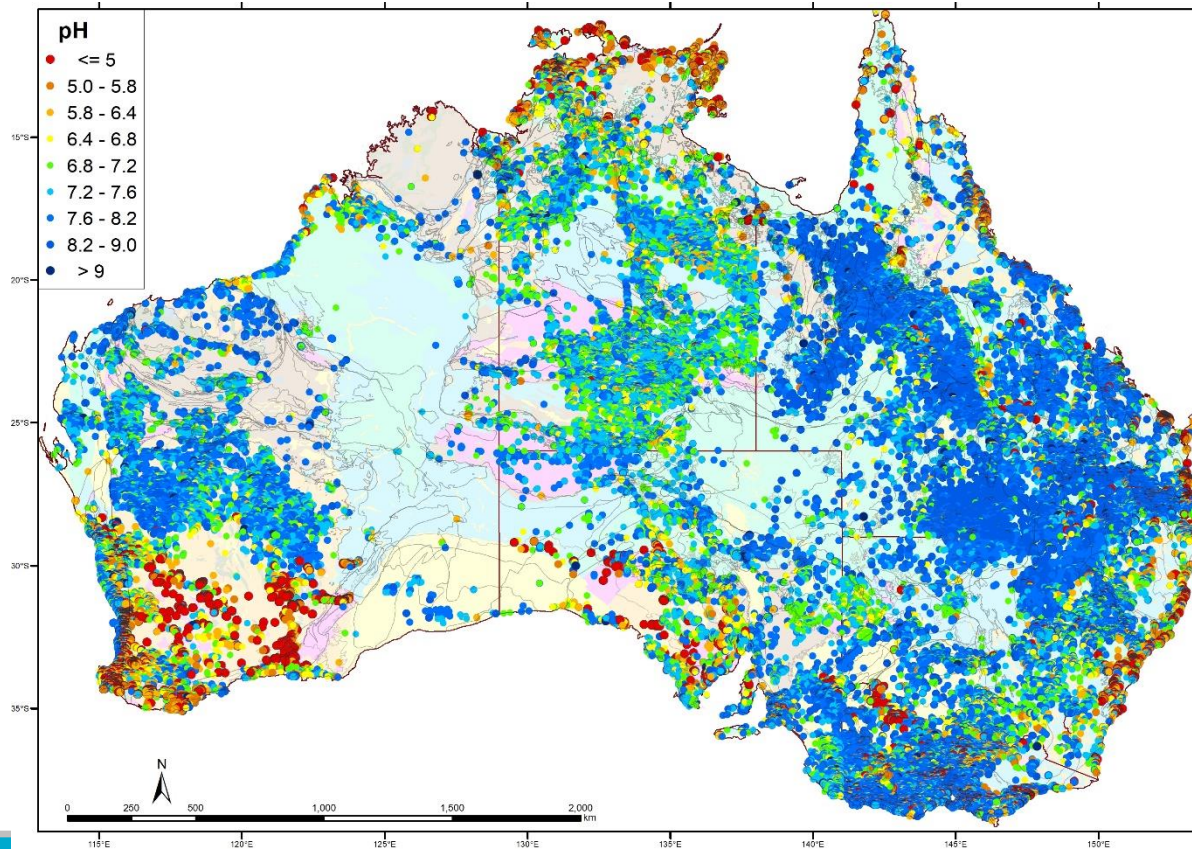
- Sampling log books, training guides, tablet field app
- Email nathan.reid@csiro.au

FAIMS Android app

- The app has been adapted for CSIRO protocol geochemical sampling
- Allows for all geochemical data collection and basic mapping functionality. Photo tagging, sketches, site information and lithological descriptors.
- There is also a field server provided to prevent data loss and syncing with multiple devices.
- All hydro samples are now collected this way – and its open source so we are happy to help others

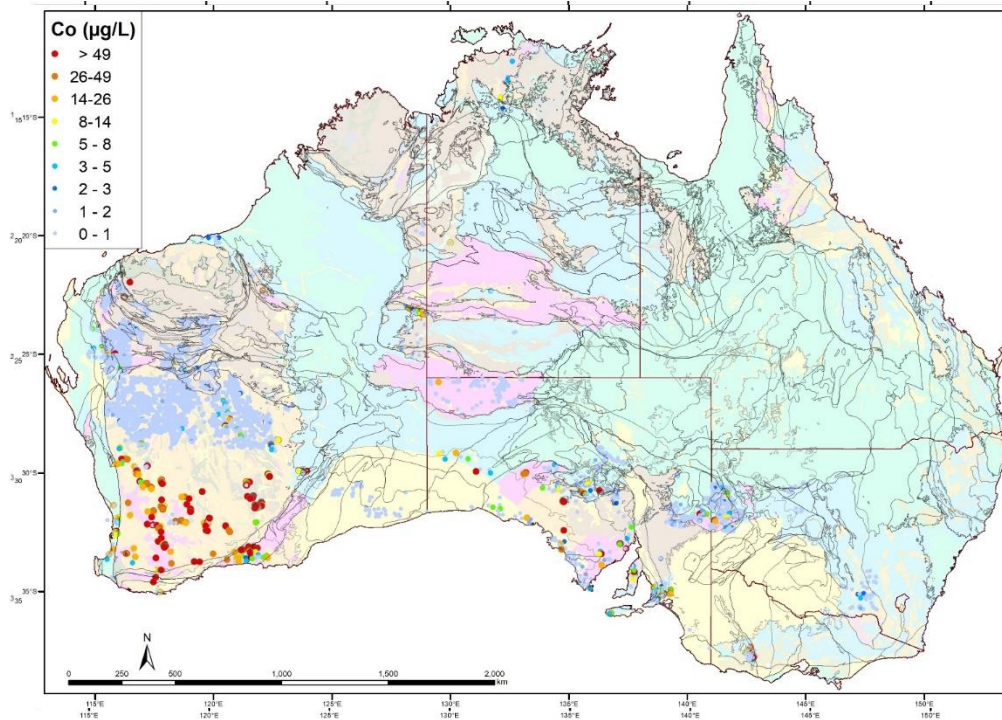


Continental Scale Hydrogeochemistry

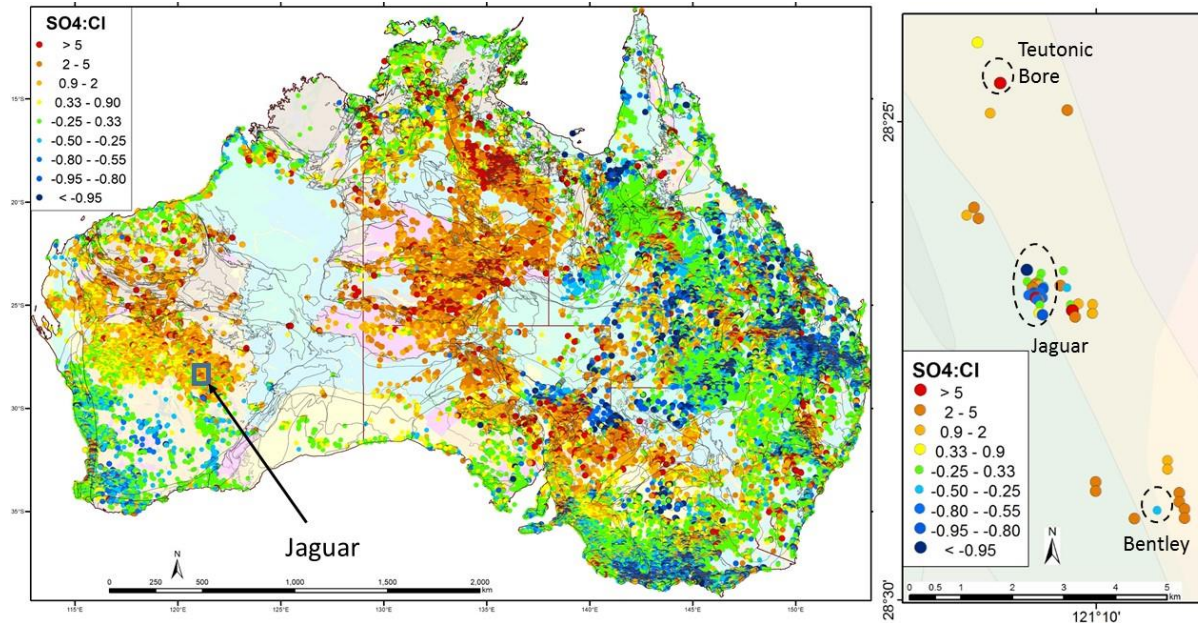


Continental Scale Hydrogeochemistry

Different elements have different data densities



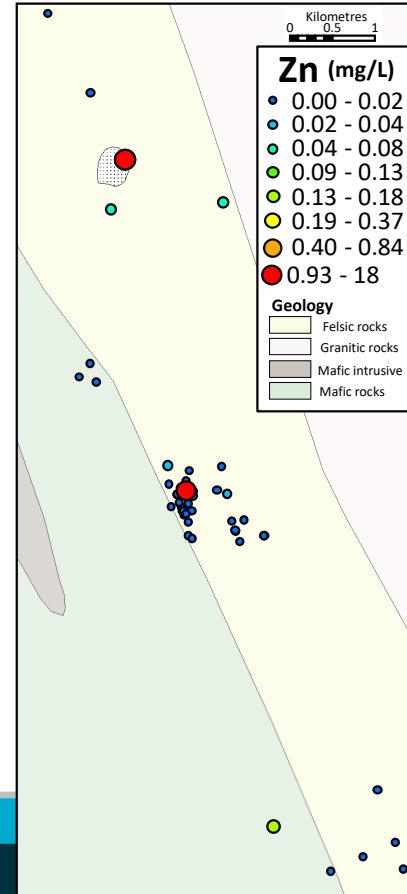
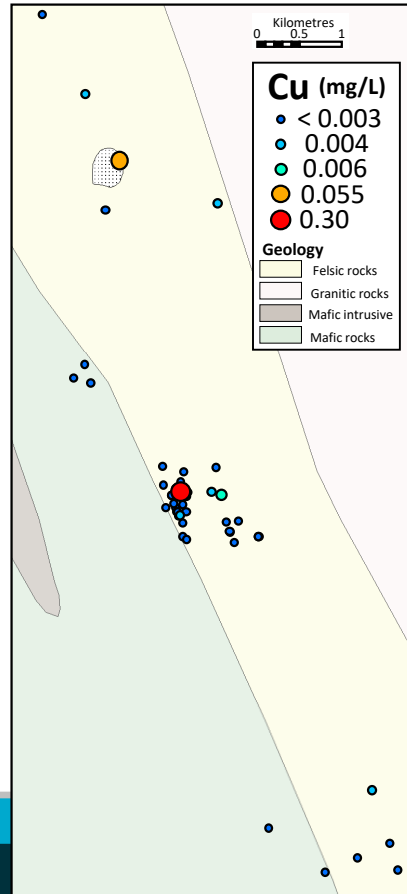
Relevance of scale



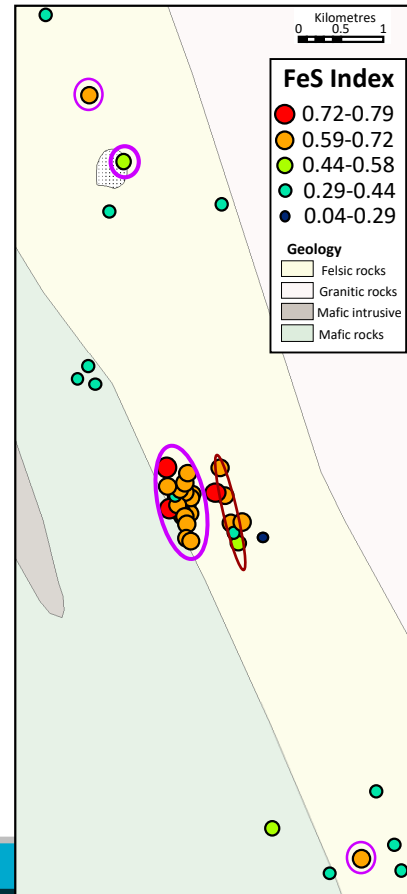
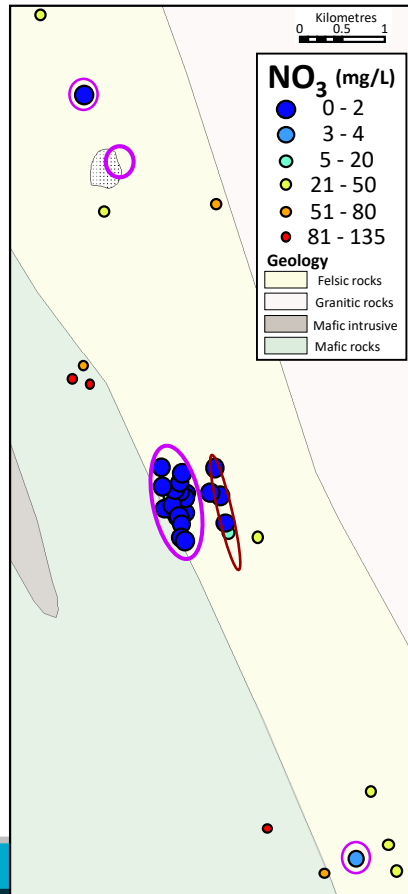
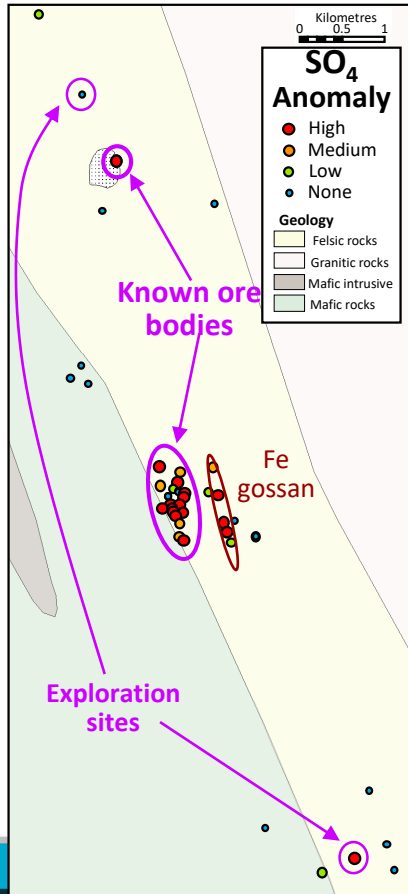
Left) Continental scale SO₄:Cl ratio, showing large scale lithology changes and Right) at smaller scale showing areas of weathering sulfides at the Jaguar/Teutonic Bore/Bentley VHMS ore bodies, this data was collected prior to the Bentley discovery.

Direct metals not great indicators: Jaguar area

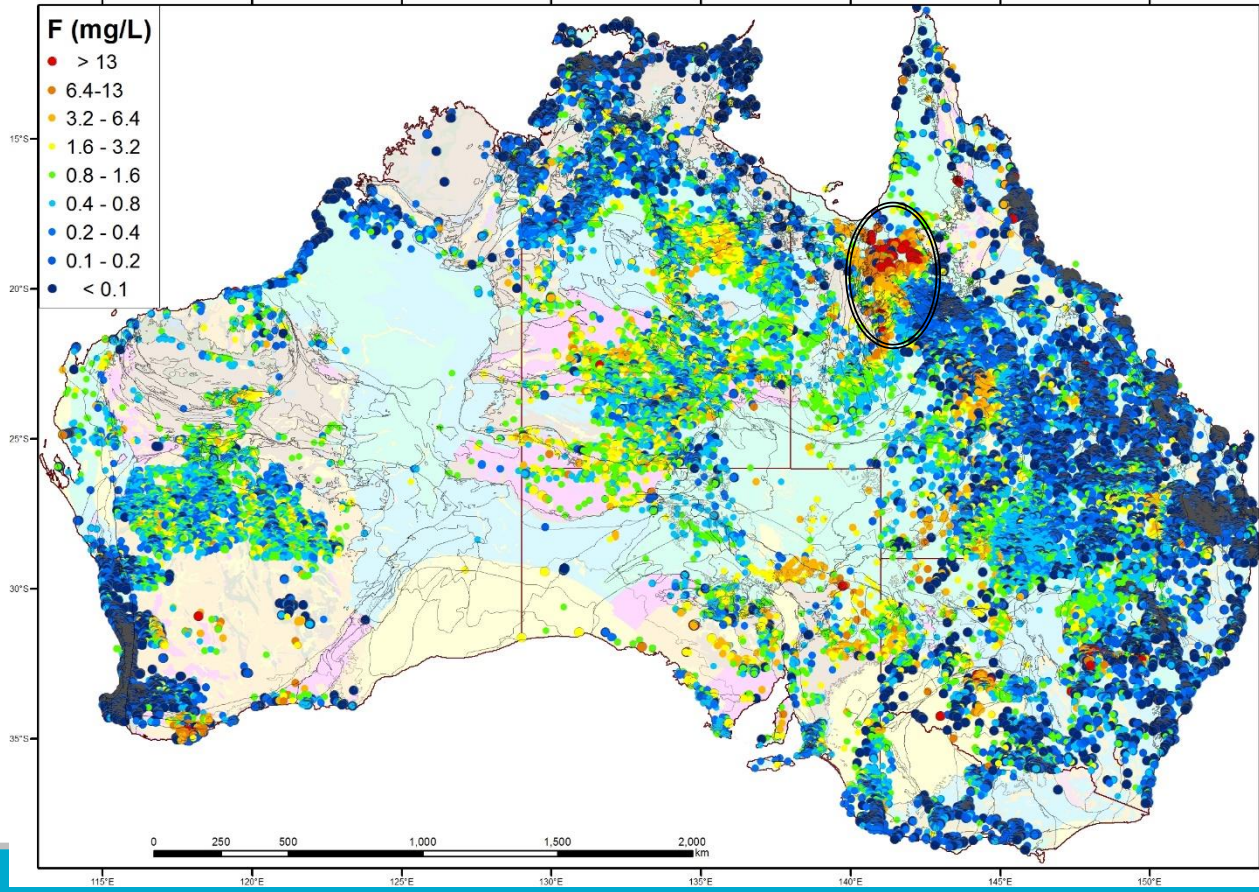
Dissolved
base metal
data very
patchy!



SO₄, NO₃ and FeS Indices – Jaguar

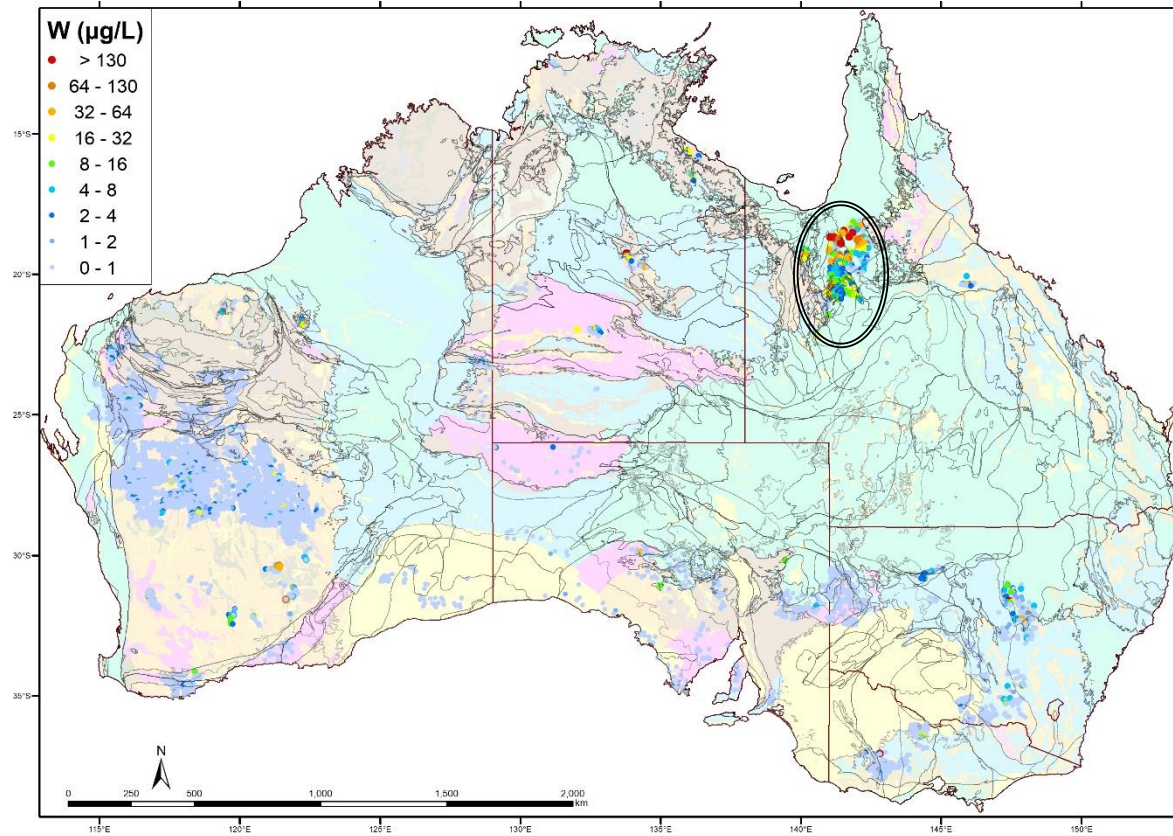


Fluoride – exploration and health



- Large areas of naturally elevated concentrations
- State Datasets used

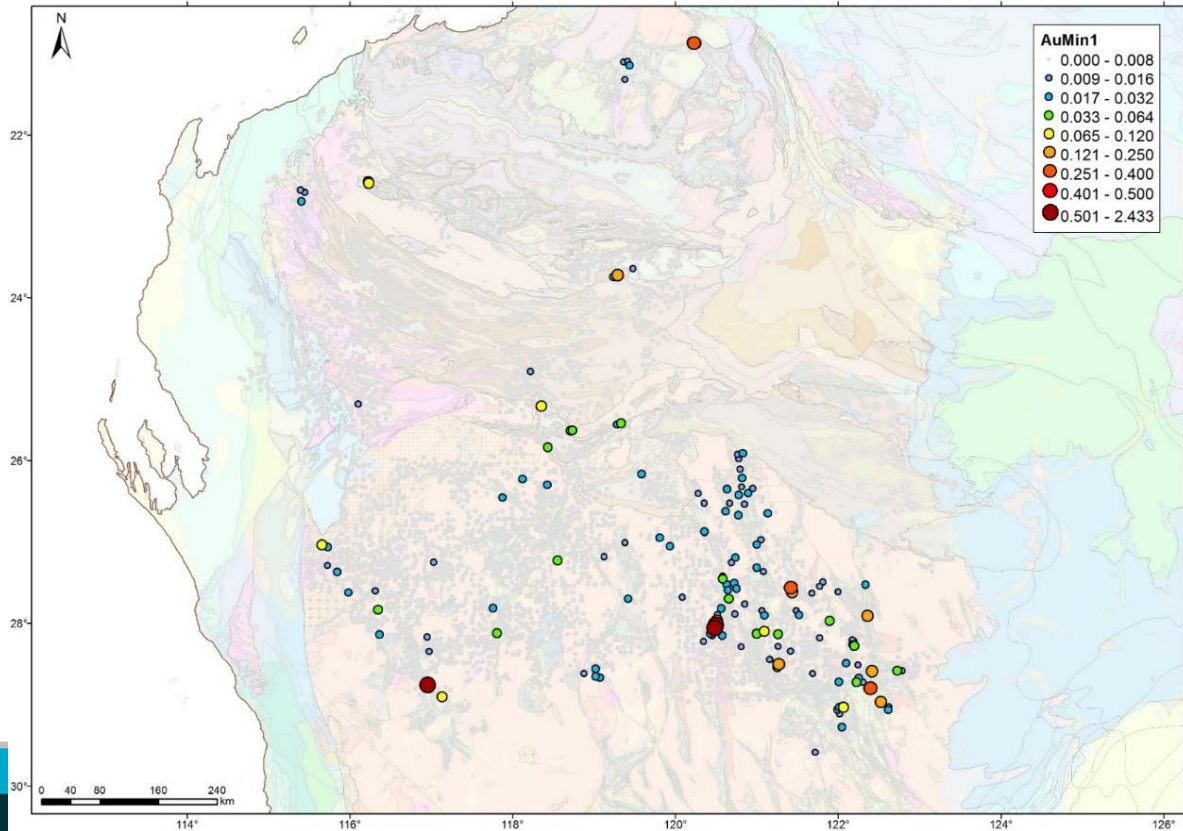
Dissolved Tungsten



- Extremely high F, W ...
- What does this tell us about the geochemistry of this lithological unit?
- Potential for mineralisation?
- Also demonstrates the value and robustness of anions such as F, and of oxy-anions:
V, Mo, W, As, Sb
Cr, (in absence of Fe^{2+}) ...
Ge, Sn, Bi ???

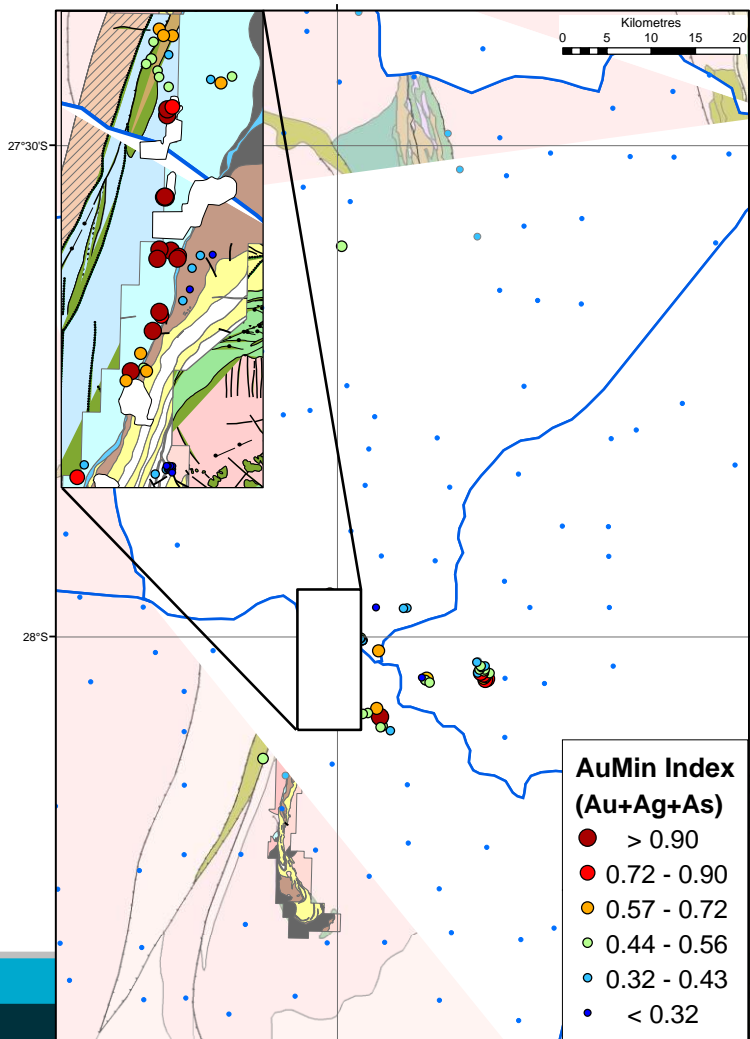
Derived indices – often better than single elements

- Au mineralisation index (Au+As+Ag)

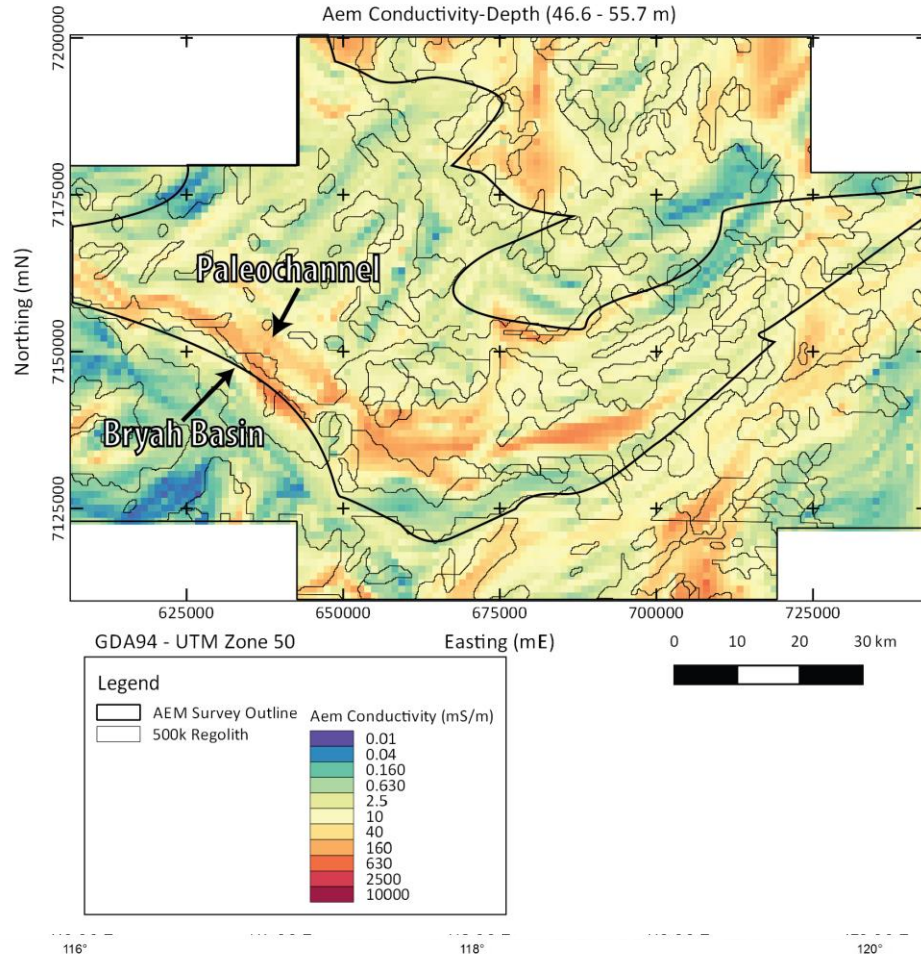


AuMin Index Regional vs Prospect

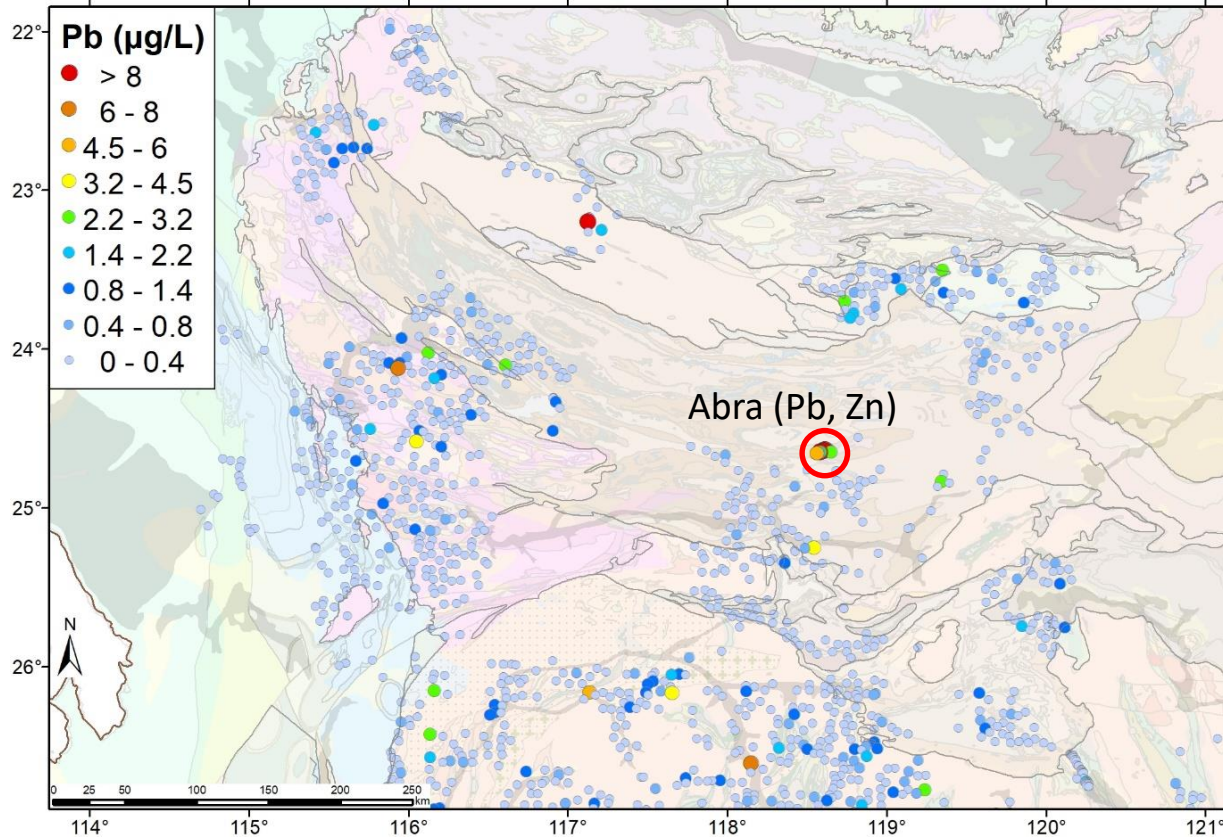
- Use indexed Au+Ag+As
- Regional sampling finds main camps
- Very high AuMin values at Agnew
- Most from sampling in or near pits
- Some additional highly anomalous areas



Sampling through cover



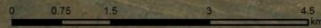
Abra case study



Groundwater samples

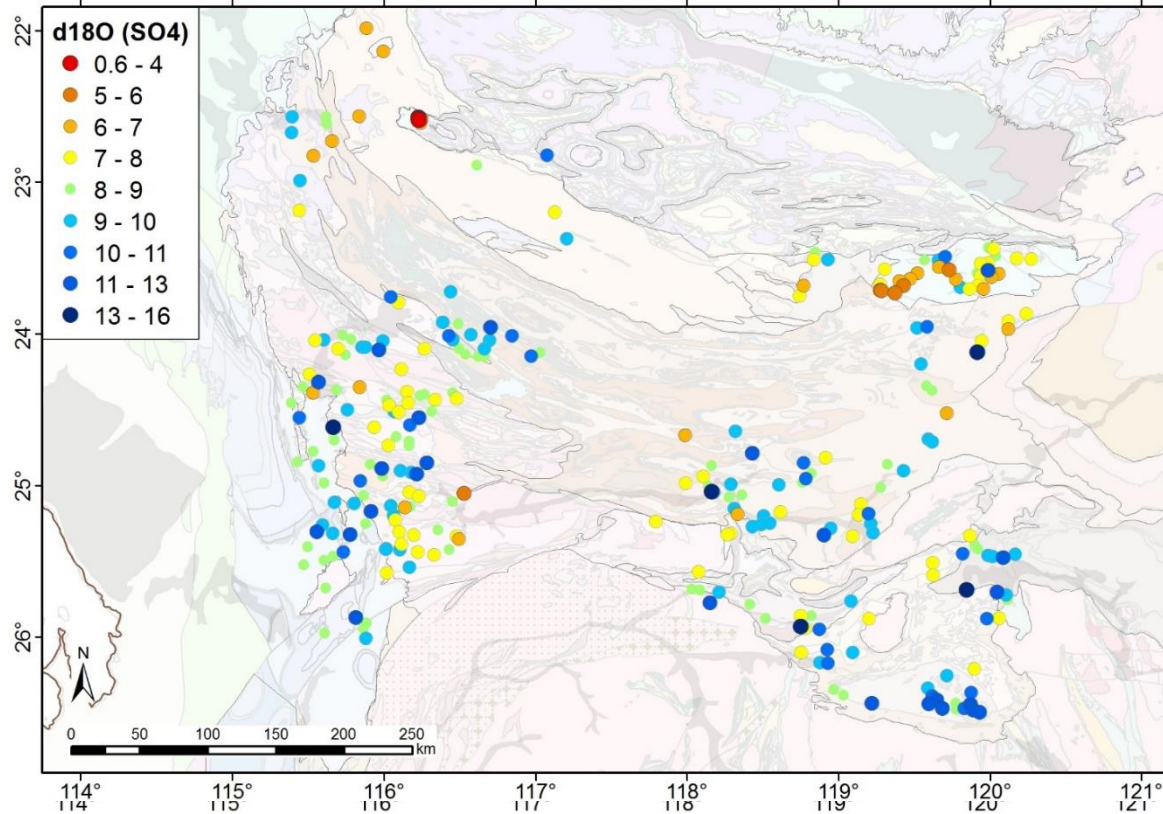
Pb ($\mu\text{g/L}$)

- > 8
- 6 - 8
- 4.5 - 6
- 3.2 - 4.5
- 2.2 - 3.2
- 1.4 - 2.2
- 0.8 - 1.4
- 0.4 - 0.8
- 0 - 0.4

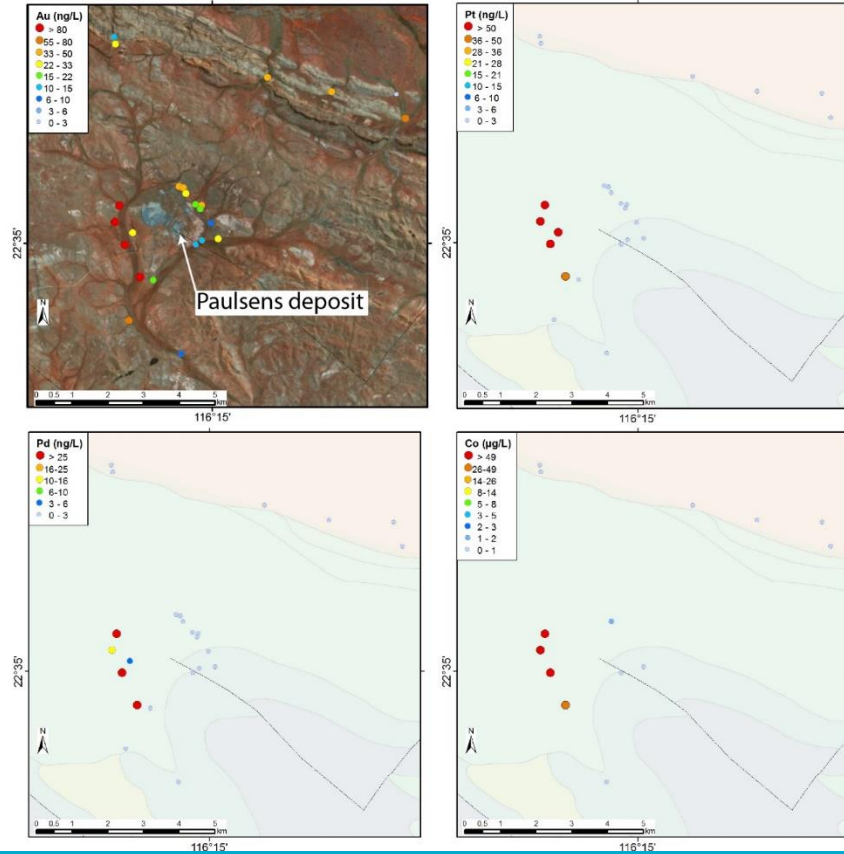


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroX, CartoSat, AerialGrid, IGN, ISP, swisstopo, and the GIS User Community

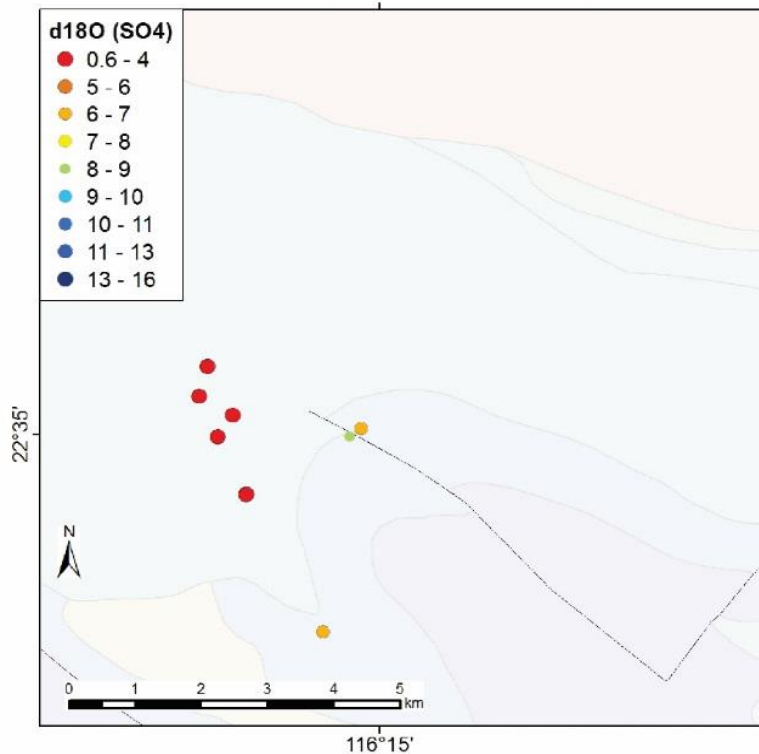
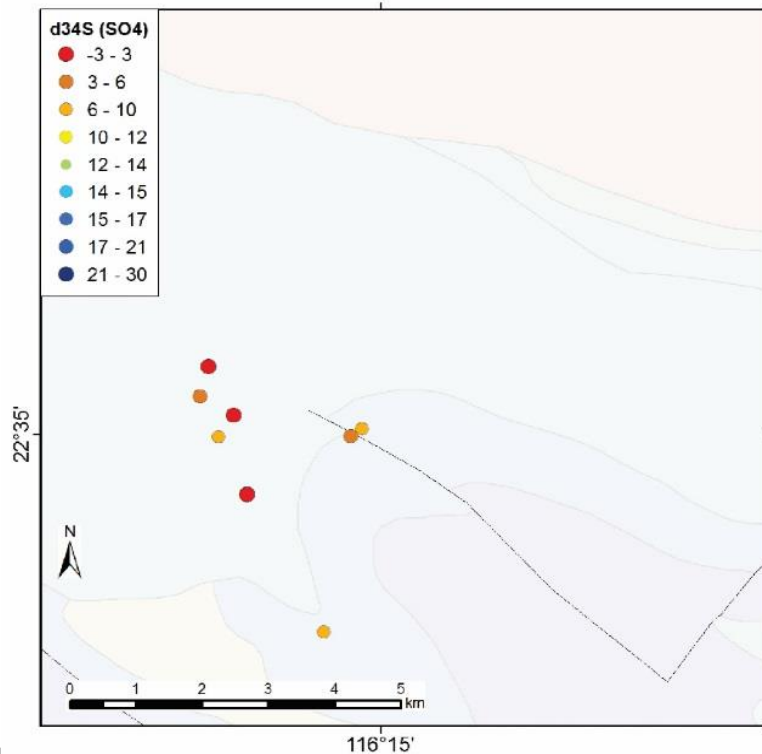
Isotopes - Sulphur and Oxygen



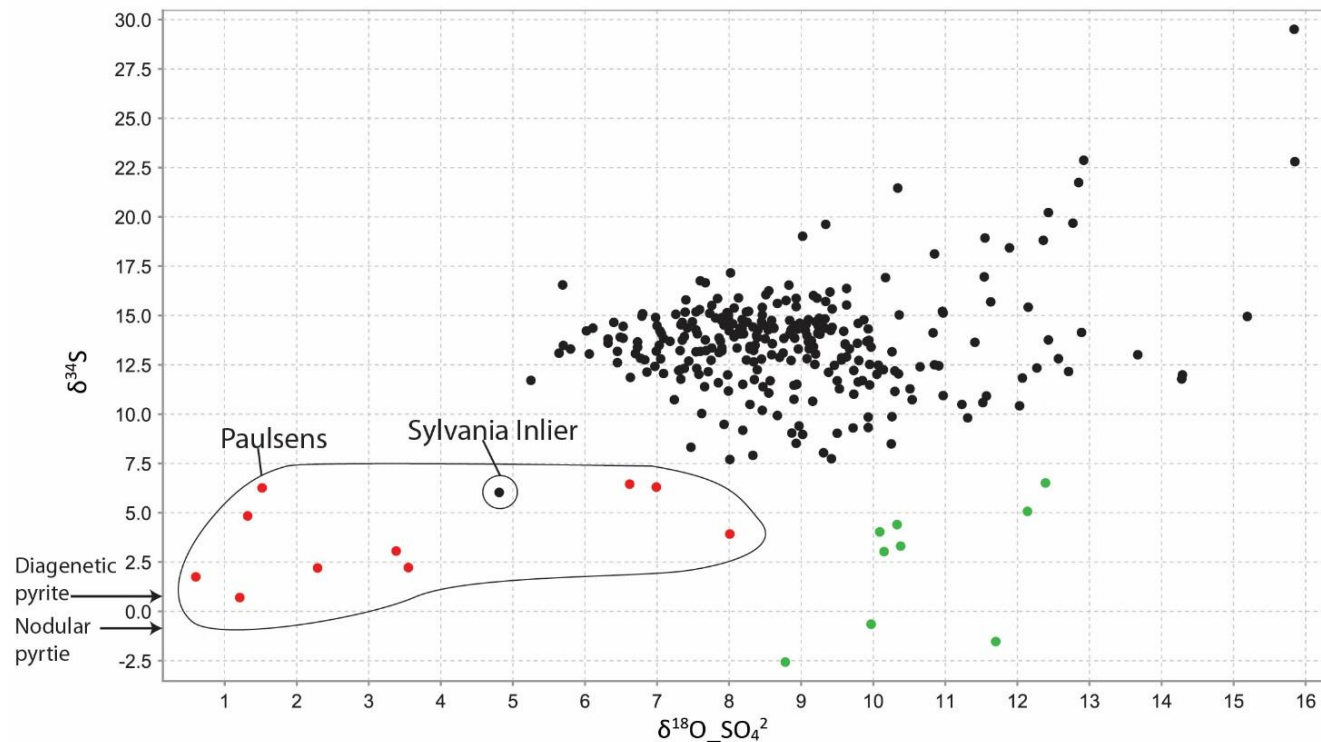
Paulsens Gold deposit



$\delta^{34}\text{S}$ and $\delta^{18}\text{O}_{\text{SO}_4^2}$ from sulphate at Paulsons



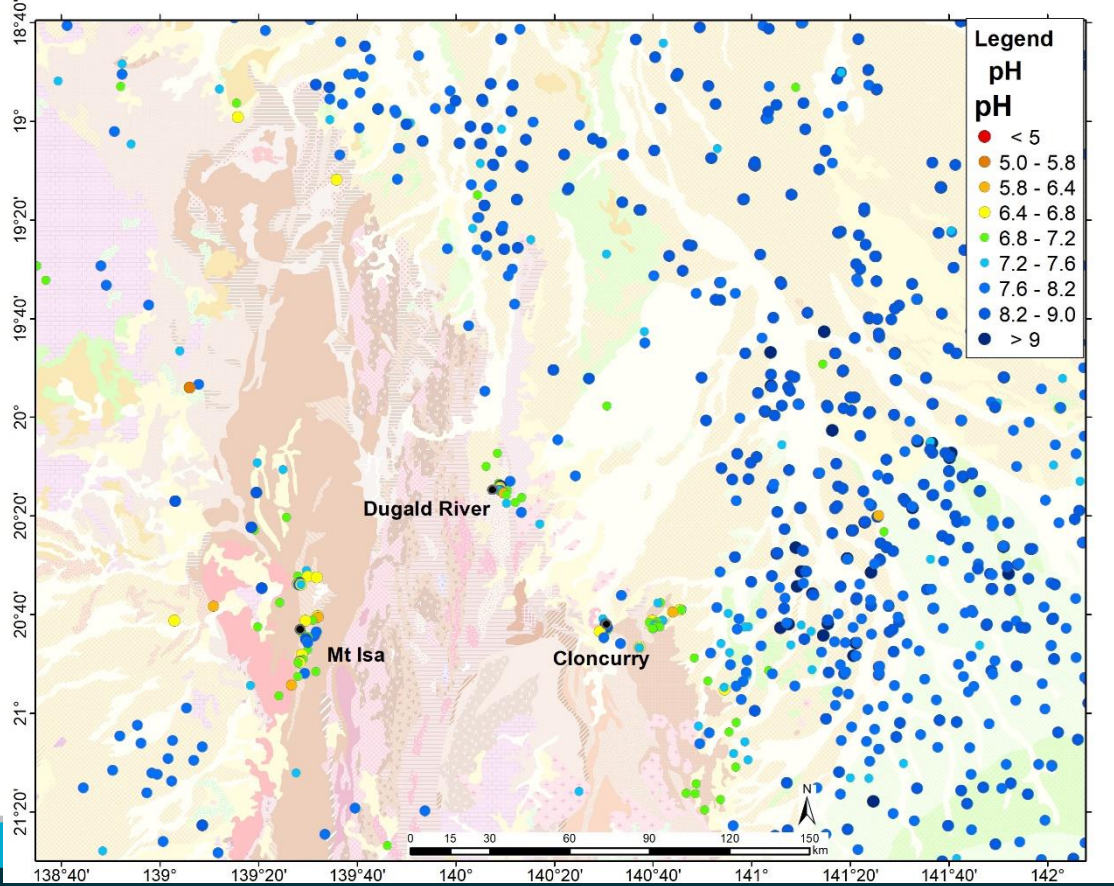
$\delta^{34}\text{S}$ and $\delta^{18}\text{O}_{\text{SO}_4^{2-}}$ from sulphate - Capricorn



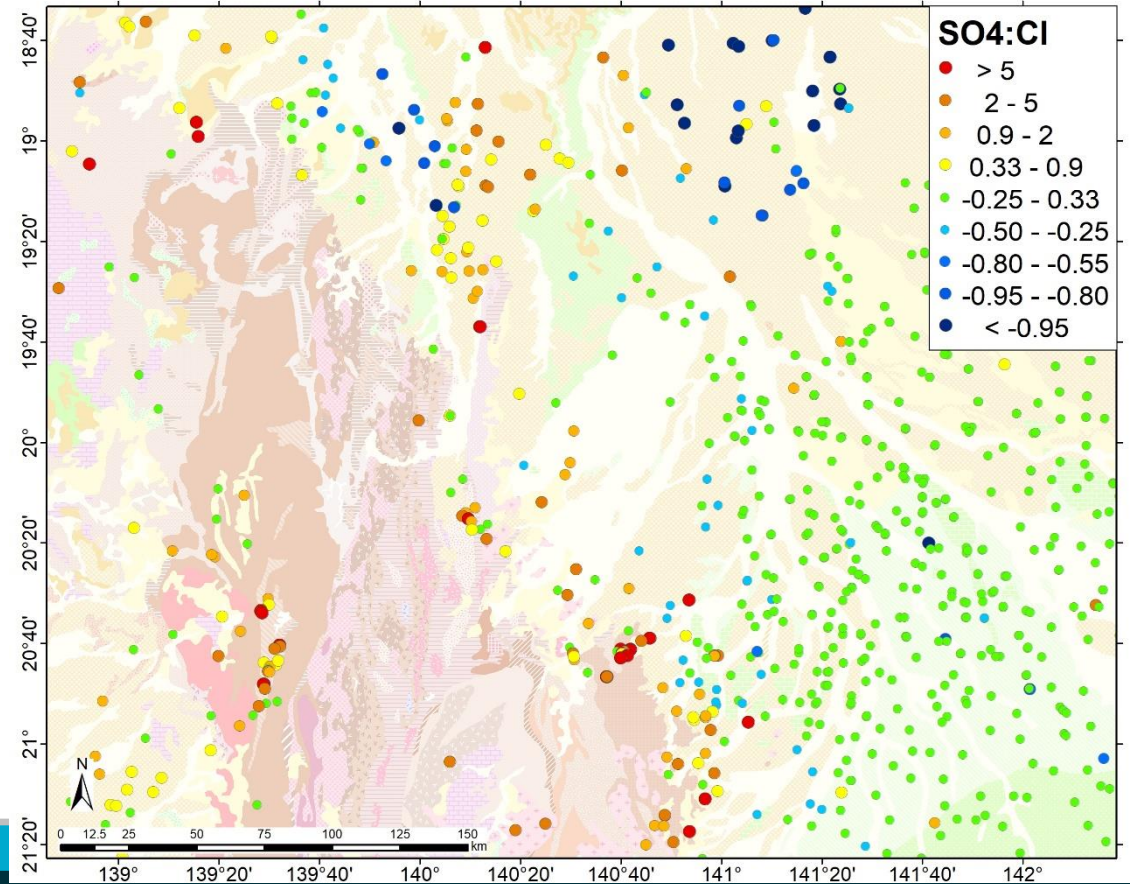
Sulphur Isotope comparison

Deposit	Sulphide	Water
Paulsens (Au)	-0.8 – 0.7	0.5 – 6.2
Abra	19.4 – 26.6	18 - 23
Prairie Downs	6.7 – 10.1	7.8 - 16

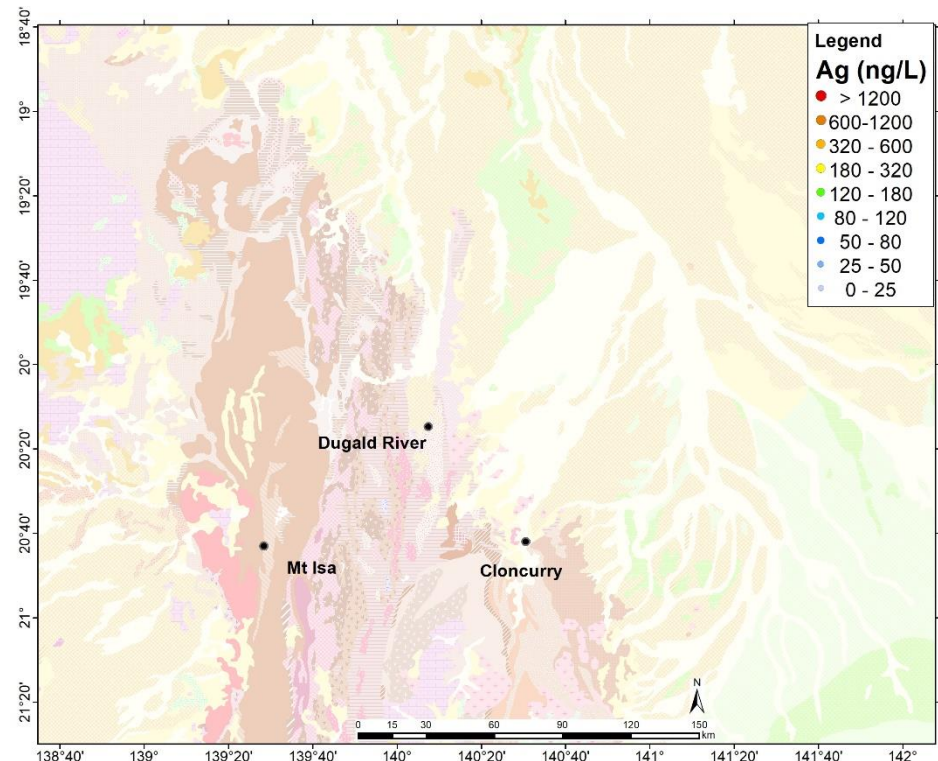
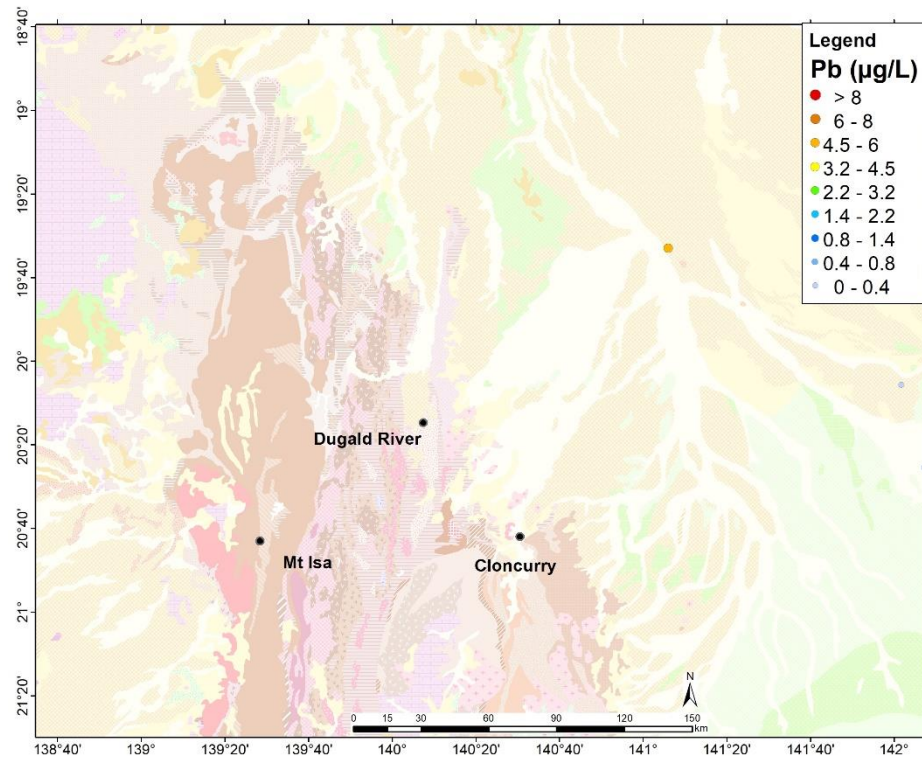
Mt Isa region



Mt Isa



Mt Isa



New Mt Isa sampling

323 new sample points.

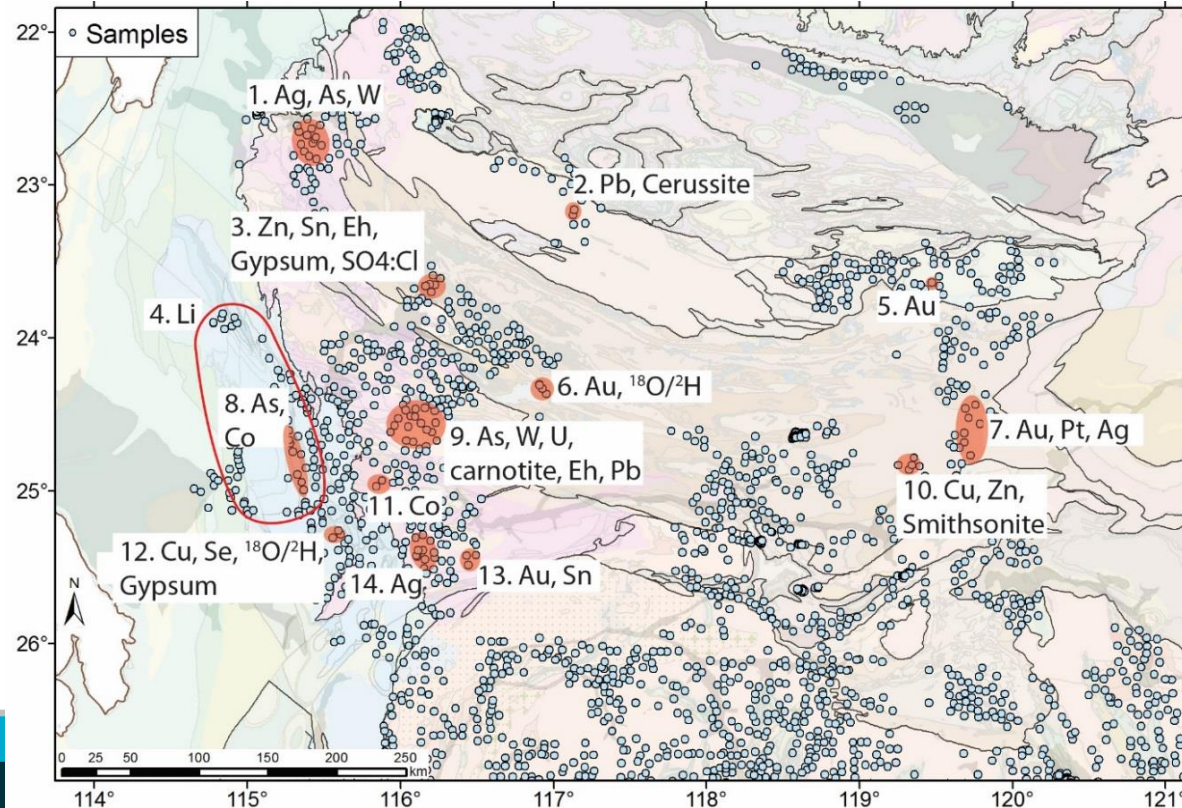
East of Mt Isa block

Moving under cover

Sampling complete.

Regional hydrogeochemistry - outcomes

- New targets with no known deposits – prospectivity maps now produced for North Yilgarn, Capricorn and South Australia



What are valuable deliverables to date?

- Direct concentrations of target metals – U, Au, Ni, Cu, Zn
 - Known pathfinders but anomaly size small
- Anionic chalcophiles (As, Sb, Mo, W)
 - Useful pathfinders with larger anomalies
- Mineral Saturation Indices
 - Valuable for Uranium
- Use of SO_4^{2-} , NO_3^- , Cl, Br to show sulfides
- Metal indices
 - e.g. Ni, Co, Pt for NiS; Zn, Cu, Pt, Ag for VMS – larger anomalies
- As, Cr, NO_3^- – environmental / health

So how can we help?

- The regional data can provide new areas of interest for picking tenements
- New samples collected can be placed in context with the regional background – please talk to us
- Understanding hydrogeochemical signatures of lithology and mineralisation at both regional and camp scales
- Support using the FAIMS field app for sample collection

Thank you

Mineral Resources

Nathan Reid

Team Leader: Minerals and Water

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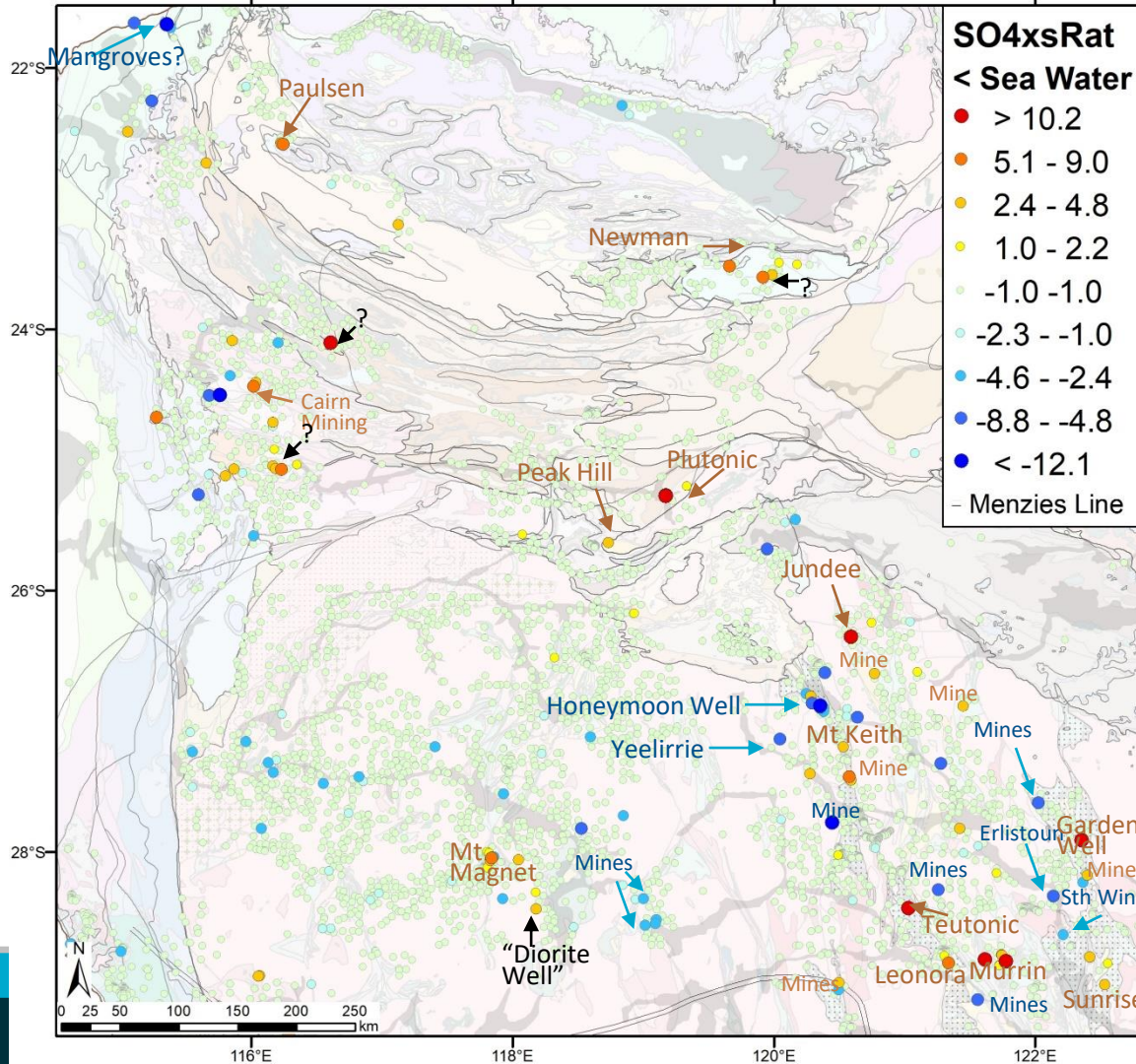
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Anomalous Sulfate

- Exploration

- Take away SO_4 from gypsum and alunite effects
- This excess SO_4 shows reasonable spatial correlation with mineralised systems
- Uses major element data alone

