The Geochemistry Tool Kit (GTK)

&

Hydrogeochemistry for Prospectivity project

Queensland Government's New Discovery Program in NW Queensland, University of Queensland
24 September 2018

Joseph Tang
Geological Survey of Queensland, DNRME

Geological Survey of Queensland Celebrating 150 Years Exploring Queensland's Resources

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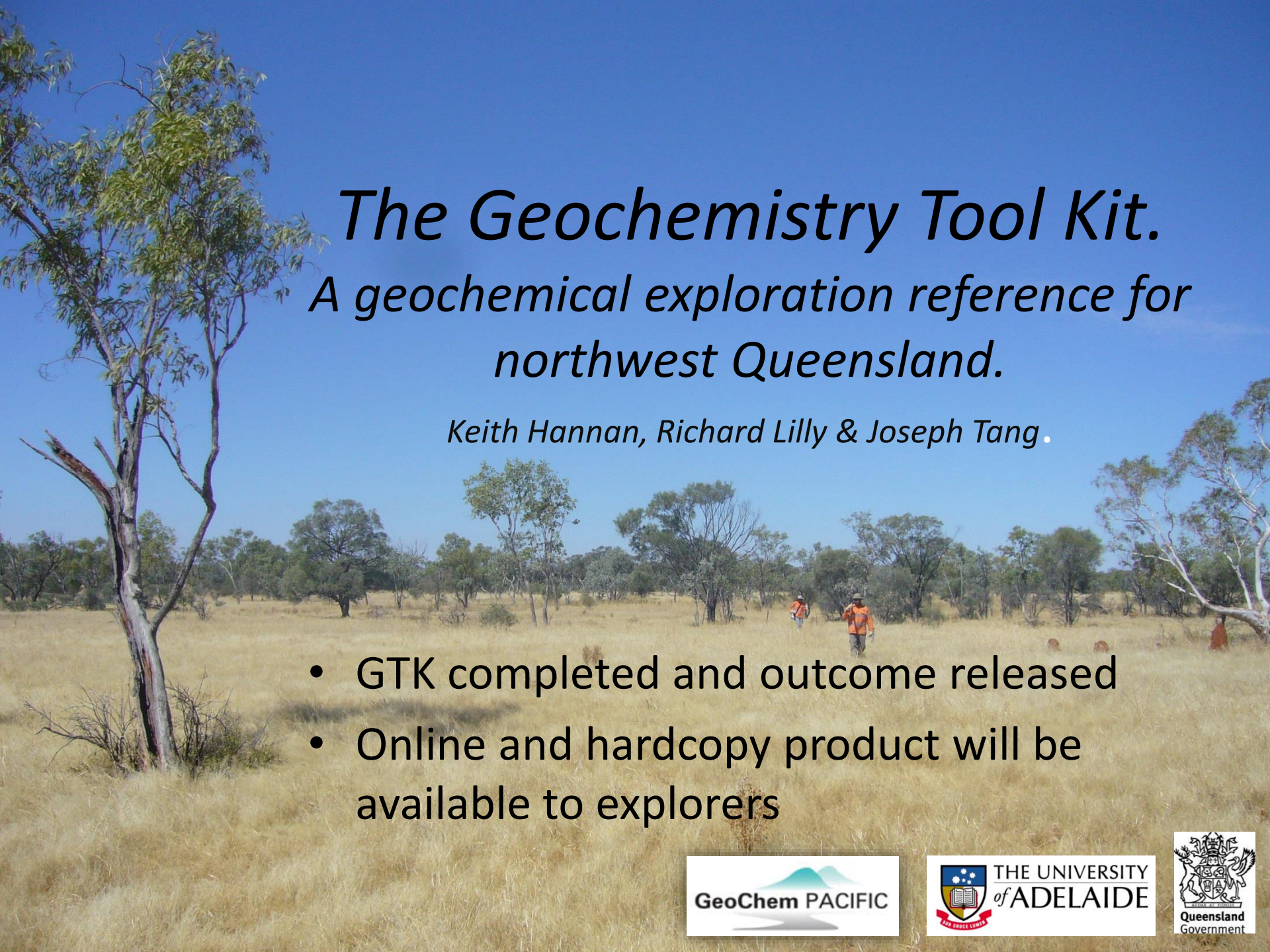

The Geochemistry Tool Kit.

A geochemical exploration reference for northwest Queensland.

Keith Hannan, Richard Lilly & Joseph Tang.

- GTK completed and outcome released
- Online and hardcopy product will be available to explorers

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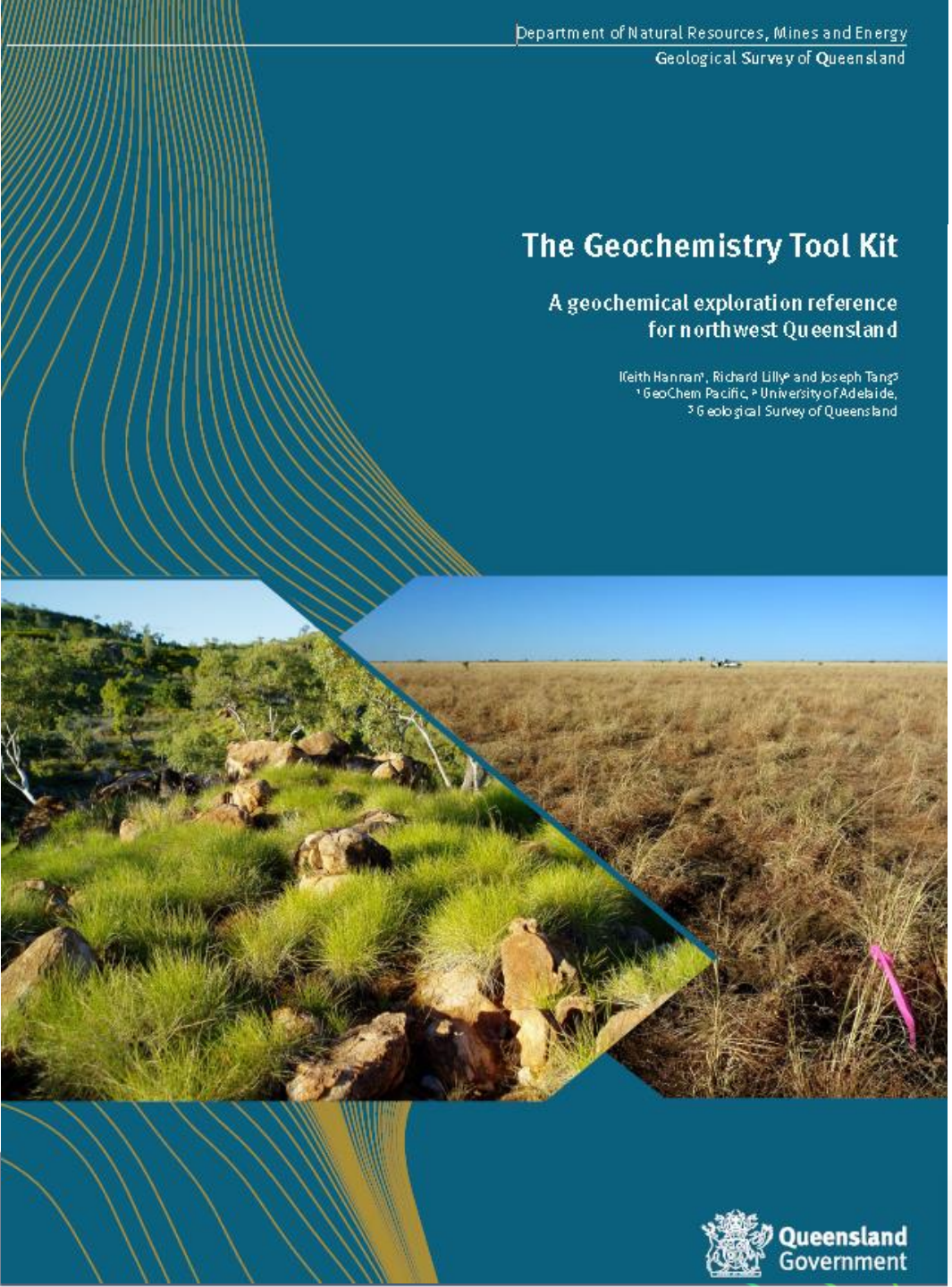

GTK Availability

- HANNAN, K., LILLY, R. & TANG, J., 2018: *The Geochemistry Tool Kit. A geochemical exploration reference for northwest Queensland*. Geological Survey of Queensland, DNRME, Brisbane.
- Released online as QDEX report **CR108260**

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Preamble

- The Mount Isa Inlier is a mature exploration destination with over 70 years of systematic exploration covered by >3500 tenures
- Over $200 million (analytical cost only) were spent on geochemistry exploration
- Explorers are well informed about the prospective host rock units, controlling structures and deposit styles, however, most of these information is unexposed, and/or concealed under the Carpentaria, Eromanga and Georgina basins.
- ***Targeting problem***

The role of the GTK

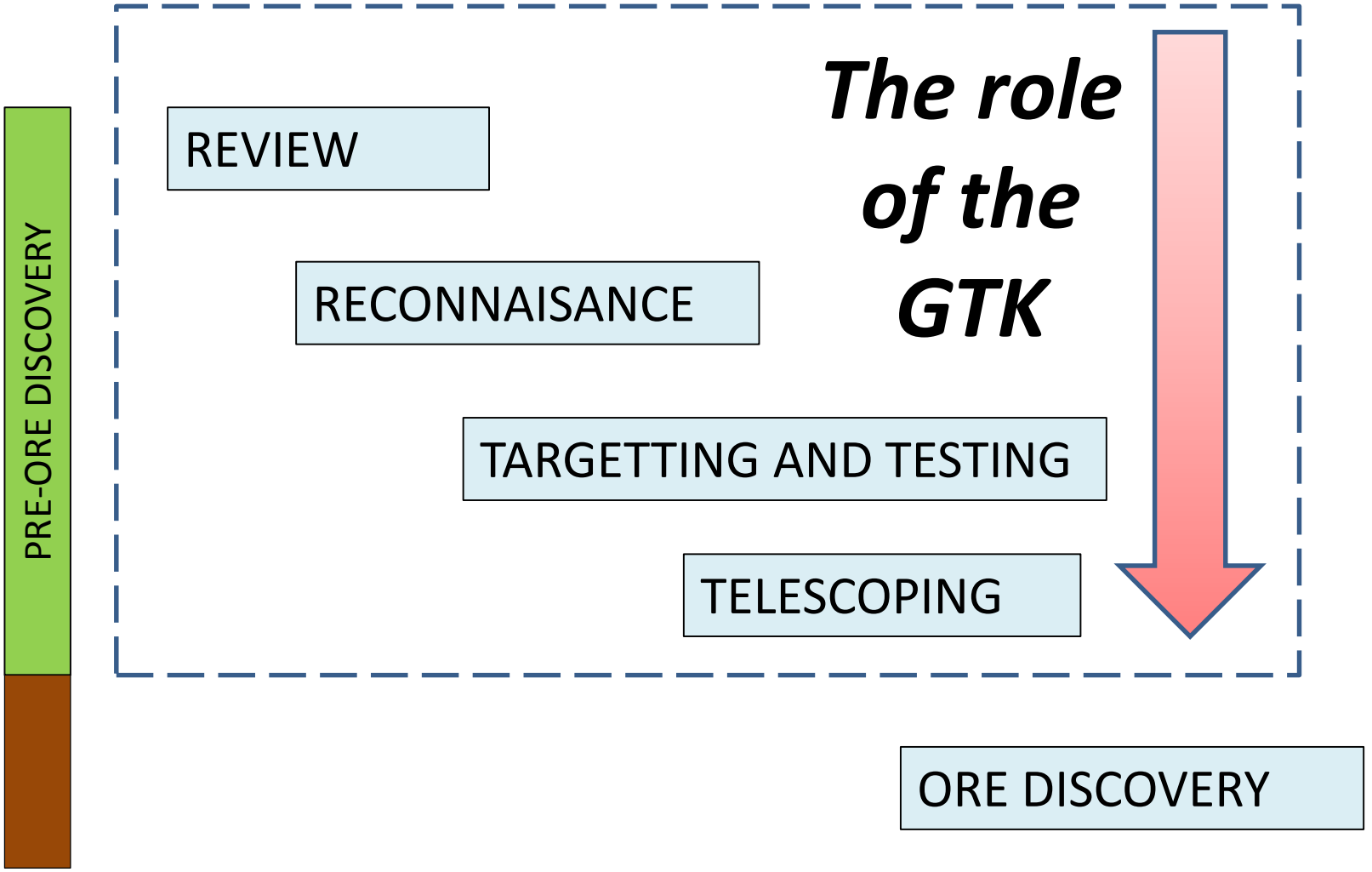
- GTK is intended as the blueprint for future geochemical exploration in NWQLD.
- GTK is designed as a manual with practical guidelines and contains illustration for optimising **pre-discovery** target testing and/or generation.
- Reviews the range of geochemical techniques, appraises existing data, evaluates case studies, and provides instruction, expert advice and learned opinions on techniques that are pragmatic to ore characterisation and discovery.

The role of the GTK - contd.

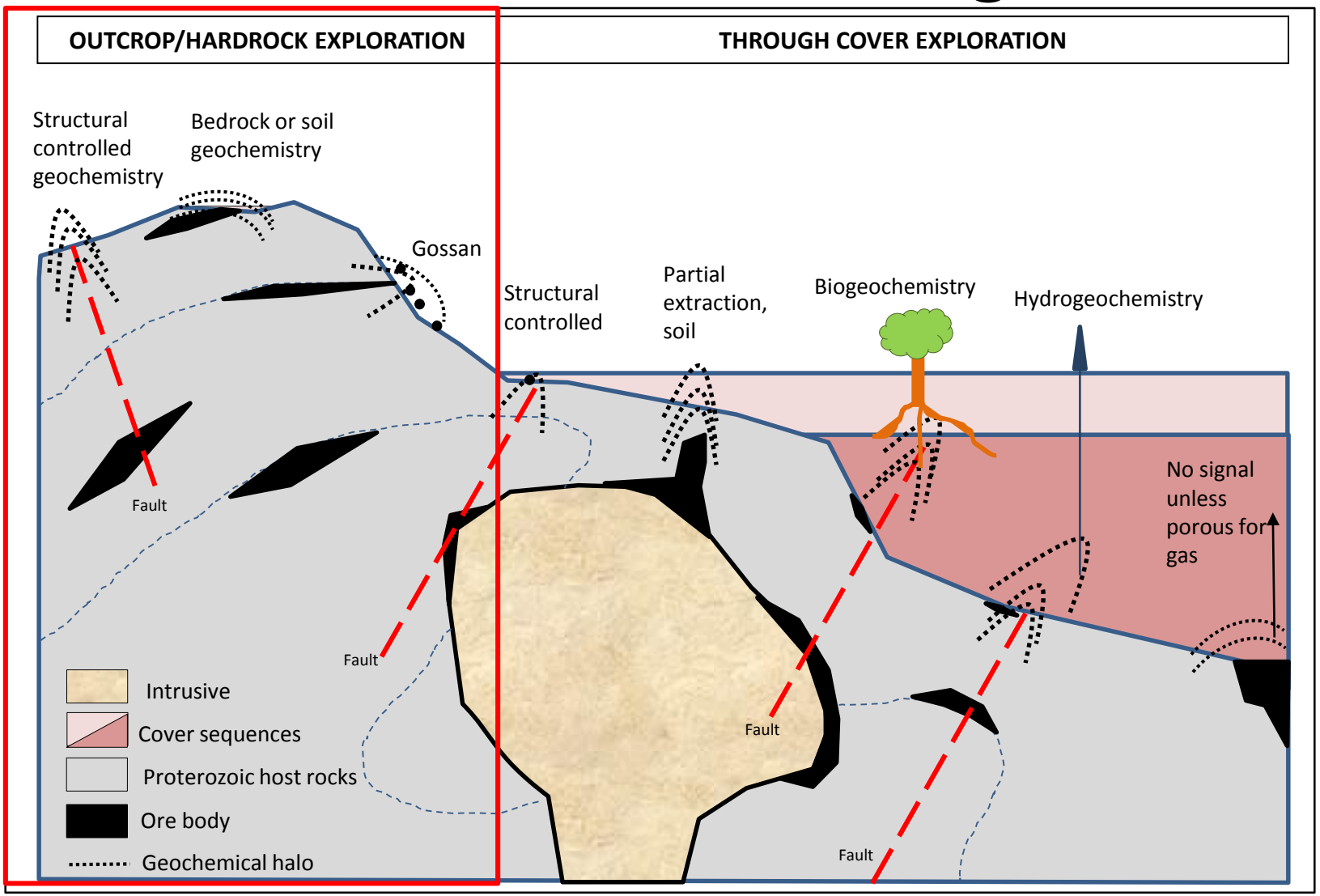
- Provides overviews of each sampling method or analytical technique in both outcropping and undercover areas.
- Provides guidelines to appropriate data processing, presentation and interpretation.
- Contains examples of data processing*.
- Encourages exploration of ‘greenfields’ through cover sequences.

*Appreciation: Glencore, MIM Resource Development, Minotaur Exploration, South32, Chinova Resources, etc.

Mineral Exploration Stages



Geochemical settings



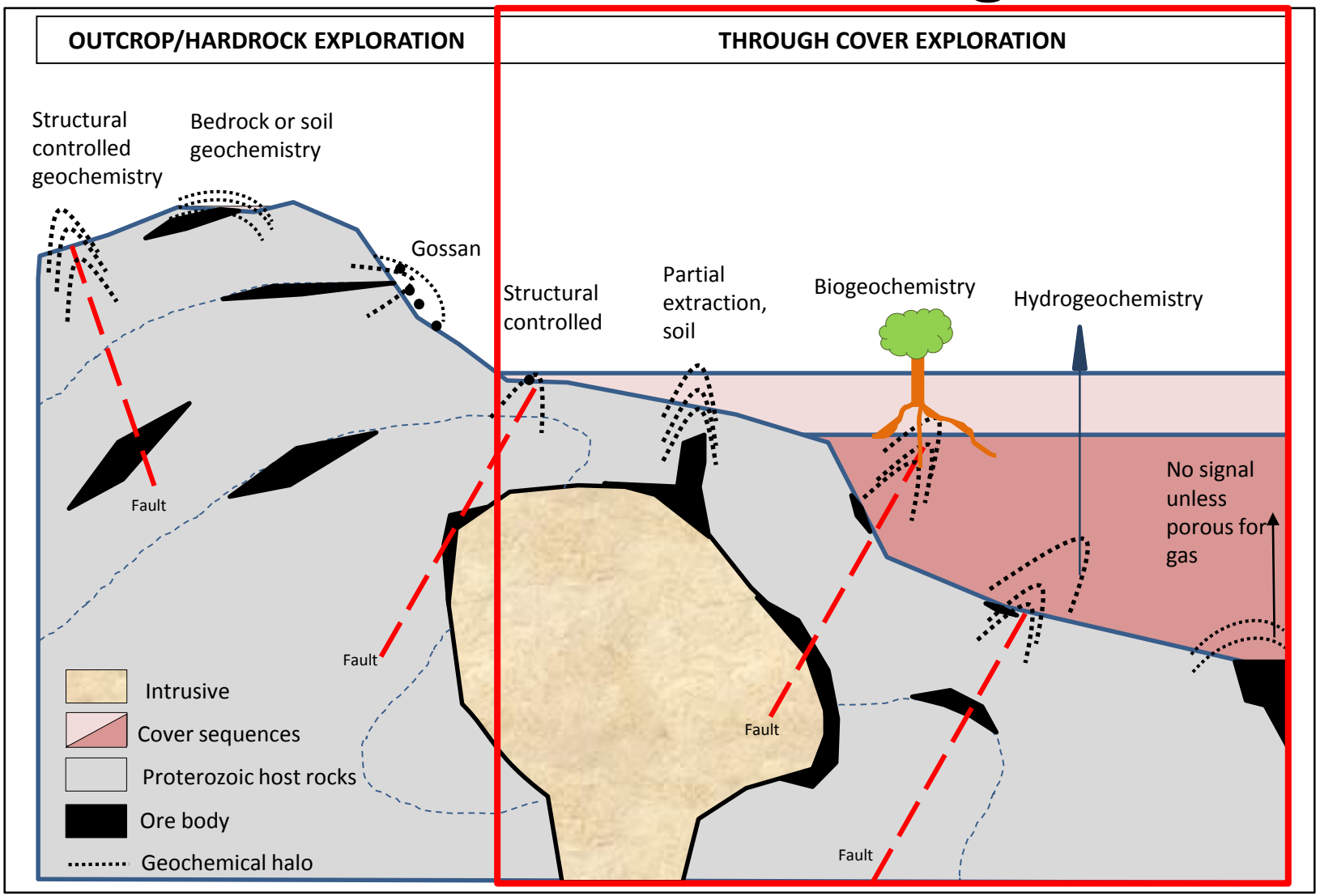
Contents of the GTK – Outcrop/hardrock exploration

- *Chapter 1*: Surface geochemistry: Outcrop domain
- *Chapter 2*: Discrimination of gossans and ironstones
- *Chapter 3*: Use of the Pb-Pb isotope method for base metal exploration
- *Chapter 4*: Bedrock geochemistry: Stable isotopes carbonate O and C, sulphide S

Outcrop/hardrock Exploration

- Near-surface and outcropping mineralisation, exposed Proterozoic bedrock
- Availability of ore material, host rock, drill cores and/or regolith derived from such material
- Chemical detection and recognition of blind targets in surficial regolith or at outcrop
- Identifying locally sourced secondary dispersions at the surface (conventional surface geochemical)
- Discuss various geochemical exploration techniques suitable for the detection of blind and deep-seated orebodies

Geochemical settings



Contents of the GTK – Through Cover Exploration

- *Chapter 5*: Transport mechanisms, sample media and analytical methods
- *Chapter 6*: Secondary dispersions of blind ore deposits#
- *Chapter 7*: Exploration campaigns*
- *Chapter 8*: Groundwater chemistry case study: Ernest Henry mine and district

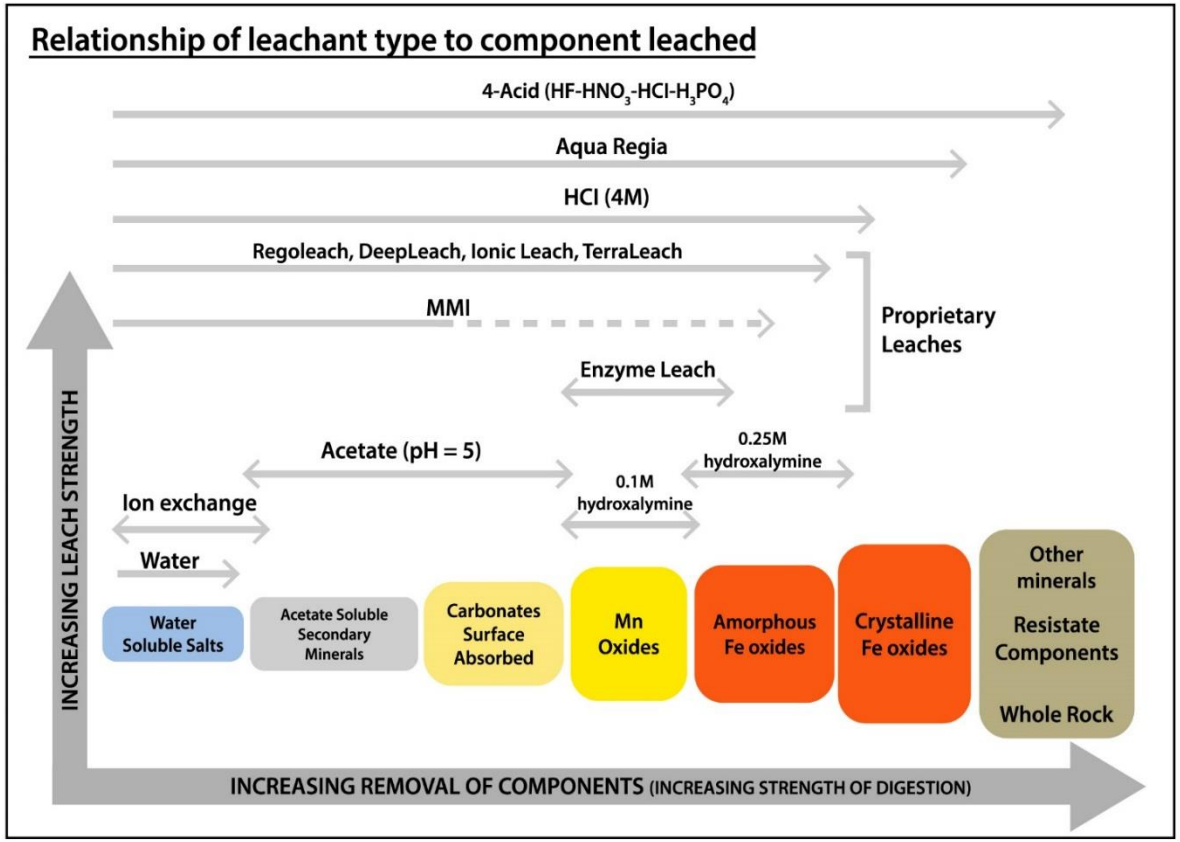
Ernest Henry, Osborne, Eloise, E1, Cannington

*Southeast, northeast, Northwest

Through Cover Exploration

- Geochemical targets concealed under >1 to ~100+ metres of transported cover
- Identifying deeply sourced secondary dispersions at the surface (non-conventional surface geochemical exploration)
- Identifying secondary dispersions from drill hole samples within, and at the base of, transported cover (unlithified or lithified)
- Chemical transport mechanisms in transported cover, sample media

Exploration and analytical methods



- Selection of geochemical exploration techniques suitable for the detection of buried and blind orebodies
- Sampling procedures, nature of data, identification of anomalies

Geochemistry – The next step..

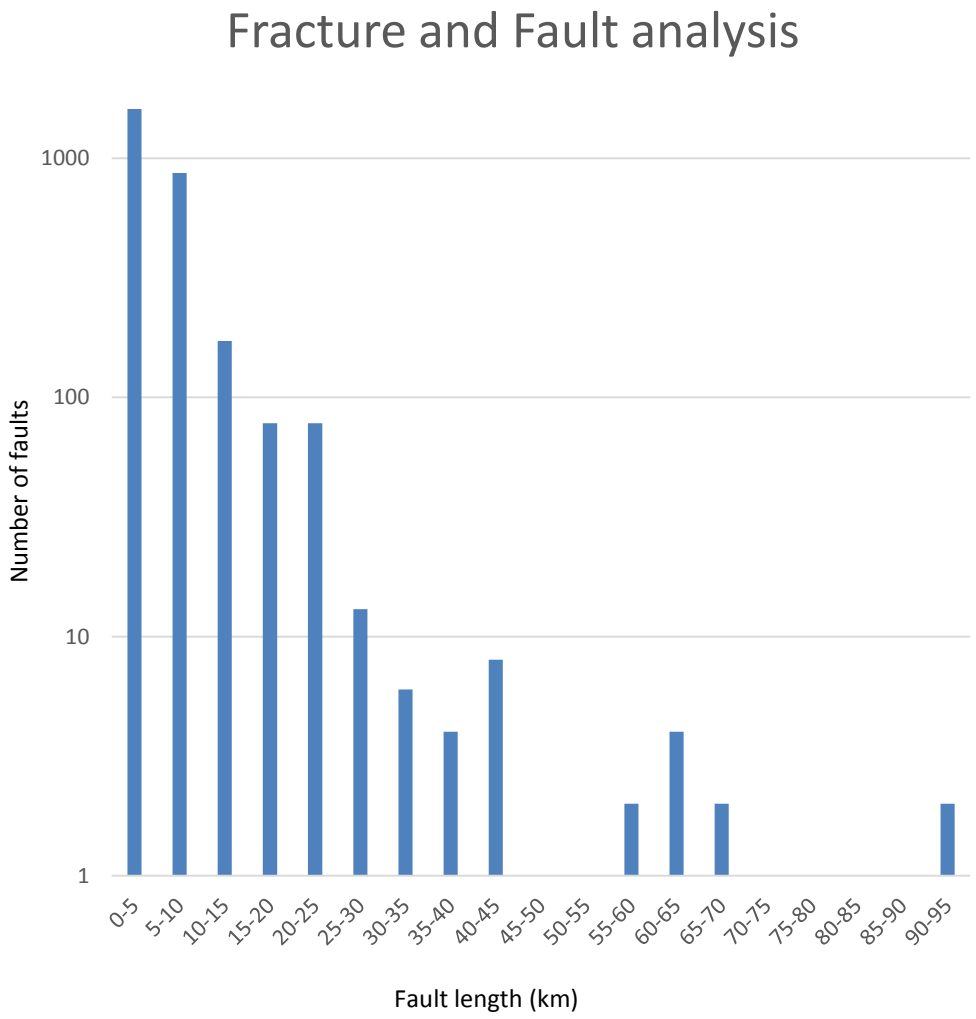
Hydrogeochemistry for Prospectivity

- Fieldwork will commence in 2019
- Groundwater is collected from pumping windmills/bores or by bailer
- Samples are tested for cation, anion, alkalinity, Au/PGE and stable isotopes
- Applying specific chemical indices enables the identification of different mineralization styles
- Understanding hydrogeological dispersion patterns allows vectoring towards deposits
- Powerful exploration-through-cover tool

Intended Outcomes

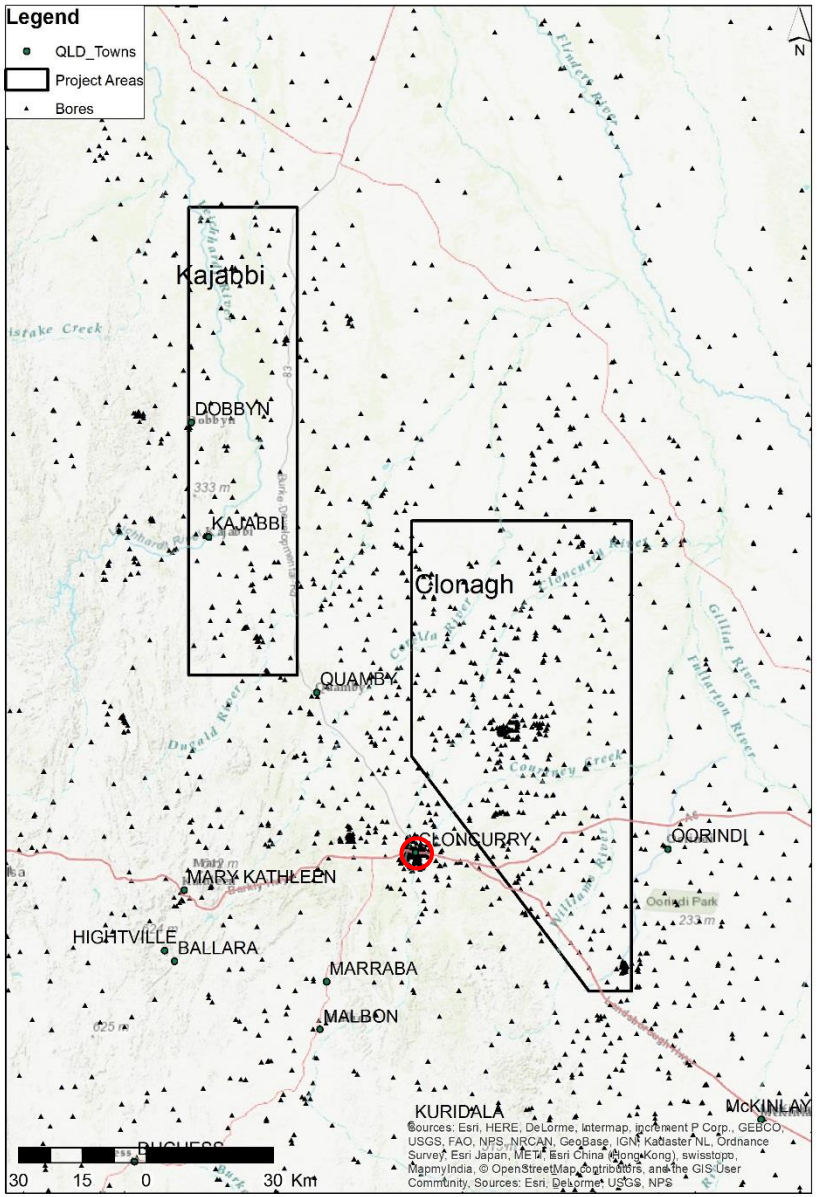
- ***Metals and pathfinders concentration*** to define geochemical anomalies, environmental baselines and water quality assessment
- ***Specific Mineralisation Indices*** to define mineralisation potentials (IOCG, VHMS, MIM and Century mine systematics)
- ***Mineral Saturation Indices*** for exploration e.g. carnotite saturation for uranium exploration
- ***Derived indices*** (SO_4 anomaly, FeS, Acids, NO_3 depletion) to identify weathering of rock sulphides
- Produce a ***Hydrogeochemical Atlas*** for project area
- A levelled ***hydrogeochemistry database***

Borehole spacing analysis



- Mount Isa Inlier is highly fractured i.e. ideally, good groundwater connectivity
- 56% of fractures are less than 5 Km
- Assuming the radius of influence of well is based on inter-fault spacing and fault length, the optimal well spacing is computed to <2 km

Hydrogeochemistry Program



- Based on a <2 km well radius, ~400 boreholes will be sampled in the Cloncurry, Clonagh, Quamby and Coolullah 1:100K map sheets
- **Data from mining companies (e.g. groundwater monitoring programs) would be extremely valuable in the hydrogeochemical studies**
- **Field access assistance**

Proposed work schedule

Milestone	Deliverable	Timeframe
Milestone 1	Contract commencement	August 2018
Milestone 2	Field sampling programs	April – October 2019
Milestone 3	Analytical phase	October-December 2019
Milestone 4	Data analysis	December 2019-March 2020
Milestone 5	Report preparation	April-August 2020
Milestone 6	Report and data release	September 2020

Summary

- GTK highlights that geochemistry is pivotal in future ore discovery particularly along the covered extensions of the of the Mount Isa Inlier
- Geochemical exploration must take advantage of archival surface and drill hole geochemical data
- Geochemical exploration must take new initiatives to
  - Explore through cover
  - Acquire high resolution metals and pathfinder element data
  - Use innovative analytical technologies to identify mineralisation through varying cover thicknesses
  - Use groundwater data to modelled distal secondary dispersions to ore
  - Use of mineral-specific methods to detect and recognise distal expressions of ore deposits