Strategic Resources Exploration Program

New Discovery Program

Queensland Government

The Strategic Resources Exploration Program

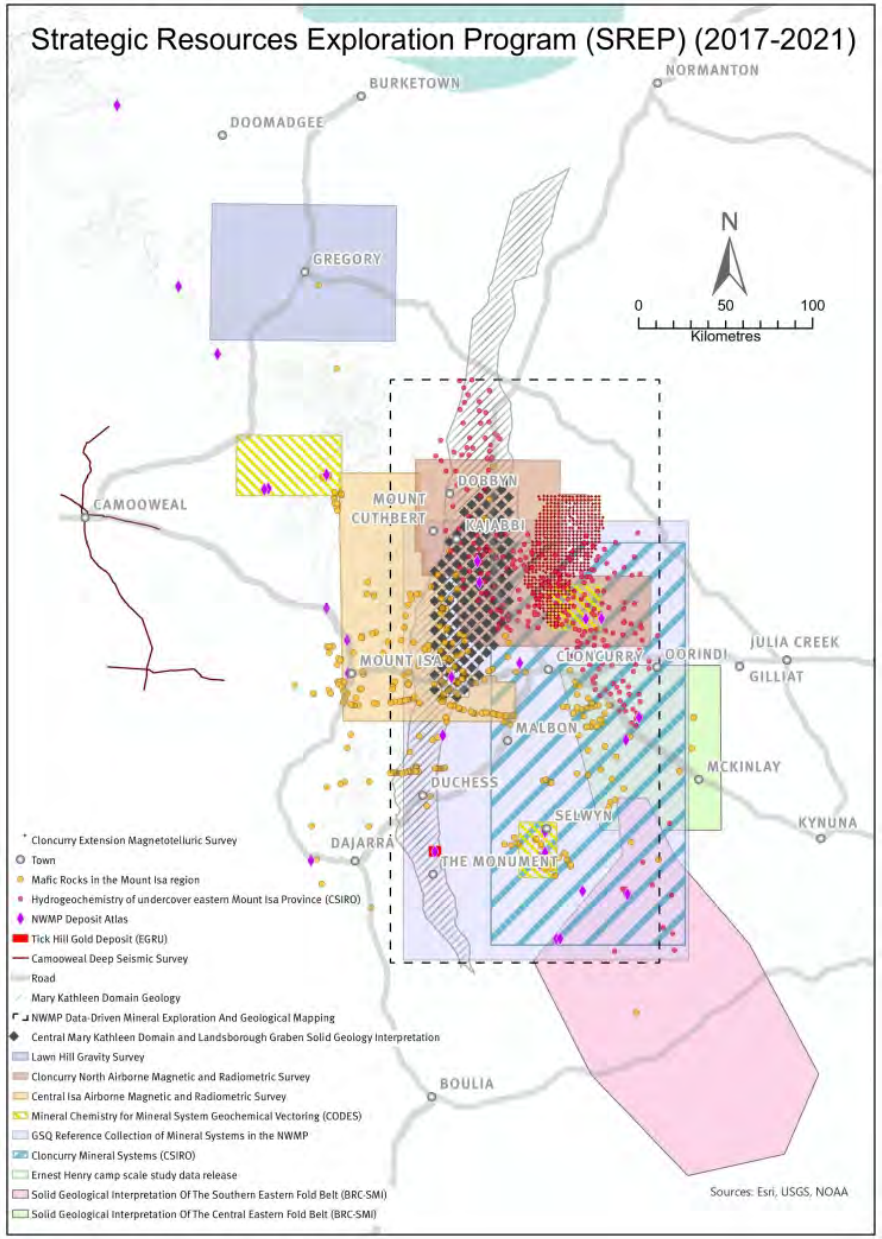
The Strategic Resources Exploration Program (SREP) was proposed to expand resource exploration and development for base metals and gas in North West Queensland. SREP forms a key component of the Strategic Blueprint for Queensland's North West Minerals Province, supporting exploration for the next round of mineral deposits to ensure economic longevity and community resilience in the North West. The program was active from 2017-2021.

Key outcomes of the SREP included:

- Geophysics to pinpoint the locations of potential new mineral prospects over wide areas
- Geochemistry programs to identify geochemical and hydrogeochemical anomalism in surface and water samples, which may be related to base metal deposits under cover
- Mineral synthesis studies to develop a comprehensive and integrated understanding of the geology of the North West Minerals Province
- Research into advanced analytical techniques used in the discovery of mineral deposits in frontier regions
- Exploration for gas in the Georgina, South Nicholson and Isa Super Basins
- The Geoscience Data Modernisation Program, to modernise legacy systems and enabling data driven exploration and resource development opportunities for Queensland
- funding for the Collaborative Exploration Initiative, expanding and building on the past success of the Collaborative Drilling Initiative.

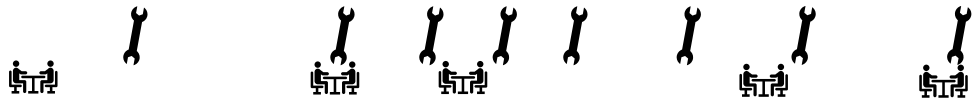
GSQ Projects and Funding

Strategic Resources Exploration Program



- Cloncurry Extension Magnetotelluric Survey
- Town
- Mafic Rocks in the Mount Isa region
- Hydrogeochemistry of undercover eastern Mount Isa Province (CSIRO)
- NWMP Deposit Atlas
- Tick Hill Gold Deposit (EGRU)
- Camooweal Deep Seismic Survey
- Road
- Mary Kathleen Domain Geology
- NWMP Data-Driven Mineral Exploration And Geological Mapping
- Central Mary Kathleen Domain and Landsborough Graben Solid Geology Interpretation
- Lawn Hill Gravity Survey
- Cloncurry North Airborne Magnetic and Radiometric Survey
- Central Isa Airborne Magnetic and Radiometric Survey
- Mineral Chemistry for Mineral System Geochemical Vectoring (CODES)
- GSQ Reference Collection of Mineral Systems in the NWMP
- Cloncurry Mineral Systems (CSIRO)
- Ernest Henry camp scale study data release
- Solid Geological Interpretation Of The Southern Eastern Fold Belt (BRC-SMI)
- Solid Geological Interpretation Of The Central Eastern Fold Belt (BRC-SMI)

Timeline



Workshops

IAP Meetings

PROJECT	PARTNERS	2017/18				2018/19				2019/20				2020/21			
		Sep	Dec	Mar	Jun	Sep	Dec	Mar	Jun	Sep	Dec	Mar	Jun	Sep	Dec	Mar	Jun
Geochemical Toolkit	Geochem Pacific; Adelaide University; GSQ																
Cobalt and HREE Mineral Systems in the Mount Isa Block	KDC Consulting																
NWMP Compilation	UQ-SMI																
NWMP Predictive Modelling Pilot Project	CSIRO; GSQ																
Magma Fertility of the Mary Kathleen Domain of the Mt Isa Inlier	JCU-EGRU; GSQ																
Geological setting of the Tick Hill Gold Mine, Mount Isa Inlier, Queensland, Australia	JCU-EGRU																
Mineral Geochemistry Vectoring: Uncovering Northwest Queensland's Hidden Potential	Utas-CODES																
Northwest Mineral Province Deposit Atlas	UQ-SMI																
Cloncurry Metal	CSIRO																
Hydrogeochemistry	CSIRO;GSQ																
Queensland's Critical Metal Prospectivity	GSQ																
Cobalt in Copper Tailings	GSQ; UQ-SMI																
Mary Kathleen Domain Geology	GSQ; QUT; GA; JCU																
GSQ Reference Collection	GSQ; QUT; GA																

Complete In Progress

Geophysics

- Cloncurry North Airborne Magnetic and Radiometric Survey - 102,000 line km geophysical survey covering over 9,000 sq km north of Cloncurry flown at 100m line interval.
- Central Isa Airborne Magnetic and Radiometric Survey - 89,000 line km geophysical survey covering over 8,000 sq km east of Mount Isa flown at 100m at line interval.
- Lawn Hill Gravity Survey - Regional ground gravity survey with 7230 gravity stations collected at approximately 1km station spacing in the Lawn Hill area.
- Cloncurry Extension Magnetotelluric Data - Extension of the 2016 Cloncurry MT survey in the Eastern Succession of Mount Isa. This survey extends the coverage north-west from the original array with the same station spacing.
- Cloncurry Extension Magnetotelluric Report - Cloncurry Extension Magnetotelluric Survey Report provides data analysis and preliminary 2D inversions to accompany the survey data.
- Camooweal Deep Seismic - 2D seismic survey conducted in 2019 with a primary aim to improve understanding of basin architecture underlying the area and to provide data in an area with limited exploration.

Project Summaries

Geochemistry Toolkit

Summary

Since about 1950, the Mount Isa region has been covered by more than 3500 exploration tenements, most of which were explored with geochemistry as the primary means of investigation and final assessment. Yet, during the recent 25-year period of high profile geoscience initiatives and multiple post-graduate research programs, little attention, other than company confidential projects, has been given to the evaluation of surface geochemical exploration techniques suitable for the detection of buried and blind orebodies, or the challenge of chemical data optimisation for primary halo detection in drill hole samples.

The Geochemical Tool Kit (GTK) addresses these shortcomings by providing reviews, case studies, instruction, expert advice and learned opinion. Its primary aims are to guide and enhance geochemical exploration practice in northwest Queensland and encourage more companies to explore the 'greenfields' covered domain.

Background & aims

The publication is primarily concerned with the chemical detection and recognition of buried targets in surficial regolith and drill hole samples. Overviews of conventional and innovative sampling and analytical methods are provided, and the relevance of each to typical exploration settings encountered in the Mount Isa region is demonstrated. Near-surface and outcropping mineralisation is also treated, but only in the context of data coverage and optimisation. The following framework links exploration setting and chemical exploration tactics as the major themes of the GTK:

- identifying locally sourced secondary dispersions at the surface (conventional surface geochemical)
- 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).

Collaboration & Details

The Geochemistry Toolkit is a collaboration between the Geological Survey of Queensland, GeoChem Pacific Ltd (NZ) and the University of Adelaide. Primary authorship was undertaken by Dr. Keith Hannan (Geochem Pacific). Industry contributors, by way of data or internal reports, include MIM Resource Development PL (MIMRD), Minotaur Exploration Ltd, South32 Ltd and Chinova Resources PL. The project was funded by the Queensland Government's Strategic Resources Exploration Program to increase mining activity and expedite mineral discoveries in northwest Queensland.

Project Leader:	Joseph Tang - GSQ
Timing	June 2017 – June 2018
Participants:	Keith Hannan, Geochem Pacific Richard Lilly, Adelaide University Joseph Tang, GSQ

Outcomes

The outcomes of the project were delivered in the form of a report and appendices. The first half of the document comprises four chapters in which conventional sampling and chemical analytical methods are discussed. The subject matter includes: the quality and effectiveness of compiled surface geochemical data (DNRME, openfile), the optimisation of future surface and drill hole sample geochemical data, and the applicability of isotopic and mineral-based technologies. The second half, Chapters 5 to 8, concerns sampling and chemical analytical methods designed, or intended for, the measurement of chemically introduced secondary dispersions. Topics covered include: chemical transport mechanisms in transported cover, sample media and sampling procedures, nature of the data and the identification of anomalies..

Link to Domain Map NWQ

Deliverables & links

(ctrl click icons for links)

Link to final report and appendices

Presentation September 2018

Webinar 30 April 2020
Joseph Tang

Webinar 30 April 2020
Dominic Brown

Webinar 23 July 2020
Joseph Tang

Cobalt and HREE Mineral Systems in the Mount Isa Block

Summary

Significant opportunities exist in the Mount Isa Block for HREE mineralisation associated with igneous systems responsible for the IOCG deposits in the Cloncurry area. The element association in these IOCG systems is similar to the element suite, viz., Co-Ni-Cu-Au-Pt-Pd-F in the Idaho cobalt belt, where high concentrations of HREEs have been discovered. As Idaho was located adjacent to the north east margin of Precambrian Australia during the Mesoproterosoic ~1600 - 1400 Ga years ago, the hypothesis that Co systems in the Mount Isa Block could contain similar elevated HREE concentrations was tested.

Background & aims

China is the leading supplier of high-value heavy rare earth elements (e.g., Dysprosium Dy). These elements are considered to be "critical rare metals" because their supply from China, is being threatened by increased Chinese domestic consumption and environmental concerns regarding their extraction from ionic clay deposits by artisanal operated mines. This has stimulated a global search to secure alternative sources of HREEs. However, unlike the light rare earth elements Neodymium (Nd) and Praesodymium (Pr) which occur in abundance in carbonatites, deposits that are enriched in HREEs are significantly less common.

As this possibility had not previously been investigated, a litho-geochemical study of cobalt ores from deposits in the Eastern Succession was undertaken to improve understanding of cobalt mineral systems with the potential to stimulate exploration for the rare heavy rare earth elements, yttrium and scandium in addition to other battery metals like Co and Cu and associated precious metals gold and the platinum group elements.

Collaboration & Details

This study was undertaken under the auspices of the GSQ New Discovery Program with two objectives. (1) to improve understanding of Mesoproterozoic cobalt mineralization in the Eastern Succession of the Mount Isa Block, reviewed by Munro-Smith (2007). (2) to determine if any northwest Queensland cobalt mineralisation contained the high-levels of heavy rare earth elements and yttrium reported from Mesoproterozoic hydrothermal deposits in the Idaho Cobalt Belt (Bookstrom et al.,2007;Slack, 2010; 2012).

Project Leader:	Ken Collerson – KDC Consulting
Timing	June 2018 – December 2018
Participants:	Ken Collerson – KDC Consulting

Outcomes

- REE and other trace element data presented in this report shows a clear genetic link between cobalt-bearing IOCGs in the Eastern Succession with multi-element (Co- HREE-Au-PGE-Ni) mineralisation in the Idaho Cobalt Belt, where a number of the Co deposits are in reality HREE, Au and PGE resources.
- Earlier studies of this mineral system suggested that Cu, Au, F, U, P and REEs as well as S were derived from the Williams Naraku Granite via a magmatic-hydrothermal fluid (Williams et al., 2015). However given the element association (Co, Ni, Sc as well as PGE's), a more plausible explanation is that metals in the system were derived from an ultramafic to mafic alkaline igneous source, like the Sc, HREE, Cu, Ni, Au and PGE rich olivine websterites discovered in this study, at Mount Cobalt.
- There is high potential for discovery of other HREE, Sc, PGE, Au, Ni, Co-enriched, alkaline ultramafic bodies that are similar to the Mount Cobalt (intrusion?), possibly associated with carbonatites, a hypothesis originally proposed by Groves and Vielreicher (2000).
- Thus the Cloncurry District has significant and as yet untested prospectivity for discovery of a new source of high-value heavy rare earth mineralisation.

Deliverables & links

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Link to report and appendices on GSQ Open Data Portal

Presentation September 2018

Seminar July 26 2019

NW Mineral Province Compilation

Summary

The objective of this project is to carry out a compilation of precompetitive geoscientific studies for the Northwest Mineral Province

There is a wealth of information available arising from exploration, mapping and research by GA and the GSQ, Universities, research organisations and exploration companies, but much of that information is buried in reports and theses, spread around the internet, not geographically referenced, hidden in proprietary datasets, and not placed into the context of previous and subsequent studies. Most exploration companies do not have the time, resources and background knowledge to bring this information into a form in which its usefulness to industry is maximised. Key questions relating to compilation of previous geoscientific data include:

- What information is available?
- What is the priority order of information to be compiled based on its perceived usefulness to exploration companies?
- What forms should the data compilation be delivered in?
- What needs to be done to ensure that compiled data is understood and used by explorers

Collaboration & Details

The project aims to assemble information relating to all relevant geoscientific studies of the region and to extract information on the geographic extent, key focus, outcomes and a range of other parameters relating to each study.

Project Leader:	Rick Valenta – SMIBRC - UQ
Timing	June 2017 – June 2018
Participants:	Rick Valenta, UQ Mark Hinman, UQ Dominic Brown, GSQ Courteney Dhnaram, GSQ

Background & aims

The Mount Isa region is one of the world's best endowed belts of Zinc, Lead, Silver, Copper and Gold. It hosts several world class deposits and has been intensely explored for the last 50 years or more. Over that time, there have been many geoscience initiatives aimed at studying the characteristics and geoscientific expressions of the major deposit types in the region, and a large proportion of the region's exploration data has been compiled in multiple phases, resulting in a large resource of open file geoscientific data. Whilst the existing precompetitive datasets have been very valuable to exploration in the region, there is abundant remaining potential to realise value from these datasets through additional analysis and delivery in a form in which it can be most effectively used by the region's explorers.

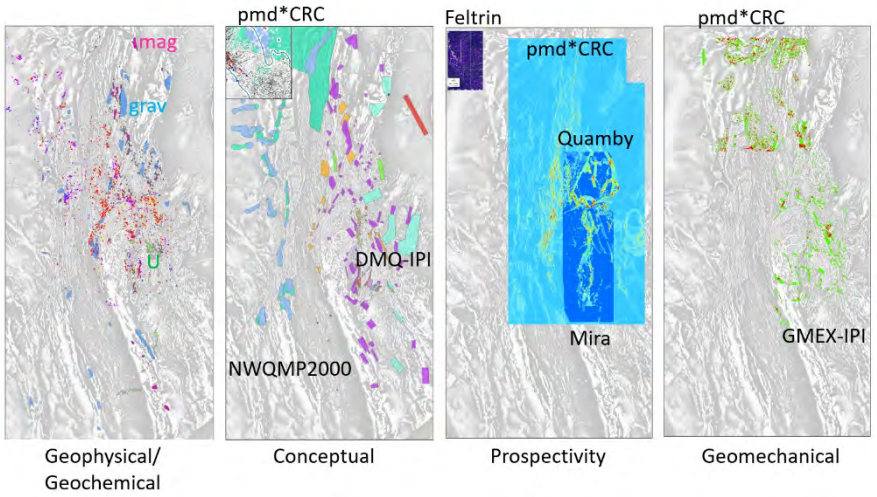
The objective of this project is to carry out a compilation of precompetitive geoscientific studies for the Northwest Mineral Province

Outcomes

Data compiled to date includes:

- a prototype for an Atlas of Northwest Mineral Province ore deposits containing Ernest Henry and Mount Isa
- Updated event stratigraphy chart
- Timesliced stratigraphy, structure and igneous events
- Compilation of polygon outlines/isopachs/isodepths from existing 3D models
- Draft structure of final GIS project outputs
- Compilation of exploration targets from previous prospectivity studies
- Compilation of miscellaneous legacy GIS datasets (Metamorphic map, NABRE sections, CRC LEME regolith)
- A draft Spatial Data Index (SDI) prototype
- Secure set of drillcore and accompanying materials from Mount Isa, George Fisher and Ernest Henry for storage and study at DNRM Core facility
- An update of existing solid geology interpretations

A Gap Analysis of Industry Priorities and Compilation results has allowed the definition of a Gap Analysis and Action Plan which can form a basis for future precompetitive research activities aiding exploration in the NW Mineral Province.



Deliverables & links

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Prototype Spatial Data Index

Report

NWMP Target Compilations

Timesliced stratigraphy, isopachs, structure and igneous events

3D Model Compilation

Seismic Interpretations

Workshop June 2019

Southern EFB Solid Geology

Workshop September 2019

Presentation September 2018

Central Eastern Fold Belt Solid Geology

Summary

This project builds on previous BRC projects to produce a detailed and integrated geological and structural interpretation and solid geology map, that extends the highly prospective Eastern Fold Belt (EFB) undercover to the east and south.

Three distinct crustal blocks (basement terranes) are present in the mid to lower crust of the project area: 1) Mount Isa Province (thick, poorly reflective crust); 2) Numil Province (thinner highly reflective crust), and 3) an intervening competent block of moderately reflective crust (referred to here as the central competent block). The structural geology of the upper crust in the NW area of the AOI comprises a network of extensional faults developed during the ca 1680-1650 Ma SCG extensional event. Integrated interpretation of the seismic with the plan view datasets provides the first interpretation of the network of extensional faults in this region. The faults mapped in this study are broadly NE trending and NW trending faults consistent with the regional ~NW-SE to E-W extension direction for the Calvert / Sybella extensional event in the Western Fold Belt (e.g. Gordon, 2004 Gibson et al., 2008). Variations in the fault trends reflect both syn-extensional control by the underlying basement and reactivation during Isan Orogeny compression.

Collaboration & Details

The project aims to produce a detailed and integrated geological and structural interpretation and solid geology map, that extends the highly prospective Eastern Fold Belt (EFB) undercover to the east and south. Work was carried out by K Connors, with input from Paul Donchak, Ian Withnall, Paul Gow and Rick Valenta.

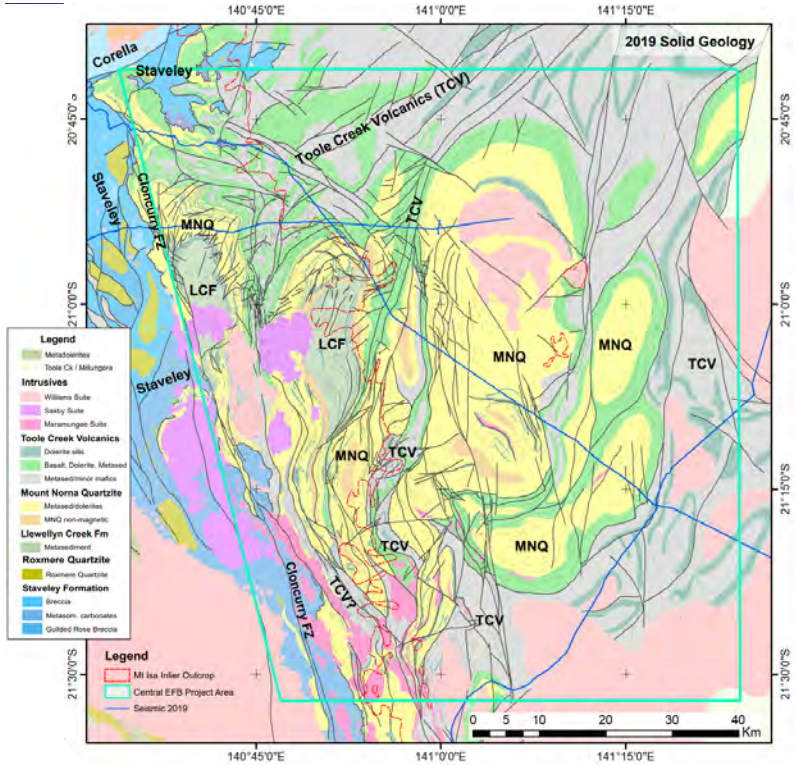
Project Leader:	Karen Connors – SMIBRC - UQ
Timing	April 2019 – November 2019
Participants:	Karen Connors, UQ

Background & aims

A comprehensive understanding of the geology, structure and evolution provides the foundation for resource exploration in any region. Exploration in the exposed and near surface regions of Australia, including the Eastern Fold Belt, is maturing and as a result economic discoveries have been decreasing over several decades. The need to explore in areas of deeper cover and/or further from outcrop is currently driving a range of research initiatives and data acquisition programs. The resulting knowledge advancement and growing wealth of precompetitive data acquired by Australian state and federal governments, provide new opportunities for industry but also require detailed interpretation and integration with existing datasets in order to continue to progress our understanding of the fundamental geology of the covered regions.
The main aim of this project was to produce a new solid geology interpretation of the central EFB resulting in an improved understanding of the structural complexity, as well as the context and controls on mineralisation, and to provide a basis for interpretation of permit and mine scale exploration datasets in the area.

Outcomes

This project provides an understanding of the upper crustal geology and structure as well as the underlying crustal architecture both of which are critical to a minerals system approach to exploration for Broken Hill Type Ag-Pb-Zn massive sulphide as well as IOCG-style Cu-Au deposits in this region. It provides the first interpretation of the ca 1680- 1650 Ma extensional fault system of the Soldiers Cap Domain and its control on subsequent shortening during the Isan Orogeny (ca 1610-1500 Ma), and hence provides significant support for exploration in this highly prospective covered region. This project also defines the extent of underlying basement terranes, their control on upper crustal structural evolution and the location of crustal scale structural zones that potentially provide deep-seated fluid conduits. Follow-up work is recommended in order to test this interpretation, including more detailed mapping and integration with prospect and mine scale data. Reassessment of the Soldiers Cap Group stratigraphy and distribution of the three main units is also recommended in several areas.



Deliverables & links

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Report and GIS Datasets

Presentation November 2020

NWMP Data-Driven Mineral Exploration and Geological Mapping

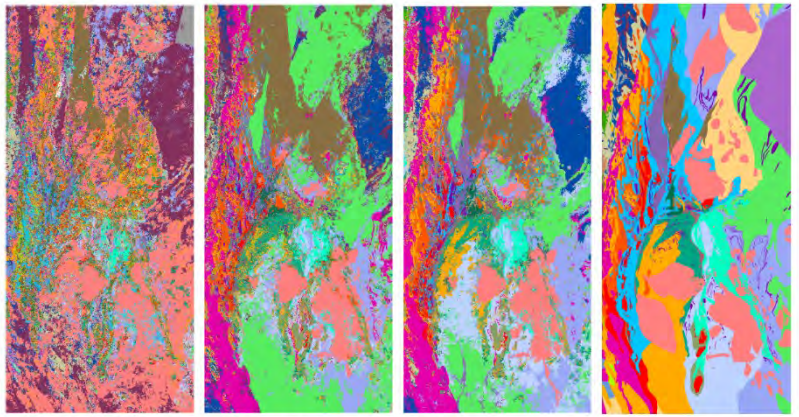
Summary

We have conducted several experiments to assess the utility of different machine learning algorithms applied to freely available data covering the North West Minerals Province (NWMP) in Queensland. The first experiment focused on accessing the copper and gold mineral prospectivity of the Quamby area. The second suite of experiments aimed at the digital geological mapping of the Eastern Succession in the Mount Isa Inlier. Finally, we attempted to predict the concentration of Cu, Au, Pb, Zn indicating possible mineralisation in bedrock as if no cover existed, using in situ soil samples

The process of exploring for mineral resources consists of several interconnected steps, where the probability of finding a deposit or target is evaluated based on the geological, geochemical and geophysical surveys conducted in an area. All of the acquired data form the foundation of an integrated approach to geological mapping and exploration targeting.

Background & aims

The overall aim of the project was to investigate how aspects of machine learning can support geologists in order to make quicker and more informed interpretations. We have conducted several experiments to assess the utility of different machine learning algorithms applied to freely available data for the North West Minerals Province in Queensland. The first experiment focused on the comparison of the traditional weights of evidence (WoE) method to logistic regression in the Quamby area in assessing copper and gold mineral prospectivity of the Quamby area. In the second experiment, we attempted to predict concentrations of Cu, Au, Pb, and Zn using in situ soil element concentrations as training and geophysical data as explanatory variables in order to find anomalous regions suitable for exploration targeting. The third suite of experiments evaluated several approaches to the automated geological mapping of the Eastern Succession in the Mount Isa Inlier. We tried to provide an insight on how we could enhance the abilities of a geologist by a data-driven interpretation as an aid in the mapping process. We attempted to classify lithological units, discover undetected granite outcrops, and find anomalous regions in the interpreted geological maps based on a multivariate dataset.



(a) Model prediction – 2 points per class. (b) Model prediction – 20 points per class. (c) Model prediction – 200 points per class. (d) Solid geology interpretation.

Figure 6.9.: Sparse geology classification – *Random forest* with *all* covariates. The model prediction is shown for varying number of training points (a maximum of 2, 20, and 200) per class. Figure 6.9d shows the existing solid geology interpretation for comparison.

Collaboration & Details

The project will leverage a multidisciplinary team from CSIRO Mineral Resources and Data61 and will include project management and expertise in minerals exploration and data analytics. Others with complementary expertise may be brought in by CSIRO as required. Participants from GSQ included Vladimir Lisitsin and Matthew Greenwood

Project Leader:	Vladimir Listsin- GSQ
Timing	October 2017 – December 2018
Participants:	David Cole, Lachlan McCalman, Vasek Metelka, Alexander Otto, Jess Robertson, Andrew Rodger, and Daniel Steinberg, CSIRO Vladimir Listsin, Matthew Greenwood, GSQ

Outcomes

While limited to a single region of study, this project has demonstrated the value of information obtained within large, freely available datasets and the potential of machine learning to extract that information in an automated way to improve existing processes. The geochemical element predictions successfully uncovered links between deep geophysical and surface geochemical signatures which can be utilised as an alternative to traditional prospectivity mapping while the anomaly detection and geological classifications provide a more objective assessment for mapping efforts both historical, in production, or planned.

The development and use of new data integration and analysis techniques will not only allow for easier, faster, and more repeatable interpretation of multi-source data but can also improve future data collection practices, all to maximise the value of information gathered for a region of interest.

Deliverables & links

(ctrl click icons for links)

Link to report and appendices

Presentation June 2019 – Vasek Metelka

Presentation October 2019 – Matthew Greenwood

Presentation October 2019 – David Cole

Magma Fertility of the Mary Kathleen Domain of the Mt Isa Inlier

Summary

Four different groups of intrusive rocks from the Cu-Au and U-REE mineralised Mary Kathleen Domain, Mt Isa Inlier are studied to examine their magma fertilities. LA-ICP-MS zircon U-Pb dating results reveal these extrusive rocks formed in the time period between ca 1450 and ~1800 Ma. Bulk rock geochemistry demonstrates that these intrusive rocks experienced extensive magma fractionation and possible magma mixing. The oldest, one of the petrographic phases from the Wonga Granitoids, does not show a close connection with the regional Cu-Au and U-REE mineralisation. Pegmatite from Mt Godkin may be the youngest phases, and contains most obvious mantle components in the Mary Kathleen Domain. Ore elements Cu and Au are most enriched in the Lunch Creek gabbro. Uranium and REE concentrations are elevated in certain phases of the Burstall and Wonga granitoids.

Background & aims

Substantial progress on understanding magma fertility has been achieved in porphyry Cu±Au field in recent years, leading to the development of effective exploration tools. It has been recognized that porphyry Cu±Au deposits are most commonly formed by hydrothermal fluids exsolved from water-rich oxidized calc-alkaline magmas in arc settings (Hedenquist and Lowenstern, 1994). Several parameters have been recognized to address magma fertility in porphyry Cu±Au deposits. By contrast, there has been very little work on understanding magma fertility in relation to IOCG mineral systems, probably because connections between magmatism and mineralization remains vague.

In this study, we examine the magmatic rocks from the Mary Kathleen IOCG Cu-Au and skarn U-REE mineral field including the Mt Godkin Complex, the Burstall and Wonga Suites, and the Lunch Creek gabbroic rocks, aiming to explore the magma fertility parameters from intrusive rocks through establishing the connection between magmatic activities and mineralization in this region. The results will be used to test the magma fertility of other IOCG associated magmatic rocks in the northwestern Queensland.

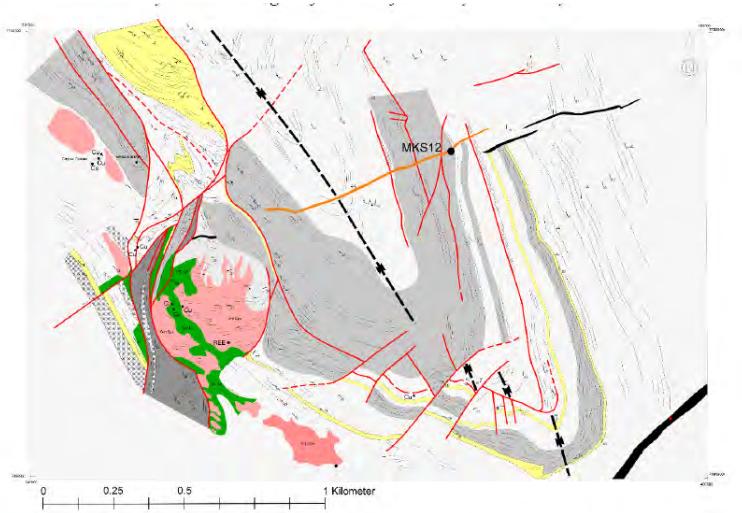


Fig. 8. Map showing ENE trending monzodiorite dyke intruding across the core of the Mary Kathleen Syncline. The Elaine Dorothy Prospect is shown to the left hosted in skarn.

Collaboration & Details

The project is being carried out by staff and students of JCU, with collaboration involving the spatially-overlapping Mary Kathleen Domain Geology Project being carried out by the GSQ

Project Leader:	Paul Dirks, Ioan Sanislav - JCU
Timing	January 2018 – March 2021
Participants:	Ioan Sanislav, Paul Dirks, Joshua Spence, Alexander Edgar, Truong Le, Grace Manestar, Pieter Creus, Travis Mackay, Jan Huizenga, Carl Spandler

Outcomes to date

- Bulk rock geochemical analysis of 51 samples of various igneous phases of the Burstall, Wonga and Mount Godkin Granitoid complexes have been obtained and analysed. These results point to an intraplate, A-type classification for these igneous rocks.
- LA-ICP-MS U-Pb dating of igneous zircons indicate that the Mount Godkin granite and granitic rocks associated with the Little Eva Cu deposit formed at ca. 1750 Ma.
- New mapping in the Mary Kathleen Syncline and LA-ICP-MS U-Pb dating of igneous zircons indicate that:
  - deformation related to the Mary Kathleen Syncline largely predates ~1740-1730 Ma. This may re-define the relationship between plutonism and deformation in the region.
  - the stratigraphy and deformation in the area predates ~1770 Ma. Together with age results from the Mary Kathleen syncline this suggests that: a) there may be an early (pre-1740) compressional stage affecting rocks of the Mary Kathleen Domain; b) the current stratigraphic correlations in the Mary Kathleen Domain do not hold.
- Analysis of various stages of scapolite formation around the Elaine Dorothy Cu-REE deposit show systematic variations in Cl/Br ratios and sulphur contents with distance from the orebody. These results demonstrate the potential for scapolite to be used as a vectoring tool in mineral exploration.

Deliverables & links

(ctrl click icons for links)

Link to report and appendices

Presentation June 2019

Presentation March 2019

Presentation September 2019

Webinar 14 May 2020

Igneous Geology of the Mary Kathleen Domain of the Mt Isa Inlier

Summary

The Mary Kathleen Domain comprises multiply deformed Paleoproterozoic (<~1780 Ma) metasedimentary and associated igneous rocks, which form the westernmost part of the Eastern Subprovince or Eastern Succession of the Mount Isa Inlier. To the east, the domain is bounded by the Pilgrim Fault in the south and by the Mount Rose Bee Fault, a probable extension of the Pilgrim Fault offset by the Fountain Range Fault, in the north. The western margin of the domain borders the ~1875–1850 Ma Kalkadoon–Leichhardt Domain in an irregular, partly faulted and partly unconformable contact. The Kalkadoon–Leichhardt Domain is unconformably overlain by the Magna Lynn Metabasalt and Argylla Formation (~1780–1775 Ma), the oldest units of the Mary Kathleen Domain.

These volcanic-dominated units are unconformably overlain by the Ballara Quartzite and Corella Formation of the Mary Kathleen Group. The Corella Formation is the most extensive unit in the domain and consists mainly of calc-silicate rocks that have been metamorphosed up to middle–upper amphibolite grade and Na–(Ca–) metasomatised over wide areas. The Corella Formation and older units are intruded by a distinctive group of strongly deformed syntectonic granitoids of the ~1740–1730 Ma Wonga Igneous Subprovince, as well as by a penecontemporaneous group of higherlevel granitoids dominated by felsic compositions—the ~1740–1720 Ma Burstall Igneous Subprovince. The Mary Kathleen Domain also includes a younger assemblage of shallow- to deep-marine metasedimentary rocks—the Mount Albert Group, which hosts the mineralisation at the Dugald River Zn–Pb–Ag mine.

Collaboration & Details

The project is being carried out by staff of the GSQ, in collaboration with researchers from JCU, QUT and Geoscience Australia.

Project Leader:	Dave Purdy, GSQ
Timing	July 2017 – June 2021
Participants:	R.J. Bultitude, D.J. Purdy, D.D. Brown & D. Hoy

Background & aims

Popular models for the formation of IOCG deposits incorporate at least partial involvement of magmatic fluids derived from these relatively young and little-deformed granitoids (e.g., Rotherham et al., 1998; McLellan et al., 2010). Although the relationship between Au and Cu deposits and granitic rocks was first postulated about 80 years ago (e.g., Nye & Rayner, 1940), there is still a general lack of understanding of how mineralisation and episodes of magmatism throughout much of the inlier are inter-related.

The main aims of the project were to:

- Provide an up-to-date assessment of the mineralisation potential of the Mary Kathleen Domain.
- Provide updated constraints on the ages of selected units in the domain
- Define igneous provinces in the Mary Kathleen Domain
- Investigate felsic units in the Mary Kathleen Group.
- Establish an isotopic framework for granitic rocks of the domain.
- Combine study results with recently acquired high-resolution airborne geophysical data to aid in the interpretation of the geology of the domain

Outcomes

The project has produced an updated geochronological and geochemical database and several synthesis reports dealing with aspects of the igneous geology have been or are in the process of being published (Kositcin et al., 2019, 2021; Bodorkos et al., 2020). In addition, financial support has been provided to researchers at James Cook University to undertake detailed studies in the Tick Hill, Green Creek (Myubee Igneous Complex), Mary Kathleen, and Mount Godkin areas, and a magma fertility study of the granitoids of the entire inlier.

The results of specialist geochemical, geochronological and isotopic studies provide some idea of the variations through time and space in crustal source compositions and relative inputs from crustal and juvenile (mantle) sources. The timing and distribution of such events are important in evaluating tectonic models.

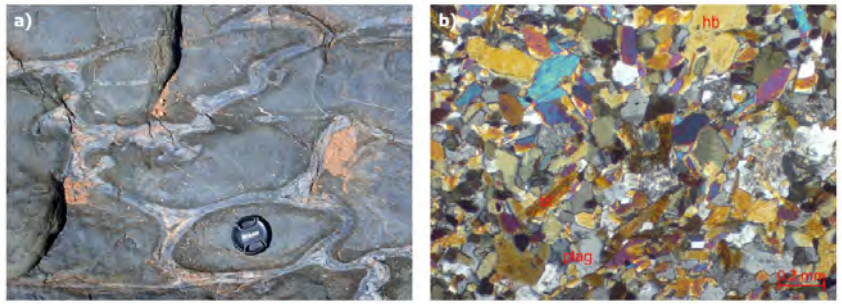


Figure 5.2.2.3. a) Part of a pillowed lava flow exposed in the bed of the Cameron River. The more rapidly chilled margins of the individual elongate to lobate pillows are marked by thin, dark zones in contrast to the paler tones of the more slowly cooled cores of the pillows, which show no internal structures. Individual pillows are separated from each other by interpillow matrix distinguished by relatively pale tones in the above image. The composition of this matrix is unknown. Lens cap is ~52 mm in diameter. b) Photomicrograph, taken in cross-polarised light, of metabasalt (pillow lava) consisting of hornblende (hb), variably sericitised plagioclase (plag), and minor biotite (bt) and opaque oxide (not labelled). No igneous textures or minerals are preserved. Scale bar is 0.2 mm long. Lime Creek Metabasalt, bed of the Cameron River at MGA 397203 7705757.

Deliverables & links

(ctrl click icons for links)

Link to report and data

Presentation March 2019 – Dave Purdy

Presentation September 2019 – Dominic Brown

Presentation September 2019 – Derek Hoy

Geological setting of the Tick Hill Gold Mine

Summary

The Tick Hill Au deposit is located in the Mary Kathleen Domain, 110 km southeast of Mount Isa in NW Queensland. The deposit was discovered by MIM Exploration in September 1989 during Cu-Au exploration, and was mined by Carpentaria Gold between 1991-1994, in both open pit and underground workings. The deposit produced approximately 511,000 ounces (~15.9 tons) of gold at an average grade of 22.52 g/t Au. The ore body was about 140m long, 1 to 30m wide, and extended 320m down dip (240m below surface). The high-grade of the deposit, the lack of sulphides and the presence of almost exclusively free gold within upper-amphibolite facies, quartz-feldspar mylonite units, makes Tick Hill a unique gold-rich deposit in the Mount Isa Inlier, of interest to mineral exploration.

Collaboration & Details

The project is being carried out by PhD student Truong Le under the supervision of Prof. Paul Dirks, Dr. Ioan Sanislav, Dr. Jan Huizenga. Glencore, Carnaby Resources and Superior resources have each provided assistance to the project.

Project Leader:	Paul Dirks – JCU/EGRU
Timing	April 2018 – June 2021
Participants:	Truong Le under the supervision of Prof. Paul Dirks, Dr. Ioan Sanislav, Dr. Jan Huizenga, JCU

Background & aims

The Tick Hill Au deposit is located in the Mary Kathleen Domain, 110 km southeast of Mount Isa in NW Queensland. The deposit was discovered by MIM Exploration in September 1989 during Cu-Au exploration, and was mined by Carpentaria Gold between 1991-1994, in both open pit and underground workings. The deposit produced approximately 511,000 ounces (~15.9 tons) of gold at an average grade of 22.52 g/t Au. The ore body was about 140m long, 1 to 30m wide, and extended 320m down dip (240m below surface). The high-grade of the deposit, the lack of sulphides and the presence of almost exclusively free gold within upper-amphibolite facies, quartz-feldspar mylonite units, makes Tick Hill a unique gold-rich deposit in the Mount Isa Inlier, of interest to mineral exploration.

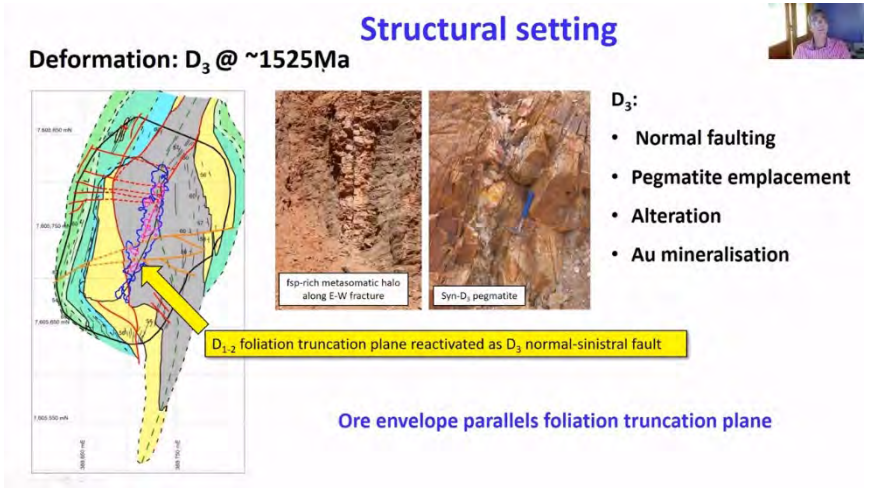
Available research data and the interpretations derived from that are at times contradictory, which sugests that the Tick Hill deposit could be more complex and the result of more than one control. At this point, there is too little information on the deposit available in the public domain. The study conducted by JCU and funded by GSQ is intended to correct this and aims to: (1) characterizes the geological setting of the deposit; (2) clarify the mineralization style for the deposit; and (3) constrain the timing of mineralization.

Outcomes

The volcano-sedimentary host rocks at Tick Hill, which were previously interpreted as Corella Formation, are likely to be much older and could be part of the Leichhardt volcanics. This means that the volcano-sedimentary sequences in the Kalkadoon-Leichhardt domain could be prospective for gold.

Gold may have formed early, and did not get introduced during the pervasive fluid events that dominate the alteration assemblages in the pit (i.e. the chlorite-epidote-actinolite-carbonate alteration), but instead was introduced with the earlier alteration assemblage of silica-magnetite-hornblende. Exploration should focus on Mt-qtz alteration with elevated Bi-Se rather than typical IOCG style alteration/mineralisation.

The D3 deformation structures determine the current, local geometry of the orebody, but they may have been unrelated to deformation patterns at the time of gold formation.



Deliverables & links

(ctrl click icons for links)

Link to Final Report on GSQ Open Data Portal

Presentation March 2019

Webinar 14 May 2020

Mineral Geochemistry Vectoring: Uncovering Northwest Queensland's Hidden Potential

Summary

The Mount Isa district contains numerous base and precious metal systems which have suites of sulfide, silicate, and carbonate minerals that are ideal for trace element geochemical analysis. Furthermore, many of the mines in the Mount Isa district are approaching end-of-life scenarios, which could have a significant negative socio-economic impact on the region. Finding new resources and re-vitalizing the Northwest Queensland Mineral Province is therefore of paramount importance.

The LA-ICP-MS facilities at CODES, University of Tasmania, are at the forefront of mineral geochemistry research, both nationally and internationally. Over the last decade, our laser labs have enabled us to produce cutting-edge results in pyrite, chlorite, and epidote vectoring and paragenetic studies, leading to high-profile publications in major peer-reviewed scientific journals. We therefore have the expertise and capacity to adequately manage high sample throughput and data analysis in a timely manner.

Collaboration & Details

The trace element geochemistry research program will be carried out over a 3-year period by a team of CODES researchers using existing sample material in storage at CODES, as well as new samples collected in the field in the Mount Isa region. The raw data collected via LA-ICP-MS analyses will then be screened and processed at CODES before delivery to the Department for further analysis and application. Sample collection and analysis is being carried out in collaboration with complementary programs by the GSQ and CSIRO.

Project Leader:	David Cooke, Shaun Barker - CODES
Timing	March 2018 – June 2021
Participants:	David Cooke, Shaun Barker, Jonathan Cloutier, Jeff Steadman,Max Hohl CODES

Background & aims

UTAS objectives will be to provide the Department with new geochemical information on known systems in the Mount Isa district, which will then be applied to greenfields targets elsewhere in the province, with the ultimate objective of providing new pre-competitive regional geochemical datasets that can aid in the exploration for, and discovery of, new base- and/or precious-metal resources to revitalize the Mount Isa region. The objectives of UTAS are more specifically to:

- Provide the Department with a pre-competitive mineral geochemistry database on known deposits in the Mount Isa region that can be used by exploration and mining companies to inform decision making regarding their exploration activities in the region.
- Explore the patterns of mineral geochemical zoning in common sulphide, carbonate and silicate components of sediment-hosted base metal and iron oxide copper-gold deposits in the region.
- Develop new mineral vectoring tools which can be easily applied by researchers and explorers working in the Mt Isa region.
- Use these data to interpret how the ore deposits and their alteration halos formed, leading to high-impact publications in international journals and presentations at conferences.

Outcomes

Trace element chemical analysis of hydrothermal minerals via LA-ICPMS techniques is a powerful tool in the explorer's toolbox. Studies of numerous sulfide, oxide, silicate, carbonate, and phosphate mineral species in the Cloncurry district, Eastern Fold Belt, Mt. Isa Inlier, NW Queensland, demonstrate that this approach is valid for use in the exploration for Starra-, SWAN-, and Ernest Henry-style Cu-Au targets. Future LA-ICPMS trace element studies in this district should target the ubiquitous sulfide- and oxide-bearing assemblages in the first instance, but we also recommend an equal (if not greater) focus on the silicate minerals, especially chlorite, epidote, actinolite, and diopside but also titanite.

The LA-ICPMS methods which formed the foundation of our work in the Cloncurry IOCG district also proved reliable in the sediment-hosted base metal systems of the Western Fold Belt at the Lady Annie and Lady Loretta deposits as well as the deposits of the Capricorn Copper (Gunpowder) district. Our data indicate that the main pulse of Cu mineralization in the Lady Annie and Gunpowder areas is chemically distinct from that in the Eastern Fold Belt, but there is evidence also of a different (later?) Cu event, one that bears much greater resemblance to the Cloncurry signal (e.g., weight-percent Co in pyrite). Future LA-ICPMS trace element research in these districts should center on sulfide and carbonate assemblages, with a minor focus on the applicability of hematite and goethite as ore proximity indicators.

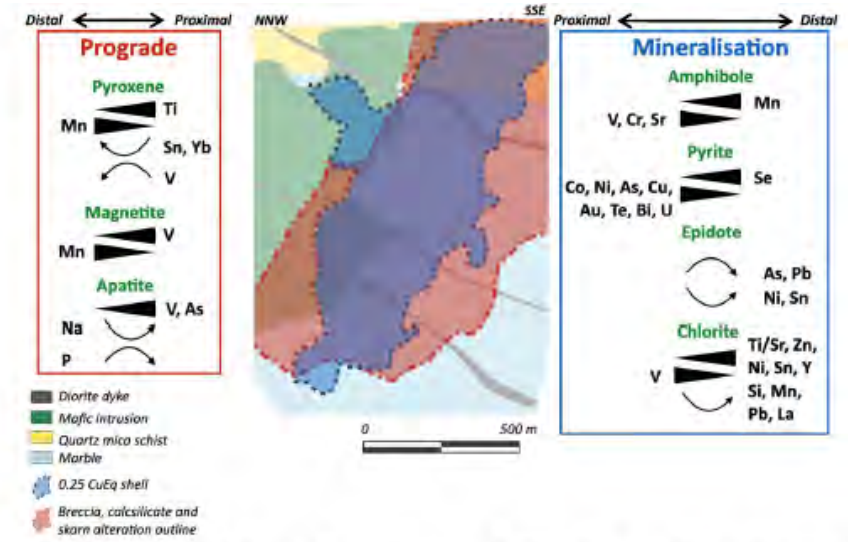


Figure 2.40: Summary of the mineral chemistry vectoring at SWAN. Most minerals show an elevated concentration in V proximal to the deposits whereas Mn concentration progressively increases with distance from the deposit.

Deliverables & links

(ctrl click icons for links)

- Final Report on GSQ Open Data Portal
- Presentation September 2018
- Presentation March 2019
- Presentation September 2019
- Webinar 30 April 2020
- Webinar14 May 2020
- Webinar 23 February 2021 (Steadman)
- Webinar 23 February 2021 (Cloutier)
- Webinar 30 September 2021

Northwest Mineral Province Deposit Atlas

Summary

A key component of the NW Mineral Province Compilation project was the preparation of prototype Mineral Deposit Atlas entries for Mount Isa and for Ernest Henry. The Mineral Deposit Atlas research component was ranked second by Industry feedback out of 26 proposed areas of research for the Northwest Mineral Province New Discovery Program.

The aim of the atlas is not to extensively revisit and update the well-studied and long-debated process models for each deposit type (summarised for example, in the NWQMEP 2011 report). As noted by McCuaig et al (2010), as exploration progresses to more detailed scales there is a decrease in the effectiveness of model-based conceptual targeting and an increasing reliance on direct detection, with its associated high high risk of “false positives”. The best way to maximise the effectiveness of exploration at this scale is to ensure that exploration is being carried out with the most comprehensive knowledge possible of the expression of the outer and inner haloes of the deposit style in question.

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Collaboration & Details

The Project is being carried out by staff of the WH Bryan Mining and Geology Research Centre, part of the Sustainable Minerals Institute at the University of Queensland. Many companies have provided data to help with the compilation, including, Glencore, Chinova, South32, Red Metal, FMR, Capricorn Copper, Carnaby Resources, Hammer Metals, MMG, and Aeon Metals. GSQ and CSIRO have also provided data which have been included in the atlases

Project Leader:	Paul Gow, Rick Valenta – UQ BRC
Timing	July 2018 – June 2020
Participants:	Paul Gow, Rick Valenta, Nathan Fox, Mark Hinman, Ali Parchegani, Sasha Aivazpourporgou, UQ BRC

Background & aims

The Mount Isa region is host to many large deposits of Cu, Pb, Zn, Ag and Au, and there is significant variation between the deposits. Knowledge relating to the geology, mineralogy and geochemistry of each deposit and its associated inner and outer haloes as they are expressed in common exploration datasets can provide important information for assessment of exploration projects in a number of ways including:

- Provision of a basis for assessment of mineral system affinity of a new early stage exploration target
- Provision of assistance in the vectoring of exploration drillholes on the basis of geochemical, geological, and/or mineralogical gradients found to exist in known deposits of similar type.

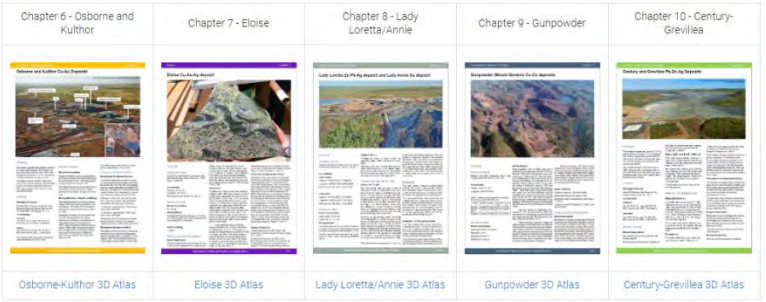
The objective of this project is to complete an atlas of all significant mineral deposits in the Northwest Mineral Province as an aid to future exploration in the region.

Outcomes

The deposit atlas entries have been progressively released as they have been completed, and each atlas has been delivered in the form of a pdf document as well as a 3D Compilation of data in Geoscience Analyst (along with common file format copies of the constitutent datasets for use in other programs. The project is now complete, and covers 24 deposits.

Feedback to date from NW Mineral Province explorers has been positive, and a survey is currently in circulation aimed at identifying potential improvements and next steps.

Link NWMP Atlas on GSQ Data Portal



Deliverables & links

(ctrl click icons for links)

Link to SMI-BRC page with all downloadable atlases

Presentations December 2018

Presentations June 2019

Webinar 23 April 2020

Webinar 10 April 2020

Paul Gow Ore Deposits Hub Presentation October 2020

Presentation Nov 2020 NWMP Deposit Atlas Launch

Cloncurry Metal

Summary

The objectives of the project are to collect a consistent mineralogical-geochemical-petrophysical data-base on identical samples from major deposits of the Cloncurry district. The Outcomes will be used to:

1. Provide an up-to-date consistent understanding of the Cloncurry mineral system, which will be expressed as an Altlas of alteration types and petrophysical responses.
2. Develop a toolkit consisting of techniques developed in order to identify critical mineral system indicators using relatively inexpensive tools, i.e., tools that can be made available in the core shed.

The toolkit which can be used in conjunction with an Atlas, to identify where samples extracted might sit relative to known mineral occurrences.

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Collaboration & Details

CSIRO will be responsible for the management of the project, the sampling of materials, which will be coordinated separately with third parties, and the preparation of all samples, other than the generation of rocks powders for geochemistry. CSIRO will provide materials to GSQ, for the generation of rock powders, but GSQ will be responsible for the generation of rock powders.
CSIRO will be responsible for the acquisition of the majority of the data collected, including TIMA imagery and analysis, and all petrophysical datasets including: AMS, Magnetic Susceptibility, Remanence (NRM), Density, Radiometrics and Conductivity, as outlined in the table below.

Project Leader:	Jim Austin - CSIRO
Timing	July 2018 – June 2020
Participants:	Jim Austin, Andreas Bjork, Ben Patterson (CSIRO, North Ryde, NSW) Jess Stromberg, Renee Birchall, Mark Pearce and John Walshe (CSIRO, Kensington, WA)

Background & aims

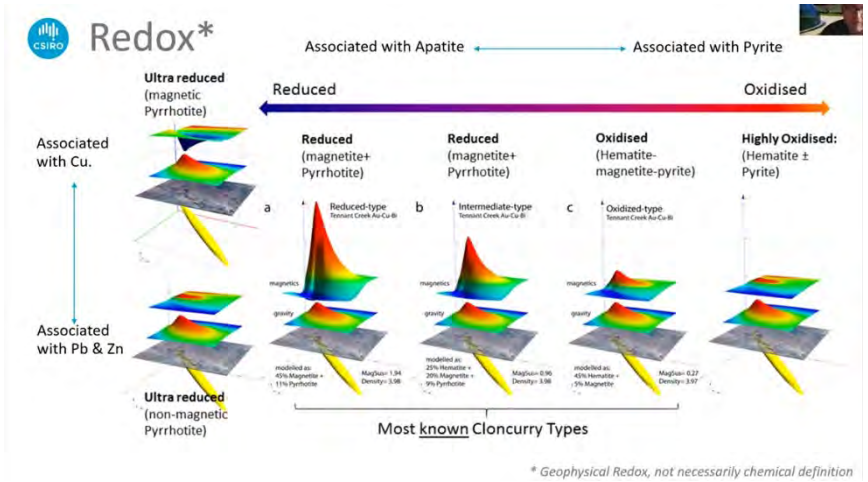
One of the main outcomes of the Uncover Cloncurry Project was that it developed a methodology to evaluate a vast suite of deposit types consistently, using the same five techniques, and most importantly at the same scale. This project builds on that theme, including:

- Completing work on Major Deposits (e.g., Eloise, Cannington, Great Australia, Dugald River, etc); Incorporating additional techniques e.g., conductivity, radiometrics and hyperspectral core mapping; Utilising the existing reference library to locate dateable minerals for geochronology; Expanding the workflow out to regional scales, on the surface and undercover.
- Conducting more comprehensive principal component analyses of the datasets to identify indicators of mineralisation that may not be apparent using more qualitative approaches.
- Generating a comprehensive reference library and condensed Atlas of deposit types, the association between geochemistry, mineralogy, alteration minerals, alterations types, structural controls and various petrophysical parameters (e.g., density, conductivity radiometrics, MagSus, NRM).
- Adapting the workflow, such that industry can incorporate the outcomes into their exploration programs, including using handheld petrophysical tools and also developing a method to convert geochemistry to alteration using hyperspectral scanning.

Outcomes

The Cloncurry Metal Database is the primary outcome of the project, and it is intended to be used by industry and research geoscientists to de-risk and improve exploration success in NW Queensland.

It contains information for 1590 samples, extracted from 23 deposits and prospects, across the Cloncurry District, Northwest Queensland. All data has been collected using a consistent methodology on 2 cm cylinders (standard palaeomagnetic “rounds”). It incorporates 2712 columns of scale-integrated data from 10 different analytical techniques measuring density, magnetic susceptibility, remanent magnetisation, magnetic fabrics using anisotropy of magnetic susceptibility (AMS), radiometrics, conductivity, modal mineralogy and texture from scanning electron microscopy (SEM) using the Tescan Integrated Mineral Analyser (TIMA), geochemistry (from both portable XRF analyses and analysis of powders), and short-wave infrared (SWIR) hyperspectral data.



Deliverables & links

(ctrl click icons for links)

Link to Final Report and data on GSQ Open Data Portal

Presentation September 2018

Presentation March 2019

Webinar 14 May 2020

Cobalt in Copper Tailings

Summary

The project seeks to undertake first-pass characterisation assessments in terms of critical metal abundances and their modes of occurrence in tailings and other mine wastes in north Queensland.

The mine waste features at 9 sites in Queensland (Lady Annie, Capricorn Copper, Century, Osborne, Selwyn, Baal Gammon, Wolfram Camp, Mt Oxide, Pindora) have been sampled for new economy metal exploration funded by the GSQ. Preliminary assay data for these samples has been collected (NB. some samples require additional analysis) so only limited interpretations are presented in this interim report. Samples were collected from 6 sites in January-February 2020, with tailings samples also provided from the New Century, Osborne and Chinova sample stores).

Mineralogy (XRD and MLA) and mineral chemistry (LA-ICPMS) data is outstanding. A UQ honours student, Ruby Fritz, has joined this project and is working on identifying indigenous bacteria at Capricorn Copper.

Background & aims

Australia is well endowed in base and precious metals, but to date critical metals (e.g., Co, In, W, Ga, Ge) have not been the focus of the Australian mining industry, and are instead by-products of mining for other commodities (i.e., Cu, Pb, Zn). The 2019 Critical Metal Strategy commissioned by the Australian Government identified that out of 30 critical metals, Australia was the top global producer for just one, lithium. With increasing global pressure to utilise low-carbon technologies there is greater demand for critical metals to support this development with mine waste materials representing a potential resource to help supplement the supply of these sought after metals and minimising potential environmental impacts they may have on the surrounding environment, such as the release of acid and metalliferous drainage (AMD). However, determining their contents and mode of occurrence in mine waste is vital in assessing if a potential economic deposit exists and indeed, the most appropriate metallurgical processing pathways suited to their extraction. The Queensland State Government recognise there is great potential to explore for these critical or 'new economy' metals in mine waste materials produced by mines across the state and is the focus of this project.

Collaboration & Details

Site-based sample collection for the project is being undertaken as a cooperative effort involving both BRC and GSQ staff. Support has been provided by several NWMP Companies including Glencore, Capricorn Copper, New Century, Chinova and Lady Annie

Project Leader:	Anita Parbhakar-Fox – UQ SMI BRC
Timing	November 2019– June 2020
Participants:	Anita Parbhakar-Fox, Nathan Fox, Ruby Fritz, Rick Valenta, BRC Dominic Brown, Friedrich von Gnielinksi, GSQ

Outcomes

Field-based sampling activities for the project are now complete and preliminary analyses have been received. An interim report has been delivered to the GSQ, and final reporting will be complete by the end of June

This project has rolled into an ongoing and larger project aimed at documenting a large number of waste sites in Queensland

Deliverables & links

(ctrl click icons for links)

Reports:

Selwyn | Osborne | Baal Gammon | Capricorn

Wolfram Camp | Pindora | Lady Annie | Mt Oxide

Webinar 28 October 2021 Parbhakar-Fox 1

Webinar 28 October 2021 Jackson

Presentation December 2019

Webinar 14 May 2020

Webinar 28 October 2021 Nichols

Webinar 28 October 2021 Mejias

Webinar 28 October 2021 Parbhakar-Fox 2

Webinar 28 October 2021 Whitworth

GSQ Reference Collection

Summary

The GSQ Reference Collection project aims to understand the geoscientific signatures of known mineralised systems in the NW Mineral Province in order to better understand and interpret results from sparse datasets collected as part of exploration in unknown targets. The intended use of the data is to help in the early understanding of greenfields explrioation targets, and to aid in application of the mineral systems approach to exploration under cover.

Data collected as part of the project will help explorers to answer questions such as:

- Have I intersected the halo of a potential orebody
- How far might I be away from economic mineralisation
- What geochemical factors could be used to vector towards mineralisation

The GSQ has been collecting suites of samples from many of the important mineral systems in the region, and this new data will be incorporated into compilations and interpretations from other concurrent projects in order to improve the understanding of system footprints in the region

Collaboration & Details

The Geochemistry Toolkit is a collaboration between the Geological Survey of Queensland, GeoChem Pacific Ltd (NZ) and the University of Adelaide. Primary authorship was undertaken by Dr. Keith Hannan (Geochem Pacific). Industry contributors, by way of data or internal reports, include MIM Resource Development PL (MIMRD), Minotaur Exploration Ltd, South32 Ltd and Chinova Resources PL. The project was funded by the Queensland Government's Strategic Resources Exploration Program to increase mining activity and expedite mineral discoveries in northwest Queensland.

Project Leader:	Vladimir Lisitsin - GSQ
Timing	July 2019– June 2021
Participants:	Vladimir Lisitsin, Courteney Dhnaram, Matthew Valetich, Jacques Batumike , GSQ

Background & aims

It is now widely acknowledged that discovery rates are decreasing, and that new approaches are necessary in order to make discoveries in the new and challenging environments which are the focus of modern exploration. One of the approaches which has been increasingly applied in recent times is one which attamepts to expand the footprint of mineral systems by documenting the far-field expressions of systems, rather than simply focusing in on the ore-grade parts of the system. The aim of this approach is to increase the odds of recognising the significance of explrioation "near-misses".

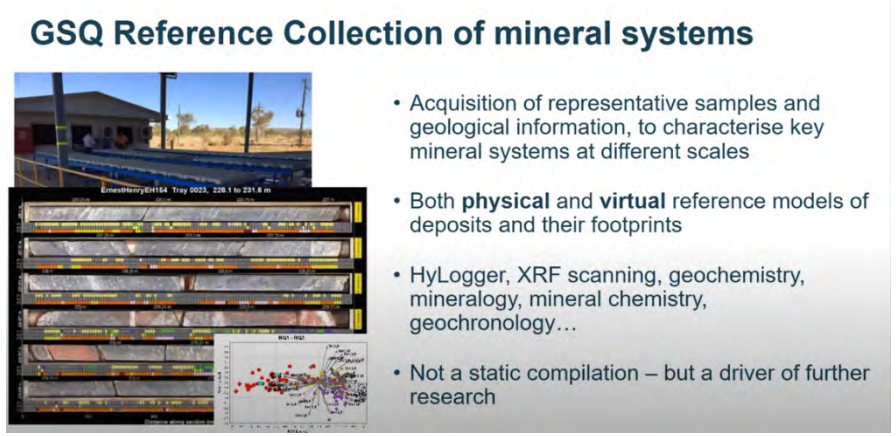
In more detail the aims are:

- To collect systematic baseline geochemical information on known mineral systems, both from existing data and, where necessary, from new sampling
- To collect, analyse and interpret a suite of samples from these systems, in order to provide a new dataset based on currently applied techniques, but also to retain a suite of appropriate samples for future testing of new ideas and methods.
- To assemble representative drillcore from as many NWMP deposits as possible

Outcomes to date

Sampling and analysis have now been carried out for a large number of mineral systems in the region. These results have so far been communicated in the form of internal 6-monthly reports, and the aim is to publicly report the geochemical results.

Under this project, a large number of drillholes have been measured with Hylogger, XRF scanning, geochemistry, mineralogy, mineral chemistry, and geochronology for selected samples. Hylogged holes have been progressively released, and some of the other data have been incorporated into the NW Mineral Province Deposit Atlas releases.



Deliverables & links

(ctrl click icons for links)

Link to Ernest Henry Report and data on GSQ Open Data Portal

Presentation September 2018

Presentation December 2018

Presentation June 2019

Hylogger Workshop September 2019

Webinar 14 May 2020

Hydrogeochemistry

Summary

The GSQ has finished a program in the eastern part of the Mount Isa region which involved taking borehole water samples from both static and flowing boreholes. These samples have been analysed for cation and anion concentrations, alkalinity, Au/PGE and stable isotopes. Suites of over 60 elements have been collected in order to develop and apply chemical incies to enable the identification and fingerprinting of different mineralisation styles. With an understanding of the water table and regional fluid flow patterns, this can be used to develop and undersdtanding of hydrogeological dispersion patterns which could allow vectioring towards deposits.

This dataset is a powerful tool in the increasingly prevalent challenge of exploration through cover. The project will aid in filling a hole in the data in a very prospective part of the region, and will add data for mineral types not currently available to the Australian hydrogeochemical atlas. It may also open up new areas for exploration based on the results of the new analyses.

Collaboration & Details

The Geochemistry Toolkit is a collaboration between the Geological Survey of Queensland and CSIRO. CSIRO is contributing assistance in the areas of survey planning, purchasing of equipment and consumables, and training fof staff in sampling and analysis procedures. CSIRO is also arranging for samples to be analysed for low level Au, Ag and PGEs as well as a range of other measures.

Project Leader:	Joseph Tang - GSQ
Timing	September 2018 – June 2021
Participants:	Joseph Tang, Dominic Brown, Dave Purdy, Derek Hoy, GSQ Nathan Reid, Patrice deCaritat, David Gray, Robert Thorne, Ryan Noble, CSIRO

Background & aims

The aim of the project is to bring together hydrogeochemical data from the Mount Isa Region into a unified dataset. This has involved training GSQ staff in hydrogeochemical sampling procedures and methods, planning of field sampling campaigns, and analysis of newly collected samples

The project will develop and apply indices for exploration in the region allowing for the hydrogeochemical signatuire of differing mineralisation styles to be identified. Understanding the hydrogeochemical dispersion patterns will also allow vectoring towards deposits in the region. The anomalies generated can be compared to those seen in other regionas across Australia with similar groundwater properties to determine the relative size and importance of these anomalies.

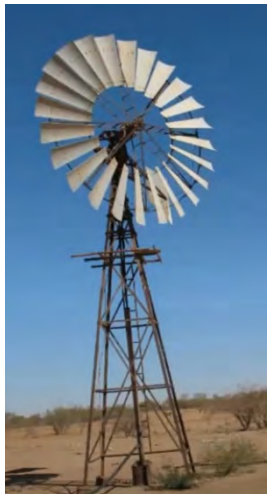
Processing of previous data and additional sampling from recognised bore or drilling can be integrated to produce mappable hydrogeochemistry. Recording of QA/QC and metadata will allow the results to be interpreted robustly.

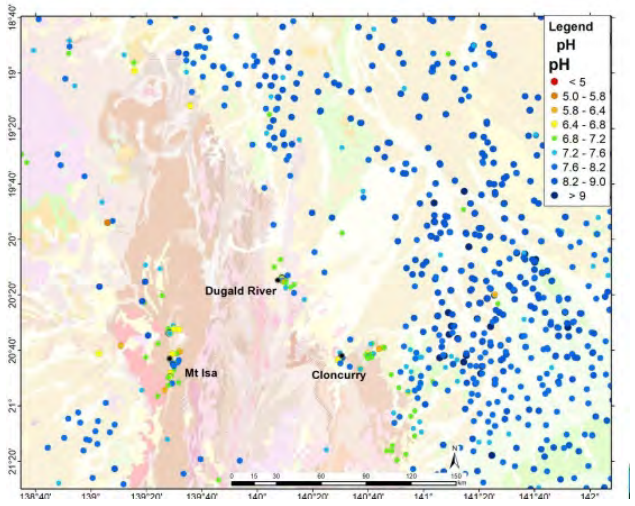
Outcomes to date

The intended outcomes of the project are to deliver:

- 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 (SO4 anomaly, FeS, Acids, NO3 depletion) to identify weathering of rock sulphides
- Produce a Hydrogeochemical Atlas for project area
- A levelled hydrogeochemistry database

The project is currently in a phase of data processing, in which results from the sample collection and analysis are levelled based on variations in water chemistry so that results across the regiona can be compared on an equal basis.





Deliverables & links

(ctrl click icons for links)

Presentation September 2018

Presentation September 2019

Webinar 30 April 2020

Presentation November 2020

Industry Engagement

Workshop Series – 2018 to 2021

Webinar Series – 2020 - 21

Introduction to the Webinar Series

Dr Helen Degeling - Director Minerals Geoscience - GSQ

9 April, 2020

In early 2020, in response to travel restrictions, the Geological Survey of Queensland and UQ's SMI inaugurated a webinar series to help continue to support Queensland's explorers. The series has attracted a large amount of interest from explorers and other interested attendees from all over the world, and has also attracted a very strong group of presenters, including global representation. Curated by Dr Helen Degeling, the Director of Minerals Geoscience for the Geological Survey of Queensland, the main goal of the series is to find new ways to support the minerals industry in Queensland during this unprecedented time. With most explorers deskbound and probably at home, there is a great opportunity to think about new techniques that can remotely, and the hope of the webinar series is to be able to trigger some lightbulb moments, and to possibly introduce to the exploration community something that will help to define new and exciting targets that can be tested when field activities resume. Each webinar is also followed by an onlin networking session for those that want to stay around for a digital drink!

Link to GSQ-UQ Webinar Series Youtube Recordings