Intrusion-related mineral systems of NE Queensland – 3-year collaborative research project

1st year results:

SP 11 – Geochemical signatures of intrusion-related mineral systems (JCU-TS-K)
SP10 – Regional alteration mapping using remote sensing methods (JCU)
SP 09 – Comprehensive prospectivity analysis (JCU-GSQ)

Arianne Ford, John Carranza

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**SP-11 Geochemical signatures of IRMS**

**Objectives:**

- Compile, analyse, and integrate multi-element and isotope geochemistry data characterising intrusion-related mineralisation and associated hydrothermal alteration in NE Queensland;

- Develop and test efficient methods of multi-element geochemistry data analysis directly applicable to practical geochemical exploration for intrusion-related mineralisation in NE Queensland;

- Integrate geochemical datasets into interpretative geochemical anomaly maps which can be used in exploration targeting for intrusion-related mineralisations in the region;

- Provide feasible timely inputs (data and communication) to sub-projects 1-6 and 9;

- Produce the required outputs within the constraints of time, cost, scope, and quality as specified.
SP-11 Geochemical signatures of IRMS

Year 1 Activities:

- Compilation and validation of multi-element and isotopic geochemistry data across the region on a common GIS platform;
- Literature review and workshop discussions of multi-element and isotope geochemistry of intrusion-related mineral systems relevant to NE Queensland;
- Preparation of a report describing: effective routine methods of geochemical data interpretation in exploration for intrusion-related mineral systems; geochemical zoning patterns of intrusion-related versus other genetically distinct mineral systems in the region (Terra Search and Klondike Exploration, in consultation with JCU).

SP-11 Geochemical signatures of IRMS

Year 1 Activities:

- Compilation and validation of multi-element and isotopic geochemistry data across the region on a common GIS platform;
  - Stream sediments: 287,138 unique sample locations within NEQ
  - Soil samples: 351,795 unique sample locations
  - Rock chip: 129,993 unique sample locations
  - Drill hole: 34,691 unique sample locations
  - Whole rock: 10,506 unique sample locations
  - Catchment sediments: 73 unique sample locations
SP-11 Geochemical signatures of IRMS
Year 1 Activities: Results

**Concentration-Area Analysis**
- How much area (A) is there with values above a concentration (C)?

Au Anomalies
- Concentration-Area Analysis
  - Background
  - Anomalous (> 0.0012 ppm)

Sn-W Anomalies
- Background
- Weak anomaly (>1.361 ppm)
- Strong anomaly (>3.6475 ppm)

Sample location
SP-11 Geochemical signatures of IRMS
Year 1 Activities: Results

PC4 scores

CT area

ML: Mt Leyshon
PJ: Pajingo
MW: Mt Wright
RV: Ravenswood

Au-(Sn-Sb)

PCA of lithology-corrected residuals for As, Au, Bi, Mo, Sb, Sn, Te and W:
PC1 – Bi-Sb-As-W
PC2 – As-(Mo-Sb)
PC3 – Au-(Sb)
PC4 – Au-(Sn-Sb)

SP-11 Geochemical signatures of IRMS
Year 1 Activities: Results

Cu \times Zn
\frac{Pb}{Pb}

ML
MW
CT
RV
PJ

Cu (ppm)
Zn (ppm)
Pb (ppm)
SP-11 Geochemical signatures of IRMS
Future Work:

- Interpretation of geochemical signatures in Georgetown region, and district-scale analyses for Mt Carlton, and northern Sn-W districts
- Analysis of data for generation of geochemical vectors towards intrusion related mineral systems in additional regional- to district-scale study areas
  - Stream sediments (regional-scale)
  - Drill hole and rock chip data (district-scale)
- Integrate new results from geochemical analysis from other sub-projects into existing data compilations and subsequent comprehensive prospectivity analysis

Future Work:

- Regional alteration mapping using remote sensing methods and spaceborne multispectral, airborne hyperspectral data, and ground-collected hyperspectral data.
- Test models of spectral signatures of intrusion-related mineral systems in NE Qld for recognition of exploration targets beyond deposit-scales.

SP-10 Regional alteration mapping by RS
Objectives:
Review of literature on hydrothermal alteration patterns of intrusion-related mineral systems relevant to eastern Queensland regions.

Acquire:
- Spaceborne multispectral data (ASTER)
- Airborne hyperspectral data (HyMap)
- Ground-based hyperspectral data (PIMA, specTerra) over representative deposits of intrusion-related mineral systems.

Input of spectral datasets into the GIS database.

SP-10 Regional alteration mapping by RS
Year 1 activities: Results

Abundance
- High
- Medium
- Low
- NIL

Au Deposit

AIoH Group Content (inc. muscovite, phengite, paragonite, illite, smectite, kaolinite)
SP-10 Regional alteration mapping by RS

Future Work:

- Analysis and interpretation of new alteration map products produced by CSIRO
- Assisting CSIRO with ground-truthing the new alteration maps produced (ongoing)
- Determining alteration footprints of intrusion related mineral deposits in north-east Queensland from the available regional- to district-scale datasets

SP-9 Prospectivity analysis

Objectives:

- Document and validate expert beliefs on the critical factors controlling the formation and spatial distribution of intrusion-related mineral deposits representing distinct mineral systems;
- Formulate robust conceptual prospectivity models for individual intrusion-related mineral systems;
- Generate a series of regional to camp-scale mineral prospectivity maps highlighting areas assessed to have a high potential for undiscovered intrusion-related mineral deposits;
- Produce the required outputs within the constraints of time, cost, scope and quality as specified.
SP-9 Prospectivity analysis
Year 1 activities:

- Literature review on the economic geology of intrusion-related mineral systems in the region;
- An expert workshop to discuss and document the current state of knowledge on intrusion-related mineral systems in the region and their main geological controls;
- Build spatial databases (in ArcGIS) for various mineral systems addressed by the other sub-projects;
- Create preliminary prospectivity maps for individual mineral systems, based on existing expert beliefs about each system using available data, to identify information and data gaps to guide regional data acquisition under other sub-projects.
SP-9 Prospectivity analysis
Year 1 activities: Results

- Develop a mineral systems model for Charters Towers region
  - Two distinct mineral systems:
    - Silurian-Devonian orogenic
    - Permo-Carboniferous intrusion-related

[Diagram showing mineral system processes and spatial proxies]

SP-9 Prospectivity analysis
Year 1 activities: Results

[Map showing prospectivity analysis results with highly favourable and unfavourable areas, marked with Charters Towers and Ravenswood locations]

Highly favourable  Unfavourable
(Ordovician)-Silurian-Devonian Intrusions
SP-9 Prospectivity analysis
Year 1 activities: Results

Precambrian Metamorphics

NNE-trending faults
SP-9 Prospectivity analysis
Year 1 activities: Results

NW-trending faults

- Highly favourable
- Moderately favourable
- Unfavourable

Cu/Pb Ratio

- Unfavourable
- Moderately favourable
- Highly favourable
SP-9 Prospectivity analysis
Year 1 activities: Results

Highly favourable Moderately favourable Unfavourable
U/K Radiometric Ratio

Silurian-Devonian intrusions
NNE-trending faults
Cu/Pb Ratio
Precambrian metamorphics
NW-trending faults
U/K Radiometrics

Spatial proxies for orogenic mineral system
Prospectivity map for (O)-S-D orogenic gold mineral system

Preliminary results for Permo-Carboniferous Intrusion-related gold systems (IGRS)

Spatial proxies for source/driver

Proximity to intrusion centres

Presence of intrusive bodies
Preliminary results for Permo-Carboniferous Intrusion-related gold systems (IGRS)

Spatial proxies for transport

- Proximity to ENE-trending faults
- Presence of NNW-trending faults

Spatial proxies for trap

- Presence of Au-(Sn-Sb) anomalies
- Presence of CuZn/Pb anomalies
SP-9 Prospectivity analysis

Year 1 activities: Results

Prospectivity map for IRGS

Prospectivity analysis:

Conclusions:

- It is working!
- Results predict location of known mineralization for both the Silurian-Devonian and Permo-Carboniferous mineral systems.
- New areas have been identified that are geologically prospective for intrusion-related gold mineralization in Charters Towers area.
SP-9 Prospectivity analysis

Future Work:

- Updating existing prospectivity maps as new data is acquired
- Integrate new understanding and data from other sub-projects to update mineral systems models and prospectivity maps
- Developing mineral systems models for:
  - Georgetown region
  - Mt Carlton area
  - Herberton Sn-W district
  - Mt Carbine/Wolfram Sn-W district
- Implementing mineral systems models to produce additional prospectivity maps

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