

Geochemical and sedimentological classification of Tanami Group rocks

We propose a project with Northern Star Resources (NSR) that will focus on:

- 1) geochemical and mineralogical classification of Tanami Group sedimentary and volcanic rocks and their alteration, vectoring towards gold mineralisation in the Tanami Region, and
- 2) interpretation of depositional environment.

The work will be carried out in the Groundrush, Tanami Mine Corridor (CTP - Hurricane-Repulse-Jim's), Stubbins, Bald Hill, Brown's Dome, and Coyote (WTP) areas, or as agreed. The sedimentological work under part 2 will mainly focus on Groundrush, Tanami Mine Corridor and Coyote areas.

The classification will be validated by a baseline dataset (drill core data) generated as part of the project and interpreted using Northern Star Resources data. The mineralogical and geochemical data will be interpreted with existing structural models based on geophysics, in order to create a geological map for the study area. The data can be further used by validation with other data sources, e.g. spectral data, gamma ray data.

The second part of the project will focus on defining the depositional environment and developing a sequence stratigraphic framework, which will help to unravel the basin evolution of the Tanami Group. Although mineralisation occurred during an orogenic phase, identification of pre-existing deeper tapping faults as part of basin development could have played an important role during mineralisation. Understanding geochemistry and sedimentology is also fundamental for identifying stratigraphic marker horizons, such as carbonaceous shales or tuffs.

The project aims to develop an exploration tool for identification of prospective host units for Au based on their geochemistry, mineralogy, and sedimentology.

Data Assessment, Collection and Interpretation

- 1) NSR Data Mining
 - Data provided by NSR will be quality controlled and assessed (including petrography, core logging, geochemical data, gamma ray data, aeromagnetic data, geological maps)
- 2) New Data Acquisition (requisite NSR drill core access)
 - Representative sample set for validation of lithology (based on core logging) by whole rock geochemistry (100-200 samples),
 - Petrographic (10-20 samples) and mineralogical studies (50-100 samples, XRD) for rock classification (depending on existing data).

- *Carbon-Oxygen stable isotopes on carbonates (50-100 depending on presence).*
- 3) Litho geochemistry and Mineralogy
- Interpretation of geochemical data by CSIRO-developed classification vectors,
 - Interpretation of mineralogy in regard to regional metamorphic grade, contact metamorphic grade and alteration assemblages,
- 4) Sedimentology
- Logging of core in context of facies variations and interpretation of depositional environments (up to 5 drill cores per area depending on availability),
 - Interpretation of geophysical data for better understanding of structural and lithological framework (aeromagnetic data, downhole gamma ray),
 - Assessment of historical stratigraphic framework based on project outcomes.

The project will also encompass training, knowledge transfer and provision of CSIRO staff to regular site/office visits and monthly update reports.

Project Deliverables

The project will deliver the outcome as a final report (including digital appendices), but will also provide monthly update reports as presentations. The report will include separate chapters for each area (Groundrush, Tanami Mine Corridor (CTP - Hurricane-Repulse-Jim's), Coyote (WTP), Brown's Dome, Stubbins and Bald Hill) with individual interpretations and recommendations. The final data include a facies/stratigraphic model across the NSR areas, alteration indices, geochemical vectoring (including whole-rock geochemistry and C/O stable isotopes), and geophysical/geochemical interpreted maps. The outcome will be presented as a workshop at the end of the project.

Any material increase or change in scope is to be agreed in advance by NSR prior to undertaking the work.

Reporting

Reporting for this project will be delivered via monthly progress presentations. The final report will be completed within 18 months of commencement of the project.

Personnel

The project will involve a total of 140 days from CSIRO including experts in geochemistry, sedimentology and structural analysis. This work will mainly split between 2 key researchers and with assistance and input from a broader CSIRO team. The team works on economically focussed studies, including the Paterson and MacArthur Basins:

- Leader Dr. Susanne Schmid (Principal Geologist) has twenty years' experience in the field of sedimentology, mineralogy and geochemistry with a focus on basin and systems analysis of sediment-hosted mineral systems in non-metamorphosed and metamorphosed rocks.
- Dr. Marcus Kunzmann (Research Scientist) focuses on basin analysis (facies analysis, sequence stratigraphy, chemostratigraphy, tectonostratigraphy, inorganic and isotope geochemistry) of sedimentary and weakly metamorphosed sedimentary successions to inform mineral exploration programs and to develop region-specific targeting concepts.

Timing and Workflow Details

- 1) **July 2019 ongoing** - Compilation of data provided by NSR, including QA/QC if needed (NSR data if available including geochemistry, petrography, mineralogy, gamma ray data, aeromagnetic, gravity, structural maps, drill hole logs).
- 2) **August 2019** - Field work (max. 10-12 working days on site, plus travel) for logging core (Groundrush, Jim's, and Hurricane-Repulse) with assistance of NSR field staff. This includes half-day training and knowledge exchange of site geologists. Timing and duration may depend on availability of flights/vehicles to NSR sites.
- 3) **August 2019 ongoing** – laboratory work and interpretation of data collected during field trip and integration of existing data (sedimentology, geochemistry, mineralogy, petrography)
- 4) **September 2019** – Field work (max. 10-12 working days on site, plus travel) for logging core (Coyote, Brown's Dome) with assistance of NSR field staff. This includes half-day training and knowledge exchange of site geologists. Timing and duration may depend on availability of flights/vehicles to NSR sites.
- 5) **March 2020** – Presentation of preliminary models and results (*milestone*).
- 6) **December 2020** – Presentation of final report and 1-2 day workshop in Perth or on site (*milestone*).

The data collection workflow and methods will be tailored towards the Tanami Region and a standard operating procedure established as part of the CSIRO - industry knowledge transfer. The work schedule is an estimate and might vary depending on the field work timing.

Costs

This will be a collaborative project between CSIRO Mineral Resources and Northern Star Resources. The total project **value** is **\$288,441**. The cost for NSR is **\$200,509** (plus GST), while CSIRO Mineral Resources will contribute **\$85,932**. NSR will carry the cost for transport from-to Alice Springs, and accommodation at site during the field work.

An initial invoice of 35% of the total agreed budget will be issued prior to June 30th 2019, a second invoice for 25% of the work to be issued once the collection of field data is concluded, a third invoice for 20% of the work to be issued after presentation of preliminary data (March 2020) and the final 20% upon receipt of the final report.