National Argon Map: an AuScope initiative

Data Acquisition Project Proposal

This form should be completed and returned to Geoff Fraser (Geoff.Fraser@ga.gov.au) for consideration by the National Argon Map Oversight Panel

Project Proponent

Name: Anthony Reid
Affiliation and position: Senior Principal Geoscientist, Geological Survey of South Australia
Collaborators: Dr Marnie Forster
Project Title: Dating of mineralisation-related alteration in the Olympic Cu-Au Province, Gawler Craton
Geographic Region: Olympic Cu-Au Province
Geological Province or Tectonic Unit: Gawler Craton

Brief Project Description:

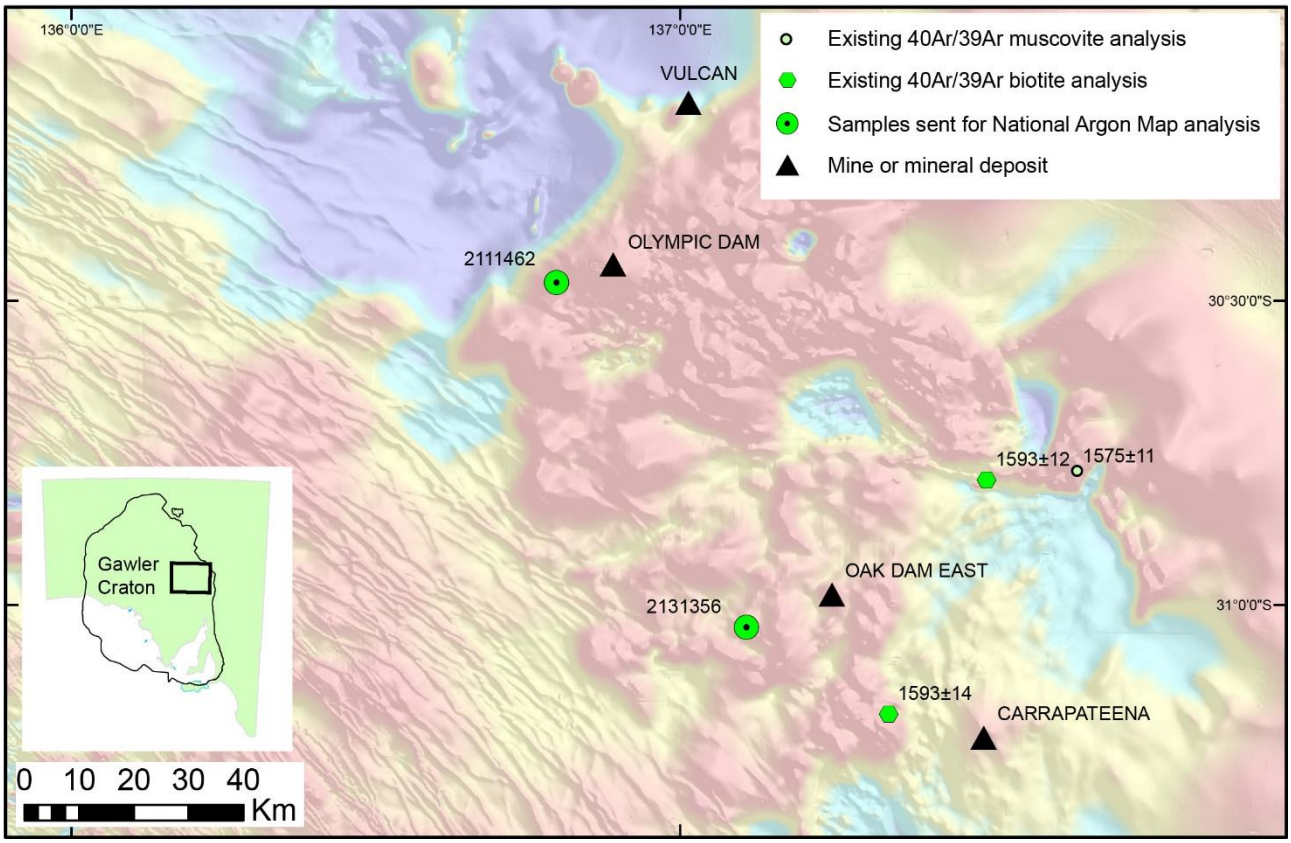
Approximately 500 word maximum. Include what geological process/problem will be addressed, and how new $^{40}Ar/^{39}Ar$ data from the specific samples to be dated will contribute. Please include reference to pre-existing geochronological constraints, if any exist. Please include a simple location map which showing the spatial distribution of samples in their geological context (with scale).

The Olympic Cu-Au Province is a metallogenic province in South Australia that contains one of the world's most significant Cu-Au-U resources in the Olympic Dam deposit. The Olympic Cu-Au Province also hosts a range of other iron oxide-copper-gold (ICOG) deposits including the Prominent Hill and Carrapateena deposits.

Previous thermochronology work within the region of the Olympic Dam deposit has demonstrated that the mineralising event at c. 1590 Ma is also recorded as a thermal event by biotite and muscovite in country rocks of the region (Skirrow et al., 2007).

However, to the north east of Olympic Dam, $^{40}Ar/^{39}Ar$ dating of hydrothermal K-feldspar suggests that younger events have also modified the crust in this region, with evidence for c. 1.3 – 1.1 Ga fluid flow (Reid et al., 2017).

The thermal evolution of the Olympic Cu-Au Province is poorly constrained and the influence of younger events poorly known. This proposal seeks to build on the 3 existing $^{40}Ar/^{39}Ar$ analyses from the region around Olympic Dam with two more samples. The first is from a hematite altered but unmineralised granite in the vicinity of Olympic Dam. The second is an altered granite in the vicinity of the Oak Dam prospect.



Location map of samples submitted for this National Argon Map application. Note the samples of biotite in the vicinity of Carrapateena and Oak Dam East are from Skirrow et al. (2007).

Approximate number of samples proposed for $^{40}Ar/^{39}Ar$ analyses:

Three samples are submitted, detailed in the below table.

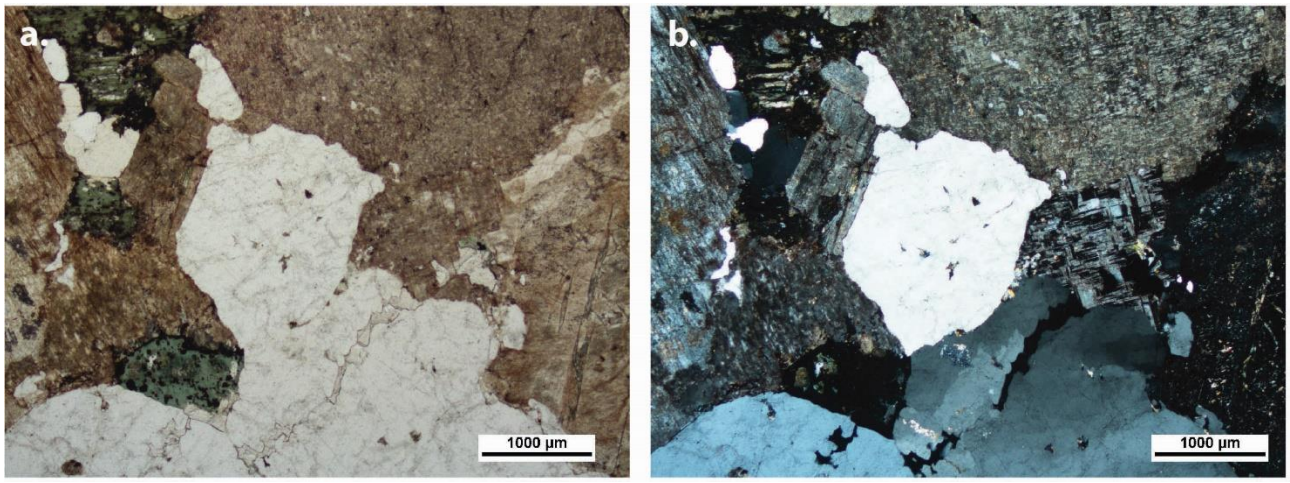
Sample number	Location	MGA East	MGA North	Zone	Target mineral	Lithology
2131356	DH ASD 1	701270	6564445	53	muscovite	altered granite
2111462	Blanche 1	672516	6627750	53	K-feldspar, muscovite	altered granite

Lithologies and minerals proposed for $^{40}Ar/^{39}Ar$ analyses:

Sample 2131356 is an altered granite from drill hole ASD 1. The granite is hematite altered and the muscovite is medium to fine grained. The analysis of K-feldspar in this sample and or muscovite may provide constraints as to the timing of the alteration in the region to the east of Oak Dam Oak Dam is a major new discovery by BHP in the region. Previous analysis of K-feldspar by the laser ablation methods yielded ages c. 900 – 600 Ma, while coexisting muscovite yielded an age of c. 1533 Ma.

Sample 2111462 is a coarse grained granite from geothermal drill hole Blache 1. Previous dating from this drill hole was attempted by Hall et al. (2018), who analysed apatite via U-Pb and fission track methods. The

Photomicrographs of sample 2131356. a. Plain polarised light. b. Cross polars. Opaque mineral is massive magnetite.



Photomicrographs of sample 2111462. *a. Plain polarised light. b. Cross polars. Photographs show the transition from the hornblende-rich magnetite-bearing alteration on the left of the field of view to the quartz and sericite altered feldspar that represents the granite on the right.*

Do you have a preferred ^{40}Ar-^{39}Ar laboratory? (ANU, Curtin, UQ, UMelb):
ANU as the furnace methodology is vital for T-t modelling with diffusion parameters.

Guidelines and Criteria
Project Proposals for funding support as part of the AuScope National Argon Map initiative will be assessed on the following criteria.
Australian: Samples must come from Australia (this may include Australian offshore regions)
Non-confidential: ^{40}Ar/^{39}Ar data must be made publicly-available (ie non-confidential)
Impact: to what extent new ^{40}Ar/^{39}Ar data from the proposed samples will contribute to geographic data coverage, or address key geological questions
Feasibility: whether the nature of the work is tractable via ^{40}Ar/^{39}Ar geochronology and the scale of the proposal is realistic within the time frame of the National Argon Map initiative (January 2020 – June 2021)?
Appropriate sample material: whether the proposed samples are (i) appropriate for ^{40}Ar/^{39}Ar analyses, and (ii) available within the time-frames of the National Argon Map initiative?

Oversight Panel
Dr Geoff Fraser, Geoscience Australia
Professor Zheng-Xiang Li,
Dr Anthony Reid, Geological Survey of South Australia
Peter Rea, MIM/Glencore
Dr Catherine Spaggiari, Geological Survey of Western Australia
Dr David Giles, MinEx CRC

Dr Marnie Forster (observer role as Project Coordinator)

Expectations

AuScope funding will cover the costs of sample irradiation and isotopic analyses.

Project Proponents will be responsible for:

- Provision of appropriate sample material. This includes mineral separation, which can be arranged at the relevant $^{40}Ar/^{39}Ar$ laboratories (in many cases this is preferred), but costs of mineral separation will be borne by the project proponent. The relevant laboratory reserves the right not to analyse material if it is deemed unsuitable for $^{40}Ar/^{39}Ar$ analysis.
- Provision of appropriate sample information. A sample submission template will be provided. Information in these sample submission sheets will form the basis of data delivery/publication, and the oversight committee or relevant laboratory reserves the right not to proceed with analyses unless and until appropriate sample details are provided. This includes description and geological context for each sample.
- Leading the preparation of reports and/or publications to deliver $^{40}Ar/^{39}Ar$ results into the public domain within the duration of the National Argon Map initiative (January 2020 – June 2021).
- Project Proponents will be expected to communicate directly with the relevant $^{40}Ar/^{39}Ar$ laboratory once a project has been accepted by the Oversight Committee, in order to clarify project expectations, arrange sample delivery, discuss results, collaborate on reporting and data delivery etc.

Participating Ar Laboratories will be responsible for:

- Providing advice to project proponents regarding suitable sample material and feasibility of proposed work
- Irradiation of sample material
- $^{40}Ar/^{39}Ar$ isotopic analyses
- Delivery of data tables, and analytical metadata to project proponents

Queries regarding possible projects as part of the National Argon Map initiative can be directed to Marnie Forster (Marnie.Forster@anu.edu.au) or Geoff Fraser (Geoff.Fraser@ga.gov.au)

References

Hall, J.W., Glorie, S., Reid, A.J., Collins, A.S., Jourdan, F., Danišík, M., Evans, N., 2018. Thermal history of the northern Olympic Domain, Gawler Craton; correlations between thermochronometric data and mineralising systems. Gondwana Research 56, 90-104.

Reid, A.J., Jourdan, F., Jagodzinski, E.A., 2017. Mesoproterozoic fluid events affecting Archean crust in the northern Olympic Cu–Au Province, Gawler Craton: insights from 40Ar/39Ar thermochronology. Australian Journal of Earth Sciences 64, 103-119.

Skirrow, R.G., Bastrakov, E.N., Barovich, K., Fraser, G.L., Creaser, R.A., Fanning, C.M., Raymond, O.L., Davidson, G.J., 2007. Timing of iron oxide Cu-Au-(U) hydrothermal activity and Nd isotope constraints on metal sources in the Gawler Craton, South Australia. Economic Geology 102, 1441-1470.