National Argon Map: an AuScope Initiative
$^{40}Ar/^{39}Ar$ Geochronology Laboratory Sample Submission Form

This form must be completed and returned to Marnie Forster (Marnie.Forster@anu.edu.au) before any work can be commenced in the Argon Laboratories.

Person submitting samples: Anthony Reid
Affiliation: Senior Principal Geoscientist, Geological Survey of South Australia
Project Title: Dating of mineralisation-related alteration in the Olympic Cu-Au Province, Gawler Craton
Sample Number(s) (including IGSN if one exists): 1978579
Mineral separation required? Yes or No: **Y**
Date submitted: 20/03/2020

GEOGRAPHIC AREA/ PROVINCE/ BASIN : Gawler Craton	
1:250k SHEET NAME: BILLA KALINA	**NUMBER:**
1:100k SHEET NAME: Engenina	**NUMBER:**
LOCATION METHOD: (GPS: WGS84 / AGD66 / AGD84 / GDA94) GDA2020	
ZONE: 53	
EASTING: 511919.52	**NORTHING:** 6758776.47
LATITUDE: -29.2999413	**LONGITUDE:** 135.122733

STRATIGRAPHIC UNIT FORMAL NAME *: Hiltaba Suite
STRATIGRAPHIC UNIT INFORMAL NAME: NA
LITHOLOGY: altered granite

DRILLHOLE ID (if applicable):
PROSPECT (if applicable): Cairn Hill Mine
DEPTH FROM (metres):
DEPTH TO (metres):

* Stratigraphic Unit names can be searched and checked within the Australian Stratigraphic Units Database via the following link: https://asud.ga.gov.au/

Dating Objective

What is the geological question $^{40}Ar/^{39}Ar$ analysis will address?

The Cairn Hill Fe-Cu deposit is an example of magnetite-dominant iron oxide copper gold (IOCG) mineralisation in the Gawler Craton. Hematite-dominant IOCG deposits are well represented within the Olympic Cu-Au Province, including Olympic Dam, Prominent Hill and Carapateena (Skirrow et al. 2007; Skirrow 2009). Magnetite IOCG's are less common, with Cairn Hill the only deposit of economic viability in South Australia.

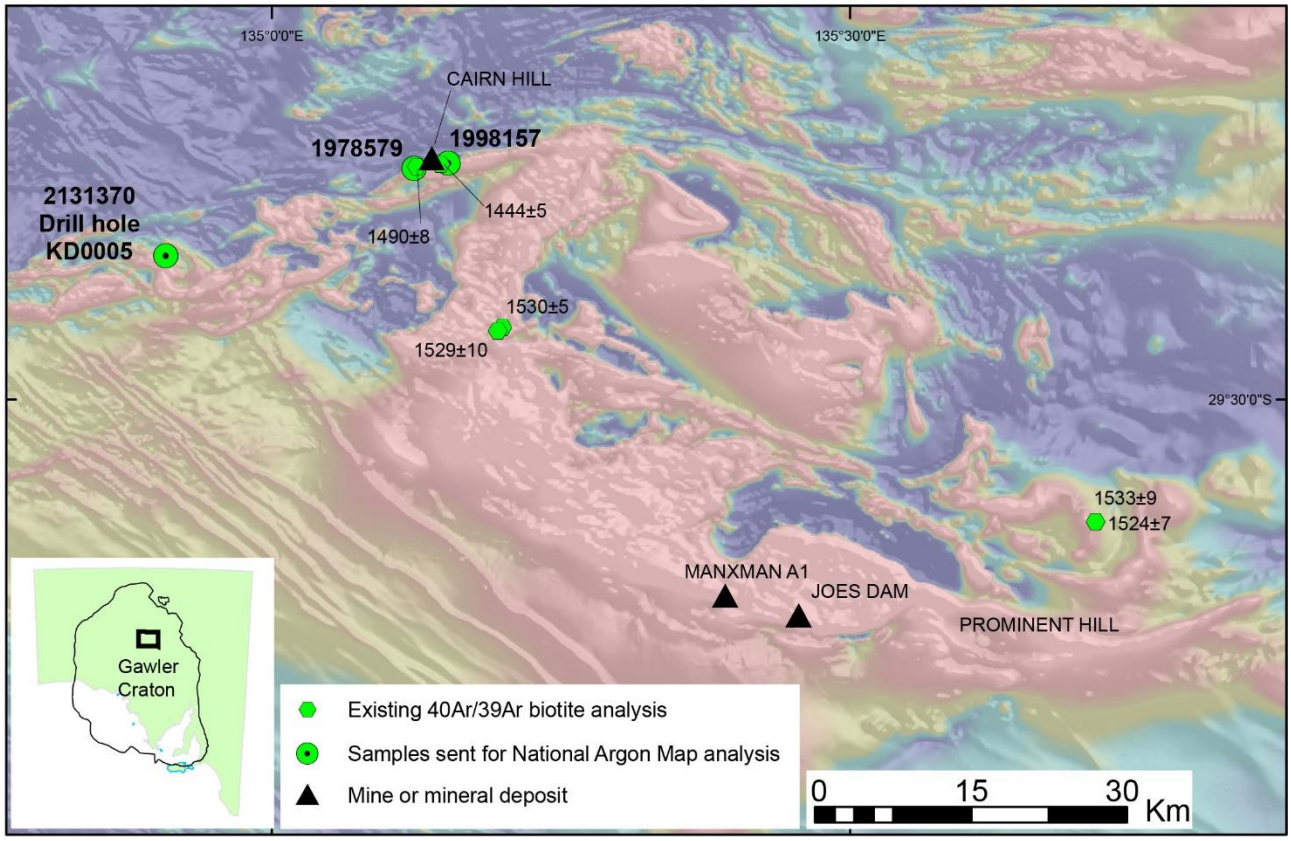
Previous work at Cairn Hill has dated two rock types by zircon U-Pb (Jagodzinski and Reid, 2015). The host monzogranite has a tectonic fabric defined by elongate quartz ribbons and the alignment of the minor biotite. This rock was emplaced at 1572 ± 6 Ma. A second sample of unmineralised and weakly deformed microgranite was emplaced at 1514 ± 8 Ma.

The mineralisation is magnetite-rich and is associated with apatite-amphibole-phlogopite alteration. A previous attempt to date the amphibole (hornblende) and

phlogopite was made via laser ablation $^{40}Ar/^{39}Ar$ methods (Jagodzinski and Reid, 2015). However, due to rapid outgassing of both the hornblende and phlogopite, both age spectra is dominated by single steps, which yielded ages
c. 1490 Ma and c. 1460 Ma respectively. The current proposal is to date the hornblende and phlogopite in the alteration mineralogy via furnace step heating methods to refine this age and our understanding of magnetite-rich IOCG mineral systems in the northern Gawler Craton.

In addition we also submit a second sample of biotite gneiss from drill hole KDD005.This sample is an example of the regional host rock in the vicinity of the Cairn Hill mine and will enable the further characterisation of the cooling history of the region that can be compared with the analysis or hornblende from the mineralisation itself.

These new samples compliment two samples of biotite analysed by Fraser et al. (2012) which are in the vicinity of the Cairn Hill mine, and yielded ages of 1490 ± 8 Ma (sample 2007371062, Biotite gneiss CD93 2 175.7–176.0m) and 1444 ± 5 Ma (sample 2007371063, Granitic gneiss, DD86EN33 85.1–85.3m). In addition, there are also four samples of biotite analysed by Forbes et al. (2012) from elsewhere in the Mt Woods region. These ages are older than the biotite dated by Fraser et al. (2012). This suggests that movement along some of the major shear zones in the region, evident in the magnetic intensity image, could be responsible for the younger ages for the biotite in the vicinity of Cairn Hill.



Location map of samples submitted for this National Argon Map application. Note the samples of biotite in the vicinity of Cairn Hill Mine are from Fraser et al. (2012); other samples are those of Forbes et al. (2012).

What type of age(s) are expected? (e.g. magmatic crystallisation, metamorphism, fluid alteration/mineralisation, cooling, shearing etc):

Timing of alteration.

Mineral target(s) for dating:

Hornblende

Estimated $^{40}Ar/^{39}Ar$ age (e.g. Cenozoic, Mesozoic, Paleozoic, Proterozoic, Archean – provide estimated numerical age range if possible):

Mesoproterozoic

Sample Information

Location description (e.g. a sample of x was collected from y, z km from abc town):

Altered, foliated Hiltaba Suite granite.

Lithological characteristics (rock description):

Sample 1978579 is a quartzofeldspathic gneiss with an emplacement age of 1572 ± 6 Ma with a vein of magnetite-amphibole (hornblende) alteration that cuts the main fabric. Thin section reveals the coarse grained nature of the hornblende suitable for dating.

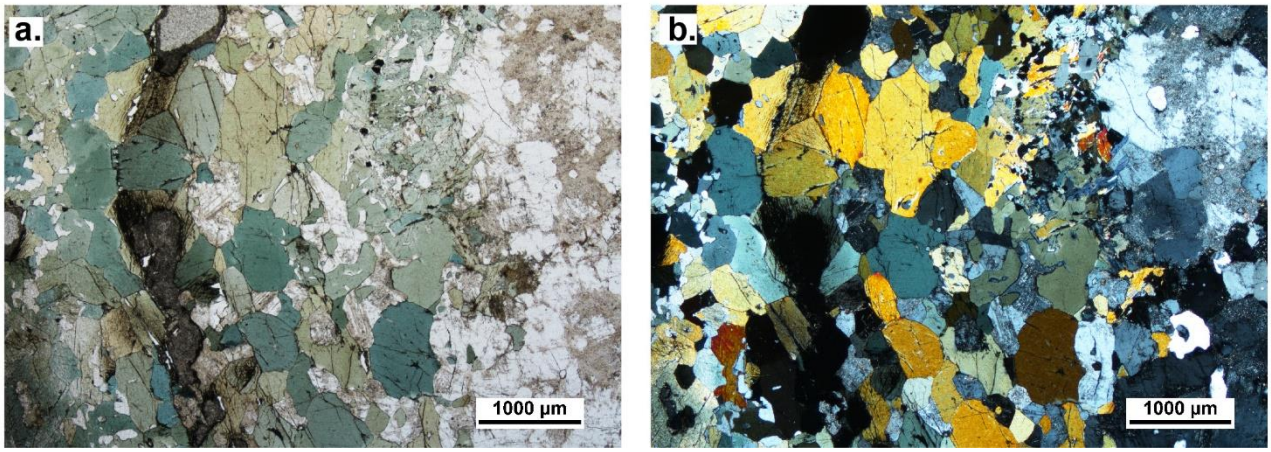
Relative age constraints (pertinent geological relationships with surrounding rock units and any previous geochronology):

The granite host has been dated at 1572 ± 6 Ma (Jagodzinski and Reid, 2015)

Thin section description (if available):

Photograph(s) e.g. field site, hand-specimen, photomicrograph:

Photograph of sample 1978579. The coarse-grained dark alteration cuts the pre-existing granitic fabric and is also associated with sericitisation of the feldspar.



Photomicrographs of sample 1978579. 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.

Relevant bibliographic references:

Jagodzinski, E.A., Reid, A.J., 2015. PACE Geochronology: Results of collaborative geochronology projects, 2013-2015. Government of South Australia. Department of the Premier and Cabinet. Report Book, 2015/00003. https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/RB201500003.pdf