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: Ar-Ar thermochronology age constraints on mafic and felsic magmatism, and deformation in the Curnamona Province
Sample Number(s) (including IGSN if one exists): 2876974
Mineral separation required? Yes or No: **Y**
Date submitted: 17/05/2021

GEOGRAPHIC AREA/ PROVINCE/ BASIN : Gawler Craton	
1:250k SHEET NAME: SH5414 CURNAMONA	**NUMBER:**
1:100k SHEET NAME: 7034 Mulyungarie	**NUMBER:**
LOCATION METHOD: (GPS: WGS84 / AGD66 / AGD84 / GDA94) GDA2020	
ZONE: 54	
EASTING: 470325.65	**NORTHING:** 6485716.45
LATITUDE: -31.7636705	**LONGITUDE:** 140.6866391

STRATIGRAPHIC UNIT FORMAL NAME *: Bimbowrie Suite
STRATIGRAPHIC UNIT INFORMAL NAME: NA
LITHOLOGY: two mica granite

DRILLHOLE ID (if applicable): YAM 52C
PROSPECT (if applicable):
DEPTH FROM (metres): 179.7
DEPTH TO (metres): 182.2

* 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 application of Ar-Ar for thermochronology and understanding deformation history in the Mundi National Drilling Initiative (NDI) area in NSW and the Olary Domain in SA will further our geological understanding of the Curnamona Province, the Adelaide Rift Complex and the Delamerian Orogeny – with implications for the geodynamic setting and mineral systems potential in western NSW, eastern South Australia and western Victoria.

The Curnamona Province is host to one of the world's largest mineral deposits at Broken Hill and has prospectivity for IOCG mineral systems as witnessed by deposits such as Kalkaroo and Portia. There is, however, very little argon geochronology from the Curnamona Province. Overview of sample information (Figure 1):

- New South Wales – a maximum of ten samples selected from drillholes and outcrop in rock units present in the MinEx CRC Mundi NDI area of the Curnamona Province

- South Australia – two samples selected from drillholes in the Olary Domain of the Curnamona Province

This sample;

Exposed outcrops and drilling intercepts of ~1590 Ma (Page et al. 2005) quartz–K feldspar–biotite–muscovite granite of the Mundi Mundi Suite occur in the Mundi NDI area. These granites can be dated by U-Pb analysis of zircon, although initial results using this method on similar samples has not produced definitive magmatic ages (Waltenberg pers. comm.). However, Ar-Ar thermo-geochronology of K-feldspar and mica can provide information on the post-crystallisation history of the granites, including thermal pulses and deformation events. Samples have already been collected (and thin sections made) from both exposure (outcrop) and drill core (Figure 1).

Samples have also been collected of equivalent granite from South Australia (Figure 1), the Honeymoon Granite in drill hole YAM 052C. This two-mica granite has been documented in two publications by GSSA (Fricke and Reid, 2009; Jagodzinski and Fricke, 2010). The SHRIMP zircon U-Pb emplacement age of 1541 ± 59 Ma is poorly defined and the majority of zircons recovered from the sample were inherited and discordant. Dating of muscovite, biotite and K-feldspar (orthoclase) form two samples of this granite will provide further constraints on the thermal evolution of this granite, and potentially on the timing of alteration in the granite. Fricke and Reid (2009) document a variety of alteration styles within this granite that may be related in some way to the nearby Honeymoon uranium deposit, located in overlying Cenozoic sandstones.

The dates from this two-mica granite will complement the existing National Argon Map project that has dated similar granites from the western portion of the Curnamona Province, in the Bimbowrie area and in drill hole Frome 12 (Figure 1).

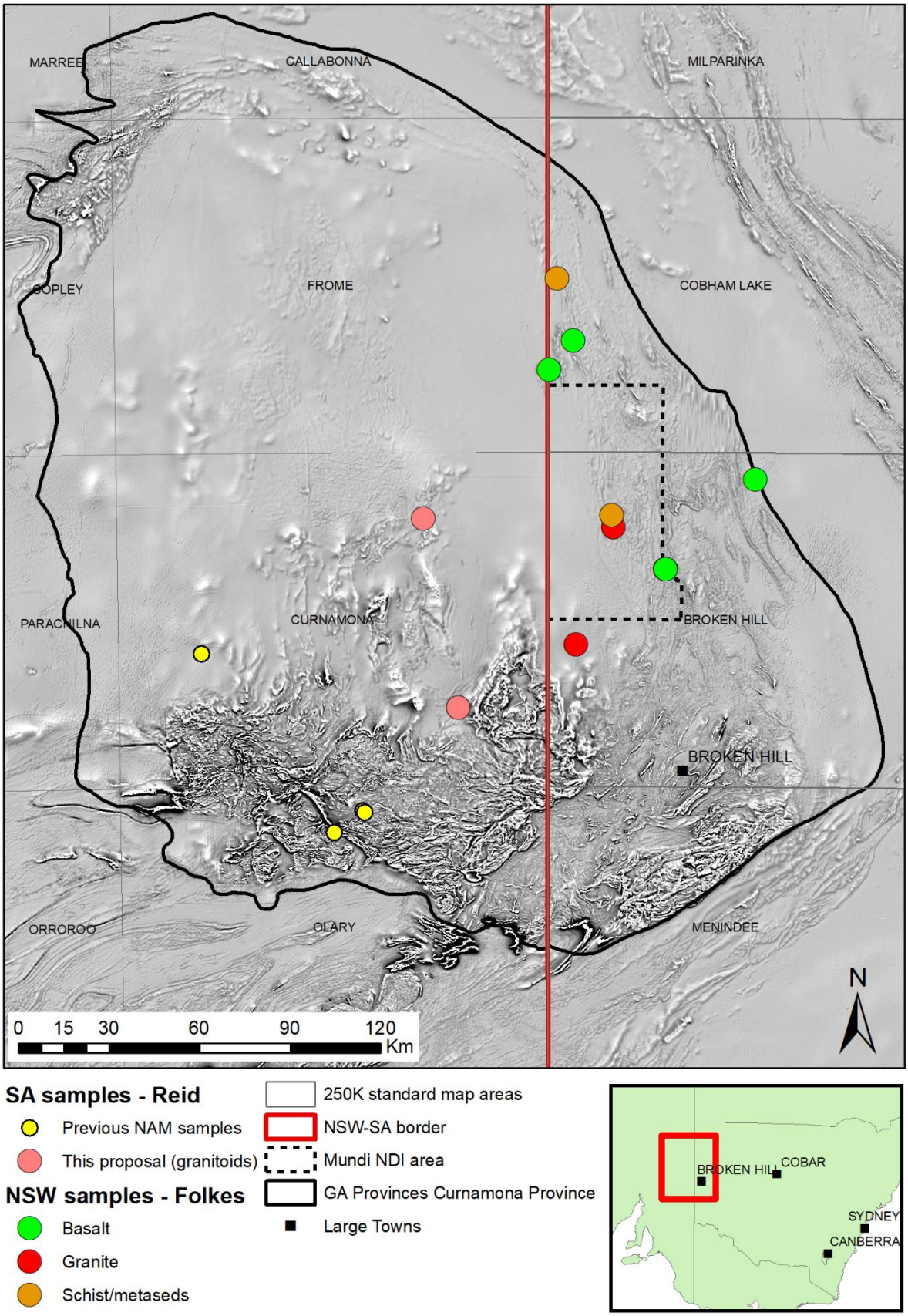


Figure 1. Location of proposed samples from the Curnamona Province. The MinEx CRC Mundi NDI area is shown. The background image shows the 2019 Geoscience Australia greyscale national total magnetic image (TMI) first vertical derivative (1VD). Previous samples submitted for the National Argon Map from the Curnamona Province in South Australia are also shown.

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

Cooling age

Mineral target(s) for dating:

Muscovite. K-feldspar (microcline)

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

Mesoproterozoic - Paleozoic

Sample Information

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

Lithological characteristics (rock description):

Sample 2876974 is a leucocratic two-mica monzogranite with tourmaline and rare microcrystalline possible zircon, typical of the Bimbowrie Suite from the Curnamona Province. The sample is ideal for defining the thermal history of the Curnamona Province as expressed in the Bimbowrie Suite granites.

Photographs of sample 2016096. a. shows general texture. b. shows the weak foliation of the granite (vertical in the image) defined by alignment of mica and fracture planes within feldspar.

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

This granite has been dated at 1541 ± 59 Ma (Jagodzinski and Fricke, 2010).

Thin section description (if available):
Description of nearby thin section:

A visual estimate of the modal mineral abundances:

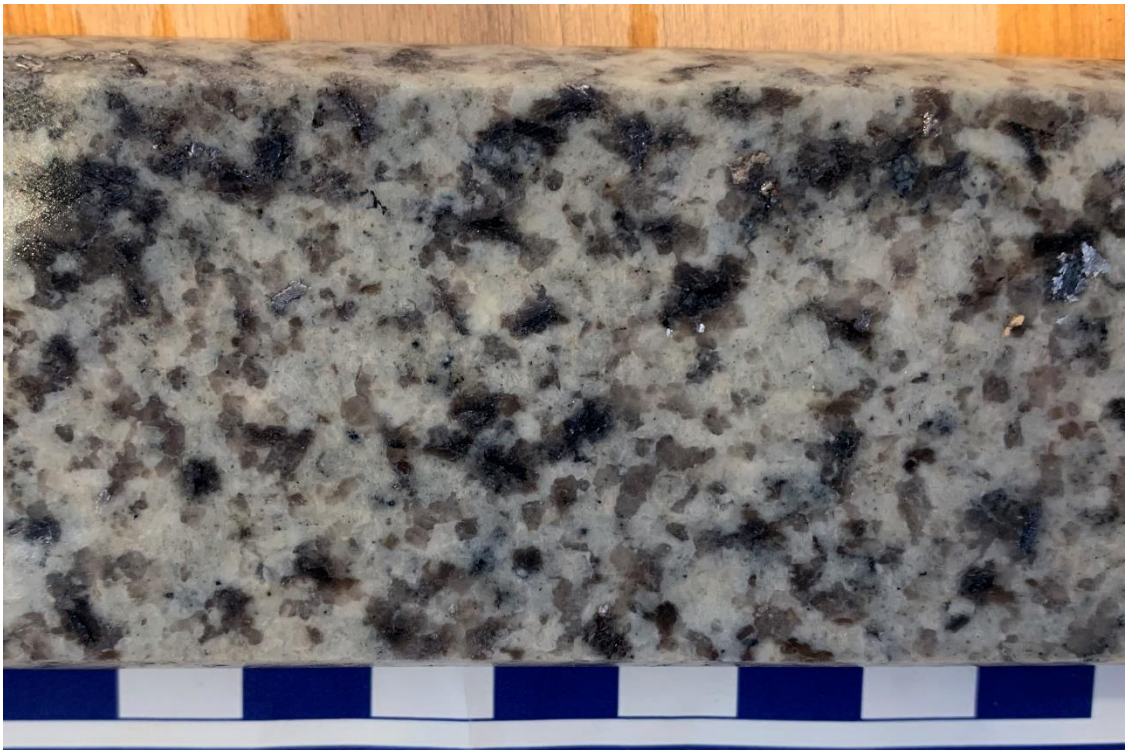
Mineral		
Quartz	39%	Igneous (partly altered)
K-spar	29%	Igneous (partly altered)
Plagioclase (albite?)	18%	Igneous (partly altered)
Muscovite	10%	Igneous (partly altered)
Ex-biotite (clay-leucoxene)	3%	Igneous (partly altered)
Tourmaline + opaque oxide	1%	Igneous (partly altered)

This sample is related to R1641796 and has abundant quartz in aggregates to 5mm in diameter accompanied by plagioclase as partly bladed crystals and anhedral grains to 4mm long and granular microcline to 4mm in diameter, locally enclosing anhedral plagioclase. Muscovite occurs as partly poikilitic plates to 4mm long, with fine-grained muscovite in plagioclase and to a lesser extent in microcline. Biotite to 2mm ion grainsize seems to have been altered to clay and leucoxene and small patches of similar clay also occur in feldspar. A small aggregate of green tourmaline is about 1mm in diameter and possible zircon was seen, 30micron long.

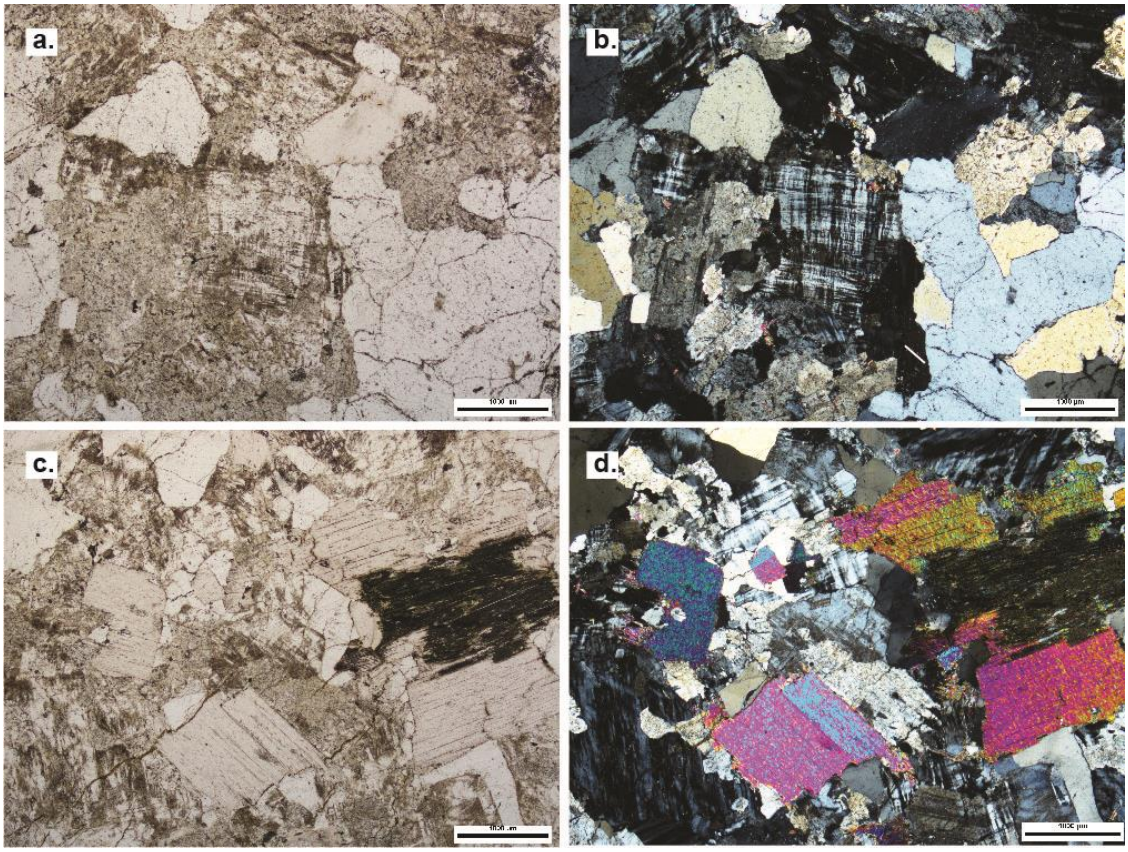
Interpretation

This sample could represent leucocratic two-mica monzogranite or pegmatite.

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



Photograph of sample rock from drill hole YAM 52C..



Photomicrographs for sample 2876974. Left, plain polarised light. Right, cross polars. A., B. emphasising microcline texture. C, D. emphasising muscovite texture.

Relevant bibliographic references:

Fricke, C., Reid, A.J., 2009. Alteration of uranium-rich granite and its relationship to uranium mineralisation in the Honeymoon area, South Australia. South Australia. Department of Primary Industries and Resources. Report Book, 2009/00004 https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/RB200900004.pdf

Jagodzinski, E.A., Fricke, C.E., 2010. Compilation of new SHRIMP U-Pb geochronological data for the southern Curnamona Province, South Australia, 2010. South Australia. Department of Primary Industries and Resources. Report Book 2010/00014.