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: Dave Kelsey
Affiliation: The Geological Survey of Western Australia
Project Title:
Sample Number(s) (including IGSN if one exists): 109760
Mineral separation required? Yes or No: Yes
Date submitted: 17th May 2021

GEOGRAPHIC AREA/ PROVINCE/ BASIN : Paterson Orogen	
1:250k SHEET NAME: Nullagine	**NUMBER:** SF51-05
1:100k SHEET NAME: Braeside	**NUMBER:** 3155
LOCATION METHOD: (GPS: WGS84 / AGD66 / AGD84 / GDA94) GPS GDA94	
ZONE: 51	
EASTING: 312900	**NORTHING:** 7657900
LATITUDE: -21.17068	**LONGITUDE:** 121.19789

STRATIGRAPHIC UNIT FORMAL NAME *: Gregory Range Suite
STRATIGRAPHIC UNIT INFORMAL NAME:
LITHOLOGY: Muscovite schist

DRILLHOLE ID (if applicable):
PROSPECT (if applicable):
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?

EITHER What is the cooling/exhumation age from this sample? OR What is the age of deformation and metamorphism (mica growth) in this sample? We are seeking to address whether the age recorded by muscovite is related to the initiation or inversion of the Neoproterozoic Yeneena Basin, as the Gregory Range has many NNW-trending faults that are likely to be basin-bounding faults active at the time of Yeneena Basin initiation and/or inversion.

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

Either cooling/exhumation or deformation/metamorphism.

Mineral target(s) for dating:

Muscovite, if it allows (the sample has multiple fabrics and the muscovite is fine-grained and potentially intergrown/"unclean").

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

Mid- to Late-Neoproterozoic, possibly between 850 and 650 Ma, constrained by the likely c. 830 Ma age of mafic intrusions and c. 650 Ma age of granitic intrusions in the Paterson Orogen area.

Sample Information

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

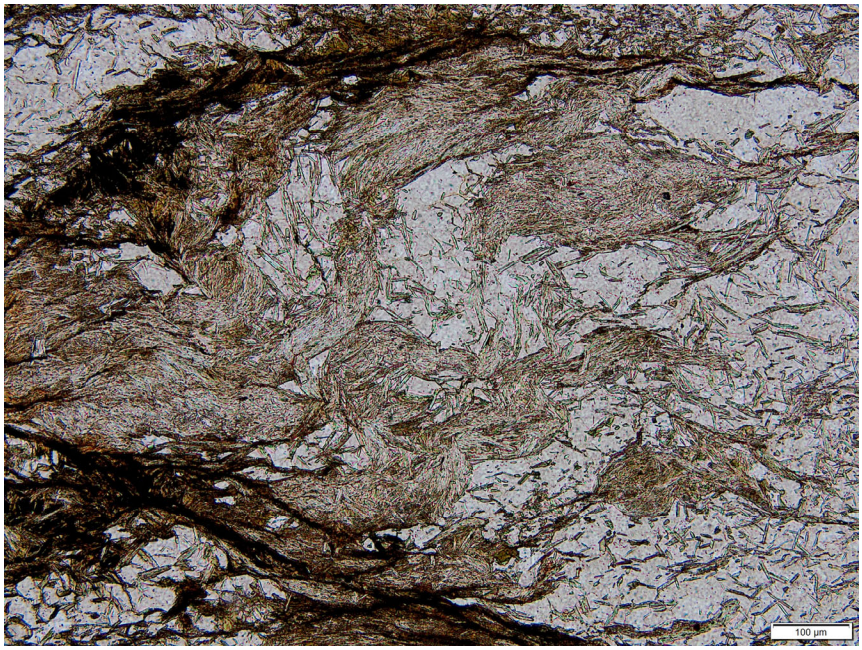
WAROX database (field observations) site GSD109760, about 330 km southeast of Port Hedland in Western Australia. This sample is from the next fault panel across to the east from samples 232630 and 109759. It is 2.4 km NNE from 232630 and 1.3 km east from 109759.

Lithological characteristics (rock description):
Fine-grained, crenulated muscovite–quartz schist. The sample has a brownish tinge to it but this is Fe-staining I think rather than biotite. The hand specimen is a silvery-coloured, fine-grained, mylonitic to proto-mylonitic schist. Small porphyroclasts of either single feldspar or quartz–feldspar grain aggregate grains occur dispersed through the fabric. The fabric is defined by alternating mica-rich and quartz–feldspar-rich layers.

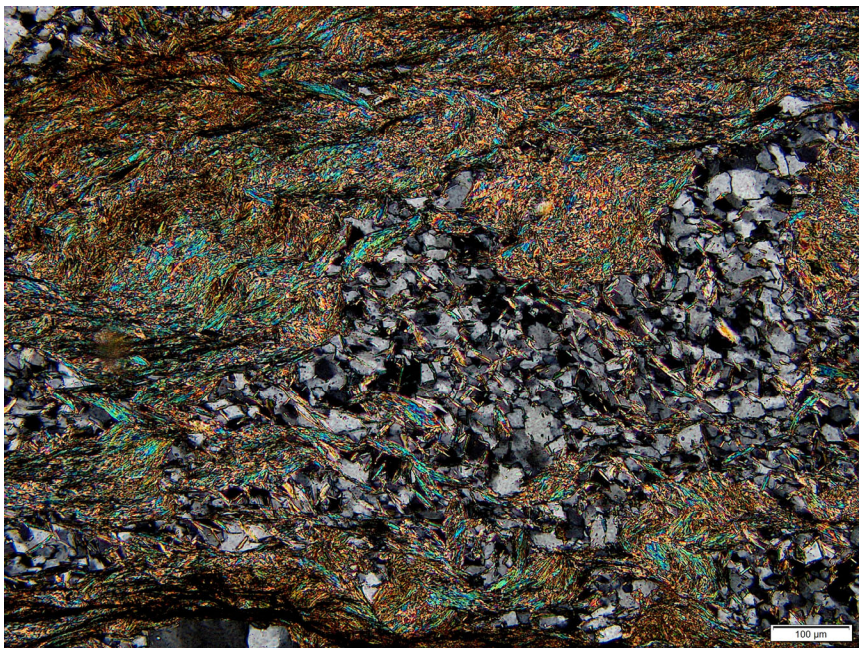
Relative age constraints (pertinent geological relationships with surrounding rock units and any previous geochronology):
Magmatic or extrusive ages in the Gregory Range area are 2763—2757 Ma. Cooling/exhumation age is expected to be Neoproterozoic, corresponding to the Miles (c. 810 – 650 Ma) or Paterson (c. 550 Ma) Orogenies. However, within the Capricorn Orogen (along southern margin of Pilbara Craton) there are Ar–Ar ages of c. 1640 Ma and c. 960–820 Ma (Edmundian Orogeny; Piechocka et al., 2018 *Precambrian Research*; Occhipinti and Reddy, 2009 *Geol Soc London Spec Pub*) and as such it is possible that this timeline could occur in the Gregory Range.

Thin section description (if available):
Muscovite is abundant and occurs as matted grain aggregates that define an anastomosing and folded schistosity. The schistosity is crenulated and also has a local S–C-like character which has a dextral offset in the plane of the thin section. The hinges of the crenulations are at an angle to C-planes which may mean there are three fabric generations in this sample. In quartz-rich domains fine-grained muscovite is more randomly oriented but may represent local grain-scale manifestations of the crenulating of the rock. Feldspar is present and is most easily discernible by twinning preserved in coarser-grained, porphyroclastic grains or grain aggregates preserved in the matrix. Tiny grains of FeTi oxide occur particularly in matted muscovite-rich portions of the rock.

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


100 µm


100 µm



Relevant bibliographic references:

Occhipinti, SA and Reddy, S 2004, Deformation in a complex crustal-scale shear zone: Errabiddy Shear Zone, Western Australia, in *Flow processes in faults and shear zones* edited by *GI Alsop, RE Holdsworth, KJW McCaffrey and M Hand: The Geological Society of London, Special Publication 224, p. 229–248.*

Piechocka, AM, Sheppard, S, Fitzsimons, IC, Johnson, SP, Rasmussen, B and Jourdan, F 2018, Neoproterozoic $^{40}Ar/^{39}Ar$ mica ages mark the termination of a billion years of intraplate reworking in the Capricorn Orogen, Western Australia: Precambrian Research, v. 310, p. 391–406, doi:10.1016/j.precamres.2018.04.006.

Williams, IR and Trendall, AF 1996, Braeside, WA Sheet 3155: Geological Survey of Western Australia, 1:100 000 Geological Series.

Williams, IR and Hickman, AH 2007, Nullagine, WA Sheet SF 51-16 (3rd edition): Geological Survey of Western Australia, 1:250 000 Geological Series.