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: Mark Eastlake
Affiliation: GSNSW
Project Title: New $^{40}Ar/^{39}Ar$ age constraints on the timing of deformation on major faults in the Lachlan Orogen, NSW
Sample Number(s) (including IGSN if one exists): NSWSJAF0258.01A and NSWSJAF0258.01B
Mineral separation required? Yes
Date submitted: 27/05/2020

GEOGRAPHIC AREA/ PROVINCE/ BASIN :	
1:250k SHEET NAME: Cobar	**NUMBER:** SH 55-14
1:100k SHEET NAME: Canbelego	**NUMBER:** 8134
LOCATION METHOD: GPS (GDA94)	
ZONE: 55	
EASTING:	**NORTHING:**
LATITUDE: -31.98917	**LONGITUDE:** 146.295300

STRATIGRAPHIC UNIT FORMAL NAME *: Nymagee Igneous Complex
STRATIGRAPHIC UNIT INFORMAL NAME:
LITHOLOGY: Granitic mylonite

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?

The submitted samples comprise granitic mylonite from a discrete shear zone cross cutting the Nymagee Igneous complex. S–C fabric development suggests dextral strike slip is the dominant sense of motion. C-planes are well developed and defined by zones of fine-grained white mica (sericite). $^{40}Ar/^{39}Ar$ dating of fabric forming white mica (sericite) will provide timing constraints on this dextral strike slip event with implications for the movement history of the Rookery Fault System.

Two samples have been supplied (from the same shear zone) to run duplicate analyses that will assess the consistency and reproducibility of $^{40}Ar/^{39}Ar$ ages between samples.

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

Sericite defining C-planes in the mylonite are expected to yield a deformation age.

Mineral target(s) for dating:

There are two proposed targets for dating in this sample. The priority is to date fine-grained (0.03 to 0.1 mm long) acicular to bladed white-mica (sericite) defining the mylonitic fabric to date deformation of the granite protolith. The second target is fine-grained (typically 0.15 to 1 mm long) muscovite porphyroclasts (mica fish) in order to understand the $^{40}Ar/^{39}Ar$ isotope systematics of this inherited muscovite component.

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

The mylonitic fabric overprints the Nymagee Igneous complex, which is dated at 428.1 ± 4.3 Ma (Downes et al. 2016). An Early to Middle Devonian age (c. 419–382 Ma) is considered likely based on the known deformation history of the Cobar Basin (e.g. Glen 1990, Perkins et al. 1994, Glen et al. 1996).

Sample Information

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

The samples were collected adjacent to Rosevale Road on a sweeping bend where it crosses the main northwest–southeast trending ridge associated with the Nymagee Igneous Complex c. 8.8 km NNW of Nymagee township. Sample NSWSJAF0258.01B is an oriented sample collected in situ from slightly weathered outcrop, whilst sample NSWSJAF0258.01A is from relatively fresh blast rubble exposed during road construction.

Lithological characteristics (rock description):

Samples consist of medium-grained granitic mylonite displaying well-developed S–C fabrics that indicate dextral strike slip shear sense. S-planes are defined by felsic lenses of quartz and feldspar porphyroclasts and C-planes are well developed and defined by zones of fine-grained white mica (sericite).

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

The mylonite zone overprints (and thus post-dates) the Nymagee Igneous Complex, which has a U–Pb SHRIMP age (determined on monazite) of 428.1 ± 4.3 Ma (Downes et al. 2016).

Thin section description (if available):

The rock predominantly consists of K-feldspar, plagioclase, muscovite and rare biotite porphyroclasts enveloped by a mylonitic foliation with distinct S–C fabric elements. Igneous accessory minerals include bladed tourmaline, stubby apatite and zircon.

C-planes in the mylonitic fabric are characterised by bands of very-fine (c. 0.01–0.03 mm) dynamically recrystallised quartz alternating with bands of sericite ± minor biotite. S-planes are emphasised by lens shaped aggregates/ribbons comprising a patchwork of strained quartz grains (slightly coarser than in the C-planes) with elongate sub-grain boundaries and bulging Qz–Qz grain boundaries. In some examples these aggregates are probably remnants of primary quartz crystals.

Fabric defining sericite is typically acicular and 0.03 to 0.05mm long with slightly larger blades 0.05 to 0.1 mm long locally developed. In some examples these slightly coarser muscovite blades occur with an opaque oxide phase replacing remnants of greenish-brown primary biotite.

Primary muscovite occurs as mica fish localised along foliation planes as well as blocky plates that are intergrown with/included within feldspar porphyroclasts. There is also a light dusting of ultra-fine sericite white-mica across most plagioclase porphyroclasts, which may relate to pre-deformation deuteric processes. This “primary” sericite is mostly much finer (<0.03 mm) than the fabric forming sericite.

The muscovite fish are stubby to elongate and typically 0.15 to 1.0 mm long. Most display undulose extinction and are partly replaced by slender blades of neocrystalline muscovite whist others are shreaded out along the foliation plane. Kink bands are also locally present.

Potassium-feldspar porphyroclasts include simply-twinned perthite and microcline commonly producing rounded and near sigmoidal shapes. Many have myrmekite and/or muscovite replacements at their margins and show signs of dynamic recrystallisation to fine-grained quartz-feldspar aggregates that pass laterally into the mylonitic foliation.

Plagioclase porphyroclasts are very mildly sericitized and locally deform by brittle fragmentation but also show signs of incipient dynamic recrystallisation at the crystal margins.

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

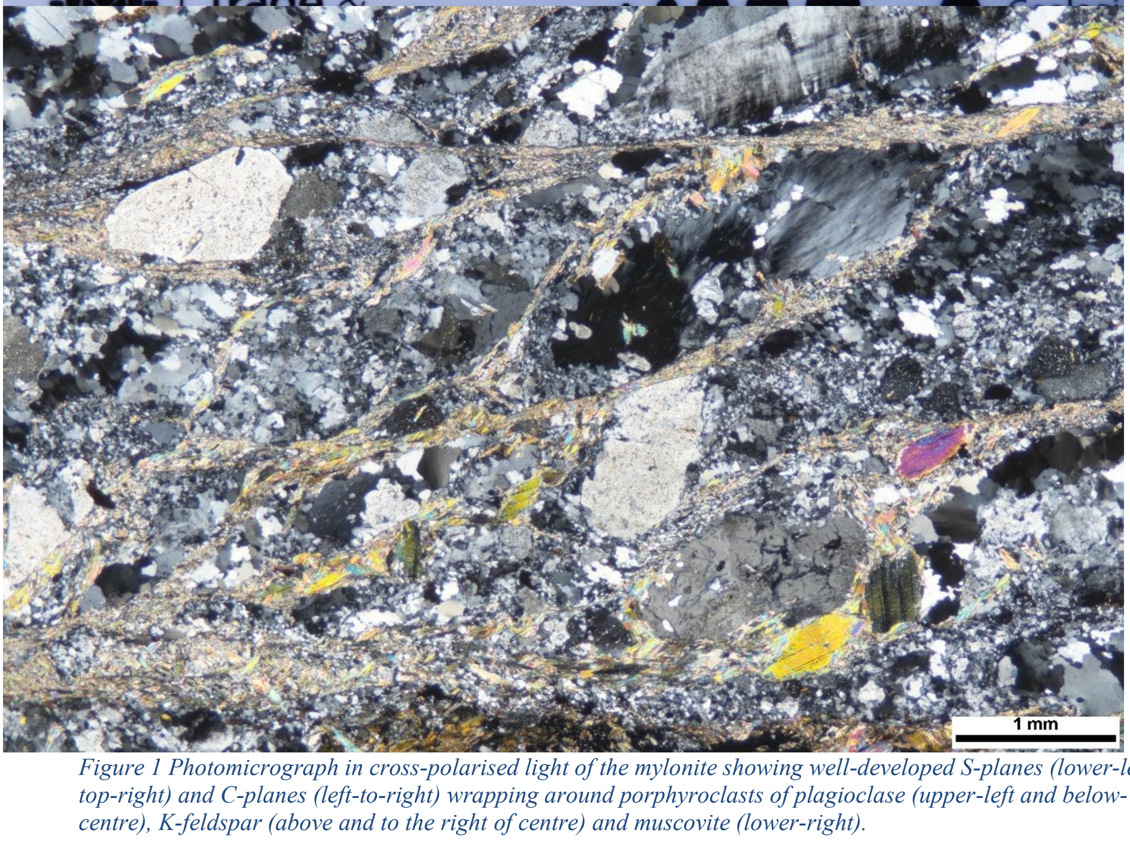

Figure 1 Photomicrograph in cross-polarised light of the mylonite showing well-developed S-planes (lower-left to top-right) and C-planes (left-to-right) wrapping around porphyroclasts of plagioclase (upper-left and below-centre), K-feldspar (above and to the right of centre) and muscovite (lower-right).

Figure 2 Field of view as for Figure 1 in plane-polarised light.

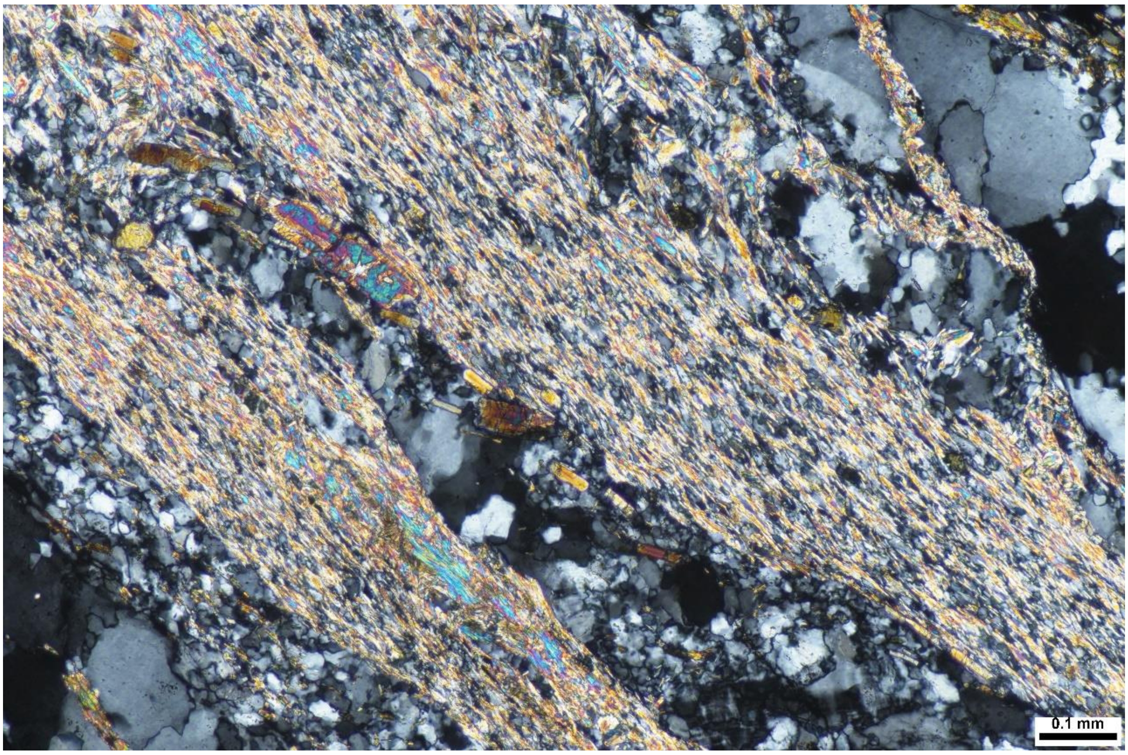

Figure 3 Photomicrograph in cross-polarised light showing detail of sericite-rich domains (aligned top-left to bottom-right) defining the mylonitic foliation. Note also the tourmaline prisms to the left of centre.

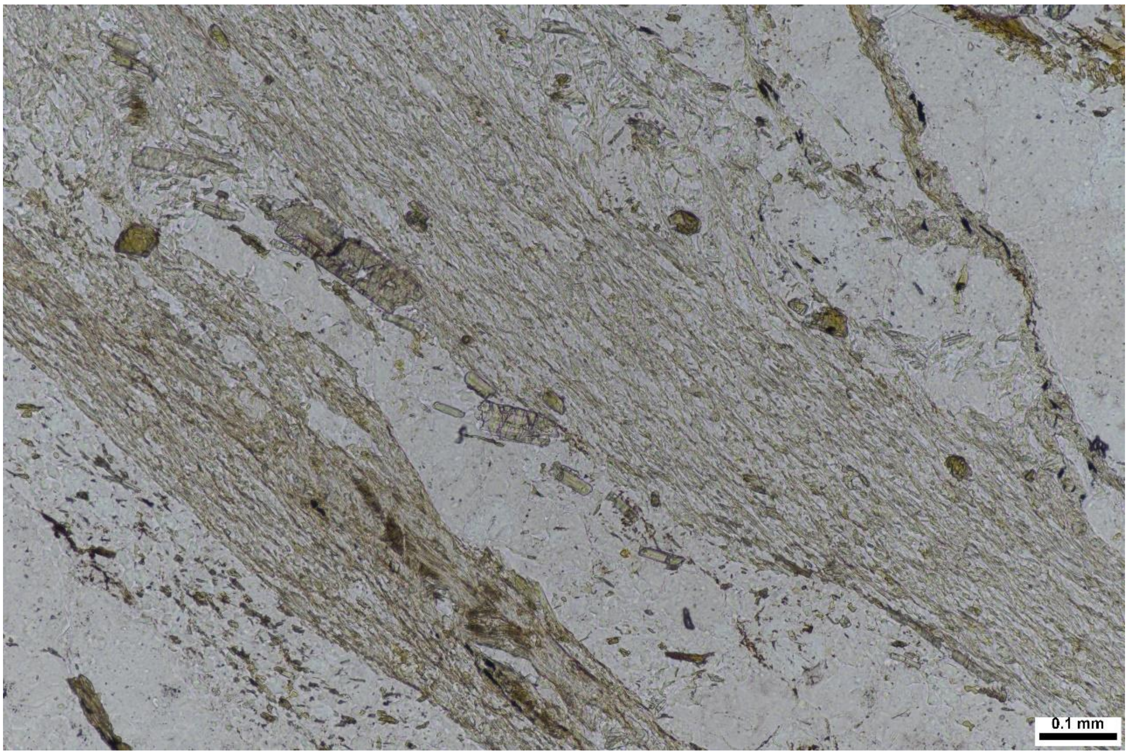

Figure 4 Field of view as for Figure 3 in plane-polarised light.

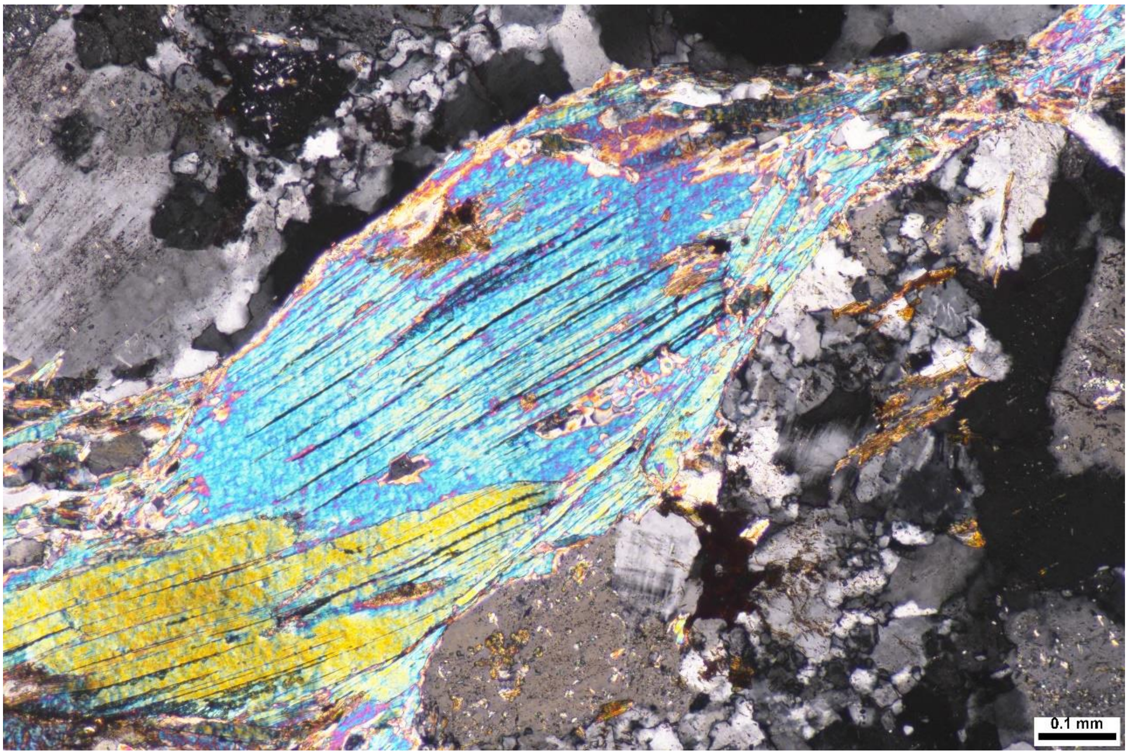

Figure 5 Photomicrograph in cross-polarised light showing detail of a muscovite fish (centre) with partly recrystallised margins (e.g. top-right).

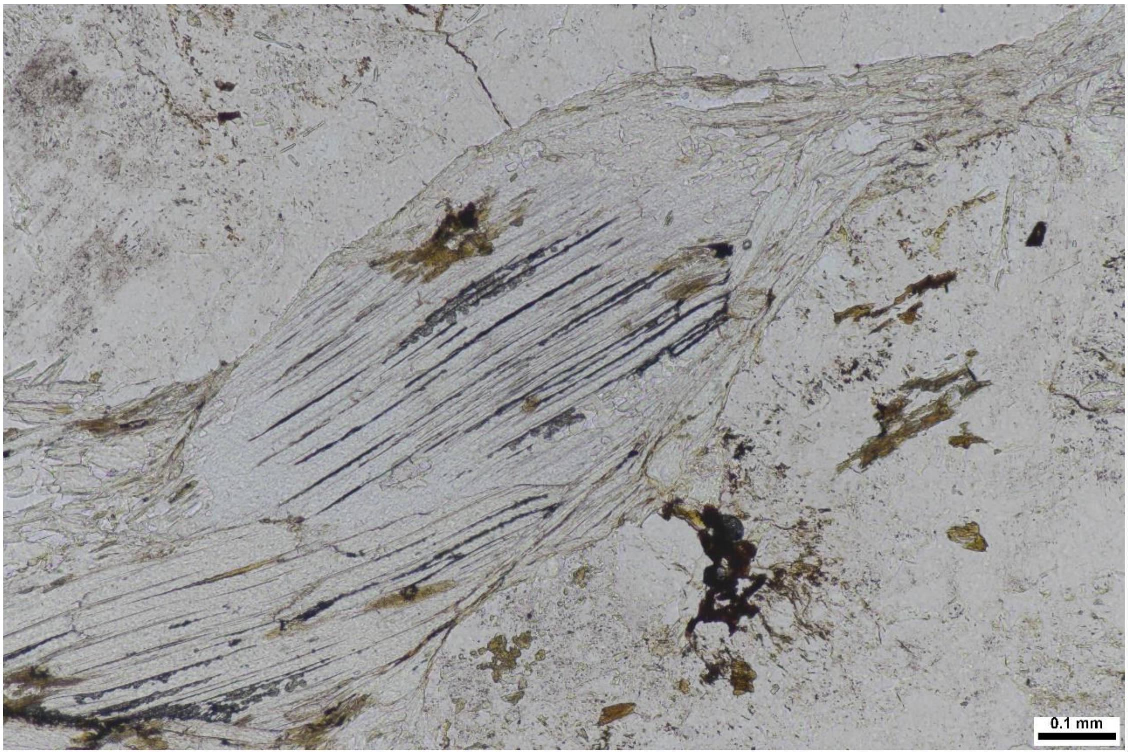

Figure 6 Field of view as for Figure 5 in plane-polarised light.

Relevant bibliographic references:

Downes P.M., Blevin P.L., Armstrong R., Simpson C.J., Sherwin L., Tilley D.B. & Burton G.R. 2016. Outcomes of the Nymagee mineral system study — an improved understanding of the timing of events and prospectivity of the central Lachlan Orogen. *Quarterly Notes of the Geological Survey of New South Wales*, 147.

Glen R.A. 1990. Formation and inversion of transtensional basins in the western part of the Lachlan Fold Belt, Australia, with emphasis on the Cobar Basin. *Journal of Structural Geology*. **12 (5/6)**, 601–620.

Glen R.A., Clare A. & Spencer R. 1996. Extrapolating the Cobar Basin model to the regional scale: Devonian basin-formation and inversion in western New South Wales. In: Cook W.G., Ford A.J.H., McDermott J.J., Standish P.N., Stegman C.L. & Stegman T.M. eds. The Cobar Mineral Field - A 1996 Perspective, pp.43–83. Australasian Institute of Mining and Metallurgy, Melbourne, 3/96.

Perkins C., Hinman M.C. & Walshe J. L. 1994. Timing of mineralisation and deformation, Peak Au mine, Cobar, New South Wales. *Australian Journal of Earth Sciences*. **41(5)**, 509–522.