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: Geological Survey of NSW
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): ERIVMAE0052.01C
Mineral separation required? Yes
Date submitted: 27/05/2020

GEOGRAPHIC AREA/ PROVINCE/ BASIN: Eastern Riverina district, southern central NSW/ Central Lachlan Orogen.	
1:250k SHEET NAME: Cootamundra	**NUMBER:** SI/55-11
1:100k SHEET NAME: Barmedman	**NUMBER:** 8329
LOCATION METHOD: GPS (GDA94)	
ZONE: 55	
EASTING:	**NORTHING:**
LATITUDE: -34.175928333333	**LONGITUDE:** 147.21376666667

STRATIGRAPHIC UNIT FORMAL NAME *: Yalgogrin Granite
STRATIGRAPHIC UNIT INFORMAL NAME:
LITHOLOGY: Granitic mesomylonite

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?

This sample is a mesomylonite from the Ellon Vale Shear Zone, a broad sinistral strike-slip shear zone that overprints/offsets the mid-Silurian Yalgogrin Granite in the Central Lachlan Orogen. An $^{40}Ar/^{39}Ar$ age of fabric forming white-mica will constrain the timing of shear zone development. It will also provide an opportunity to assess the consistency and reproducibility of $^{40}Ar/^{39}Ar$ ages from this structure by comparison with the results obtained by Matchan & Phillips (2017; their analysis of sample ERIVMAE0052.01B) and with analysis of sample ERIVMAE0691.01, which was collected c. 4.3 km to the southeast on the same structure.

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

$^{40}Ar/^{39}Ar$ dating of fabric forming white-mica is expected to yield a deformation age or potentially cooling age for the shear zone.

Mineral target(s) for dating:

There are two white-mica populations that are targets for dating in this sample: 1) the priority is very fine-grained (0.03–0.05 mm) white-mica (sericite) defining the mylonitic foliation to determine the deformation age; 2) the second target is muscovite fish remnant from the granite protolith in order to understand the argon isotope systematics of this inherited white-mica component.

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

Initial attempts to date fabric development in this sample by $^{40}Ar/^{39}Ar$ geochronology returned concordant apparent ages primarily in the range 405–418 Ma (Matchan & Phillips 2017).

Sample Information

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

The sample was collected from low tabular outcrops in the Southwest Woodland Nature Reserve (also known as Buggajool State Forest) c. 28 km due south of West Wyalong township.

Lithological characteristics (rock description):

The sample is a slightly weathered granitic mesomylonite displaying well-developed S–C fabrics. The mylonitic foliation, defined by fine-grained muscovite-(biotite)-rich domains and quartz-rich domains, wraps around rounded feldspar porphyroclasts typically ranging from 1–4 mm across.

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

The mylonite zone overprints the Yalgogrin Granite, which has indistinguishable U–Pb SHRIMP ages (determined on zircon) of 430.9 2.9 Ma (Black 2005) and 428.5 ± 2.3 Ma (Bodorkos et al. 2016). This provides the maximum age for the Ellon Vale Shear Zone. Two samples previously dated from the $^{40}Ar/^{39}Ar$ geochronology returned concordant apparent ages primarily in the range 405–418 Ma (Matchan & Phillips 2017).

Thin section description (if available):

The sample contains 30–40% rounded and slightly blocky feldspar porphyroclasts and lesser muscovite and biotite porphyroclasts (mica fish) enveloped by a mylonitic foliation. Relict igneous accessory phases include apatite, tourmaline and zircon.

The mylonitic foliation is defined by lenses and ribbons of dynamically recrystallised quartz crystals alternating with fine-grained white-mica ± biotite domains. The foliation, and S-plane in particular, is also locally emphasized by mica-rich stringers comprising an aggregate of shredded and partially recrystallised mica-fish.

The fabric forming white-mica and biotite forms acicular and bladed crystals typically 0.02 to 0.05 mm long with slightly longer white-mica crystals (commonly to 0.07 mm long) associated with the partial replacement of coarser igneous mica fish.

Relict igneous muscovite form mica fish (0.1–1 mm long) as well as sigmoidal lenses and stringers localised in the mica-rich foliation domains that comprise an aggregate of shredded and partially recrystallised mica fish. They have undulose extinction and kinking locally.

Primary biotite is rarely preserved as mica fish with remnants of 'foxy' red-brown colouration but most are recrystallised into stringers and irregular masses of altered greenish-brown biotite. Some show partial replacement to muscovite blades (typically 0.05 to 0.07 mm long) and a very fine-grained opaque oxide phase. Stubby blocks and laths of biotite are also included in feldspar porphyroclasts locally.

Feldspar porphyroclasts are 0.3–5 mm at the long axis with K-feldspar somewhat more abundant than plagioclase. Potassium-feldspar forms rounded porphyroclasts with inclusions of primary quartz, plagioclase and biotite occurring locally. Most display dynamic recrystallisation textures at the porphyroclasts margins and some also feature deformation induced myrmekite replacements developed at high-strain sites.

Plagioclase porphyroclasts are slightly blocky looking and commonly display sericite alteration across their cores. This secondary sericite is generally finer than foliation forming white-mica and may relate to pre-deformation deuteric processes. The plagioclase porphyroclasts display brittle fragmentation behaviour; although, incipient recrystallisation textures are locally noted at strain shadows.

Quartz is thoroughly recrystallised to fine-grained polycrystalline bands and lenses with irregular, migrating, Qz–Qz grain boundaries.

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

Figure 1 Lichen covered outcrop of the Ellon Vale Shear Zone at the sample site. Hammer is c. 280 mm long.

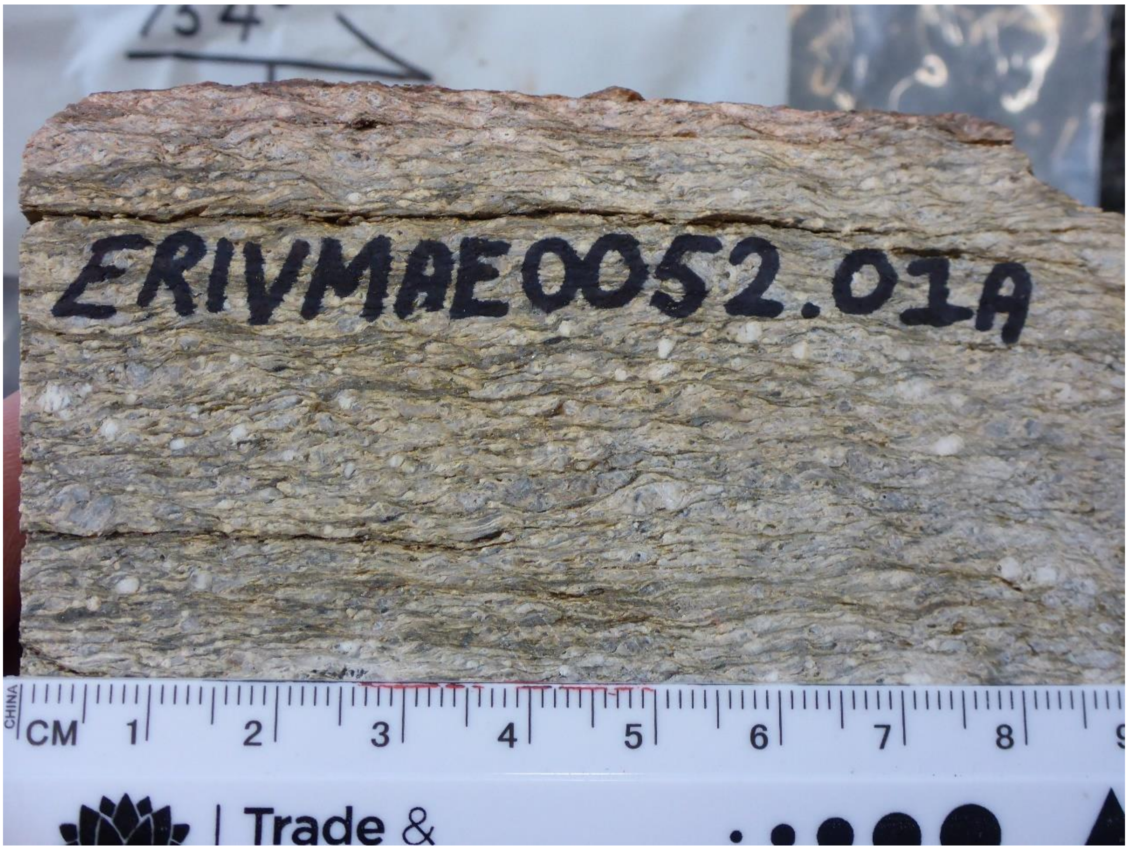

Figure 2 Cut surface oriented perpendicular to foliation and parallel to lineation. Top-to-the-right shear sense indicated by S–C fabrics in this view translates to sinistral strike-slip shear sense at the outcrop. Major increments of scale are 10 mm.

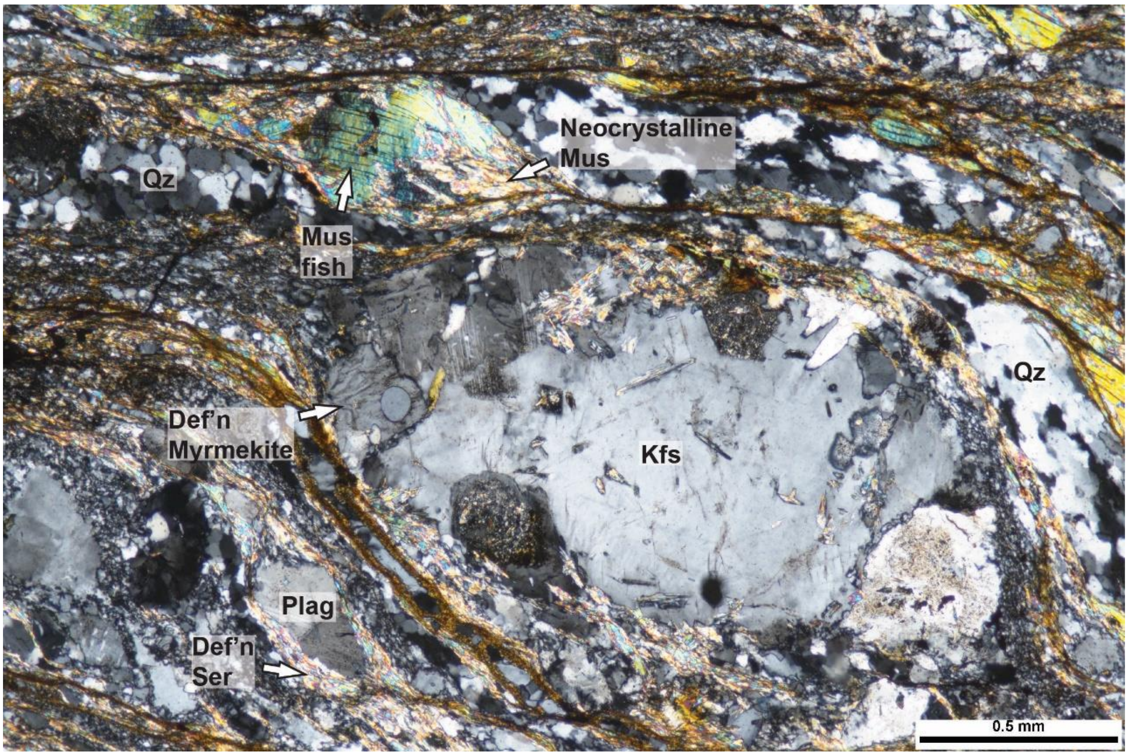

Figure 3 Photomicrograph in cross-polarised light showing a K-feldspar porphyroclast (extending from centre to lower-right) with myrmekitic replacements (left porphyroclast margin) and a partly recrystallised muscovite fish (top left) wrapped by the mylonitic foliation defined by polycrystalline quartz bands and sericite-rich foliation domains.

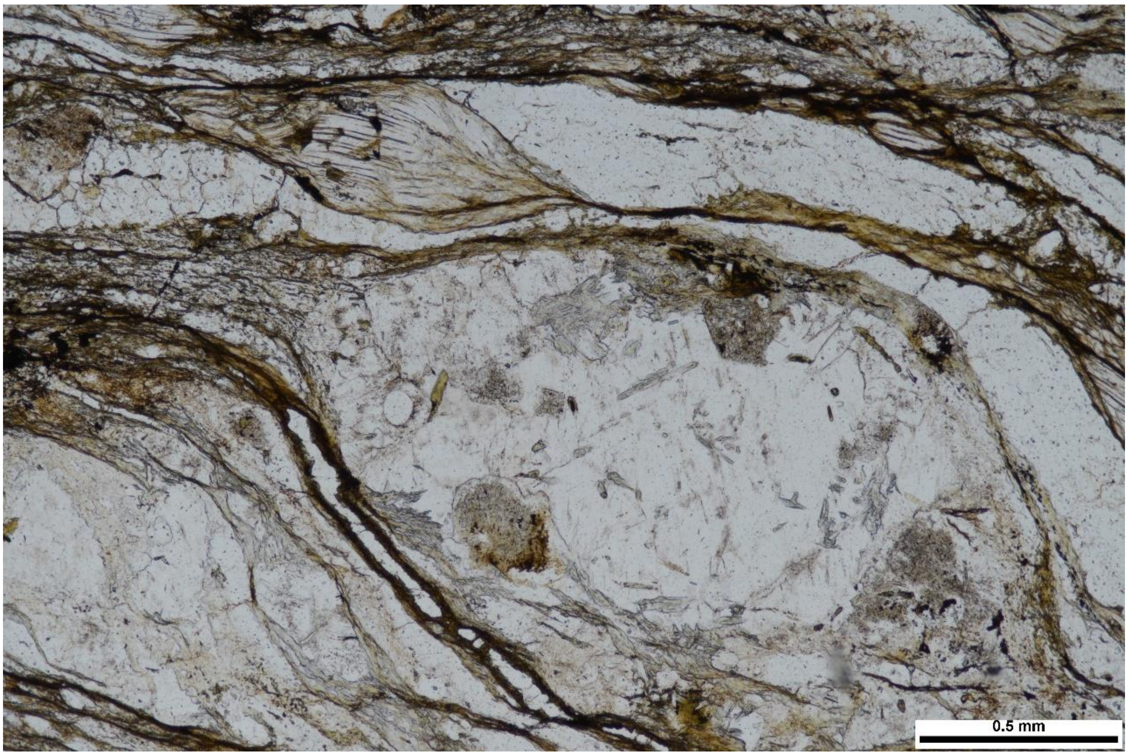

Figure 2 Field of view as for Figure 1 in plane-polarised light.

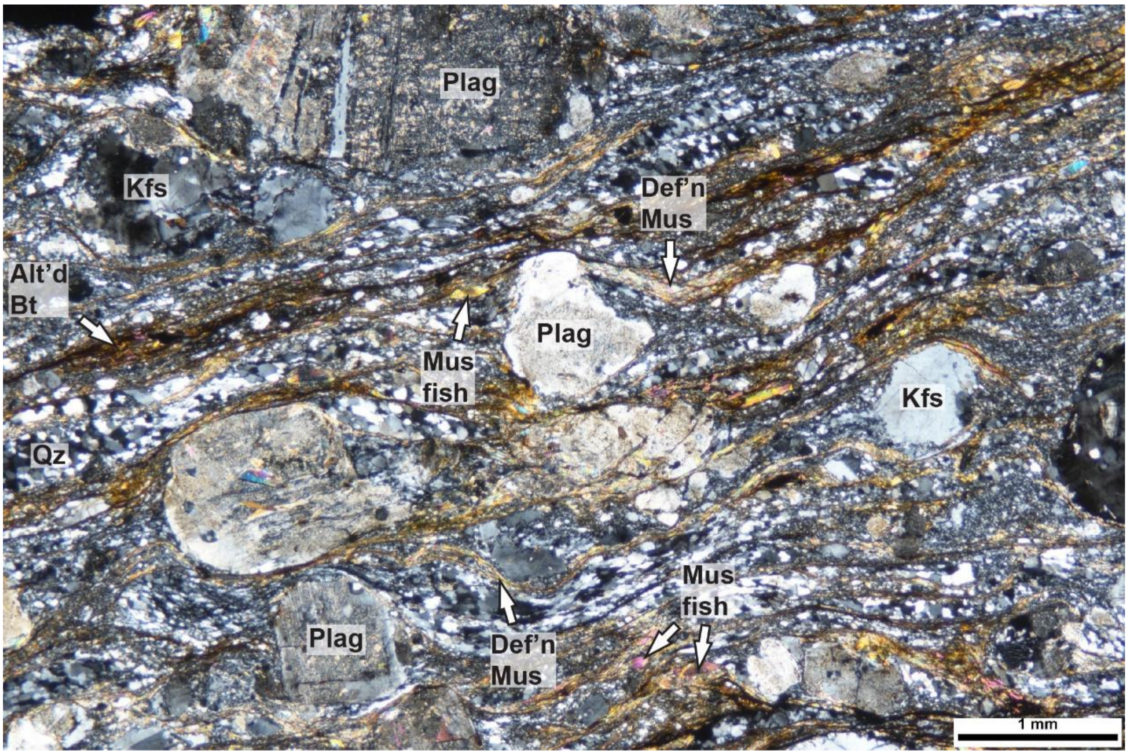

Figure 3 Photomicrograph in cross-polarised light showing a representative microstructure of the mylonite.

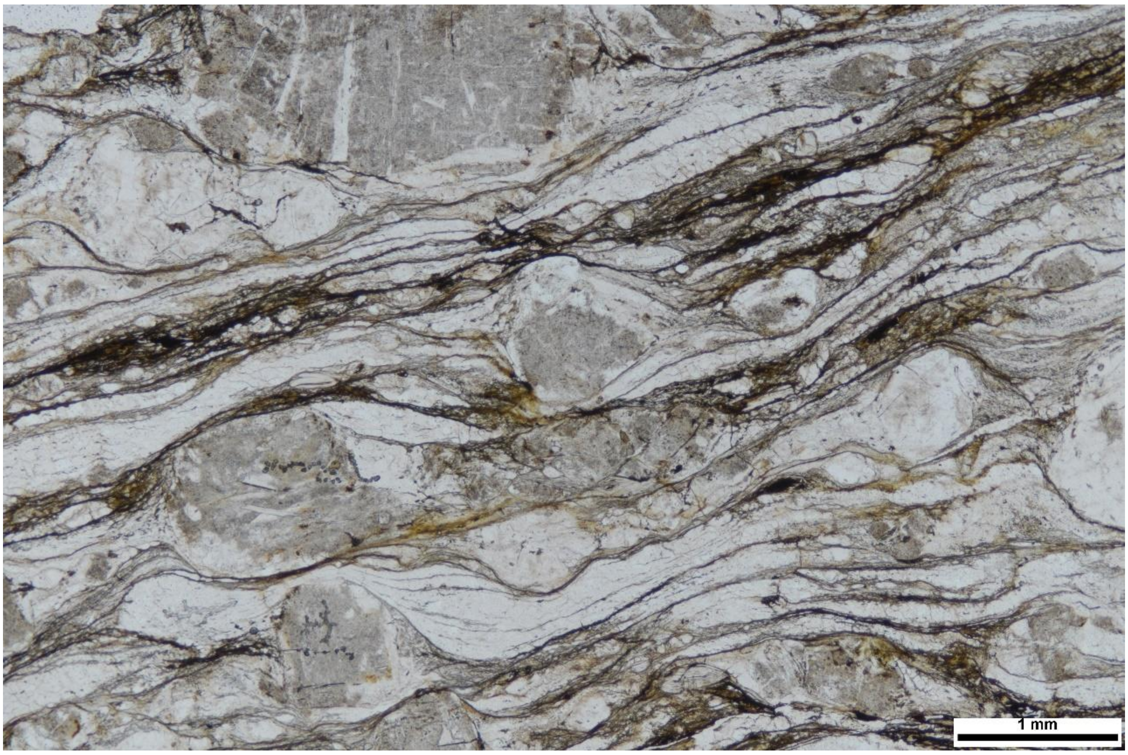

Figure 4 Field of view as for Figure 3 in plane-polarised light.

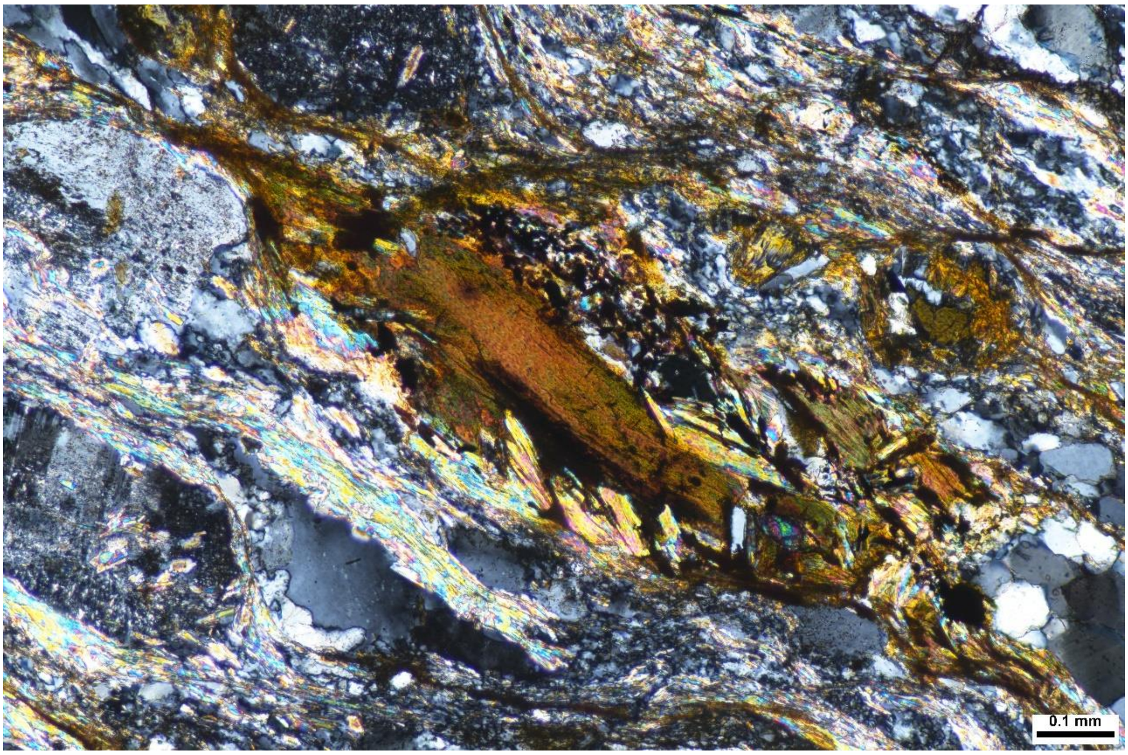

Figure 5 Photomicrograph in cross-polarised light showing a biotite fish that is partly replaced by neocrystalline muscovite + an opaque oxide phase along the porphyroclast margin.

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

Relevant bibliographic references:

Black L.P. SHRIMP U–Pb zircon ages obtained during 2004/05 for the NSW Geological Survey. Geological Survey of New South Wales, File GS2005/745.

Bodorkos S., Bull K.F., Campbell L.M., Eastlake M.A., Gilmore P.J. & Trigg S.J. 2016. New SHRIMP U-Pb ages from the central Lachlan Orogen and New England Orogen, New South Wales. Geoscience Australia Record 2016/21. Geological Survey of New South Wales, Report GS2016/0343.

Matchan E. & Phillips D. 2017. $^{40}Ar/^{39}Ar$ step-heating analysis of muscovite from East Riverina samples ERIVMAE0003.01B, ERIVMAE0052.01B and ERIVMAE0229.01D (Wagga Omeo Belt). University of Melbourne, Report UM17-0601.