

National Argon Map: an AuScope Initiative

$^{40}\text{Ar}/^{39}\text{Ar}$ 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: Nick Roberts
Affiliation: Mineral Resources Tasmania
Project Title: Mid-Cenozoic chronostratigraphy of central and northern Tasmania
Sample Number(s) (including IGSN if one exists): R003680 (MRT Reg. No.)
Mineral separation required? Yes or No: No
Date submitted: 20/07/2021

GEOGRAPHIC AREA/ PROVINCE/ BASIN: Central Plateau, Tasmania	
1:250k SHEET NAME: Geology of NW Tasmania (2020)	NUMBER: SK55-3 Burnie (old series)
1:25k SHEET NAME: Liena	NUMBER: 4239
LOCATION METHOD: (estimated from Hydro-Electric Commission of Tasmania files: GDA94)	
ZONE: 55	
EASTING: 428677	NORTHING: 5393841
LATITUDE: 41°36'14"S	LONGITUDE: 146° 8'39"E

STRATIGRAPHIC UNIT FORMAL NAME *: Lemonthyme Tillite
STRATIGRAPHIC UNIT INFORMAL NAME:
LITHOLOGY: Basalt clast from diamictite (possibly a tillite)

DRILLHOLE ID (if applicable): HEC-5808 (MRT ID 15589)
PROSPECT (if applicable):
DEPTH FROM (metres): 17.7 (58 feet)
DEPTH TO (metres): 17.7 (58 feet)

* 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 $^{40}\text{Ar}/^{39}\text{Ar}$ analysis will address?

Provide a maximum age constraint on the diamictite into which the basalt clast has been incorporated. This upper age limit is so far lacking and will help determine whether the diamictite could date to the latest Eocene or earliest Oligocene as has been suggested by Macphail et al. (1993).

The numerical age on this clast will also help evaluate whether it could have been derived from the Tertiary basalt sequence immediately upslope (3 km to the east-southeast) at Emu Plains (sample A500737 also submitted in this batch) or if it can only have been derived from older basalts elsewhere. The former relationship would suggest the diamictite was possibly emplaced as a mass movement whereas the latter relationship would provide strong evidence for long-distance glacial transport. Additionally, if the cooling age on the clast (i.e. maximum depositional age for the diamictite) postdates the earliest Oligocene, then the hypothesis that the diamictite records glaciation at the start of the Oligocene can be ruled out.

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

Cooling age of an individual basalt flow that was the source of this clast, which thus represents a maximum age limit for the diamictite into which it is incorporated.

Mineral target(s) for dating:

Groundmass.

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

Likely Cenozoic. A single K-Ar age and corroborative pollen/spore assemblages from a biostratigraphically correlative site suggest that the minimum age for the diamictite is ca. 26.7 Ma (middle/late Oligocene) (see 'Relative age constraints' below). At youngest, the sampled basalt clast can thus be slightly older than ca. 26.7 Ma. Based on ^{40}K - ^{40}Ar and $^{40}\text{Ar}/^{39}\text{Ar}$ ages of Tertiary basalt-flow sequences in this part of Tasmania, the maximum age of the basalt clast is likely to be 40 Ma, if it is locally derived. However, if the basalt clast was derived from a distant flow farther south it could be older as basalt ages from that part of the state are poorly constrained.

Sample Information

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

This drillhole is located 400 m east of Lemonthyme Power Station, between Lemonthyme Road and the Lemonthyme penstock.

Lithological characteristics (rock description):

Basalt clast from a diamictite.

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

The maximum age of the diamictite is poorly constrained because it unconformably overlies Cambrian-age Dove Group basement rock. The basalt flow from which the sampled clast was derived is likely to be mid-Cenozoic in age since most basalts in Tasmania are middle Eocene to early Miocene in age.

Minimum age constraints on this diamictite unit are provided by: 1. palynostratigraphy of overlying lacustrine sediments from a nearby borehole (HEC-5825, 630 m to the northeast), which contains pollen/spore assemblages of exclusively early-Oligocene age (Macphail et al., 1993); and 2. a single K-Ar age (26.7 Ma [i.e. middle/late-Oligocene]) from basaltic breccia in a borehole from near Wilmot Dam (HEC-4558, 16 km to the north) that caps a lacustrine unit with correlative palynostratigraphy to the lacustrine sequence overlying the diamictite near at Lemonthyme Creek (Macphail and Hill, 1994). From these two sites the age of the diamictite at Lemonthyme Creek has been suggested to be latest Eocene to earliest Oligocene (Macphail et al., 1993) and very likely no younger than late Oligocene (Macphail and Hill, 1993). This contrasts the initial Pleistocene age proposed for the diamictite by Paterson et al. (1967)

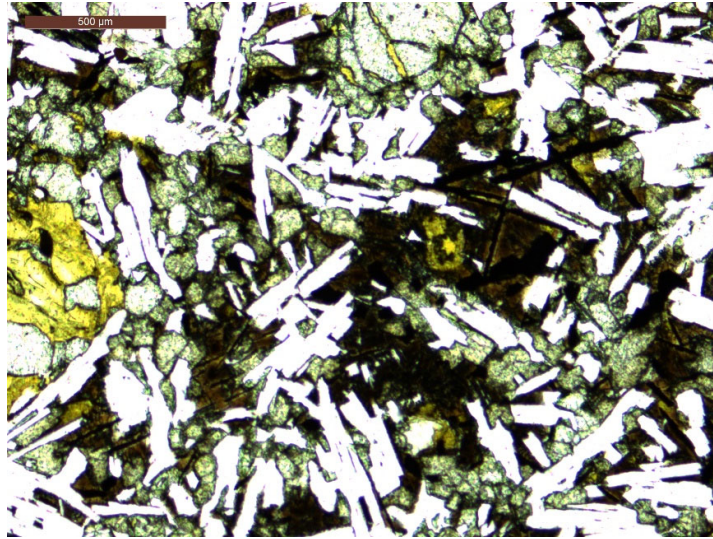
Two other samples submitted in the same batch may be of comparable age. Sample R003682 is a basalt clast from the same diamictite in the base of drillhole HEC-5833 (~450 m to the southeast). It may have been derived from the same flow (or flow sequence) as this sample and may, therefore, have a comparable age. Sample A500737 is from near the base of the Tertiary basalt sequence immediately upslope at Emu Plains (~3 km to the east-south east and ~350 m higher); that sequence could be the source of the basalt clasts and sample A500737 may, therefore, yield a similar age to this sample.

Thin section description (if available):

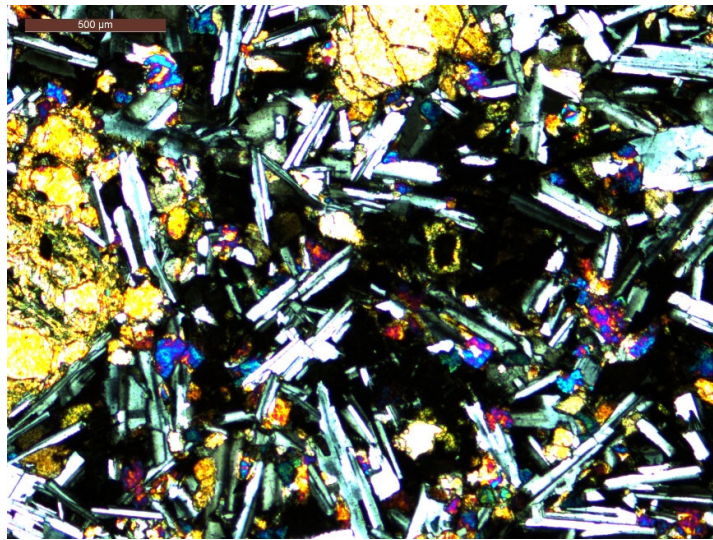
Partly altered olivine phenocrysts (≤ 2.5 mm) in an intersertal groundmass of plagioclase laths (~300 – 800 μm), clinopyroxene granules and an interstitial mesostasis of acicular to bleb-like opaque grains and pale reddish-brown glass, partly replaced by pale yellow-brown finely fibrous alteration products.

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

These and additional photomicrographs have been provided to laboratory staff at Curtin University.



R003680_Lemonthyme5808-58'_x5_PPL



R003680_Lemonthyme5808-58'_x5_XN

Relevant bibliographic references:

Macphail, M.K., Colhoun, E.A., Kiernan, K. and Hannan, D. 1993. Glacial climates in the Antarctic region during the Late Paleogene: evidence from northwest Tasmania, Australia. *Geology* 21: 145-148.

Macphail, M.K, Hill, R.S. 1994. K-Ar dated palynofloras in Tasmania 1: Early Oligocene *Proteacidites tuberculatus* zone sediments, Wilmot Dam, northwestern Tasmania. *Papers and Proceedings of the Royal Society of Tasmania* 128: 1-15.

Paterson, S.J., Duigan, S.L., Joplin, G.A. 1967. Notes on the Pleistocene deposits at Lemonthyme Creek in the Forth Valley. *Papers and Proceedings of the Royal Society of Tasmania* 101: 221-225.