National Argon Map: an AuScope initiative

Data Acquisition Project Proposal

This form should be completed and returned to Geoff Fraser (Geoff.Fraser@ga.gov.au) for consideration by the National Argon Map Oversight Panel

Project Proponent

Name: Ian Terence Graham
Affiliation and position: UNSW Sydney, Senior Lecturer
Collaborators: Sahand Tadbiri (PhD student, UNSW Sydney), Dr David Och (WSP), Prof Horst Zwingmann (Kyoto University), A/Prof Robin Offler (University of Newcastle), Dr Glen Bann (University of Wollongong), Ms Samar Abu Shamma (ARIMCO), Mark Krejci (South 32), Prof Martin Van Kranendonk (UNSW Sydney) and Dr Paul Lennox (UNSW Sydney)
Project Title: Age of basaltic intrusions within the Sydney Basin, NSW
Geographic Region: Hunter Valley, Sydney and South Coast, NSW
Geological Province or Tectonic Unit: Sydney Basin

Brief Project Description:

Approximately 500 word maximum. Include what geological process/problem will be addressed, and how new $^{40}Ar/^{39}Ar$ data from the specific samples to be dated will contribute. Please include reference to pre-existing geochronological constraints, if any exist. Please include a simple location map which showing the spatial distribution of samples in their geological context (with scale).

This proposal is for Ar-Ar dating of basaltic dykes that display distinctive geochemical groupings and intrude the Permo-Triassic Sydney Basin. These dykes are important because of: 1) their effects on engineering projects, especially in the Sydney CBD 2) their effects on longwall coal mining and 3) the compositional changes they record during the opening of the Tasman Sea, hot-spot activity and mantle processes that operated at the time they were emplaced. All of the samples chosen for this study have either already been analysed (quantitative XRD, laboratory XRF and ICP-MS) or will be analysed as part of this project, which forms an integral part of the PhD thesis of Sahand Tadbiri at UNSW Sydney.

Previous K-Ar dating of basaltic dykes within the Sydney Basin have shown a range of ages from the Jurassic to Cenozoic, with the youngest being the Maroota basalt at 44.7 Ma. Most of the dates come from the Hunter Valley and Sydney regions. Only one well-studied dyke of Jurassic age intruding the Permian Bombo Latite Member has been dated. Thus there is a real need if we are to better understand magmatism across the whole of the Sydney Basin and how it relates to plate and mantle processes over time.

Diamond drilling before construction of the Hunter Expressway intersected a relatively unaltered doleritic dyke near Branxton (B561A 21.8 m depth). Ages of dykes in this region span from the Jurassic to Cenozoic and thus the age of this dyke will further constrain the volcanic evolution of this part of the Sydney Basin.

The Great Sydney Dyke is an iconic well-exposed geological feature within the Sydney metropolitan region. Previous K-Ar dating of plagioclase extracted from this dyke gave an age of 163.02 Ma. The sample chosen for Ar-Ar dating is from an outcrop at White Bay (GSD White Bay). In thin-section the feldspars are unaltered.

Abu Shamma (Honours, 2018), conducted a detailed study on over 20 basaltic dykes between Kiama and Gerroa in the South Coast that intrude the sedimentary rocks of the Shoalhaven Group. Basalts (5), alkali basalts (8) and foidites (23) were identified, but neither their absolute or relative ages are known. The least-altered alkali basalt is chosen for Ar-Ar dating (SA1705a), as well as a foidite (SA1701A) and basalt (SA1405) to ascertain if there is a correlation between basalt type and age. In addition, further south is the Kinghorn Point sill of possible Permian age based on our detailed mapping and petrographic analysis. The sample chosen for dating is KHP02 from the centre of the sill.

A preliminary petrographic and geochemical study of basaltic dykes which have intruded the coal in the Dendrobium mine, west of Wollongong found that there were three groupings: 1) dolerite dykes and sills (sample S2334 is chosen for this study) 2) lamprophyre with high Cr, Ni and Zr (sample S2332) and 3) foidites (sample S2319, the least altered sample from this group).

Approximate number of samples proposed for $^{40}Ar/^{39}Ar$ analyses: 9

Includes:

1 from the Hunter Valley region (Hunter Expressway micro-dolerite)

1 from the Sydney region (Great Sydney Dyke at White Bay)

3 from between Gerringong and Gerroa.

1 micro-dolerite sill from Kinghorn Point

3 which intersected coal seams at the Dendrobium mine

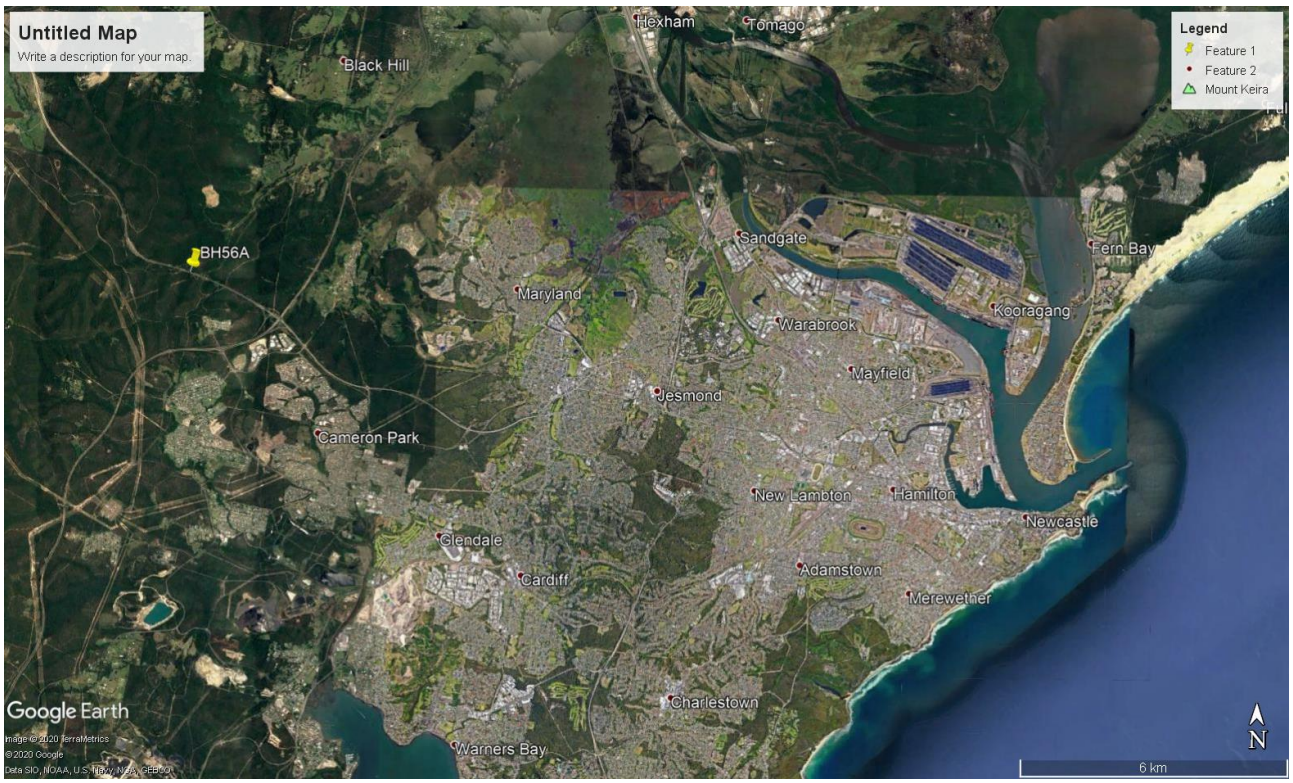
Lithologies and minerals proposed for $^{40}Ar/^{39}Ar$ analyses:

Plagioclase separates for the coarser-grained rocks and wholerock for the aphanitic varieties.

Do you have a preferred ^{40}Ar-^{39}Ar laboratory? (ANU, Curtin, UQ, UMelb):
If so, why you prefer this laboratory (e.g. student affiliation, ongoing relationship, sample type etc):
As we have used the facility at Curtin University for our previous age-dating of dykes within the Sydney Basin and have an agreement with them already concerning publication, we would prefer to use this facility for this project


Untitled Map
Write a description for your map.
Legend
Feature 1
Feature 2
Mount Keira
BH56A
Newcastle
Central Coast
Blue Mountains
Katoomba
Great Sydney Dyke at White Bay Gleb Island
New South Wales
Sydney
Woolnough Knoll
Campbelltown
S2332
S2319
S2334
Wollongong
Tasman Plain
1701
1705
1405(1718)
Nowra
Kinghorn Point
Google Earth
© 2020 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
N
100 km


Untitled Map
Write a description for your map.
Legend
Feature 1
Feature 2
Mount Keira
Robertson
Bundanoon
Meryla
Kiama
1701
1705
1405(1718)
Berry
Nowra
Culburra Beach
Kinghorn Point
Sanctuary Point
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2020 Google
Image Landsat / Copernicus
N
20 km


Untitled Map
Write a description for your map.
Legend
Feature 1
Feature 2
Mount Keira
Hexham
Tomago
Black Hill
BH56A
Sandgate
Fern Bay
Maryland
Kooragang
Warabrook
Mayfield
Jesmond
Cameron Park
New Lambton
Hamilton
Newcastle
Glendale
Cardiff
Adamstown
Merewether
Charlestown
Warners Bay
Google Earth
6 km
N


Untitled Map
Write a description for your map.
Legend
Feature 1
Feature 2
Mount Keira
S2332
S2334
S2319
Corrimal
Mount Pleasant
Wollongong
Dapto
Yallah
Albion Park
Oak Flats
Google Earth
20 km
N


Untitled Map
Write a description for your map.
Legend
Feature 1
Feature 2
Mount Keira
Snails Bay
Birchgrove
Mert Bay
Dawes Point
Walsh Bay
Balmain
Balmain East
Millers Point
The Rocks
Sisters Bay
Rozelle
Johnstons Bay
Jones Bay
New South Wales
Great Sydney Dyke at White Bay Gleb Island
Pyrmont Bay
Sydney
Pyrmont
Cockle Bay
Potts Point
Rozelle Bay
Lilyfield
Blackwattle Bay
Sydney
Lake of Reflections
Haymarket
Darlinghurst
Annandale
Glebe
Forest Lodge
Ultimo
Leichhardt
Lake Northam
Google Earth
Camperdown
N
1 km

Guidelines and Criteria

Project Proposals for funding support as part of the AuScope National Argon Map initiative will be assessed on the following criteria.

Australian: Samples must come from Australia (this may include Australian offshore regions)

Non-confidential: $^{40}Ar/^{39}Ar$ data must be made publicly-available (ie non-confidential)

Impact: to what extent new $^{40}Ar/^{39}Ar$ data from the proposed samples will contribute to geographic data coverage, or address key geological questions

Feasibility: whether the nature of the work is tractable via $^{40}Ar/^{39}Ar$ geochronology and the scale of the proposal is realistic within the time frame of the National Argon Map initiative (January 2020 – June 2021)?

Appropriate sample material: whether the proposed samples are (i) appropriate for $^{40}Ar/^{39}Ar$ analyses, and (ii) available within the time-frames of the National Argon Map initiative?

Oversight Panel

Dr Geoff Fraser, Geoscience Australia
Professor Zheng-Xiang Li,
Dr Anthony Reid, Geological Survey of South Australia
Peter Rea, MIM/Glencore
Dr Catherine Spaggiari, Geological Survey of Western Australia
Dr David Giles, MinEx CRC
Dr Marnie Forster (observer role as Project Coordinator)

Expectations

AuScope funding will cover the costs of sample irradiation and isotopic analyses.

Project Proponents will be responsible for:

- Provision of appropriate sample material. This includes mineral separation, which can be arranged at the relevant $^{40}Ar/^{39}Ar$ laboratories (in many cases this is preferred), but costs of mineral separation will be borne by the project proponent. The relevant laboratory reserves the right not to analyse material if it is deemed unsuitable for $^{40}Ar/^{39}Ar$ analysis.
- Provision of appropriate sample information. A sample submission template will be provided. Information in these sample submission sheets will form the basis of data delivery/publication, and the oversight committee or relevant laboratory reserves the right not to proceed with analyses unless and until appropriate sample details are provided. This includes description and geological context for each sample.
- Leading the preparation of reports and/or publications to deliver $^{40}Ar/^{39}Ar$ results into the public domain within the duration of the National Argon Map initiative (January 2020 – June 2021).
- Project Proponents will be expected to communicate directly with the relevant $^{40}Ar/^{39}Ar$ laboratory once a project has been accepted by the Oversight Committee, in order to clarify project expectations, arrange sample delivery, discuss results, collaborate on reporting and data delivery etc.

Participating Ar Laboratories will be responsible for:

- Providing advice to project proponents regarding suitable sample material and feasibility of proposed work
- Irradiation of sample material
- $^{40}Ar/^{39}Ar$ isotopic analyses
- Delivery of data tables, and analytical metadata to project proponents

Queries regarding possible projects as part of the National Argon Map initiative can be directed to Marnie Forster (Marnie.Forster@anu.edu.au) or Geoff Fraser (Geoff.Fraser@ga.gov.au)