

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: Dr Ian Graham
Affiliation and position: Senior Lecturer, UNSW
Collaborators: Nick Raffan PhD Student, UNSW
Project Title: Geology, Petrology and Gem Minerals of the Anakie Gemfields, central Queensland.
Geographic Region: Central Queensland.
Geological Province or Tectonic Unit: Hoy Province/Anakie Inlier.

Brief Project Description:

The object of this project is to produce the first extensive study of the Anakie Gemfields including the basalt geochemistry, petrology, tectonic architecture and structural geology. Ages of volcanism help constrain tectonic events such as faulting and rifting, and the timing of eruptive phases that may have elevated sapphires to the surface.

Faulting and rifting controlled emplacement of the Hoy plugs and dykes. The ages of Hoy basalt plugs (over 70 in total but less than 10% dated) range greatly in age from 67 to 16Ma. Given current estimates of the rate of propagation of the Australian-Indo Plate, it is not possible that all basalt outpourings were derived from the same magma chamber. Mt Leura, the largest plug, covers an area of around 2km². However, in the Drummond Range, some 17 km north of Bogantungan we have found eroded remnants of an undocumented central/strata volcano with a magnetic signature covering nearly 16km², the "Billaboo" Volcanic (BV) which is not shown on any current geological maps. Some volcanoclastic rocks of the gemfields contain over 50% dolomite, suggesting a possible carbonatite source. Carbonatites are sometimes associated with central volcanoes. Volcaniclastic rock has been sampled from BV and trace element geochemistry will be compared with samples collected from around the sapphire fields. Given the altitude of BV, pyroclastic eruptions probably blanketed the region. Age dating of the BV is expected to help constrain the timing of transport of sapphires to the surface, and have implications for hotspot theory, i.e. fixed or not. Three samples from BV are NRSP-BL-100 (mafic volcanic containing large hornblende megacrysts), NRSP-BL-B1 (fresh basalt) and NRSP-BL-R1 (fresh rhyolite).

At the northern extremity of the project area there is a large outcrop of what appears to be the remains of a nested maar volcano. This feature is mapped as DgH or Iron Hut Quartz Monzonite of Middle to Late Devonian in age. The rock is a pyroclastic, varying in texture with evidence of phreatomagmatic processes. It is comparatively fresh and might be expected to be mid-Oligocene to mid-Miocene in age, but this needs to be determined - sample NRSP-KD1.

Mount Hoy is one of the prominent Hoy plugs and the province is named after it. It is spatially related to a thick bed of volcanoclastic rock that has yielded sapphires concentrated from ash along parts of Hut Creek. Strangely enough, it has not been dated. How the age of Mt Hoy compares with dated plugs is a matter of interest - sample NRSP-MH-01.

Near Rubyvale is a small basalt plug unusually rich in megacrysts and xenocrysts (e.g. mantle olivine, ilmenite nodules and large spinels are common). The ground surrounding this plug was extremely rich in sapphire and spinel. Nearby ash deposits are possibly related and dating of this plug may constrain the age of pyroclastic volcanism - sample **NRSP-5**.

Within the Glenalva gemfield, a sample from a small pipe, seems an explosive basaltic breccia. This may represent a maar diatreme and perhaps constrain the age of nearby volcanoclastic rocks and provides additional insights concerning volcanism and tectonic events - sample **NRSP-GLA-60**.

Sample	Easting	Northing	M A.S.L.
NRSP-BL-100 (a)	147.29472	-23.59855	489
Hornblende (b)			
NRSL-BL-B1	147.29187	-23.53262	851
NRSP-BL-R1	147.29237	-23.5389	792
NRSP-KD1	147.60333	-23.01248	292
NRSP-MH-01	14742459	-23.39259	376
NRSP-GLA-60	147.58188	-23.6466	289
NRSP-5	147.73563	-23.43195	246

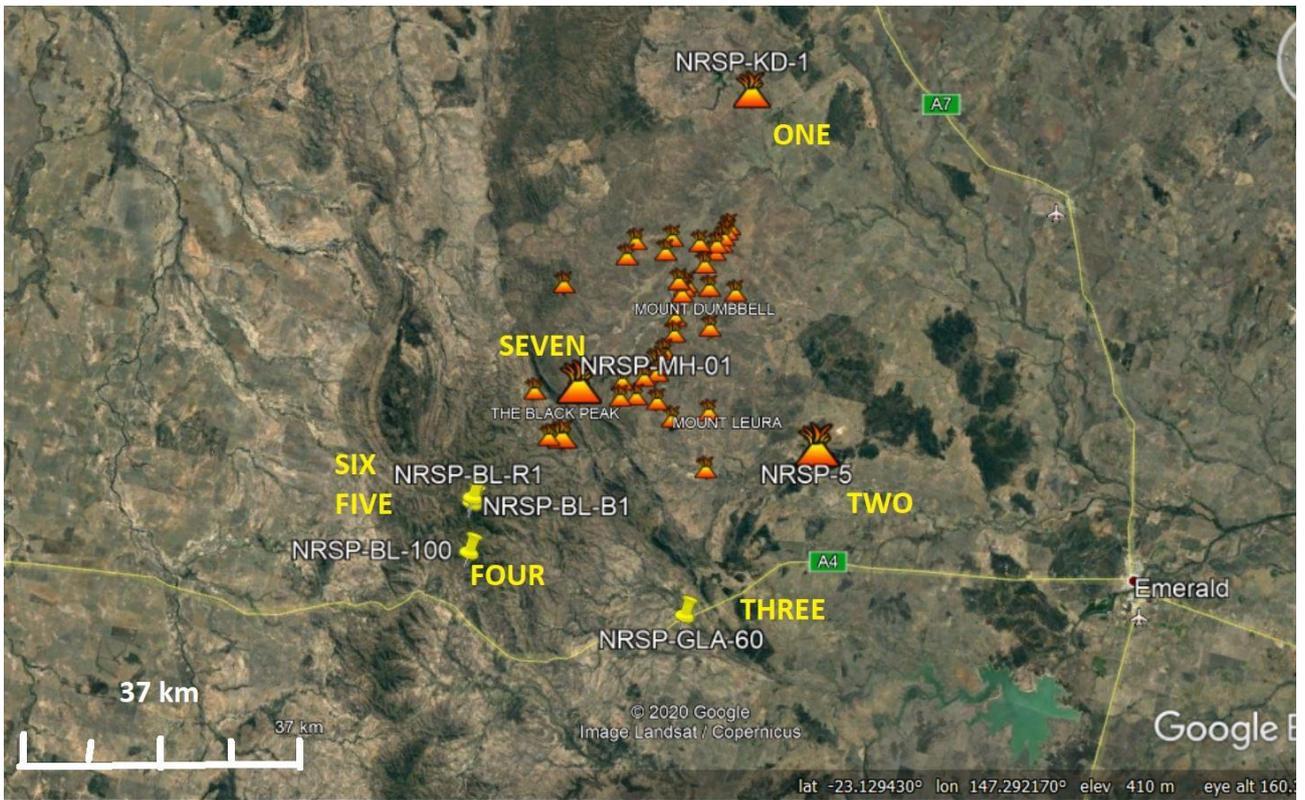
Approximate number of samples proposed for $^{40}\text{Ar}/^{39}\text{Ar}$ analyses: EIGHT (8) from seven samples. Samples have already been collected and thin-sectioned. Wholerock geochemical analyses (XRF and ICP-MS) will also be conducted on these samples.

Lithologies and minerals proposed for $^{40}\text{Ar}/^{39}\text{Ar}$ analyses: Either feldspar separates (if possible – preferred) or whole rock analyses for all samples, plus additional dating of hornblende megacrysts from sample NRSP-BL-100.

Do you have a preferred $^{40}\text{Ar}-^{39}\text{Ar}$ laboratory? (ANU, Curtin, UQ, UMelb):

If so, why you prefer this laboratory (e.g. student affiliation, ongoing relationship, sample type etc):

As the Ar-Ar facility at the University of Queensland has been widely used to determine age dates of the intraplate basalts throughout eastern Queensland and any results that we acquire would be directly compared to these, this is the preferred facility for this proposal.



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

Impact: to what extent new $^{40}\text{Ar}/^{39}\text{Ar}$ 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 $^{40}\text{Ar}/^{39}\text{Ar}$ 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 $^{40}\text{Ar}/^{39}\text{Ar}$ 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 $^{40}\text{Ar}/^{39}\text{Ar}$ 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 $^{40}\text{Ar}/^{39}\text{Ar}$ 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 $^{40}\text{Ar}/^{39}\text{Ar}$ 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 $^{40}\text{Ar}/^{39}\text{Ar}$ 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
- $^{40}\text{Ar}/^{39}\text{Ar}$ 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)