**40Ar/39Ar analysis information (ANU CAN #110)**

*Flux Monitor:* GA 1550 @ 98.5 ±0.8 Ma (Spell & McDougall, 2003)

(36Ar/37Ar)Ca correction factor 3.5E-04

(39Ar/37Ar)Ca correction factor 7.96E-04

(40Ar/39Ar)K correction factor 2.7E-02

(38Ar/39Ar)K correction factor 1.15E-02

Ca/K conversion factor 1.90 x 39Ar/37Ar

Discrimination factor 1.00815 ±0.17%

Lambda 40K 5.5430E-10

The canister was irradiated at the HIFAR Reactor, Sydney Australia. Irradiation was 193 hours between the 19 to 27 December 2003, the canister was rotated 180° three times to ensure even neutron flux through the entire batch. Canister had cadmium shielding.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sample  Name | J-Factor | ± % error on J | Mineral | Measurement Date |
| \*AG01-01 | 4.5292E-3 | 0.277 | K-feldspar | June 2004 |
| \*AG02-01 | 4.5321E-3 | 0.298 | K-feldspar | June 2004 |

\*Latitude / Longitude for both samples N: 36.71071667, E: 25.29366667; Datum WGS84.

Abundances are corrected for background (blanks), mass discrimination and radioactive decay and interfering nuclear isotopes. Noting that 1) the backgrounds are measured for every step-heating analysis and are subtracted from the isotope intensities 40Ar, 39Ar, 38Ar, 37Ar, 36Ar; and 2) the nuclear interfering values for the correction factors are listed above are done for the reactions and uncertainties for (40Ar/39Ar)K, (39Ar/37Ar)Ca, (36Ar/37Ar)K and (38Ar/39Ar)K, and are calculated in the laboratory prior to sample analysis.

Data reductions was done with an adapted version of *Noble* Software. The data reduction was based optimising an MSWD on isotope intensities with a linear best fit methodology.

The Discrimination factor was calculated by analysing three Air Shots analysis on either side of sample analysis, this was based on the 40Ar/36Ar ratio, the amu was then calculated and the 1 amu was used for the Discrimination factor.

The J-factor was calculated from the analysis of the standard GA1550 which has a known age. The GA1550 are dispersed throughout the irradiated cannister, between the unknown age samples. Approximately 40 GA1550 analysis are analysed and the measured data was extrapolated across the samples in nonlinear best fit fashion for the calculation of their J-factor and J-factor uncertainty.

Samples were analysed in the Argon Laboratory at the Research School of Earth Science, The Australian National University, Canberra, Australia. Samples were analysed using the furnace step-heating technique, flux monitors were analysed with the fusion technique with the argon-ion continuous wave laser, both were analysed in the VG3600 mass spectrometer with 100% gas release of 39Ar.

**MINERAL SEPARATION AND CHARACTERISATION:**

Samples were chosen for their structural context, AG01-01 to represent a mylonite from the core of a north-sense shear zone, AG02-01 for a south-sense shear zone with overprinting of north-sense. Both samples pristine potassium feldspars from augengneiss. Samples were collected by G Lister and myself in October 2001.

Mineral separation was undertaken to collect only potassium feldspars that represented the north sense of shear for AG01-01, and south sense of shear for AG02-01 (noting that north sense shearing was overprinting feldspars in this sample). Zones with these feldspars were cut from the rock and then separated using the traditional crushing methods and heavy liquid floatation before final separation, sized between 150 µm and 250 µm. All samples were washed in deionized water prior to hand picking to produce a 99% pure sample for analysis.

**SAMPLE IRRADIATION DETAILS:**

The prepared grains were wrapped in aluminium packets and placed into an aluminium irradiation canister together with aliquots of the flux monitor GA1550. Packets containing K2SO4 and CaF2 were placed at either end of the canister to monitor 40Ar production from potassium.

Irradiation of samples for 40Ar/39Ar analysis was undertaken at the HIFAR nuclear reactor in Australian prior to analysis. Irradiated samples were unwrapped on their return to the Research School of Earth Science, and then rewrapped in tin-foil. Backgrounds were measured prior to each step analysis and subtracted from each step analysis. For analysis samples were dropped into the furnace and the tin-foil melted and gas pumped away prior to analysis of sample. Potassium feldspars where analysed with 43 steps, with two or more isothermal steps at each new temperature, and with temperatures of the overall schedule rising from 450°C to 1450°C (Lovera et al., 1989). The furnace was degassed at 1450°C for 30 minutes and gas pumped away prior to each analysis. Temperature increases in the schedule were increased in small increments so as to minimize mixing of different gas populations on each step. See Table 1 for the analysis details including the heating schedule, Ar isotope abundances and uncertainty levels, %Ar\*, 40Ar\*/39Ar (K), Cumulative 39Ar%, Age and uncertainty, Ca/K, Cl/K, noting that the fractional uncertainties are shown as %, and are stated in the headings of the appropriate columns. Uncertainty levels of the calculated ages are at 1 σ.

Flux monitors, GA 1550, were analyzed using an argon-ion continuous wave laser and the VG3600 Mass Spectrometer. Gas released from each step was exposed to Zr-Al getters to remove active gases for 12 minutes, the purified gas was then isotopically analysed in the mass spectrometer. The furnace was decontaminated between samples. Corrections for argon produced by interaction of neutrons with K and Ca were made using the following correction factors: (36Ar/37Ar)Ca = 3.5 x 10-4, (39Ar/37Ar)Ca = 7.96 x 10-4, (40Ar/39Ar)K = 2.7 x 10-2and (38Ar/39Ar)K = 1.15E-02 (Tetley et al., 1980). 40K abundances and decay constants are taken from standard values recommended by the IUGS subcommission on Geochronology [Steiger and Jager, 1977]. Stated precisions for 40Ar/39Ar ages include all uncertainties in the measurement of isotope ratios and are quoted at the 1 sigma level.

The reported data have been corrected for system backgrounds, mass discrimination, fluence gradients and atmospheric contamination. Errors associated with the age determinations are one sigma uncertainties and exclude errors in the age of the fluence monitor GA1550. Decay constants are those of Steiger & Jager (1977). The 40Ar/39Ar dating technique is described in detail by MacDougall and Harrison (1999).

**References:**

Tetley, N., I. McDougall, & H. R. Heydegger. 1980. Thermal neutron interferences in the 40Ar/39Ar dating technique. *Journal Geophysical Research*, **85**, 7201– 7205.

McDougall, I., & T. M. Harrison (Eds.). 1999. Geochronology and Thermochronology by the 40Ar/39Ar Method, 2nd ed., 269 pp. Oxford Univ. Press, New York.

Lovera, O. M., F. M. Richter, & T. M. Harrison. 1989. 40Ar/39Ar thermochronometry for slowly cooled samples having a distribution of diffusion domain sizes. *Journal Geophysical Research,* **94**, 17, 917– 17,935.

Spell, T. L., & I. McDougall. 2003. Characterization and calibration of 40Ar/39Ar dating standards. *Chemical Geology*, **198**, 189–211.

Steiger, R. H., & E. Jager. 1977. Subcommission on geochronology: Convention on the use of decay constants in geo- and cosmochronology. *Earth Planetary Science Letters*, **36**, 359–362.

**XML DATA FOR FORWARD MODELLING WITH MACARGON:**

Input data for MacArgon for forward modelling for Sample AG01-01

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3 0.040000 0.090000 67.050000 2.530000

4 0.090000 0.210000 388.720000 1.870000

5 0.210000 0.420000 29.870000 0.450000

6 0.420000 0.840000 161.240000 0.920000

7 0.840000 1.500000 20.820000 0.130000

8 1.500000 2.440000 69.930000 0.250000

9 2.440000 3.900000 18.180000 0.080000

10 3.900000 5.640000 34.290000 0.160000

11 5.640000 7.980000 16.390000 0.090000

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34 83.690000 85.290000 41.440000 0.840000

35 85.290000 86.980000 43.140000 1.400000

36 86.980000 87.740000 46.210000 0.630000

37 87.740000 88.850000 56.170000 0.290000

38 88.850000 90.810000 61.780000 0.300000

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14 800 15

15 800 35

16 850 15

17 850 35

18 900 15

19 900 35

20 950 15

21 950 35

22 950 70

23 1000 15

24 1000 35

25 1050 15

26 1050 35

27 1050 70

28 1100 15

29 1100 35

30 1100 70

31 1100 120

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39 1290 15

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