Geophysical Research Abstracts
Vol. 13, EGU2011-11841, 2011
EGU General Assembly 2011

Laser step-heating system for dating of young volcanic rocks by the 40Ar-39Ar method

Dan N. Barfod, Darren F. Mark, and Ross C. Dymock
Argon Isotope Facility, NERC/SUERC, East Kilbride, United Kingdom (d.barfod@suerc.gla.ac.uk)

Laser heating of geologic materials is one of the most versatile methods for extracting sample gases for 40Ar-39Ar geochronology. Laser based systems are well suited to step-heating of 10's to 100's of mg of volcanic material and provide an alternative to conventional furnace based heating. Advantages of laser step heating include low blanks, smaller sample sizes and speed of gas extraction and clean-up. The promise of lower blanks, especially relative to furnace heating, permits younger samples to be dated. Disadvantages are non-uniform heating of sample material due to the Gaussian power distribution across the beam width. This is a significant issue as the strength of the step heating technique is the unmixing of argon gas components via thermally uniform, incremental sample heating.
Two approaches have been employed by various labs to 'smooth' the laser power distribution and produce more uniform heating in a given extraction step; optical (via defocusing or beam integrators) (e.g., Renne et al. 1997) or mechanical (sample or beam movement) (e.g., Wijbrans et al. 2010). We describe here a custom built CO2 scanning laser system constructed using commercially available components. Specifically an industrial high-precision digital scanhead that uses two computer-controlled, adjustable mirrors for 2-D scanning that improves homogeneity of sample heating. The system is purpose built for the dating of young volcanic rocks and we compare the results from this method with conventional furnace step heating of the same samples. Initial results show that CO2 laser step-heating yields broadly similar gas release behavior and age precision compared to furnace extraction.

References: Renne, P.R., et al.: 40Ar/39Ar Dating into the Historical Realm: Calibration Against Pliny the Younger. Science 29 August 1997, Vol. 277 no. 5330 pp. 1279-1280, DOI: 10.1126/science.277.5330.1279. Wijbrans, J., et al.: 40Ar/39Ar geochronology of Holocene basalts; examples from Stromboli, Italy. Quaternary Geochronology (2010), DOI: 10.1016/j.quageo.2010.10.003