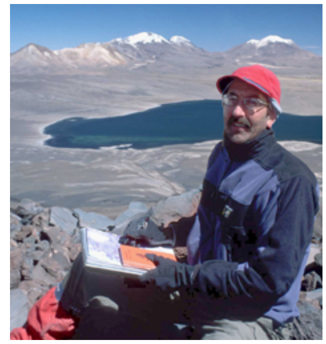
$^{40}Ar/^{39}Ar$ multi-collector revolution and implications for the Quaternary Geomagnetic Instability Time Scale (GITS)



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Reversals and excursions of the geomagnetic field are recorded globally by sedimentary and volcanic rocks. These geodynamo instabilities provide a rich set of chronostratigraphic tie points for the Quaternary period that can constrain age models central to paleoclimate studies. Radioisotopic dating of volcanic rocks, mainly $^{40}Ar/^{39}Ar$ dating of lava flows, coupled with astronomically-dated deep sea sediments, reveals 10 polarity reversals and 27 field excursions during the Quaternary (Singer, 2014). A key question concerns the accuracy and precision of radioisotopic dates of these geodynamo instabilities. For Quaternary rocks in which the build-up of ^{40}Ar by decay of ^{40}K may be overwhelmed by atmospheric ^{40}Ar at the time of eruption, the uncertainty in $^{40}Ar/^{39}Ar$ dates derives from three sources: (1) analytical uncertainty associated with measurement of the isotopes; this is straightforward to estimate; (2) systematic uncertainties stemming from the age of standard minerals, such as the Fish Canyon sanidine, and the ^{40}K decay constant; and (3) biases introduced during analysis, mainly the size and reproducibility of procedural blanks. Whereas 1 and 2 control the precision of an age determination, 2 and 3 also control accuracy. In parallel with an astronomical calibration of 28.201 Ma for the Fish Canyon sanidine standard, awareness of the importance of procedural blanks, together with a new generation of multi-collector mass spectrometers capable of exceptionally low-blank and isobar-free analyses, are dramatically improving both accuracy and precision of $^{40}Ar/^{39}Ar$ dates (Jicha et al., 2016). New results from transitionally-magnetized mafic lavas erupted during the upper Matuyama Chron, the Matuyama-Brunhes reversal and its precursor excursion, plus sanidine in the normally-magnetized Bishop Tuff will be used to demonstrate advances facilitated by multi-collector mass spectrometry.

Provisional & mainly multi-collector $^{40}Ar/^{39}Ar$ age determinations (±2σ analytical uncertainty):

Bishop Tuff rhyolite, California:	764.8±0.3	ka	(25 sanidine; new WiscAr data)
Matuyama-Brunhes reversal, Maui:	771.8±2.2	ka	(5 lavas; new WiscAr data)
Matuyama-Brunhes precursor, Chile:	784.2±2.4	ka	(4 lavas; new WiscAr data)
Santa Rosa excursion, Galapagos:	925.6±4.6	ka	(1 lava; Balbas et al., 2016)
Santa Rosa excursion, New Mexico:	932.0±5.4	ka	(sanidine; Singer, 2014)
End Jaramillo subchron, Tahiti:	978.8±6.4	ka	(2 lavas; new WiscAr data)
Intra-Jaramillo excursion, Tahiti	1004.0±8.1	ka	(1 lava; new Wiscar data)
Start Jaramillo subchron, Tahiti:	1071.1±3.3	ka	(3 lavas; new WiscAr data
End Cobb Mtn. subchron (AC sanidine):	1186.4±0.3	ka	(Jicha et al., 2016)

Balbas, A., Koppers, A.A., Kent, D.V., Konrad, K. and Clark, P.U. (2016) Identification of the short-lived Santa Rosa geomagnetic excursion in lavas on Floreana Island (Galapagos) by $^{40}Ar/^{39}Ar$ geochronology. *Geology*, *44*, 359-362.

Jicha, B.R., Singer, B.S., Sobol, P. (2016) Re-evaluation of the ages of $^{40}Ar/^{39}Ar$ sanidine standards and supereruptions in the western U.S. using a Noblesse multi-collector mass spectrometer. *Chemical Geology 431*, 54-66.

Singer, B.S. (2014) A Quaternary geomagnetic instability time scale *Quaternary Geochronology 21*, 29-52.