Geophysical Research Abstracts,
Vol. 10, EGU2008-A-07941, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-07941
EGU General Assembly 2008

Investigations into the altitude dependence of terrestrial cosmogenic nuclide production rates

A. Williams, R. Pik and P. Burnard

CRPG-CNRS, 15 rue Notre Dame des Pauvres, 54501 Vandoeuvre-les-Nancy, FRANCE

(alicejw@crpg.cnrs-nancy.fr / Phone: +33 383 594211)

The scaling factors used for correcting production rates of terrestrial cosmogenic nuclides (TCN) for the effects of atmospheric absorption and the geomagnetic field on the cosmic ray flux, remain perhaps the largest source of uncertainty in determinations of surface exposure ages and erosion rates using the TCN technique. Two recently published studies have reported altitude-dependent variations in cosmogenic ^{3}He/^{10}Be ratios in samples from high-elevation sites in the Himalayas, suggesting that the two nuclides may scale differently with elevation and that it may be necessary to develop nuclide-specific scaling factors for use with the TCN technique (Gayer *et al.*, 2004; Amidon *et al.*, 2007). In the framework of the CRONUS-EU Marie Curie research training network, established to refine TCN scaling factors and production rates, we present TCN data from basaltic lava flows at two localities in East Africa, spanning an altitude range of 600 to 4300m, in an effort to further investigate the effect of altitude on the production of different TCN.

At Mt.Kilimanjaro, Tanzania (03˚S) well-preserved ankaramitic flow-tops were sampled at 300m intervals between 2700m and 3700m for calibration of cosmogenic ^{3}He and ^{21}Ne production rates in olivine and pyroxene phenocrysts. Cosmogenic ^{3}He concentrations of $6.56 \pm 0.21 \times 10^{7}$ at/g to $11.06 \pm 0.46 \times 10^{7}$ at/g are consistent with exposure ages of c. 150 ka for these near-contemporary flows (if calculated using published production rates and scaling factors). Negligible variation in measurements of multiple samples ($< 5\%$ uncertainity) supports preservation of original flow-top features and the absence of post-eruptive erosion or burial of flows, and demonstrates the suitability of the flows for absolute calibrations. However, independent age determinations with $^{40}Ar/^{39}Ar$ dating have proved difficult thus far and attempts with alternative chronological techniques are being pursued. In addition to the absolute calibration sites, samples were also collected from surfaces at altitudes up to 4300m for examination of the variation in $^{3}He/^{36}Cl$ with altitude. At the time of writing, efforts are being made to measure cosmogenic ^{36}Cl in pyroxenes for direct cross-calibration of cosmogenic ^{3}He and ^{36}Cl production in these minerals.

The second locality targeted was Baddi Volcano in the Dabbahu region of the Afar rift in Ethiopia (12˚N). Well-preserved flow-tops were sampled at 100m elevation intervals along a single basaltic lava flow on the flanks of the small volcano. Olivine phenocrysts have been separated for high altitude-sensitivity calibrations of cosmogenic ^{3}He and ^{21}Ne production rates. Additional samples were obtained from the flow-interior for independent age determinations using the K-Ar technique. Preliminary cosmogenic ^{3}He determinations demonstrate that accurate measurements are possible at this high sampling resolution. Cosmogenic ^{3}He concentrations ranging from 5.2 to 6.9×10^{6} at/g correspond to a c. 30% increase in the ^{3}He production rate between 600 and 900m elevation.

References:

Gayer et al., 2004. EPSL 229, 91-104

Amidon et al., 2007. EPSL 265, 287-301.