Geophysical Research Abstracts, Vol. 7, 04079, 2005
SRef-ID: 1607-7962/gra/EGU05-A-04079

A paleoaltimeter based on ancient cosmogenic ^{3}He record

P.-H. Blard (1,2), J. Lavé(3), R. Pik (1), X. Quidelleur(4), D. Bourlès(2)

(1) Centre de Recherches Pétrographiques et Géochimiques, CNRS, Vandoeuvre-lès-Nancy, France (blard@crpg.cnrs-nancy.fr), (2) Centre Européen de Recherche et d'Enseignement des Géosciences de l'Environnement, Univ. Paul Cézanne – CNRS, Aix-en-Provence, France, (3) Laboratoire de Géodynamique des Chaînes Alpines, Univ. Jospeh Fourier - CNRS, Grenoble, France, (4) Laboratoire de Géochronologie Multi-techniques, Univ. Paris Sud - IPGP, Orsay, France

Constraining paleoaltitudes of a given surface is a major challenge for geomorphologic, tectonic and paleo-climatic geosciences. This study presents a paleoaltimeter based on the elevation dependency of the cosmogenic nuclides production rate. This approach relies on the investigation of ancient cosmic ray exposures recorded by superimposed lava flows, using the cosmogenic nuclides concentration accumulated at the top of the underlying flow. In order to compute a past cosmogenic production rate, the paleo-exposure duration is calculated using K-Ar-based determinations of the precise lag-time between the emplacement of the successive lava flows. The so-determined production rate is thus converted in a paleoaltitude using standard scaling factors. The reliability of this method was tested measuring the cosmogenic ^{3}He in the mafic phenocrysts of Quaternary K-Ar dated basaltic flows of Mount Etna volcano (Sicily, 38˚N). Cosmogenic-derived and sampling elevations revealed a good agreement within uncertainties ($1\sigma \leq 500$ m) and demonstrated the paleoaltimeter reliability. However, for older records, the paleoaltimeter precision and accuracy may be affected by K-Ar dating uncertainty, Earth's paleomagnetic fluctuations and physical erosion during the flow exposure. Several simulations were thus performed to constrain and evaluate the respective influences of these parameters. Finally, it turned out that the cosmogenic-based paleoaltimeter could potentially provide records with a better resolution than $\sim$1000 m, even for several Ma-aged flows.