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In situ cosmogenic ^{36}Cl chemistry on silicates from basaltic flows of Mount Etna (Sicily 38N)

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One of the CRONUS-EU goals is to provide high quality calibration sites from independently dated surfaces. Several previous studies have been conducted on ^{36}Cl production rate calibration (e.g. Zreda et al. 1991, Stone et al. 1996, Phillips et al. 2001), which, however, used different protocols and yielded ^{36}Cl production rates with about 40% discrepancy. The objectives of this study are 1- to understand the source of this discrepancy and 2- to calibrate ^{36}Cl production rates from its most abundant target elements ^{49}Ca, ^{39}K and ^{35}Cl. As a first step we focus on testing the chemical protocols. Cosmic rays produce about 10 times more ^{36}Cl in the atmosphere than in a Ca rich mineral. A preliminary cleaning procedure is therefore necessary to remove any meteoric Cl contamination that might be bound to the grain surface. We carried out leaching and dissolution experiments on crushed whole rock samples and Ca rich feldspar minerals from Mt. Etna. Mount Etna (Sicily 38°N) provides an excellent calibration site because 1- this volcano has not been affected by major altitudinal changes since the flows emplacement, 2- its lavas are suited for K-Ar dating, and 3- the pahoehoe features of its flows allow the negligible erosion condition to be checked.

The samples, sieved to different grain size fractions between 140 and 1000 μm, were first leached in hot dilute HNO_3, then stepwisely dissolved in 3 to 6 stages by limited quantities of a HF/ HNO_3 mixture. After each step, the dissolved sample was collected for AgCl precipitation while the residual solid was rinsed, dried and weighed. ^{36}Cl and Cl_{total} concentrations were determined by isotope dilution mass spectrometry at LLNL. Concentrations of the target elements Ca, K, Fe and Ti were determined by ICP-OES for each leaching and dissolution step to monitor the target element release

in the solutions.

Both Cl and ^{36}Cl concentrations from the first dissolution steps are high, 4000 – 1200 ppm and 10^7 - 10^6 at/gram of rock dissolved, respectively. After about 20% dissolution of the feldspar samples, concentrations decrease until reaching plateau values (20-30 ppm for Cl and 10^4-10^3 at/gram of rock for ^{36}Cl). Using the Phillips et al. (2001) ^{36}Cl production rate for the Ca rich feldspar, this plateau concentration yields an exposure age which is in agreement, within uncertainty, both with K-Ar dating and cosmogenic ^{3}He ages (Blard et al. 2005). This result suggests the proposed leaching procedure is effective to remove the meteoric chloride contamination from the feldspar minerals. On the contrary, the whole rock samples concentrations decrease gradually never reaching plateau values suggesting the method is not suited for whole rocks ^{36}Cl decontamination. Future ^{36}Cl measurements should thus be preferentially performed on pure separated feldspar minerals.

*References: P.H. Blard et al., EPSL, **236** (2005) 613-631; M.G. Zreda et al., EPSL, **105** (1991) 94-109; J.O. Stone et al., Geochim. Cosmochim. Acta, **60** (1996) 679-692; F.M. Phillips et al., Chem. Geol. **175** (2001) 689-701*