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The SPICE Project: Cross-calibration of six terrestrial cosmogenic nuclide production rates in quartz, olivine, and pyroxene from the 72 ka SP lava flow, AZ, USA

CASSANDRA R. FENTON[1], SAMUEL NIEDERMANN[2], STEVEN A. BINNIE[3] AND TIBOR DUNAI[3]

[1]Colorado Mesa University
[2]Deutsches GeoForschungsZentrum GFZ
[3]University of Cologne
Presenting Author: cassiefenton@gmail.com

The SPICE Project (**S**P Flow **P**roduction-Rate **I**nter-calibration Site for **C**osmogenic-Nuclide **E**valuations Project) grew out of our CRONUS-EU study and centers around the formally named SP Flow, a quartz-, olivine- and pyroxene-bearing basalt located in the arid desert climate of northern Arizona, USA. The flow has an $^{40}Ar/^{39}Ar$ age of 72±4 ka (2σ) and its surface exhibits an unweathered appearance and lack of soil development, indicating it has undergone negligible erosion and/or burial. Here, we present cross-calibrated production rates for ^{3}He, ^{10}Be, ^{14}C, ^{21}Ne, and ^{26}Al in quartz, olivine, and pyroxene from the SP Flow. Error-weighted mean, SLHL spallogenic production rates of ^{10}Be, ^{14}C, ^{21}Ne, and ^{26}Al (quartz) are 3.73±0.26, 9.2±0.6, 16.6±1.0, and 25.0±2.4 (2σ) at/g/yr, respectively, using time independent Lal (1991)/Stone (2000) scaling factors. Preliminary mean, SLHL production rates of ^{3}He in olivine and pyroxene range are 134±8 and 135±8 (2σ) at/g/yr, respectively,. Preliminary error-weighted mean, SLHL production rates of ^{21}Ne in olivine and pyroxene are 48.4±3.0 and 26.6±1.8 (2σ) at/g/yr, respectively. SPICE, SLHL rates overlap within 2σ with production rates in the literature and are lower if time-dependent scaling factors are used. AMS measurements have also been made for production of ^{10}Be and ^{36}Cl in pyroxene. Prior to the SPICE project, all ^{10}Be, ^{14}C, ^{21}Ne, and ^{26}Al primary production rates in quartz were calibrated on surfaces that had been exposed to cosmic rays for less than 20 ka. Between 20 and 50 ka, the geomagnetic field was weaker than it is today. Production rates of cosmogenic nuclides are expected to increase during periods of weaker geomagnetic field strength. Nevertheless, the SPICE calibrations indicate production rates for the past 72 ka are not measurably higher than rates integrated over the past 20 ka. However, SPICE production rates of ^{26}Al and ^{14}C in quartz might indicate increased production of these nuclides with increasing latitude.