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Toward the feldspar alternative for cosmogenic 10Be applications

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The possibility of quantifying surface processes in mafic or volcanic environment using the potentialities offered by the in situ-produced cosmogenic nuclides, and more specifically by the in situ-produced 10Be, is often hampered by the rarity of quartz minerals in the available lithologies. As an alternative to overcome this difficulty, we explore in this work the possibility of relying on feldspar minerals rather that on quartz to perform in situ-produced 10Be measurements in such environments. Our strategy was to cross-calibrate the total production rate of 10Be in feldspar (P10fsp) against the total production rate of 3He in pyroxene (P3px) by measuring 3He and 10Be in cogenetic pyroxene (3Hepx) and feldspar (10Befsp). The samples were collected from eight ignimbritic boulders, exposed from ca 120 to 600 ka at elevations ranging from 800 to 2500 m, along the preserved rock-avalanche deposits of the giant Caquilluco landslide (18°S, 70°W), Southern Peru. The standard chemical protocol routinely used while processing quartz minerals was revisited to make it efficient for feldspar minerals. The main problem with feldspars arise from their high cation contents (aluminum, calcium, potassium, etc.) which lead to fluoride precipitates during HF dissolution and further saturation of cation exchange columns during chromatography.
Along with data recently published by Blard et al. (2013a) at a close latitude (22°S) but higher elevation (ca. 4000 m), the samples yield a remarkably tight cluster of 3Hepx - 10Befsp total production ratios whose weighted-mean is 35.6±0.5 (1σ). The obtained weighted-mean 3Hepx - 10Befsp total production ratio combined with the local 3Hepy total production rate in the high tropical Andes published by Martin et al. (2017) allows to establish a total SLHL 10Be in situ-production rate in feldspar mineral (P10fsp) of 3.57±0.21 at.g-1.yr-1 (scaled for the LSD scaling scheme, the ERA40 atmosphere model and the VDM of Lifton et al. 2016).
The possible constraints provided by the measured 10Be concentrations in feldspar can open, when combined with other TCNs such as 36Cl that has a significantly smaller half-life, new perspectives to address complex exposure histories in geological settings (e.g. mafic environments) where this was currently not possible.