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Comparison of 36Cl and 3He measurements in glacial surfaces on the tropical Altiplano (Cerro Tunupa volcano, 20°S)

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The combination of two or more cosmogenic nuclides measured in the same rock samples allow complex landscape exposure histories to be quantified, due to the nuclide-specific production and decay rates. In supposedly simple exposure scenarios, such as moraine chronologies, the use of more than one nuclide can also help identify outliers caused by geomorphological bias (e.g. “inheritance”) or analytical problems (e.g. nuclide loss or contamination during chemical extraction).
The two cosmogenic in situ nuclides 3He and 36Cl are potentially very useful to be simultaneously measured in quartz-lacking lithologies, but their application is more challenging than that of combined 10Be and 26Al measurements, which are routinely employed in quartz-bearing rocks. This is, amongst other things, because the production of 3He and 36Cl depend on various compositional factors. Therefore, 3He and 36Cl have rarely been measured in the same samples so far.
Here, we present 36Cl measurements in plagioclases extracted from four moraine boulders and one roche moutonnée on the southern flank of Cerro Tunupa volcano, located in the tropical Bolivian Andes (3800-4500 m, 20°S). In pyroxenes of these samples, 3He has previously been measured to gain insights into the local deglaciation history and climate conditions about 15 kyr ago during the Lake Tauca highstand (Blard et al., 2009, 2013).
The ages calculated from the measured 3He and 36Cl concentrations of the 5 samples range from 12 kyr to 180 kyr and are generally in good agreement. The good age agreement of a boulder surface (TU-1C) that is significantly older than the other boulder ages from this moraine confirm the suspicion, that it was exposed to cosmic radiation previous to its last deposition (Blard et al., 2009, 2013). In contrast, the 36Cl age of the roche moutonnée surface (TU2) is significantly younger than the corresponding 3He age, but fits well with the adjacent moraine mean age. It thus arises the question if the 3He age is overestimated due to analytical complications.
The results of this study show that combined 3He and 36Cl measurements are useful to detect geomorphological or analytical biases, and that they represent a high potential for the investigation of complex exposure histories in lithologies that lack quartz.

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