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^{10}Be analysis in pyroxene - a method for routine chemical extraction

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We have developed a method for routine processing of pyroxenes for cosmogenic ^{10}Be analyses, offering a multi-nuclide (^{3}He/^{10}Be) approach for mafic terranes. Analyzing multiple cosmogenic nuclides from the same rock/mineral (most commonly, ^{26}Al/^{10}Be and ^{10}Be/^{21}Ne in quartz) enables quantification of complex exposure histories, including burial times, and erosion and denudation rates. This requires measurement of at least two cosmogenic nuclides whose production ratios and systematics are well known. For example, in quartz-bearing lithologies, the ^{26}Al-^{10}Be pair is routinely used because the production ratio of ~7 is relatively well constrained. In mafic lithologies, the ^{3}He-^{10}Be pair is a viable candidate for multi-nuclide studies because ^{3}He is routinely measured in pyroxenes, and preliminary studies demonstrate that beryllium extraction from pyroxene grains is possible. Despite the potential of this nuclide pair, there is not yet a simple method for extracting beryllium from pyroxenes given that this mineral has high elemental concentrations and retains meteoric ^{10}Be within the crystal lattice.

Here, we present a method for beryllium extraction from pyroxenes, modified from the extraction method in quartz, that will enable routine use of the ^{3}He-^{10}Be pair. We demonstrate that hydrofluoric acid leaching not only allows for separation of large amounts of clean pyroxene, even from fine-grained lithologies such as Ferrar Dolerite, but also successfully removes meteoric ^{10}Be. The addition of a simple precipitation step prior to ion exchange chromatography adequately reduces the cation load, allowing us to proceed with the same beryllium extraction chemistry used for quartz. Together, this approach allows for routine processing for ^{10}Be analyses in pyroxene. Using our ^{10}Be measurements, we present a preliminary ^{10}Be production rate in pyroxene, referenced to ^{3}He, for the McMurdo Dry Valleys, Antarctica, meaning that the ^{3}He-^{10}Be pair can already be used to evaluate complex exposure histories. With this result, we are optimistic that the presented extraction method opens new opportunities for multi-nuclide applications in mafic lithologies.