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# Constraining ice core chronologies with $^{39}$Ar and $^{81}$Kr

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Paleoclimate reconstructions from ice core records can be hampered due to the lack of a reliable chronology, especially when the stratigraphy is disturbed and conventional dating methods are not readily applied. The noble gas radioisotopes $^{81}$Kr and $^{39}$Ar can in these cases provide robust constraints as they yield absolute, radiometric ages. $^{81}$Kr (half-life 229 ka) covers the time span from 50-1300 ka, which is particularly relevant for polar ice cores, whereas $^{39}$Ar (half-life 269 a) with a dating range of 50-1400 a is suitable for high mountain glaciers. For a long time the use of $^{81}$Kr and $^{39}$Ar for dating of ice samples was hampered by the lack of a detection technique that can meet its extremely small abundance at a reasonable sample size. Here, we report on $^{81}$Kr and $^{39}$Ar dating of Antarctic and Tibetan ice cores with the detection method Atom Trap Trace Analysis (ATTA), using 5-10 kg of ice for $^{81}$Kr and 2-5 kg for $^{39}$Ar. Among others, we measured $^{81}$Kr in the lower section of Taldice ice core, which is difficult to date by conventional methods, and in the meteoric bottom of the Vostok ice core in comparison with an age scale derived from hydrate growth. Moreover, we have obtained an $^{39}$Ar profile for an ice core from central Tibet in combination with a timescale constructed by layer counting. The presented studies demonstrate how the obtained $^{81}$Kr and $^{39}$Ar ages can complement other methods in developing an ice core chronology, especially for the bottom part.

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