



## Revealing old ice with $^{81}\text{Kr}$

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The noble gas radioisotope  $^{81}\text{Kr}$  (half-life 229 ka) has early been identified as an ideal tracer for dating water and ice in the range of 50-1300 ka, particularly because it is inert, gaseous and of cosmogenic origin [1]. However, for a long time  $^{81}\text{Kr}$  dating was hampered by the lack of a detection technique that can meet its small abundance at a reasonable sample size. A few years ago,  $^{81}\text{Kr}$ -dating was demonstrated on large (~350 kg) ice samples from Taylor Glacier (Antarctica) with the laser-based detection method Atom Trap Trace Analysis (ATTA) [2]. Here, we report on  $^{81}\text{Kr}$  dating of ice samples as small as 6 kg with the latest ATTA instrument at the University of Science and Technology of China. We have applied the method to the Guliya ice cap of Tibet, for which previous  $^{36}\text{Cl}$  measurements indicate ice older than 500 ka at the bottom. We dated samples from the meteoric bottom of the Vostok ice core in comparison with an age scale derived from hydrate growth. For the Talos Dome ice core, we measured  $^{81}\text{Kr}$  in a sample from the lower section which is difficult to date by conventional methods due to a lack of a clear climatic signal. The resulting  $^{81}\text{Kr}$  ages in these studies, ranging from less than 50 ka to more than 1200 ka, provide unambiguous constraints on the timescale of the ice. These recent advances underline the usefulness of  $^{81}\text{Kr}$  for dating existing ice cores as well as searching for old ice beyond 1 Ma.

[1] Z.-T. Lu, Tracer applications of noble gas radionuclides in the geosciences, *Earth-Science Reviews* 138, 196-214, (2014)

[2] C. Buizert, Radiometric  $^{81}\text{Kr}$  dating identifies 120,000-year-old ice at Taylor Glacier, *Antarctica Proceedings of the National Academy of Sciences*, 111, 6876, (2014)

<http://atta.ustc.edu.cn/en-us/events/attaprimer.html>