New Limit on Anthropogenic Sources of Atmospheric ^{81}Kr using Atom Trap Trace Analysis

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Due to its simple production and transport in the terrestrial environment, ^{81}Kr (half-life = 230,000 yr) is the ideal tracer for old water and ice with mean residence times in the range of 10^5-10^6 years, a range beyond the reach of ^{14}C [1]. In recent years, ^{81}Kr-dating has been made available to the earth science community at large thanks to the development of Atom Trap Trace Analysis (ATTA) [2], an efficient and selective laser-based atom counting method. Further upgrades and improvements to the ATTA technique have now allowed us to demonstrate ^{81}Kr/Kr measurements with relative uncertainties of 1%.

In order to assure the usefulness of ^{81}Kr as an environmental tracer at this high level of precision, we have measured atmospheric samples collected in the 1940s, prior to the advent of the nuclear era, and compared them to modern air. We do not observe a significant difference in ^{81}Kr abundance and place a 1% limit on the anthropogenic contribution to ^{81}Kr relative to its natural abundance. The instrumental upgrades that have permitted this measurement also benefit radiokrypton analysis in environmental samples, e.g. allowing for routine measurements at < 3% precision level and being able to handle samples as small as 1μL of Kr gas (STP). This work is supported by Department of Energy, Office of Nuclear Physics, under Contract No. DEAC02-06CH11357.

[1] Du *et al*. (2003) *Geophys Research Lett*. **30**, 2068.
[2] Jiang *et al*. (2012) *Geochim. Cosmochi. Acta* **91**, 1.