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Next Generation Atom Trap Trace Analysis Instrumentation for Radiokrypton Dating

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Atom Trap Trace Analysis (ATTA) is a highly selective and sensitive atom counting technique based on laser cooling and trapping. It has now been established as a routine tool in the geosciences for radiokrypton dating of ancient groundwater and glacial ice samples on timescales of a few ten thousand to a couple million years. The isotope of interest is the cosmogenic krypton-81 with its half-life of 230,000 years and its isotopic abundance at the parts-per-trillion level in the atmosphere. ATTA has the unique advantage of being able to detect this rare isotope completely free of background from any other isotopes, isobars, or molecular interferences. Here, we will highlight recent advances of the ATTA technique that are aimed towards improving the precision of measured isotope ratios and towards enhancing the sample throughput of an ATTA instrument, as well as the development of a next-generation system that will drastically reduce cross-sample contamination. Improved precision will particularly help address to resolve apparent age differences at the younger end of the effective dating range, e.g., for samples originating from around the period of the last glacial maximum. Finally, current sample requirements and specifications for radiokrypton analysis at Argonne's Trace Radioisotope Analysis Center will be discussed.

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