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of the long-term evolution of Ar-39 produced in an underground nuclear explosion

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Measurements of gas collected from locations surrounding historic underground nuclear tests have identified that Ar-39 produced during a nuclear explosion can remain in the subsurface decades after the event occurred. As an activation product produced by the interaction of neutrons with geologic potassium, Ar-39 is produced in significant quantities in almost any underground nuclear explosion. With a half-life of 269 years, the primary loss mechanism for Ar-39 over time is dilution in the atmosphere or the geology surrounding the event. In order to better understand how the transport of Ar-39 affects its viability as a long-lived underground nuclear explosion signature, a series of simulations were performed of an initially pressure-driven Ar-39 source with varying depth and geology type surrounding the source. The evolution of both Ar-37 and Ar-39 was modeled over 30 years and the loss to the atmosphere or to dilution in the surroundings was tracked.

Promotional text

This work discusses further evaluation of the viability of Ar-39 as a potential long-term indicator of underground nuclear explosions as it compares to Ar-37, with simulations demonstrating persistently detectable subsurface Ar-39 concentrations even decades after events.

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