

Exploration of natural ^{236}U in groundwater and rock from the Beverley North sandstone-hosted uranium deposits, South Australia

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The minor uranium-236 (^{236}U) isotope with a half-life of 23 Ma is continuously produced via thermal neutron capture on ^{235}U and to a negligible extent due to the decay of ^{240}Pu . In the natural environment, neutrons arise from (α,n) reactions with light elements (like Li, Be, Na, Mg, etc.), from the spontaneous fission of ^{238}U , from neutron-induced fission of ^{235}U and at the earth's surface from cosmic rays. As our samples are all collected between 220 and 260 m below the surface the influence of cosmic radiation (~ 30 m) as well as the anthropogenic contribution of ^{236}U can be excluded.

10 to 20 L of groundwater was collected from the Pepegoona deposit and drill core rock samples were obtained from the Pepegoona, Pepegoona West and Pannikan deposits. The chemical procedure is based on the uranium extraction using UTEVA resin and the samples were measured by accelerator mass spectrometry using the 14 UD Pelletron accelerator at the Australian National University.

All samples show $^{236}\text{U}/^{238}\text{U}$ isotopic ratios at the level of a few parts in 10^{-12} . These ratios are characteristic of natural production, and are at the low end of the range previously measured in uranium ores. Due to the high uranium concentration in the drill core samples, it was possible to obtain mg quantities of uranium from them, and hence to obtain sufficient ^{238}U beam to allow measurements of $^{236}\text{U}/^{238}\text{U}$ ratios at these low levels; the ratios ranged from $(1.14 \pm 0.46) \times 10^{-12}$ to $(9.09 \pm 0.55) \times 10^{-12}$. The uranium concentrations in the water samples were, however, very low (\sim few ppb), and only one water sample collected directly within the high-grade mineralisation zone produced sufficient ^{238}U beam. The $^{236}\text{U}/^{238}\text{U}$ isotopic ratio for this sample was $(6.57 \pm 2.97) \times 10^{-12}$, which is essentially the same as that measured in the host rock.