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Regional ^{4}He Basement Flux Assessment in South Australia: Implications for H_2 Transport

ZAK MILNER[1], JON GLUYAS[1], KEN MCCAFFREY[1], BOB HOLDSWORTH[1], DR. DARREN GRÖCKE, DPHIL[1], DARREN HILLEGONDS[2], THOMAS RENSHAW[2], CHRIS J BALLENTINE[2] AND PHILIPPA ASCOUGH[3]

[1]Durham University
[2]University of Oxford
[3]Scottish Universities Environmental Research Centre

Natural hydrogen (H_2) is often found in subsurface gas systems and, if harnessed, could play a significant role in the energy transition [1]. In crustal environments, H_2 is primarily generated through water radiolysis—alongside the production of helium-4 (^{4}He)—and iron reduction.

Understanding the processes governing H_2 generation, migration, accumulation, and preservation is crucial for exploration efforts. South Australia presents a particularly promising setting for studying these principles, with recorded gas occurrences reaching up to 95.8% H_2 [2].

This study investigates noble gas isotopes (He to Xe) in groundwater samples from 19 locations across the Yorke Peninsula and Adelaide Superbasin. Radiocarbon dating enables the residence time of the groundwater to be derived and the basement ^{4}He flux into it determined.

We compare ^{4}He basement flux with modelled ^{4}He production from uranium (U) and thorium (Th) decay to evaluate how crustal ^{4}He migrates into regional groundwater aquifers. Given the similar migration behaviour of ^{4}He and H_2 [3], this approach serves as a valuable proxy for subsurface H_2 transport and can be applied to other geological settings with high natural H_2 potential.

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