

11th Applied Isotope Geochemistry Conference, AIG-11 BRGM

Characterisation of radon concentrations in Karoo groundwater, South Africa, as a prelude to potential shale-gas development.

A. Eilers^a, J. Miller^{a*}, K. Swana^a, R. Botha^b, S. Talma^c, R. Newman^d, R. Murray^e, A. Vengosh^f

^a Department of Earth Sciences, Stellenbosch University, Private Bag XI, Matieland, 7602, South Africa

^b iThemba LABS National Research Foundation, Somerset West, 7129, South Africa

^c Independent Researcher, PO Box 72906, Lynnwood Ridge, 0040, Pretoria, South Africa

^d Department of Nuclear, Radiation and Health Physics, Stellenbosch University, Private Bag XI, Matieland, 7602, South Africa

^e Groundwater Africa, 54 Irene Avenue, Somerset West, 7130, South Africa

^f Division of Earth and Ocean Sciences, Nicholas School of the Environment, Duke University, North Carolina 27708, USA

Abstract

Proposed shale-gas exploration in the semi-arid Karoo, South Africa, has created the need for the development of a robust geochemical baseline, differentiating deep and shallow groundwaters. Shallow groundwater is the main source of potable water in the Karoo, and the possibility of upwards migration of poorer quality deep groundwaters is a cause for concern. Radon concentrations of nineteen groundwater samples, from eight locations in the Karoo Basin, were determined in summer and winter. Sub-thermal waters were used as an initial proxy to define deep groundwater. Radon concentrations of < 100 Bq/L were recorded for most sites, with higher concentrations in shallow groundwaters. Seasonal and geographical variations in radon provide insight into the processes controlling radon concentrations in the Karoo groundwater. The presence of uranium and radium nuclides (possibly originating in the Karoo Uranium Province), and the presence of dolerite intrusions are important for controlling radon concentrations. Negligible uranium in deep groundwater was associated with anoxic, low alkalinity, high pH, old sub-thermal waters. Discrepancies between radon concentration and chemistry of groundwater sources defined as shallow is attested to the short half-life of ²²²Rn, which records only the last stage of the water's history. Elevated radon may be linked to seismic activity, a cause for concern considering the deep formation micro-fractures associated with hydraulic fracturing.

© 2015 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of the scientific committee of AIG-11

Keywords: Radiogenic isotopes; Karoo Basin; Groundwater; Radon

* Corresponding author. Tel.: +27-21-808-3121
E-mail address: jmiller@sun.ac.za