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O, H, C_{DIC}, Sr, B and ^{14}C isotope fingerprinting of deep groundwaters in the Karoo Basin, South Africa as a precursor to shale gas exploration

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Abstract

The possibility of shale-gas development in the environmentally sensitive Karoo Basin, South Africa has created the need to develop a hydrochemical baseline for deep Karoo groundwater. Little is known about the composition of deep (>1500m) groundwater in the Karoo because there are no functional boreholes that tap these depths. This study examined whether sub-thermal spring waters, defined as groundwater with a temperature >25°C, are suitable proxies for deep Karoo groundwater. On the basis of temperature, major cations and anions and ^{14}C, three groups of groundwaters were defined: (1) shallow (cold, young); (2) deep (sub-thermal, old); and (3) mixed (sub-thermal or cold, intermediate age). $\delta^{18}O$, $\delta^{2}H$, $\delta^{13}C_{DIC}$, $\delta^{11}B$ and $^{87}Sr/^{86}Sr$ ratios for the three groups indicate that the sub-thermal groundwaters may be suitable proxies for deep groundwater but also that mixing already occurs between the deep and the shallow groundwater systems. This does not impact on the overall groundwater quality but could leave the shallow groundwater vulnerable to future contamination should shale gas development proceed.

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Keywords: Karoo Basin, isotope fingerprinting, deep groundwater, shale gas exploration,

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