

Cation-exchange as a control on Sr isotopes in groundwater from the SE Murray Basin, Australia

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⁸⁷Sr/⁸⁶Sr ratios of Sr in groundwater from the SE Murray Basin range from 0.7106-0.7190, implying control by water-rock interaction with silicate minerals. There is a general decrease in ⁸⁷Sr/⁸⁶Sr ratios along flow paths away from the basin margins which parallele a change in primary aquifer mineralogy - namely a decline in K- and Rb-rich biotite and K-feldspar in the more distal sediments. A decoupling of ⁸⁷Sr/⁸⁶Sr ratios and ¹³C values, together with a lack of major ion evidence for calcite dissolution implies that water-rock interaction with carbonates does not significantly influence the Sr isotope budget. However, Sr vs Na and Sr vs Ca trends cannot be reconciled with simple silicate dissolution, and the mechanism for Sr isotope change is most probably cation exchange on clays derived from weathering of the primary minerals that have similar ⁸⁷Sr/⁸⁶Sr ratios to those minerals. The slow groundwater flow rates in the SE Murray Basin and the clay-rich nature of many of the aquifers promotes ion exchange.

Groundwater from different subcatchments has a distinctive range of ⁸⁷Sr/⁸⁶Sr ratios reflecting differences in aquifer mineralogy and implying that significant lateral groundwater mixing has not occurred. In the Campaspe and Goulburn subcatchments, there is a distinct difference in ⁸⁷Sr/⁸⁶Sr ratios between groundwater from the shallower Shepparton and deeper Calivil-Renmark Formations. In those subcatchments, groundwater flow in the deeper aquifers is largely subhorizontal with leakage from the shallower formations. However, the Sr isotopes do not reflect the limited groundwater mixing that was defined on the basis of major ion and ¹⁴C data. This implies that re-equilibration of Sr isotopes occurs during groundwater flow. By contrast, in the Lake Cooper and Tyrrell regions, where there is a greater degree of cross-formational flow and mixing, there is lack of distinction between ⁸⁷Sr/⁸⁶Sr ratios in the Shepparton Formation / Parilla Sands and the underlying Calivil-Renmark Formation. This homogenisation of ⁸⁷Sr/⁸⁶Sr ratios reflects the greater degree mixing in these areas.