Uranium and carbon isotopes as indicators of pre-development groundwater flow in a semi-arid aquifer system

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Groundwater systems in semi-arid and arid environments are recharged only sporadically, and the long-term processes that led to development of the groundwater composition may not coincide with modern groundwater flow conditions and geochemical processes. Here we use radiogenic isotopes of carbon and uranium with groundwater chemistry and flow system data to refine long term groundwater flow directions, vertical mixing and recharge processes within a layered aquitard-aquifer system.

The Bland Basin in southeast Australia is characterised by high potential ET rates, and low and sporadic rainfall. ^{14}C data indicate that groundwater flow paths within the confined aquifer have been reversed over almost half of the confined aquifer. This is a recent phenomenon and is most likely due to increased groundwater use from the confined aquifer and to the effects of mine dewatering nearby. Groundwater residence times in the confined aquifer are up to ~26000 years. Areas where the pmc values are significantly lower indicate zones where simple long-term groundwater flow paths cannot explain the data. In these areas water is input from a converging, fresher aquifer system.

$^{234}U/^{238}U$ ratios and $^{87}Sr/^{86}Sr$ ratios clearly indicate that leakage of groundwater from the poorer quality confining unit to the confined aquifer beneath it has occurred over time frames of thousands of years. Given the current groundwater pumping this leakage is likely to increase and the input of fresher groundwater to the system from an adjacent aquifer system may be changed. Both of these processes could significantly degrade the quality of the groundwater resource.