

Potential for a vast offshore fresh groundwater body in the Gambier Embayment, Australia

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ABSTRACT

Freshwater contained within submarine confined and semi-confined aquifers has been proposed as a possible resource to delay the salinization of onshore groundwater resources. While offshore fresh groundwater has been identified globally, there are only two cases supported by offshore data within Australia. Offshore freshwater has previously been inferred from onshore indicators in the Gambier Embayment in South Australia, a sedimentary basin including over 120 km of coastline. The presence of offshore fresh groundwater in this region may play a key role in the future municipal water supply of three coastal towns reliant on groundwater abstractions from deep-screened wells (> 200 m) close to the coastline (< 1 km). Offshore groundwater salinities in the Gambier Embayment were estimated by applying Archie's law to legacy downhole resistivity data. Onshore water samples and geophysical logs were used to obtain regional parameters for the semi-confined aquifer. These regional parameters were then applied to four offshore wells to generate estimated downhole pore-water salinity profiles that include uncertainty ranges. The results indicate that in the southern region of the Gambier Embayment, pore water with minimum calculated total dissolved solids (TDS) of 1.2 gL⁻¹ and 1.4 gL⁻¹ are found 12.2 km and 11.1 km offshore, respectively. In the north of the Gambier Embayment, the pore water salinities in offshore aquifers is more saline, with minimum TDS values of 14 gL⁻¹ and 4 gL⁻¹ found 31.1 km and 27.8 km offshore, respectively. Despite moderate uncertainty ranges, the calculated salinities when combined with concurrent work that characterizes the offshore hydro-stratigraphy, indicate that the southern offshore extension of the regional semi-confined aquifer may contain a considerable freshwater resource, which may be considered as part of the water management options for the wider region. The available offshore data for northern parts of the embayment indicate that offshore freshwater is less likely, and therefore onshore pumping has a greater likelihood of inducing salinization of water supply infrastructure by seawater intrusion. This study adds to the global body of known offshore fresh groundwater reserves, and provides insight into both the regional and down-hole salinity variability in an offshore semi-confined aquifer.