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Environmental tracer studies to characterise and quantify groundwater flow and recharge in aquifers of the Surat Basin, Queensland, Australia

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Field investigations were undertaken to study a complex multi-aquifer system in the Surat Basin, Queensland. This project is conducted within the framework of GISERA (Gas Industry Social and Environmental Research Alliance) to better characterise and understand the sustainability of deep groundwater and the potential impacts of the Coal Seam Gas (CSG) industry on these important water resources. Multiple environmental tracers (major ion chemistry, ^{18}O, ^{2}H, ^{3}H, ^{13}C, ^{14}C, ^{36}Cl, $^{87}Sr/^{86}Sr$, stable noble gases and ^{85}Kr, ^{39}Ar, ^{81}Kr) were used to estimate recharge rates and flow velocities in the Hutton and Precipice Sandstone aquifers.

Apparent groundwater ages using ^{14}C were contradictory to those for ^{36}Cl by a factor of ten in the Hutton Sandstone aquifer. It was possible to resolve this discrepancy by describing the aquifer as a large-scale 'dual porosity' system with only less than ~30% of its thickness conducting effective groundwater flow and the remainder being stagnant. This model allowed for the first time to quantify the effective deep recharge rate for this aquifer.

Groundwater flow of the Precipice sandstone aquifer has not previously been characterised by tracer measurements (two ^{14}C and two ^{36}Cl measurements prior to our study in an area of 170km x 100km). The Precipice aquifer exhibits high hydraulic conductivities estimated by various pump tests and re-injection of CSG water. Interpretation of the new tracer measurements confirms these high groundwater velocities. The Precipice therefore represents an important future fresh water resource for the cattle industry in the region.

Important for estimating the impact of CSG extraction is to assess potential flow paths between formations. Interpretation of our new stable noble gas measurements indicates vertical upward groundwater movement along faults. This is confirmed by local occurrences of water exhibiting high helium concentrations that can be described as small admixtures of old and deep groundwater ascending along the fault. The ascending water, however, is not old enough to exhibit a significant shift in the $^{36}Ar/^{40}Ar$ isotope ratio.