



Australian Government



Geological and Bioregional Assessment Program

Fact sheet 12

Isotope geochemistry of aquifer rocks in the Cambrian Limestone Aquifer

Field investigations to characterise groundwater resources of the Cambrian Limestone Aquifer (CLA) in the Northern Territory require the use of environmental tracers, many of which originate from the dissolution of minerals from rocks present in the system. The CLA, especially its Georgina Basin groundwater flow system, is a potential water resource associated with the development of unconventional gas in the Beetaloo Sub-basin. This component of the GBA Program characterised the elemental content, the strontium isotopic ratio, and the uranium and thorium contents in representative rock samples from the CLA archived in the Northern Territory Geological Survey Core Library (Figure 1).

What we did

Representative rock samples from the CLA, including formations above and below the CLA, were taken from cores from boreholes drilled along the general groundwater flow direction (Figure 2). These samples were analysed and compared to groundwater environmental tracer data to better understand the origin of groundwater and the influence of rock chemistry on groundwater evolution in the aquifers. U and Th contents are used to determine a He concentration in CLA water samples, which plays an important role in tracing water flows in and between aquifers.

Key findings

Strontium isotope ratios vary spatially (0.71 up to 0.76; Figure 3). Only the Tindall Limestone and Gum Ridge Formation show a very narrow range in strontium isotope ratios. Groundwater from the Georgina, Daly and Wiso flow paths of the CLA have a distinct signature for strontium isotopes (Figure 3). This can be used to assess the contribution from different flow paths to springs and to river baseflow. Host rocks like the Montijinni Formation, Anthony Lagoon Beds and Antrim Basalt span a wide range of strontium isotope ratios, which are higher than the analysed groundwaters. Groundwater from Gum Ridge Formation are partly outside the range measured in the host rock. Groundwater from the Tindall Limestone is also outside the values measured in the host rock. This indicates the admixture of groundwater with a higher strontium isotope ratio into the Tindall Limestone Aquifer.

Figure 1 Map showing sampling locations of cores (Core library of the Northern Territory Geological Survey) for strontium isotope analysis and the stratigraphy of the CLA

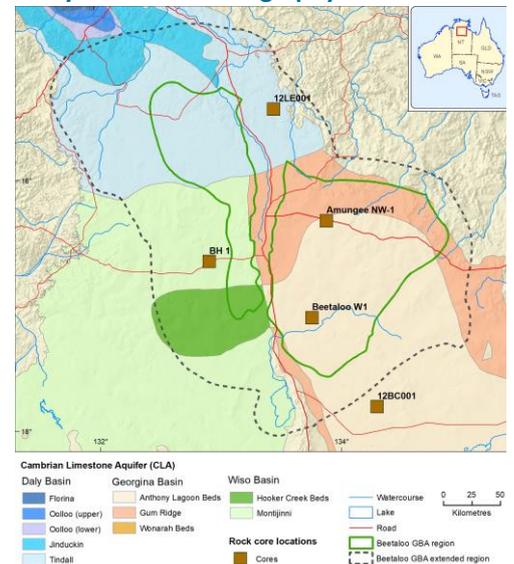


Figure 2 Tindall limestone at 119 m depth

Credit: A. Deslandes (CSIRO)



Implications

- The variability in rock within strata layers indicates either inhomogeneities during sedimentation or dissolution of minerals by groundwater.
- Groundwater chemistry in the CLA is more homogeneous than in rocks, consistent with regional scale groundwater flow processes in the CLA tending to average differences.
- This new database for isotope geochemistry of rocks in the CLA is crucial for the interpretation of tracer measurements in groundwater.

The GBA Program

The \$35.4 million Geological and Bioregional Assessment (GBA) Program is assessing the potential impacts of shale and tight gas development on water and the environment to inform regulatory frameworks and appropriate management approaches. The geological and environmental knowledge, data and tools produced by the GBA Program will assist governments, industry, land users and the community by informing decision-making and enabling the coordinated management of potential impacts.

How to cite

Geological and Bioregional Assessment Program (2021) Fact sheet 12: Isotope geochemistry of aquifer rocks in the Cambrian Limestone Aquifer (CLA) [online document] Fact sheet for the Geological and Bioregional Assessment Program.

Find out more

- Deslandes A, Gerber C, Lamontagne S, Wilske C, Suckow A (2019) *Environmental Tracers in the Beetaloo Basin - Aquifer and groundwater characterization*, Technical Report. CSIRO, Adelaide, Australia.
- Suckow A, Deslandes A, Gerber C, Lamontagne S (2018) *Environmental Tracers in the Beetaloo Sub-Basin. Historical Data and a first reconnaissance study of eight samples*, Technical Report. CSIRO, Adelaide, Australia.

Datasets that support this work are available at data.gov.au:

- Geological and Bioregional Assessment Program (2021) [Beetaloo Sub-basin cores and cuttings isotope data](#) [tabular].

More information is available at bioregionalassessments.gov.au/gba.

Acknowledgements

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Figure 3 Strontium isotope ratios of rock and groundwater samples

Data: Groundwater values shown by blue lines from Suckow et al. (2018), Deslandes et al. (2019). Rock sample ranges shown by purple dashed lines, single values by black and pink lines.

