Australia's National Science Agency

GROUND AND SURFACE WATERS

GISERA | Gas Industry Social and Environmental Research Alliance

Microbial degradation of chemicals in South Australian aquifers

This study established baselines for microbial communities in the Tertiary Limestone Aquifer (TLA) in south east South Australia and explored the potential for microbes to detoxify and breakdown chemicals used in onshore gas production.

Key points

- This project was established to gather baseline data on microbial communities in the TLA.
- CSIRO scientists also assessed the effect of the microbes on a range of chemicals used in onshore gas production.
- Results suggest that degradation of chemicals by microbial communities may offer an additional defence against chemical contamination of the local environment.
- These results are consistent with previous GISERA projects in the Northern Territory and South Australia which investigated degradation of gas industry chemicals by microbial communities in soils.

There is community concern about the expansion of the onshore gas industry on South Australia's Limestone Coast and the potential for impacts on the environment. Access to clean water is critical for communities and industries in this region.

This project, conducted through CSIRO's Gas Industry Social and Environmental Research Alliance (GISERA), responds to these community concerns and helps reduce uncertainty about potential impacts from onshore gas development.

CSIRO scientists collected and assessed groundwater samples and established baseline data about microbial communities in the TLA. They also explored the potential for these microbes to detoxify and break down chemicals used in onshore gas production.

DNA profiling was used to identify microbes in the TLA that have the potential to biodegrade chemicals used in gas exploration and development.

The Tertiary Limestone Aquifer

The TLA is the primary groundwater supply for the Limestone Coast region, which covers an area of 13,300 km^2 in the south east of South Australia.

The aquifer is used for many purposes, including town water supplies, agricultural activities, and industrial uses. The environment of the TLA is complex: rainfall actively infiltrates some parts, whereas in other sections the water is around 20,000 years old and is replenished horizontally.

Until now, little has been known about the microbiology of the TLA. This study was established to profile the range of microbial communities in the water and establish crucial baseline data.

CSIRO | Australian Government Department of Industry, Science and Resources | NSW Government | Supported by Government of South Australia | Queensland Government | Northern Territory Government | origin | Australia Pacific LNG | QGC | Santos | tamboran Resources | Empire Energy

Research activities

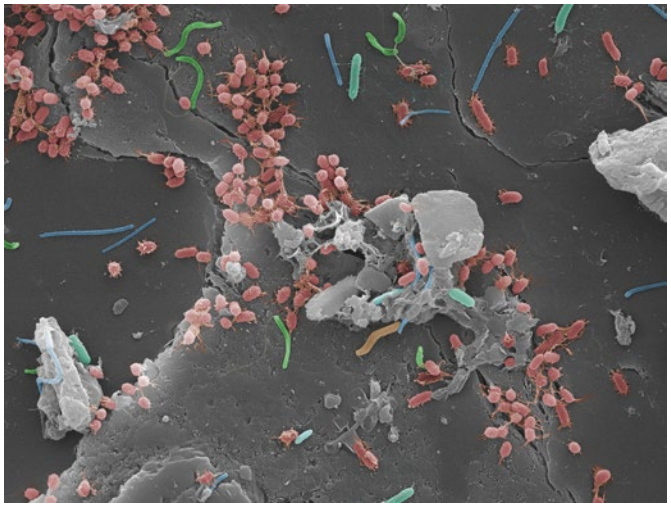
Researchers collected groundwater samples from 21 sites across the Limestone Coast region. These sites represented a range of land-use types, including orchards, pasture, small seed farming, and vegetable cropping.

These samples were used to provide baseline data for both water chemistry and microbial communities, and were essential for understanding chemical biodegradation, nutrient cycling, and environmental health monitoring.

This baseline data provides a reference against which any future changes to the environmental health of the aquifer's waters can be measured.

Twenty-six chemicals associated with onshore gas activities were individually added to aquifer water samples – at the same level of concentration they would be found in a well bore – and incubated for 120 days to determine whether different microbial communities can effectively degrade these chemicals.

DNA profiling was used to identify microbes within the TLA that have the potential to detoxify and biodegrade chemicals used in gas exploration and development.



False-colour scanning electron micrograph of subsurface microbial communities.

Key findings

The results of this study were consistent with the results of previous GISERA projects and suggest that degradation of chemicals by microbial communities may offer an additional defence against chemical contamination of the local environment.

The sampled aquifer microbes were able to partially biodegrade alcohols, butoxyethanol, isopropanol, methanol, and propylene glycol. In contrast, no biodegradation of ethylene glycol was observed across all aquifer samples tested.

In most microbial degradation experiments, the addition of chemicals caused a statistically significant shift in the microbial community profile.

Most changes to microbial communities were driven by the growth of species capable of degrading the added chemicals. Few species from the aquifer microbiomes were identified as sensitive (i.e., reduced in relative abundance) to the concentrations of chemicals examined.

DNA profiling was then used to identify microbes within the TLA that have the potential to detoxify and biodegrade chemicals used in gas exploration and development. These data identified numerous microbial species that are likely bio-degraders of these chemicals.

In terms of the microbiological baseline, 25,698 species were detected across the 21 sites. While there were numerous common aquifer-dwelling phyla detected, there was also an unusual level of diversity within the aquifers, with a high abundance of uncommon phyla and many species not readil classifiable.

The microbial and chemical baselining in this study provided a large dataset for the TLA and provides an important benchmark to measure against potential gas industry related disturbances.

Further work

To address important knowledge gaps, potential further work could include:

- sampling and analysis to gauge the stability of the baseline data,
- integrating data from this study with existing knowledge to create better models of environmental risk,
- assessing the impact of chemicals on microbial communities in combination rather than individually, and
- working to understand the potential impact of surface-spill events of chemicals at higher concentrations.

More information

Read the final report

Learn about other GISERA studies in South Australia.

Further information | 1300 363 400 | gisera@csiro.org.au | gisera.csiro.au

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