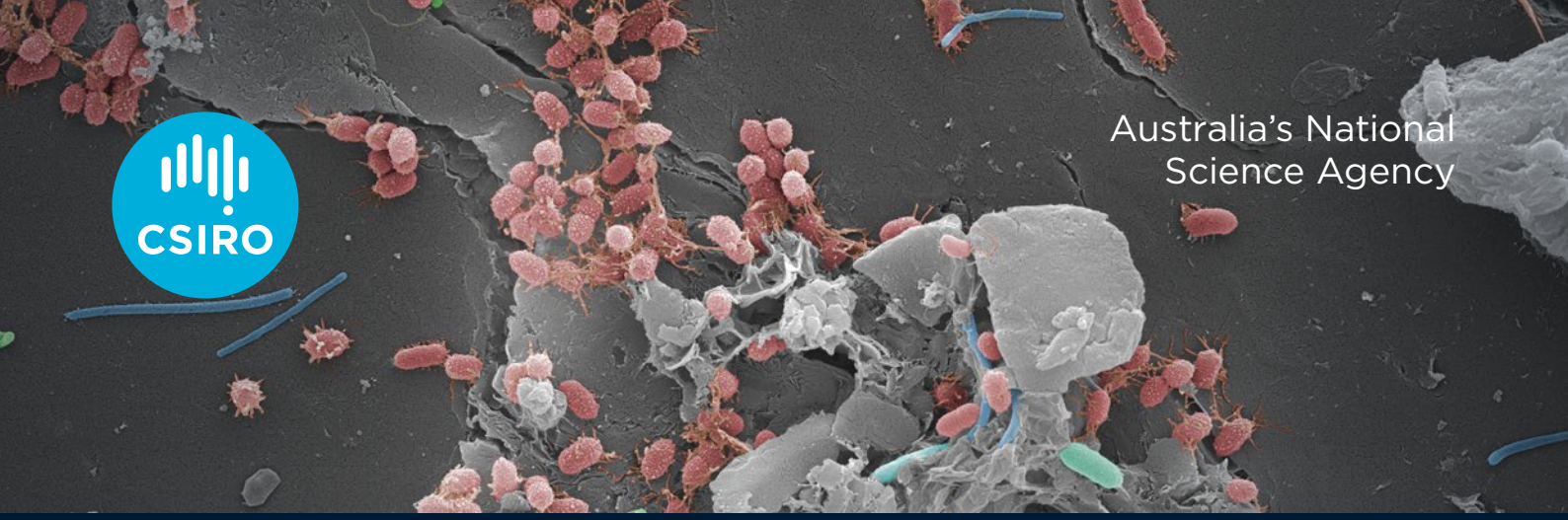


Australia's National Science Agency

GROUND AND SURFACE WATERS

GISERA | Gas Industry Social and Environmental Research Alliance

Understanding the potential for microbially influenced corrosion in onshore gas wells

CSIRO scientists will collect and analyse samples from aquifers and infrastructure in south central Queensland to gain insights into the potential for microbially influenced corrosion of gas wells.

Key points

- Southern Queensland hosts the largest coal seam gas (CSG) producing fields in Australia.
- There is community concern about the integrity of CSG well infrastructure.
- This CSIRO project addresses knowledge gaps about the potential impacts that microbes may have on cements and steels used in well construction.
- The study builds on a previous GISERA project: Queensland CSG well integrity: cements, steels and microbial activity.
- Scientists will conduct a sampling campaign in the Surat and Bowen basins.

This project, conducted through CSIRO's Gas Industry Social and Environmental Research Alliance (GISERA), will improve our understanding of potential impacts microbial activity may have on materials used in CSG infrastructure.

Image: False-colour scanning electron micrograph of subsurface microbial communities.

Scientists will collect samples from CSG-related, agricultural and domestic aquifers in the Surat and Bowen basin regions. These samples will include bulk water as well as swabs of well infrastructure surfaces.

Sample analysis, using DNA sequencing, will provide valuable data about which microbes adhere to subsurface materials. The results will provide insights into the potential impacts associated with microbially influenced corrosion (MIC) of wells in the region.

Building on previous GISERA research

GISERA recently completed a project to collate details on the materials used in well casings and cements, and to review existing literature on microbial activity in geological formations.

This study found there is limited data available on the microbiology of aquifers, especially non-CSG aquifers. No information is available on the microbiology of domestic or agricultural aquifers in the Surat/Bowen region.

This new project seeks to address the key knowledge gaps that were identified in that research, and helps address community concern about well integrity.

Improving our understanding of microbes

Microbes are tiny organisms too small to be seen by the naked eye. They include things like bacteria, fungi, and some types of algae. The only microbes found in sub-surface environments are bacteria.

Microbes are widespread in subsurface environments around the world and occur at depths hundreds to thousands of metres below ground, only limited where temperatures exceed about 120°C. Many inhabit fracture or pore networks within rocks that are filled with water.

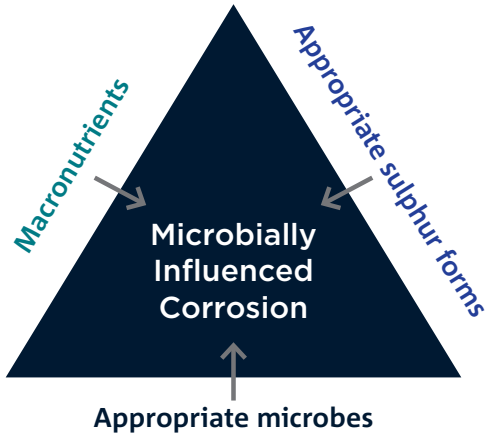
Our understanding of subsurface microbiology and ecology is poor, and contains many significant knowledge gaps. The most well studied subsurface microbial communities are related to hydrocarbon fuels, but these environments are often quite different to other subsurface environments.

Microbially influenced corrosion

We do know that microbes that are capable of producing acidic products or directly interacting with various metals occur in the subsurface, and may influence corrosion of pipes or other infrastructure.

Microbial acid production can take many forms, including production of sulphides, organic acids, protons or inorganic acids. Direct interactions can also occur i.e. some microbes can remove electrons directly from metals.

One of the main modes of microbial life in the subsurface is the formation of biofilms that adhere to surfaces including rocks and well infrastructure. These biofilms create microenvironments that promote microbial activity that can positively or negatively impact corrosion and performance of materials used in CSG well infrastructure.



In the same way that fire cannot occur without heat, fuel, and an oxidising agent, microbially influenced corrosion (MIC) caused by sulphur reducing bacteria cannot occur unless all three factors – macronutrients, microbes capable of reducing organic sulphur compounds, and suitable sulphur sources – are present in the subsurface. The subsurface waters of the Surat and Bowen basins are extremely deficient in phosphorous, and mostly deficient in oxidised forms of sulphur. Both deficiencies are likely to be a limiting factor for microbial production of sulphides.

However, all of these processes are highly dependent on geochemical conditions. For instance, microbial production of sulphide cannot occur in the absence of oxidised sulphur forms, like sulphate, sulphite, thiosulphate or elemental sulphur. Furthermore, microbial activity requires the presence of essential macronutrients such as nitrogen, phosphorus and accessible organic carbon.

There is currently no data available about biofilm formation in Queensland CSG or non-CSG subsurface settings. This project seeks to address that knowledge gap and improve our understanding of the potential impacts of MIC.

Project methods and outcomes

Researchers working on this project will collect samples from CSG-related, agricultural and domestic aquifers in the Surat and Bowen basin regions of Queensland.

DNA sequencing analyses will determine and compare microbial community profiles from planktonic communities in bulk water and adherent (biofilm) communities on infrastructure surfaces. Transcriptomics RNA sequencing will shed light on what the microbes are doing (which genes are being expressed) on these surfaces.

Additionally, analyses on a suite of water chemistry values that underpin specific microbial activities will be carried out.

The results will provide important information about which microbes adhere to subsurface materials, and what their likely activities are. It is important to note that even when a microbe has the ability to generate acidic by-products or interact directly with metals, it does not necessarily follow that this will take place.

For example, the waters of the Surat and Bowen basins are extremely deficient in phosphorous, and mostly deficient in oxidised forms of sulphur. Both deficiencies are likely to be a limiting factor for microbial production of sulphides within these coal formations.

The combination of microbial community profiles information with water chemistry data will provide crucial insights into the potential impacts associated with MIC in this region.

The final report of this project will analyse and discuss results in an ecological and risk context, and communication activities are planned to engage with government, communities, and industry stakeholders.

More information

Find out more about this project

Watch a short animation explaining MIC, and learn about previous microbial research

Read about other GISERA studies in Queensland.

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

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