Determining dissolved methane in groundwater of the Surat and Bowen Basins

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Background

- Approximately 25,000 known bores and/or wells (Figure 1) pierce the Surat and Bowen basins in Queensland (DNRME 2019A).

- Water abstraction from the Surat and Bowen catchment management area (excluding alluvium and basalt) has been estimated at approximately 90 000 ML/year and 11 500 ML/year, respectively (DNRME 2019B).

- Methane associated with coal seams in the region is well documented and the area has seen substantial development of extractive industries since the 1990s.

- The behaviour of methane in groundwater, particularly with the complex stratigraphic area of the basins (Figure 2), and its behaviour following abstraction, are poorly understood.

- Determining the total methane that could be dissolved in groundwater is a start to understanding the role that groundwater extraction has on methane emissions.
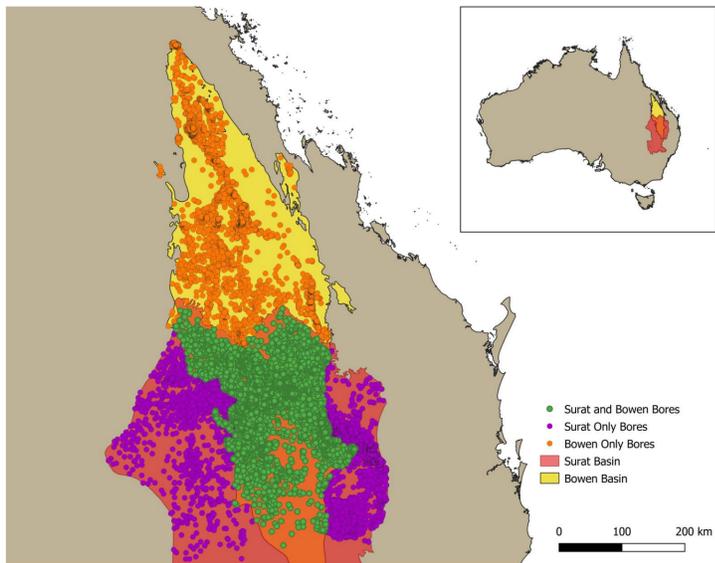

Figure 1: Queensland boreholes in the Surat and Bowen basins. Adapted from DNRME (2019 B) and ABS (2016)

References

Department of Natural Resources and Mines and Energy (2019A) , *All bore hole and well locations – Queensland;* State of Queensland, © State of Queensland (Department of Natural Resources, Mines and Energy) 2019. Updated data available at http://qldspatial.information.qld.gov.au/catalogue//

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Gaps in knowledge and challenges

- Measurements of pressure, temperature, salinity in boreholes are sparse.

- Groundwater is generally an overlooked source of gas emissions.

- Measuring emissions in thousands of bore is not practical.

- There is a lack of statistical methodologies to estimate the total emissions from a large number boreholes using measurements in fewer bores.

Methodology

- Collation of bore data from government and industry sources will be used to inform a methane solubility model based on Duan and Mao (2006).

- The model result will be validated by comparison with experimental and observed methane solubility data.

- Methane solubility will be determined for different geological units to assess the variability between units.
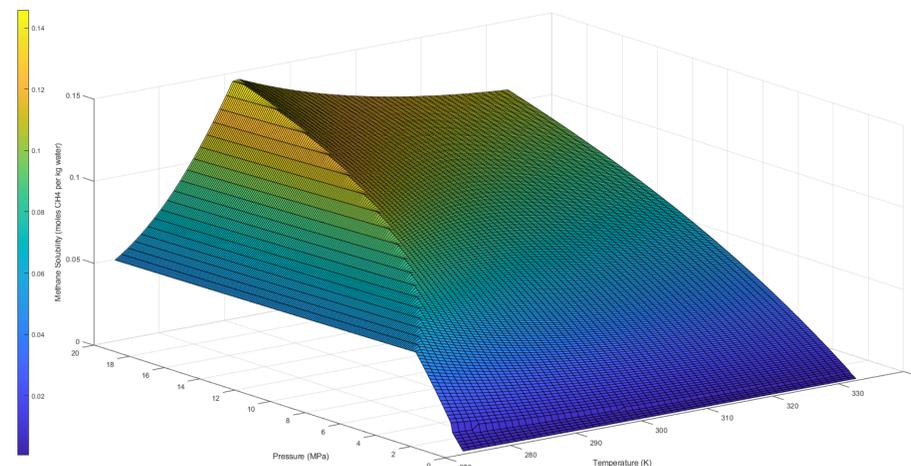

Figure 2: Solubility of CH_4 in a 0.5M NaCl H_2O solution across a range of temperature and pressure according to Duan and Mao (2006). Model code from Waite (2012).

As an example, a rough estimate of dissolved CH_4 (Figure 2) in the approximately 101 500 ML of abstracted water per year could be:
- at the *lowest solubility* in this range, 977 tons.
- at the *highest solubility* in this range, 238 kilotons.
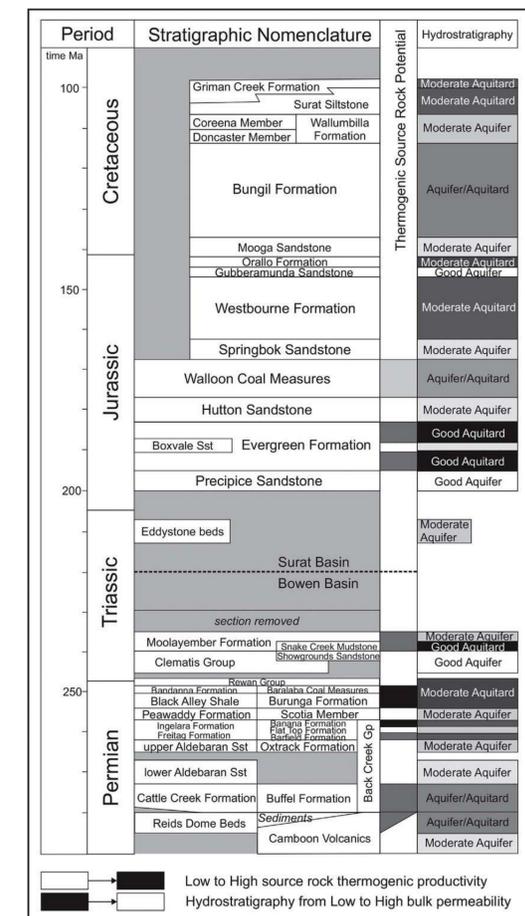
Acknowledgements

Figure 3: Stratigraphy and Hydrostratigraphy of the Surat and Bowen Basins (Underschultz et al. 2018)

Expected Outcomes

- This research is expected to provide a reliable estimate for the total methane capacity of groundwater contained in the Surat and Bowen Basins.

- Differentiation by formation or unit of the maximum dissolved methane that could be present in the groundwater.

- Estimates of total methane capacity of the groundwater will be utilised for further research to quantify the contribution of boreholes to methane emissions.

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