Biogenic methane potential for Surat Basin, Queensland coal seams

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Real-time Biogenic Methane Potential

Produced water samples collected from Surat Basin coal seams in eastern Queensland, Australia were shown to contain viable microbial consortia. Consortia from all eight of the wells sampled demonstrated the ability to produce new methane when native Walloon coal was provided as the sole organic carbon source. Methane generation rates of up to 0.9 m^3/tonne/day were observed, with overall yields up to 6 m^3/tonne coal. In comparison, total methane reserves for the Surat Basin are typically 4 to 8 m^3/tonne. These rates are comparable to the 0.1-0.5 m^3 methane/tonne/day observed for Powder River Basin enrichment cultures [1]. This is the first direct evidence of real-time biogenic coal-to-methane potential for an Australian coal seam sample; Li *et al*. [2] found that Archaea were rare or absent in samples taken from the Sydney, Surat and Port Phillip Basins. Midgley *et al*. [3] detected methanogens in a Gippsland Basin sample, but the consortia did not produce methane from a non-native coal.

Pathway and Bioavailability Results

Six of the eight Surat Basin water samples tested positive for biomethane production when H_2-CO_2 was provided as the sole methanogenic substrate. An active H_2-CO_2 pathway could be promising for the conversion of sequestered CO_2, if an *in situ* source of reduced hydrogen is present in excess. In an initial laboratory study, biomethane production from a Walloon coal was not enhanced when the bicarbonate concentration in the medium was doubled.

It is anticipated that the low surface area/solubility of coals may limit their biological conversion to methane. When a Zonyl FSN-100 surfactant was added to a Walloon coal culture, the initial methane production rate increased by 240%, and the final methane yield increased by 180% in comparison to a no surfactant control.

[1] Green *et al*. (2008) *Int. J. Coal Geol*. **76**, 34–45. [2] Li *et al*. (2008) *Int. J. Coal Geol*. **76**, 14–24. [3] Midgley *et al*. (2010) *Int. J. Coal Geol*. In press.

He and Ne as tracers of natural CO_2 migration from a deep reservoir

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Capture and geological storage of CO_2 is emerging as an attractive means of economically abating anthropogenic CO_2 emissions from large point sources. However, for the technology to be universally deployed it is imperative that a reliable method to asses the integrity of a storage site for both safety and regulation compliance exists. Hence, the ability to track, and identify the origin of, any CO_2 seepage measured at the near-surface and ground surface is critical.

As an analogue for post-emplacement seepage, this presentation will examine natural CO_2 rich springs and groundwater wells in the vicinity of the St. Johns Dome CO_2 reservoir, located on the southern tip of the Colorado Plateau on the border of Arizona and New Mexico. Extensive travertine deposits in the vacinity of St. Johns document a long history of the migration of CO_2 rich fluids to the surface. Whilst travertine formation appears to be insignificant at present, there is strong evidence of the migration of CO_2 rich fluids to the surface as shown by high levels of HCO_3^- in the surface spring waters.

Noble gases are conservative tracers within the subsurface, and combined with carbon stable isotopes, have proved to be extremely useful in determining both the origin of CO_2 and how the CO_2 is stored within natural CO_2 reservoirs from around the world including St. Johns Dome [1, 2]. This presentation will compare measurements of the dissolved $^3He/^4He$, $CO_2/^3He$, ^3He, ^4He and ^{20}Ne concentrations from surface spring and groundwater well waters with those from the deep CO_2 reservoir. We show that a component of the helium fingerprint observed in the gaseous CO_2 contained in the St. Johns reservoir can be traced in waters from both the groundwater wells and the springs emerging at the surface above the reservoir. Our results show that CO_2 can be traced from source to surface using noble gases and illustrates that this technique could be used to identify CO_2 migration from engineered storage sites.

[1] Gilfillan *et al*. (2008) *GCA* **72**, 1174–1198. DOI, 10.1016/j. gca.2007.10.009. [2] Gilfillan *et al*. (2009) *Nature* **458**, 614–618. DOI, 10.1038/nature07852