High-resolution methods for baseline groundwater monitoring in areas of energy resource development

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The presence of seemingly elevated levels of dissolved methane (CH_4) in shallow groundwater of areas of energy resource development has caused significant controversy in recent times. To address such controversies, the presence and origin of methane prior to development should be determined to generate a baseline against which future changes can be assessed. We propose that such characterization must consider the whole of the fresh water zone, identifying all features which control gas migration, including presence and abundance of low permeability strata, fracture networks and lithology. Consequently application of a proven methodology used following DNAPL contamination events in sedimentary rocks [1] was employed at the CMC Research Institutes' field research station located in Alberta, Canada. During investigations a core hole was drilled to 106 m depth through a sedimentary sequence of glacial till and coal, underlain by interbedded sandstone, siltstone and shales. Core was logged for lithology, mineralogy and fractures before sampling (including rock crushing, degassing and physical properties) at depth-discrete points of interest. Downhole geophysics approaches were employed in combination to design a bespoke multi-level monitoring system which will allow further baseline monitoring of aqueous CH_4 concentrations during additional experiments planned for the site. Initial rock crushing results show presence of CH_4 throughout the profile with abundance varying by lithology, mineralogy and distance to fracture features. Carbon isotope ratios of methane ($\delta^{13}C$ between –85 and –70‰) indicate a biogenic origin of the gas. Physical properties and results from the multi level groundwater sampling system will also be presented and discussed in the context of energy resource development.

[1] Parker *et al.* 2012. Discrete fracture network approach for studying contamination in fractured rock. *AQUA mundi* 3(2), 201-116.