Tracer approaches for identifying potential environmental impacts of shale gas development

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The recent expansion of hydrocarbon exploration from unconventional reservoirs has generated some public concern regarding potential environmental impacts including contamination of groundwater resources due to migration of fugitive gas, saline formation water and fracturing fluids. The determination of accurate baseline conditions prior to drilling of energy wells is a critical prerequisite to enable a detailed environmental impact assessment during the development of hydrocarbon resources from unconventional reservoirs.

The objective of this project was to develop innovative geochemical and isotopic tracer approaches that are suitable for establishing scientifically sound baseline data, against which potential extents of stray gas, saline water, and fracturing chemical leakage from shale gas plays into shallow groundwater can be assessed. This was successfully achieved by geochemical and isotopic characterization of water and gas samples from three essential zones: (1) the production zone including flowback and produced waters and produced gases, (2) the intermediate zone comprised of formations overlying the production zone but below the groundwater zone, and (3) shallow aquifers at various sites in Western Canada. Chemical and isotopic measurements on produced gases and flowback fluids from select shale gas plays, gases obtained from the intermediate zone, and shallow groundwater samples and their dissolved and/or free gases revealed that gases and fluids in the three zones are chemically and isotopically very distinct. Therefore, a comprehensive set of tracer parameters including the wetness parameter and the isotopic compositions of methane and ethane in gas samples, and concentrations (e.g. Na, Cl, TDS) and isotope ratios of select dissolved tracer compounds including S, Sr, B, Li, Cu and Zn were identified. These tracer compounds are highly effective for detecting and quantifying the admixture of fugitive gases or saline waters into shallow freshwater aquifers at shale gas plays in Western Canada, prvovided that suitable baseline surveys are conducted prior to the drilling of energy wells.