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Conference Abstract

Organic Solvent Contamination in Groundwater Around Natural Gas Plants

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Abstract

Alberta is a province that has vast deposits of natural gas. However, in its natural form it is considered sour in that it has impurities, i.e., it contains hydrogen sulphide (H_2S), carbonyl sulfide (COS), carbon dioxide (CO_2), mercaptans and organic sulphides. To enable the marketing of the natural gas these impurities must be removed using organic compounds and solvents. As a result of spills, leakage during processes, seepage from unlined storage ponds some of these solvents have contaminated groundwater around natural gas processing facilities.

Remediation of the organic solvents is a difficult problem. To achieve an understanding of the processes involved in their degradation, a hydrogeochemical assessment of a site can be done using existing data from the site to track the development of groundwater redox zones across the different hydrostratigraphic units (HSU). This is relevant because the oxidation is hypothesized to have contributed to the biodegradation of the compounds. The objective of this global assessment is to assign a groundwater redox zone for each sample, with special emphasis placed on defining the oxidative groundwater zone (OGZ) due to its relevance to biodegradation. Ideally, the oxic groundwater zone would be defined based on the concentration of molecular oxygen (i.e., dissolved) in groundwater (McMahon and Chapelle 2008). However, molecular oxygen, normally measured as ‘dissolved oxygen’, was not routinely measured as a field parameter in this study and therefore was unavailable to define the OGZ.

The scheme adopted considers the concentrations of terminal electron acceptors (TEA) present in groundwater and measured in commonly measured parameters including oxygen, nitrate, and sulphate and dissolved metals (manganese and iron). These TEA's are consumed under progressively more reducing conditions after oxygen reduction is complete in the order: nitrate reduction, manganese reduction, iron reduction, sulphate reduction, and finally carbonate reduction (one form of methanogenesis). The results show that redox zonation is heterogeneously distributed across the site, both within and between HSUs. Multiple lines of hydrogeochemical evidence support buffered aerobic biodegradation at the site.

Keywords

Organic solvent, groundwater redox zones, terminal electron acceptors, nitrate reduction, manganese reduction, iron reduction, sulphate reduction, carbonate reduction, methanogenesis.

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Conflicts of interest

The authors have declared that no competing interests exist.

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