

Comprehensive approach to the characterization of hydraulic fracturing flowback wastewater

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Hydraulic fracturing is a technique used to extract natural gas or oil from low-permeability sedimentary rocks. A by-product of the fracturing process is flowback wastewater, which is composed not only of the original hydraulic fracturing fluid but also chemical derivatives from subsurface reactions with the geological formation, and includes significant total dissolved solids, NORMs, and heavy metals. Relatively few components of flowback have been quantified and more comprehensive characterization methods are needed to determine more completely the composition of flowback. In this study, we use an interdisciplinary approach to characterize the inorganic and organic chemistry and toxicity of flowback from the Duvernay Formation in Alberta. A variety of analytical techniques including ICP-MS/MS, electron microscopy, and ion chromatography were used to characterize the inorganic components of the flowback solution and associated solids fraction. A broad range of organic constituents were identified and quantified using untargeted analysis with HPLC-Orbitrap-MS, and conventional GC-MS. Following the chemical characterization, LC₅₀ and EROD assays were conducted to assess sources of toxicity in the flowback. Ultimately, these results will enhance our understanding of the hazards and risks associated with flowback and lead to improved handling and disposal practices.