GEOCHEMICAL TRACERS FOR BRINE SOURCES IN THE WILLISTON BASIN

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SUMMARY: Contamination of surface water and shallow aquifers is a potential concern in some oil or gas exploration fields. Brine spills or subsurface leakages of oil and gas wastewater may contaminate freshwater by increasing salinity, radioactivity, metals, organic compounds, etc. The increasing number of contamination occurrences in freshwater has been raising concerns related to accidental release of oil and gas in the environment. Mitigating potential contamination issues requires knowledge of the source of high salinity waters; for example, knowing if the brines came from natural migration over geologic timescales or are related to recent oil/gas production. This project focuses on the Williston Basin located in parts of Montana, North and South Dakota, as well as in Manitoba and Saskatchewan provinces in Canada. In the past decade, reports of contamination in surface water have been increasing in this area. Previous studies used strontium (Sr) isotopes to determine if the contamination source was brine spills related to oil/gas production from the Bakken Shale. Data from five case studies and USGS were analyzed to examine possible trends in the isotopic and major ion chemistry of brines from oil/gas producing reservoirs within the Williston Basin, in order to test the utility of various tracers for fingerprinting brine sources. As results of the analysis, one can notice that brines in the Deadwood and Winnipeg formations have distinct Sr isotope signatures compared to brines in other formations, which show significant overlap in their Sr isotope values. In addition, brines from various formations had similar major ion chemistry. This overlap in Sr, water isotopes and in major ion chemistry among almost all geologic formations shows the difficulty of using these tracers to assess specific characteristics in each formation and contaminants present in shallow aquifers and surface waters may not necessarily be attributed to specific geologic formations. Winnipeg, Deadwood and Cambro-Ordovician formations have distinct Sr isotope signatures, but the populations analyzed are too small for the results to be conclusive. The results suggest that Sr isotopes and major ions are not unique fingerprints of brine sources in the basin. Therefore, future investigations are needed to identify additional possible tracers of contamination sources.

KEYWORDS: WILLISTON BASIN, CONTAMINATION, BRINE TRACER