

Fingerprinting Formation Waters Using Stable Isotopes: Applications to Petroleum Exploration and Production in the Williston Basin

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During petroleum exploration and production operations, the question often arises “Is the fluid recovered during well-testing pure formation water or contaminated with drilling fluid?” A variety of water chemical techniques (e.g., “stiff” diagrams) have historically been used to answer this question. However, standard chemical fingerprinting techniques can be problematic or ambiguous, especially when working in environments with evaporites (hence brine formation-water), or in shallow (fresh formation-water) settings. A new fingerprinting technique using stable isotopes of hydrogen, oxygen and strontium and the trace element bromine in formation waters has been developed that overcomes many of the problems associated with previous methods.

Our on-going sampling program has collected more than 1200 samples from producing wells and Drill-Stem-Tests in the Williston Basin (Canada-USA). These data have allowed us to create an isotopic fingerprint database of formation waters across the basin. This database has enabled the use of isotopic fingerprinting techniques in a variety of exploration and production operations, including: 1) during Drill-Stem-Testing and swabbing operations to determine if the recovered fluid is formation water; 2) as a production monitoring tool, to determine if produced fluids are originating in the perforated zone (versus “leaking” into the wellbore from other formations); 3) as a potential waterflood monitoring tool; and 4) as an aid to exploration, by enhancing understanding of reservoir continuity. This talk will present examples of the applications of these techniques in the Williston Basin.

Isotopic fingerprinting techniques are relatively fast and inexpensive, and have proven very useful to the petroleum industry.

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