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Boron and Lithium Isotopic Method for Tracing Hydrocarbons and Their By-Products

As petroleum consumption continues to rise the world is turning to unconventional oil sources, such as kerogen shale and bituminous sands, in order to keep up with global demand. Satellite imagery, gravity meters, and magnetometers are typically used to pinpoint ideal locations for drilling over conventional oil or gas reserves. However, differentiating unconventional oil sources from other layers of rock is difficult due to their similar densities, so instead, organic biomarkers are used to trace hydrocarbons (and their by-products) back to their source rock. Current organic biomarkers are redox-sensitive making them more reactive during tracing, and therefore require specialized organic chemical analyses in order to link them back to their source rock, a process which can be time consuming and expensive.

Researchers at ASU have developed a method for identifying fracking locations and monitoring groundwater contamination by using boron (B) and lithium (Li) as inorganic biomarkers in the hydrocarbon-tracing process. As kerogen and coal thermally mature into gas and oil, heavier isotopes of B and Li become more abundant and accumulate in the bitumen. This provides a stable isotropic tracer that is independent of organic compounds and not redox-sensitive, directly linking bitumen and other hydrocarbon by-products back to their source rock. This method can also be used to monitor leakage of organic contaminants into local groundwater, or to track polluted aerosols back to a coal burning power plant.

Potential Applications

- Hydraulic Fracking
- Groundwater Remediation

Benefits and Advantages

- Direct – Simplifies oil-source rock connections.
- Effective – Maximizes recovery of oil and gas from unconventional reservoirs.
- Environmental – Can be used to monitor potential mixing of hydraulic fracturing by-products with local groundwater.
- Reliable – B and Li are not sensitive to oxidation so core sample redox conditions will not alter isotopic ratios.

For more information about the inventor(s) and their research, please see

Dr. Lynda Williams's directory webpage

Dr. Richard Hervig's directory webpage