Deuterium Concentration in Oils: A Proxy for Assessment of Paleoenvironmental Conditions of Source Rocks

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The source of hydrogen for primary producers is water. The overall hydrogen isotope effect associated with water uptake and with biosynthesis of lipids by algae was found to be approximately -150 ‰. Considering that hydrogen isotopic compositions of saturated hydrocarbons are largely unaltered during diagenesis of organic matter and oil generation, the δD of oil reflects mostly the deuterium concentration in water of depositional environment.

In continental settings, δD of water is dependent on climate. Alternatively, δD in marine waters change within much smaller ranges. Therefore, δD of oils with contrasting origins, *e.g*., lacustrine and marine, must reflect the depositional environment of their respective source rocks. Accordingly, δD values of marine and lacustrine oils from Brazilian sedimentary basins have shown two distinct patterns: lacustrine oils that are isotopically heavier (-101‰< δD < -72‰) than marine and marine-evaporitic oils (-207‰< δD < -105‰).

Neocomian/Barremian lacustrine source rocks were deposited in lakes evolving under tropical-subtropical climate and consequently suffering variations in evaporation rates, and causing in the water and related organic matter distinct enrichments in deuterium.

Aptian source rocks were deposited in a marine-evaporitic lagoon evolving to less restricted conditions under warm and semi-arid climate, and subject to episodic marine incursions. Thus δD in the related organic matter reflects the isotopic composition of water in a transitional environment which non-marine and marine features coexist.

The highest D-depleted oils, generated by Upper Permian source rocks, from the Paraná Basin, reflect inputs of D-depleted waters to the global inventory, probably, due to a major post-glacial period.