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Metal Trace Elements in Oils for Quantifying the Degree of Biodegradation in Reservoirs

The use of bio-resistant compounds is a promising method to evaluate hydrocarbon mass changes linked to bacterial activity in petroleum reservoirs. One of the difficulty lies in finding stable elements or compounds well represented in crude oils that are completely oblivious to bacterial activity. Another is measuring them with high enough analytical accuracy. We have done tests on different case studies using nickel and vanadium (complexed in porphyrin structures and free formed cations), as they generally show a constant ratio in crude oils of same origin and where absolute metal concentration increases with biodegradation. It is thus possible, where the composition of the initial pole is known (non-biodegraded oils or rock extracts) to calculate a concentration factor which can be used to calculate the hydrocarbons lost by biodegradation. This method, applied to case studies, has given biodegradation weight loss ranging from 20% to 80%. At 20% it corresponds to the onset of LMW n-alkanes loss, and 80% to a reinforced stage of biodegradation (a GC trace showing only unresolved cyclo and isoalkanes, and no measurable biomarkers. Interpretation problems arise however because of low metal content in certain oils, and secondary processes (mixing, thermal maturity etcÖ). The analytical limit yields sometimes unrealistic concentration factors because of metal detection limit by conventional ICP or Atomic Absorption. Higher precision magnetic sector ICP-MS instruments detecting metals to a level concentration of parts per trillion should be tested as well as making cross checks with other super resistant biomarkers for example.