

Elemental Fingerprinting of Brazilian Petroleum: A Linkage to Gondwana?

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Trace elements, such as V and Ni, are commonly used in reservoir geochemistry for source identification. The availability of new and powerful analytical techniques, like ICPMS with its different instrumentation (quadrupole, high resolution, time-of-flight) and hyphaneted techniques (GC, HPLC) opened a new perspective for elemental characterization of crude oils, allowing their direct analysis at the ultra trace level. In parallel, systematic studies on elemental distributions in crude oil fractions showed that most elements concentrate up to ten times in the heaviest ones, asphaltenes and resins, without altering the elemental compositions when compared to the corresponding crude oil. The inorganic petroleum geochemistry of brazilian basins was investigated based on these results. Up to 50 petroleum samples from sedimentary basins of the brazilian atlantic passive margins and of Venezuela, Peru, Equador, Mexico, Iran, Iemen, Niger and Angola were analyzed by ICP-MS and ICP-OES. In order to have elemental distributions representative of the oil phase, the emulsified water was separated before fractionation of the sample; asphaltenes were separated by precipitation in heptane. Alkaline, alkaline earth and Fe-Sr-Ba were mostly concentrated in emulsified water. Trace and ultra-trace elements of the transition series were determined in the oil and its heavy fractions. In general trends, V was related to biodegradation, Ni, Co, Mo and Ga were associated to maturation processes and Zn-Cu-Pb-U-Th, to hydrothermal activity. Similar chondrite normalized elemental patterns were observed in crude oil and asphaltenes of samples from Rio Grande do Norte/Ceará and Niger, and from Rio de Janeiro (Campos) and Angola, respectively, suggesting a common origin of these oils from Gondwana basins.