

Geochemical Study of Natural Bitumen, Condensate and Gas Seeps from Sousse Area, Central Tunisia

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Abstract : Natural hydrocarbon seepage has helped petroleum exploration as a direct indicator of gas and/or oil subsurface accumulations. Surface macro-seeps are generally an indication of a fault in an active Petroleum Seepage System belonging to a Total Petroleum System. This paper describes a case study in which multiple analytical techniques were used to identify and characterize trace petroleum-related hydrocarbons and other volatile organic compounds in groundwater samples collected from Sousse aquifer (Central Tunisia). The analytical techniques used for analyses of water samples included gas chromatography-mass spectrometry (GC-MS), capillary GC with flame-ionization detection, Compound Specific Isotope Analysis, Rock Eval Pyrolysis. The objective of the study was to confirm the presence of gasoline and other petroleum products or other volatile organic pollutants in those samples in order to assess the respective implication of each of the potentially responsible parties to the contamination of the aquifer. In addition, the degree of contamination at different depths in the aquifer was also of interest. The oil and gas seeps have been investigated using biomarker and stable carbon isotope analyses to perform oil-oil and oil-source rock correlations. The seepage gases are characterized by high CH₄ content, very low $\delta^{13}\text{CCH}_4$ values (-71,9 ‰) and high C₁/C₁₋₅ ratios (0.95-1.0), light deuterium-hydrogen isotope ratios (-198 ‰) and light $\delta^{13}\text{CC}_2$ and $\delta^{13}\text{CCO}_2$ values (-23,8‰ and -23,8‰ respectively) indicating a thermogenic origin with the contribution of the biogenic gas. An organic geochemistry study was carried out on the more ten oil seep samples. This study includes light hydrocarbon and biomarkers analyses (hopanes, steranes, n-alkanes, acyclic isoprenoids, and aromatic steroids) using GC and GC-MS. The studied samples show at least two distinct families, suggesting two different types of crude oil origins: the first oil seeps appears to be highly mature, showing evidence of chemical and/or biological degradation and was derived from a clay-rich source rock deposited in suboxic conditions. It has been sourced mainly by the lower Fahdene (Albian) source rocks. The second oil seeps was derived from a carbonate-rich source rock deposited in anoxic conditions, well correlated with the Bahloul (Cenomanian-Turonian) source rock.

Keywords : biomarkers, oil and gas seeps, organic geochemistry, source rock

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