

Research Article

Biomarker characteristics of the Asmari reservoir oil in the Dezful Embayment, southwestern Zagros Fold-Thrust Belt, Iran

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Abstract

This study investigates the geochemical characteristics of oils from the Asmari reservoir in the Dezful Embayment using biomarker parameters. The results indicate that oil from the Nargesi Field contains the highest proportion of saturated hydrocarbons and the highest quality compared with the other studied oil samples. Based on biomarker parameters, including Pr/Ph, DBT/phenanthrene, CPI, TAR, oleanane/C₃₀H, Gam/(Gam+C₃₀H), $\delta^{13}\text{C}$ values of asphaltenes, C₂₇–C₂₉ steranes, C₂₆–C₂₈ triaromatic steroids, Pr/n-C₁₇ and Ph/n-C₁₈ ratios, and the Gam/(Gam+C₃₀H) versus Pr/Ph plot, all samples have a marine origin and contain predominantly Type II kerogen. Based on the crude oil classification diagram, the samples are classified as paraffinic and paraffinic–naphthenic oils. Maturity parameters, including C₂₉ $\alpha\alpha\alpha$ sterane 20S/(20S+20R), C₂₉ sterane $\beta\beta/(\alpha\alpha+\beta\beta)$, Ts/(Ts+Tm), CPI, C₃₂ 22S/(22R+22S), MDR, and TAS (total triaromatic steroids), indicate high thermal maturity and that the samples fall within the oil window to the peak oil generation stage. Among them, the Nargesi oil shows the highest maturity. The DBT/Phen versus Pr/Ph diagram indicates that the source rocks of all studied oil samples have carbonate–marl facies. The C₂₉/C₃₀ hopane versus C₃₅/C₃₄ hopane diagram indicates carbonate–marl facies for the source rocks of most samples, whereas some samples have carbonate–shale facies. The C₂₈ steranes versus C₂₈/C₂₉ steranes plot indicates a predominantly Early Cretaceous–Tertiary age for the source rocks, consistent with the oleanane/C₃₀H ratio and asphaltene carbon isotope data. Furthermore, the DMNR versus $\delta^{13}\text{C}$ of asphaltenes plot identifies the Kazhdumi Formation as the most probable source rock for the studied oil samples.

Keywords: Biomarker, Asmari, Dezful Embayment, Gas chromatography, Gas chromatograph–mass spectrometry

1- Introduction

The discovery and identification of oil and gas resources are among the most important objectives of petroleum exploration engineers and petroleum geologists. Although geophysical surveys and drilling operations are widely used in hydrocarbon exploration, complementary methods, such as organic geochemistry, are essential for confirming petroleum systems and obtaining detailed information about their origin, depositional conditions, and evolution. Biomarkers are valuable geochemical indicators used to determine petroleum origin, identify the type of precursor organic matter, reconstruct depositional environments, evaluate thermal maturity, and investigate genetic relationships between oils and source rocks (Kadkhodaei, 2022). In addition, biomarker studies play an important role in petroleum exploration and the interpretation of complex petroleum systems (Baniasad et al., 2023). Organic geochemical

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