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# Fluid inclusions evidence of deep-sourced volatiles and hydrocarbons hosted in F-Ba rich MVT deposit along the NE–SW Zaghouan Fault (NE Tunisia)

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## Résumé

Hamman Zriba F-Ba (Zn-Pb) stratabound ore is located within the Zaghouan Fluorite Province, defined as the most important sub-province, with CaF<sub>2</sub> deposits arising mainly along the Zaghouan Fault. The investigated orebodies correspond to a F-rich-MVT mineral system developed along the unconformity surface between the Uppermost Jurassic limestones and the Late Cretaceous layers. The study of fluid inclusions using microthermometry and Raman spectroscopy data in the fluorite mineralization confirms the trapping of various types of fluids, such as water, oil, kerogen, bitumen, CO<sub>2</sub>, and CH<sub>4</sub>; along with solid phases such as evenkite, graphite, kerogen, and bitumen. This contribution reports the first recorded occurrence of evenkite and graphite in fluid inclusions from MVT deposits in Tunisia. This paper addresses a critical knowledge gap regarding the chemical composition of petroleum-bearing fluid inclusions and depicts their interaction with immiscible hydrothermal and saline basinal brines. The identification of hydrocarbon fluids confirms the presence of three oil families. Families I (aliphatic compounds) is attributed to the Lower Eocene Bou-Dabbous Formation, and II (aromatic compounds) is attributed to the Albian Fahdene and Cenomanian-Turonian Bahloul source rocks, respectively, whereas family III is considered a mixture of aliphatic and aromatic compounds generated by the three sources. This paper unveils a model that correlates the tectonic background of fluorite mineralization formed during the Late Miocene compressional stage with the spatiotemporal distribution of multi-reservoir-derived fluids, including the two potential mid-Cretaceous source rocks (Fahdene and Bahloul formations), the Lower Eocene Bou Dabbous Formation, the Triassic evaporites, and presumably the Miocene magmatism. The entrapment of graphite in fluid inclusions strongly suggests the involvement of a deep-seated magmatic sources in the migration of fluids through the reservoir to the site of fluorite deposition. The findings of this study are of great significance for petroleum exploration in the region, offering valuable insights for new potential perspectives and further investigation.

**Mots-Clés:** fluorite, MVT, fluid inclusion, kerogen, oil, volatiles, graphite, evenkite, Zaghouan, Fault, Miocene magmatism, Tunisian Atlas.

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