

Trace element composition of crude oils from northern Bulgaria

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The quantities of trace metals in crude oils and processed fuels are important for both environmental concerns and economic issues (production-related) in the refineries. Further, trace metal ratios are used as an alternative tool, next to organic biomarker data, for establishing genetic oil-oil and oil-source rock correlations. Despite their environmental importance, the distribution and composition of trace elements in crude oils are not systematically investigated. To improve our understanding on metal contents of natural hydrocarbons, here we present preliminary trace element results for seven crude oils and three condensates from northern Bulgaria, and the NIST 1634c reference material for comparison. The samples were digested using a HNO₃-H₂O₂ mixture in a microwave, and trace elements, including sulfur, were measured by ICP-MS. Most metals have low concentrations compared with published data. V and Ni, while typically enriched in crude oils, also have low abundances in most studied samples; only one oil sample has higher V and Ni (10.97 ppm and 7.40 ppm, respectively). Sulfur contents plotted against V/(V + Ni) ratios have been used to classify different crude oils and assess the paleo-redox conditions during source rock deposition. According to Lewan's diagram [1], oil samples from northern Bulgaria may be associated with the sedimentation of marine shales in suboxic conditions. Recent work has shown that the likely source rocks for these oils, notably Lower-Middle Jurassic sediments from the same area, were most likely deposited in bottom oxic waters, although some of the latter rocks indicate periodic dysoxia or anoxia in the water column by the time of deposition [2]. Additional trace metal analyses of crude oils and potential source rocks are required to better characterize the metal inventory of oils and improve regional oil-source rock correlations.

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[1] Lewan, M. D. (1984). *Geochimica et Cosmochimica Acta*, 48(11), 2231-2238.

[2] Georgiev et al. (2022). *Review of the Bulgarian Geological Society*, 83(3).