Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.27780

Organic petrology of Mishash phosphorites, Israel: Insights into paleoenvironmental conditions and organic matter preservation

AYA SCHNEIDER-MOR[1], PAUL C. HACKLEY[2], RYAN J MCALEER[2], AARON M JUBB[2], BRETT VALENTINE[2], JAVIN J HATCHERIAN[2] AND JENNIFER L NEDZWECKAS[2]

[1]Geological Survey of Israel
[2]U.S. Geological Survey

Phosphorites are significant geological deposits that serve as key archives of past marine productivity, biogeochemical cycling, and sedimentary processes, as well as critical reservoirs of phosphorus, an essential element for global agriculture. Phosphorite deposition occurs under specific environmental settings, which allows for investigation of the interactions between microbial activity, organic matter (OM) preservation, and phosphate mineralization. This work focused on organic petrography of the Mishash Formation in southern Israel and offers insights into the paleoenvironmental conditions and diagenetic processes that influenced phosphorite deposition during the Late Cretaceous. The 37 samples, collected from two synclines in southern Israel (Rotem and Zin), were used to identify three distinct OM types based on their petrographic characteristics: organofacies 1 to 3, each reflecting different stages of diagenesis and environmental conditions. Organofacies 1, associated with low OM content (1 wt.% to 7 wt.%) and significant microbial activity, likely formed under reducing conditions, followed by transition to early diagenesis in more oxic environments. In organofacies 1, extensive degradation is demonstrated by high oxygen index (OI) and low hydrogen index (HI) values, along with evidence of bone-boring microbial activity and oxidized sulfides. Organofacies 2 shows little to no OM in the matrix (<0.7 wt.%); the minor OM that is present is armored by a coating of phosphate mineralization. The very low organic content appears to represent an extreme case of oxidative degradation. In contrast, organofacies 3, with higher OM content (2 wt.% to 25 wt.%), is characterized by a thick (50 µm to 500 µm) microbial mat laminae and *in situ* development of solid bitumen (a solid petroleum), suggesting preservation under reducing conditions with minimal alteration. Geochemical data reinforce these petrographic findings, showing strong correlations between OM and trace metals (Cu, Ni, Cd, Cr and Zn) in organofacies 3, but weaker correlations in organofacies 1, where oxidative degradation appears to decrease the OM more than the trace metals. This study highlights the role of varying redox conditions and microbial activity in shaping the diagenetic history of OM in phosphorites, providing valuable insights into the mechanisms of phosphorite formation and OM preservation.