Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.23576

Tracing paleoenvironmental change in the Paratethys Sea: Insights from elemental redox and salinity proxies

DAN VALENTIN PALCU[1,2], ZHANHONG LIU[3], WEI WEI[3], WOUT KRIJGSMAN[1] AND THOMAS J. ALGEO[4]

[1]Utrecht University

[2]The National Institute for Research and Development of Marine Geology and Geo-ecology – GeoEcoMar

[3]China University of Geosciences

[4]University of Cincinnati

Presenting Author: d.v.palcu@uu.nl

Reconstruction of ancient marine productivity and environmental dynamics is crucial for understanding Earth's climatic and biological evolution. The Paratethys Sea poses unique challenges due to its relative isolation, environmentally variable conditions, and endemic fauna. Employing elemental redox and salinity proxies, our research aims to decode its intricate history of watermass evolution. We developed a paleo-salinity framework utilizing boron/gallium (B/Ga) and sulfur/total organic carbon (S/TOC) ratios. Additionally, we examined the C_{ORG}:P ratios of organic-rich facies and trace-metal enrichment factors (Zn_{EF} and V_{EF}) to reconstruct the basin's redox evolution. Our new geochemical dataset has yielded a near-continuous record of paleoenvironmental change in the Paratethys realm spanning ~37 million years (~42-4.5 Ma). Our results indicate that the earliest and most intense anoxic event preceded establishment of the Paratethys, occurring during the Middle Eocene Climatic Optimum (MECO), at which time the basin's watermass was characterized by fluctuating marine to brackish salinity. The Eocene-Oligocene Transition (EOT) at ~35 Ma marked the birth of Paratethys and the onset of a phase of anoxia that lasted ~20 Myr, characterised by a gradual transition from anoxic, marine-salinity conditions to suboxic, brackish conditions. During the Middle Miocene Climatic Optimum (MMCO), salinity levels rose again, and environments became oxic, probably due to improved marine connectivity. Oxic conditions were sustained until ~12.65 Ma when another episode of fluctuating salinity associated with anoxia occurred. This event, associated with the Badenian-Sarmatian Extinction Event, marked the isolation of the basin and its transformation into a megalake. Our records also identify an episode of large salinity fluctuations and redox instability associated with the reconnection of the Paratethys Sea with the Mediterranean Sea in the aftermath of an outburst flood at ~6.7 Ma, which segued into oxic, freshwater conditions, likely due to increased outflow from the Paratethys to the Mediterranean during the Messinian Salinity Crisis.

This study presents a detailed timeline of the Paratethys's environmental past from a geochemical perspective. It highlights well-documented crisis events and reveals new, previously unnoticed turning points likely triggered by changes in marine connectivity. Moreover, our research enhances and expands the application of elemental salinity proxies to the field of paleoceanography.