

Palaeoenvironmental controls on the accumulation of hydrocarbon source rocks in Paratethys

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Project descriptor: The location and quality of organic-rich source rocks is a key component of successful oil and gas exploration, but our understanding of how, why and where these sediments form is currently rudimentary. Many world class source rocks are found in tectonically active marginal marine seas which are segmented into multiple sub-basins by faults. Restriction of the connection between sub-basins and/or the open ocean has a profound impact on source rock development through enhanced organic productivity at the surface and its preservation on the seafloor. Recent research shows that Sr and Nd isotopes can generate high resolution connectivity records for marginal marine sediments. This project will apply these new proxies to Maykop black shale sequences. These sediments were deposited in a large seaway called Paratethys that stretched from Germany to China at the beginning of the Oligocene. Over the next 30 million years, Paratethys shrank progressively and the resulting hydrocarbon-producing sediments are now well exposed around the periphery of the Black and Caspian seas. The aim of this project is to understand the controls on source rock production and preservation in Paratethys through detailed sedimentology, isotope and organic geochemistry.

For decades, Paratethyan research has been hampered by the region's endemic faunas which render global biostratigraphic systems largely inapplicable. Stratigraphic frameworks based on molluscs and other macrofauna exist locally, but cannot be tied into the global geological timescale and Paratethyan-wide correlation was impossible. Recent and on-going astronomical tuning of Late Tertiary successions in Paratethys by the Utrecht group, represents a major step change, permitting robust dating and bed-by-bed E-W correlation across the region for the first time. This project will benefit from the new chronostratigraphic framework by targeting sections and intervals that can be robustly dated and correlated for high resolution Sr and Nd isotopic records. These isotopic systems were originally developed as open ocean water mass tracers. However, in marginal marine settings, Sr isotopes have been shown to respond to basin connectivity, while Nd isotopes monitor the provenance of river discharge. High resolution records of both these isotopes will be generated in parallel with conventional sedimentary provenance data. These will be used, with climate model output, to reconstruct the evolution of the basin's hydrologic budget e.g. evaporation–precipitation+runoff+net exchange with adjacent basin(s). Comparison with quantified maps of the temporal and spatial distribution of Maykop's bulk hydrocarbon yield will provide new insights into the environmental controls on source rock generation.