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Tectonic Evolution of the Pripyat-Dniepr-Donets-Donbas Basin: Insights into Intracontinental Rifting Mechanisms and Structural Dynamics

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The Dniepr-Donets Basin (DDB) represents a significant intracontinental rift system in Europe, whose formation remains an ongoing topic of research. Central to this investigation is whether the basin developed through passive rifting—driven by far-field tectonic stresses such as back-arc extension—or active rifting, which involves localized thermal anomalies from processes like mantle plume activity. This research seeks to address these competing models through integrated geological and geophysical analyses, contributing to our understanding of continental rift evolution.

This project involves interpretation of 23 regional seismic reflection and refraction profiles including "classical" seismic profiles: DOBRE'99 and Georift-2013. The seismic data will be calibrated by c. 4000 wells with stratigraphy. Seismic analysis will be focused on mapping of 14 key stratigraphic horizons covering the entire area of the DDB (~76,900 km^2). The spatial orientation of structural elements will be resolved using potential field anomaly maps. Integration of the interpreted surfaces with the borehole stratigraphy will allow for determining the age of major unconformities and faulting. The evolution of the DDB will be quantitatively analysed using cross-section balancing technique along selected regional seismic profiles.

A key aspect of this work involves constructing a three-dimensional structural model of the DDB using borehole and seismic data. This model, still under development, aims to provide detailed insights into the basin's geometry, sedimentary layer distribution, and fault system configuration. Particular emphasis is placed on identifying structural asymmetries, which could suggest the operation of simple-shear mechanisms often linked to passive rifting. By correlating surface geological features with deep crustal structures, this research is gradually building a comprehensive picture of the basin's evolution.

Potential field data are also being analyzed to investigate mantle processes and their influence on rifting. Variations in gravity and magnetic fields are being studied for evidence of deep-seated magmatic intrusions and high-density bodies. This approach aims to evaluate whether mantle

plume activity or crustal thinning contributed to the rifting mechanism, helping to distinguish between active and passive processes.

This ongoing research integrates data across crustal and mantle processes, with the goal of correlating mantle dynamics, surface volcanism, sedimentation patterns, and tectonic evolution. The findings aim to advance our understanding of intracontinental rifting and provide insights into the conditions under which rifting transitions to full continental break-up or remains an intracontinental feature, as in the case of the DDB.