SIMULTANEOUS WIDE-SPREAD INTRA-PLATE NORMAL FAULTING AND ULTRA-SLOW OCEANIC SPREADING IN ARCTIC OCEAN: INSIGHTS FROM 3D MODELS

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ABSTRACT:

The Arctic Ocean and its continental shelf has recently attracted growing attention due to its estimated natural resources potential, observed climate and environmental changes and its puzzling tectonic evolution. The active plate boundary that runs through its youngest oceanic basin - the Eurasia Basin, includes the slowest spreading system in the world : the Gakkel Ridge. While the western part of this ridge has been explored by various Arctic expeditions, its eastern segment and associated conjugate margins are practically unexplored.

Here we present new data from the first systematic, high-resolution, 20560 km long seismic Arctic survey which image the two flanks of the basin, the slowest part of the Gakkel Ridge and the adjacent continental margins and basins. Interpretation of several seismic profiles, together with magnetic and gravity data analysis suggest that the ultra-slow spreading regime that started in the Late Eocene coincides not only with a change in the structure and bathymetry along the ridge, but also with faulting and doming in remote areas, particularly within adjacent continental blocks. Numerical 3D thermo-mechanical numerical modelling experiments suggest that this deformation is partly due to the bi-directional (transpression) active plate boundary stresses that are remotely transmitted. They show the possibility of development of complex conjugated fault patterns and simultaneous faulting in the oceanic rift domain and continental passive margin area in case of multi-directional stress field. The predicted surface deformation patterns resemble the observed topography and Late Eocene to recent faulting from the submerged Arctic continental ridges. These findings are of major importance for assessment of the mechanisms of evolution of ultra-slow spreading centers, lithosphere rheology and better understanding of the Arctic region.

Advanced ERC Grant 290864 RHEOLITH to Burov and Koptev

Mantle Lithosphere Interactions