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# Experimental study of structure-forming deformations in ultra-slow spreading Arctic and Polar Atlantic ridges

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The system of regional spreading ridges includes Reikjanes, Kolbeinsey, Mohns, Knipovich and Gakkel ridges. They are rather young (spreading initiated 58-60 Myr ago) and ultra-slow (spreading velocity < 20 mm/year). But all of them have peculiarities in structure patterns, kinematics, and morphology. In order to study geodynamical features of structure-forming on these ridges we apply experimental modeling. This study covers three of the ridges mentioned above: Reikjanes, Knipovich and Gakkel. The specified experimental complex and model material were used in modeling sets. The model material used in modeling is a colloidal system composed of mineral oils, solid hydrocarbon and surface-active substances. It has elastic-viscous-plastic properties, under temperature and strain rate, it is capable of failure like a brittle body. All experiments were held according to similarity conditions.

Reikjanes ridge is situated south-west of Iceland. It shows changes of morphology from north to south. The northern part of it is characterized by axial rise, the southern part – by axial valley. The main feature of axial morphology is presence of s-shaped axial volcanic ridges (AVRs). The angle between ridge trend and plate divergence trend is nearly 60°. All these features are explained by influence of mantle flow from the Iceland mantle plum initiating the increasing of mantle temperature. It results in decreasing of litospheric brittle layer with approaching to Iceland. The experimental setting was following. The weak zone was emplaced obliquely, crustal thickness and width of weak zone varied in sets. Conditions of northern part of the ridge were reproduced in sets with the widest weak zone and the smallest crustal thickness and vice versa. In sets reproducing conditions of northern province we received long and non-discontinued AVRs, on the other hand we received short and displaced AVRs in south-like conditions.

Knipovich ridge stretches along Spitsbergen continental margin. Ridge obliquity varies from 35 to 60° on different parts of the ridge. It consists of short divergent magmatic segments and long transform-like amagmatic segments with unstable relation of slip and extension components. Experimental setting was the following. We emplaced three weak zones according to natural geometry of spreading modeling three neighboring ridges: Knipovich, Mohns, Gakkel. Short spreading segments orthogonal to direction of extension formed in area of Knipovich model zone. They were connected by long slip segments subparallel to extension direction. Under increase of angle between extension direction and trend of "Knipovich" weak zone the length of slip segments gradually decreased and reached minimum under the angle of 50°.

The Gakkel ridge is the slowest in all the system of spreading ridges. Spreading velocity is less than 13 mm/year. Spreading is orthogonal here. Areas of volcanism are separated by 100 km long segments with minimal volcanic activity. This volcanic centers form orthogonal rises which has been stable for the last 30 Myr. Also the ridge has practically no discontinuities except the smallest with amplitude less than 13 km. Experiments were held in conditions of orthogonal extension with the smallest velocity. Formation of fractures had a linear pattern. Perpendicular to the ridge lineaments were the basic feature of structure forming. They were inherited from the primary discontinuities of fracture patterns.

Thus, experiments let to distinguish key peculiarities of structure-forming in rifting zones of these ridges. For Reikjanes ridge this is a system of s-shaped fractures which are used as channels for eruption and subsequent formation of AVRs. For Knipovich ridge this is an unstable system of pull-aparts. For Gakkel ridge this is a system of linear fractures and stable lineaments perpendicular to the ridge.