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Lena Trough (Arctic Ocean) is an oblique ultramafic continental margin

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Lena Trough is an ultraslow mid-ocean rift recent plate boundary in the Arctic Ocean. It is also, significantly, the most recent and final event in the separation of the North American from the Eurasian continent, and is the gateway for deep water circulation between the Arctic and North Atlantic oceans. Models for the tectonic configuration of Lena Trough have until now differed only in the number and length of fracture zones and spreading segments thought to be present. Most authors admit however, that because of inadequate data coverage, the tectonics of Lena Trough have remained undefined. However, persistent ice cover has prevented any systematic mapping and sampling in most of Lena Trough until now.

Here we report new mapping and sampling results from Lena Trough from the ARK XX-2 expedition of PFS Polarstern. Lena Trough is a deep fault-bounded basin with depths of 3800-4200m, and irregular, steep valley sides that are oblique to the spreading direction. Basement horst structures outcrop as sigmoidal ridges with steeply dipping sides project out of the valley floor, and are roughly parallel along flow lines to structures on either side. Ridge-orthogonal topography is simply absent (ie no segments trending parallel nor fracture zones perpendicular to Gakkel Ridge). Most faults trend approximately SSE-NNW, an obliquity with respect to Gakkel Ridge (SW-NE) of about 55?.

These results show that Lena Trough belongs to the newly defined amagmatic class of mid-ocean ridge spreading centers, which via an oblique spreading mechanism exposes nearly exclusively ultramafic mantle rocks. At the same time, Lena Trough

is a young ocean basin, having only about 9 million years of spreading history, the youngest ocean basin on Earth. Thus Lena Trough represents a transition form between a continental rift and an oceanic one.

The basement ridges are composed nearly entirely of mantle peridotite, as are the valley walls. Only at the northern and southern extremities of Lena Trough do basalts appear at all. Otherwise Lena Trough in unsegmented in any normal sense.

The Lena Trough is also the only known modern analog of the Iberia Margin, the conjugate Newfoundland Margin, as well as the ophiolite complexes of the Western Alps. It is significant that there is no evidence for low-angle detachment at Lena Trough. Instead, the thick lithosphere at Lena Trough results in decidedly thick-skinned rift tectonics, with steeply dipping fault surfaces and relatively narrow basement blocks.

Without significant basaltic infilling of the nascent ocean basin, or isostatic uplift of inside corner highs, subsidence to very great depths ($>$4000m) probably occurred rapidly after trans-tensional motion began on the plate boundary in the Miocene.