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The ultraslow spreading Gakkel Ridge - a geophysical view

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The Arctic Gakkel Ridge is not only the northernmost, but also the slowest-spreading ridge worldwide (6-13 mm/a full spreading rate). It plays therefor a key role in understanding melt generation and crustal accretion processes. Most theoretical models predict decreasing melt generation and crustal thicknesses and increasing occurence of peridotites for slow and ultraslow spreading rates. Wide-angle seismic data in the rift valley yielded crustal thicknesses well below 4 km. A three-dimensional gravity modelling revealed thicknesses between nearly zero and 6 km on the rift flanks and in the adjoining basins. The relative thin crust in the rift valley endorse these models. But all crustal thicknesses are completely independent from the spreading rate. Instead, areas of high crustal thickness werde found near several basement ridges perpendicular to the central valley. High magnetic amplitudes there, spreading anomalies across these ridges and the recovery of basalts in these areas give evidence for discrete volcanic centers and long-term focussed magma supply.

Similar observations at the Southwest Indian Ridge led to the postulation of a new class of ridges, the ultraslow spreading ridges. The main characteristics of this new class of ridges are discrete basaltic centers with relatively high crustal thicknesses, and very thin crust and the appearance of peridotites in between. For the Gakkel Ridge, this is only true for the older part, east of 3° 30' W, where spreading persists for more than 55 Ma. West of 3° 30' W, spreading began approximately 35 Ma ago. In this part, only basalts werde dredged and seismic data shows crustal thicknesses of more than 5 km in the rift valley. Gravity modelling yielded a less dense mantle beneath the valley than in the eastern section. Together with very high magnetic anonalies, this indicates a slightly warmer mantle and increased magma supply. The boundary of the two different spreading regimes is surprisingly sharp and is clearly visible in bathymetric and magnetic data. This rises the question, whether there is also a sharp

discontinuity in the upper mantle.