EXTENSIONAL DEFORMATION ALONG THE GAKKEL MID-OCEAN RIDGE [10°-28°E]: EVIDENCE OF EXTENSIONAL LOW ANGLE DETACHMENT FAULTS FROM SCICEX 98 AND 99 SIDESCAN AND BATHYMETRY DATA.

Gregory J. Kurras[1], M.H. Edwards[1], J.R. Cochran[2], and B.J. Coakley[3]

[1] Dept. of Marine Geology and Geophysics, School of Ocean Earth Science and Technology, University of Hawaii, Honolulu, Hawaii 96822; 808-956-3593; email: gkurras@soest.hawaii.edu
[2] Dept. of Geology and Geophysics, Lamont-Doherty Earth Observatory, Palisades, NY 10964
[3] Dept. of Geology, Tulane University, New Orleans, LA 70118

The slowest spreading mid-ocean ridge on Earth, the Gakkel Ridge, stretches from the Spitzbergen transform to the Laptev shelf, with full-spreading rates between 1.33 cm/yr at the western end to 0.63 cm/yr at the eastern end. In 1998 and 1999, a joint effort by the U.S. Navy and U.S. National Science Foundation acquired gravity, swath bathymetry and sidescan, and chirp sub-bottom profiler data along the Gakkel Ridge with a newly designed geophysical survey system called SCAMP (Seafloor Characterization And Mapping Pods). The SCAMP data provide complete coverage 50 km along either side of the ridge axis (~8.5 Ma crustal age) covering a range of spreading rates from 1.3 to 1.13 cm/yr [5°-74°E].

Analyses of the sidescan and bathymetry data show that tectonic deformation dominates the morphology of the ridge, with vertical relief of the axial-valley and rift-mountains frequently exceeding 2 km. Bathymetric data along a 100 km length of the ridge [10°-28°E] show a series of axis-parallel asymmetric ridges along the northeast and southwest flanks of the ridge and broad bathymetric highs along the southeast and northwest flanks. An across-axis bathymetric high with ~2 km of relief and the axial valley divide this portion of the Gakkel ridge into four distinctive quadrants. The axis-parallel asymmetric ridges within the northeast and southwest regions have vertical relief ranging from 400 to 1000 meters with dip angles from 12.5° to 26.5°. The outward (away from axis) fault planes are steeper than the inward planes in 4 of 6 cases. Gravity data for this region indicate reduced crustal thickness, with thicker crust under the across-axis high. These crustal variations, the morphologic polarity switch between the NE-SW and SE-NW regions, and the presence of the across-axis ridge are similar to 'inside corner - outside corner' geometry observed on other slow-spreading centers. This geologic setting, the style of faulting, and the current magmatic/tectonic state of this region suggest these axis-parallel ridges are large low-angle detachment faults similar to the extensional core complexes identified along the Mid-Atlantic Ridge [i.e. Blackman et al., 1998; Tucholke et al., 1998; Cann et al., 1997; Christie et al., 1997; Cannet et al., 1995].

The ridge flank morphology and style of deformation observed indicate the asymmetric axis-parallel ridges are low-angle detachment faults produced by a highly extensional stress environment with little to no magmatic input. This geology and reduced crustal thickness suggest this region of the Gakkel Ridge is in the early stages of tectonic unroofing with possible exposures of serpentized upper mantle. This style of extensional deformation along the Gakkel Ridge may account for the reduced crustal thickness and along and across-axis crustal variability inferred from regional gravity data [Coakley and Cochran, 1998.].