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Oblique extension of slow- spreading ridges

J. van Wijk(1,2) and D. Blackman(1)

(1) Scripps Institution of Oceanography, UCSD, La Jolla, CA, USA (jvanwijk@ucsd.edu), (2) Now at Los Alamos National Laboratory, Los Alamos, NM, USA

Oblique extension occurs in both continental and oceanic tectonic settings and is documented at ridge systems with various spreading rates. In this study we concentrate on a slow-spreading mid-ocean ridge segment, and study the new plate boundary that is formed after the extension direction has changed from orthogonal to oblique. Slow- and very slow oblique spreading systems are often comprised of en-echelon axial volcanic ridges. These oblique highs in the rift valley are loci of magma injections. The axial valley ridges are not necessarily oriented exactly orthogonal to the current spreading direction; they are usually sub-orthogonal. Oblique spreading rifts can exist for tens of My and appear to be stable systems; Mohns Ridge in the Norwegian-Greenland Sea for example has an average spreading direction that is oblique since Anomaly 7.

We have chosen a numerical modeling approach that enables clarification of some of the dynamic aspects of the system. Our experiments confirm most interpretations of geophysical and geological datasets of oblique, slow spreading ridges. When extension of oceanic lithosphere becomes oblique, deformation localizes in distinct upwelling centers that are oriented according to the oblique extension direction. Temperatures are elevated in these cells that form the new plate boundary and are connected by shear or accommodation zones. Because of their similarity to the axial volcanic ridges documented at Mohns and Reykjanes Ridges, we suggest that these are the loci of extensional deformation, upwelling and magmatic activity. The new spreading cells are shallow features which might explain why the system can exist for long periods of time. Magma production in the oblique ridge system is predicted to be less than in an orthogonal system because of the less developed upwelling system and conductive cooling of the short sub-segments. The orientation and length of the newly formed axial ridges are dependent on the rheology (weakness) of the axial zone, and not directly

on the extension velocity.