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A MODEL FOR FOLD AND NAPPE DEVELOPMENT IN THE DOVREFJELL MOUNTAINS, WESTERN NORWEGIAN CALEDONIDES

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The Western Gneiss Terrane of central Norway consists of a series of ductile fold nappes formed at depths of 20-60 km in the continental crust during a Silurian continental collision. A study in the northern Dovrefjell suggests that complex interference patterns characteristic of the region are the result of a single progressive deformation. Following, or coeval with, the initial stacking of four thrust sheets was the development of tight to isoclinal folds, including sheath folds, with E-W axes parallel to a strong stretching lineation, and associated with a proto-mylonitic transposition foliation. Final large scale folding was produced by steep heterogeneous shear antithetic to the earlier east-verging structures.

Computer-simulated passive folding was used to model the deformation. Simple shear of undulose layers of low amplitude ($\lesssim$1:50) creates strong sheath folding at about γ =20. Active folding should additionally accentuate this. A rotation and antithetic heterogeneous shear was then imposed. Cross-sections through the model exhibit the main geometric features observed in outcrop and map pattern.

To account for these kinematics a model for ductile nappe formation is proposed based on the instability of slip lines in a non-linear plastic material flowing under gravity. Using present flow laws quartz rich rocks will flow (-log $\dot{e}$=13 to 10 sec^{-1}) at 500-600°C and 20 km if surface slopes are 1-2°. Additional horizontal deviatoric stress, or a decrease in surface slope, will strongly steepen the slip lines. This places layering sub-parallel to old slip lines into a shortening field, resulting in fold formation. As only small stress increases are required ($\lesssim$10 MPa) multiple generations of folding can easily occur. Larger rotation of slip lines may result in antithetic shearing.