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The Mechanics Of A Growing Critical Taper: New Insights From High Resolution Video-Laser Scans And In-Situ Stress Measurements In Analogue Models

D.A. Nieuwland and M. Saher
Vrije Universiteit, de Boelelaan 1085, 1081HV Amsterdam, The Netherlands
corresponding author, D.A. Nieuwland; e-mail: nied@geo.vu.nl

The concept of a critical taper in the formation of fold-and-thrust belts has been the basis for structural interpretation and analysis of the mechanics of FTB systems. Recent analogue models, analyzed with high-resolution video-laser scans, have provided new insights into the mechanics of growing critical tapers. The results show that in particular the critical state of the taper needs to be reviewed. The video-laser scans reveal that a taper is not entirely in a critical state (failure condition), as is suggested in the original theory, but that the taper is mechanically partitioned. This partitioning is expressed through cycles of increased and reduced activity, along thrust faults within the taper. The angle of the taper is not constant, it varies systematically with the cycles. In-situ stress measurements correlate with the observed cyclic taper activity. Out-of-sequence thrusting is rule rather than exception and correlates with the measured cycles in the in-situ horizontal stress. Increased horizontal in-situ stress correlates with an increasing taper angle, which is effected by out-of-sequence thrusting. A relatively low in-situ stress correlates with a normal sequence overthrust phase.

The cycles are expected to leave a signature in sedimentation and stratigraphy. A steep taper will lead to more erosion and sedimentation, whereas a low-angle taper will be related to lower sedimentation rates.