PSEUDO-THREE-DIMENSIONAL MODELING OF DETACHMENT FOLDS

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Geologists now recognize the presence, abundance, and importance of detachment folds as fundamental structural elements in contractional fold-thrust belt systems. Numerous two-dimensional kinematic models exist to simulate such folds by maintaining constant area between the deformed and undeformed states and by assuming that detachment folds develop with fixed axial surfaces, migrating axial surfaces, or a combination of the two processes. For a majority of these published models, we created Microsoft Excel™ VBA programs that allow users to rapidly and accurately construct model detachment folds in order to examine the effects of changing various model parameters. Sequential serial sections of these two-dimensional models then were used to create pseudo-three-dimensional models of detachment folds, which allow the study of along-strike changes in detachment fold geometry (particularly those near fold terminations) implied by each of the kinematic models.

We created a library of pseudo-three-dimensional models of detachment fold terminations that assume a constant initial stratigraphy, a symmetrical fold geometry, and a constant along-strike displacement gradient (decreasing to 0 at the fold termination). Comparative analyses of the model terminations reveal significant along-strike differences, including: (1) changes in limb dip and limb length, (2) changes in fold width, (3) changes in fold amplitudes and fold plunges, (4) changes in stratigraphic thicknesses, and (5) syncline development perpendicular to the main fold axis. The along-strike characteristics unique to each model may help determine the operative deformation mechanism for natural detachment folds from map data and may help predict unconstrained characteristics of natural detachment folds (e.g., detachment depth) in subsurface interpretations.

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