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Modelling of lateral fold growth and fold linkage: Applications to fold-and-thrust belt tectonics

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We use a finite element model to investigate the three-dimensional fold growth and interference of two initially isolated fold segments. The most critical parameter, which controls the fold linkage mode, is the phase difference between the laterally growing fold hinge lines: 1) “Linear-linkage” yields a sub-cylindrical fold with a saddle at the location where the two initial folds linked. 2) “Oblique-linkage” produces a curved fold resembling a Type II refold structure. 3) “Oblique-no-linkage” results in two curved folds with fold axes plunging in opposite directions. 4) “Linear-no-linkage” yields a fold train of two separate sub-cylindrical folds with fold axes plunging in opposite directions. The transition from linkage to no-linkage occurs when the fold separation between the initially isolated folds is slightly larger than one half of the low-amplitude fold wavelength.
The model results compare well with previously published plasticine analogue models and can be directly applied to the investigation of fold growth history in fold-and-thust belts. An excellent natural example of lateral fold linkage is described from the Zagros fold-and-thrust belt in the Kurdistan Region of Iraq. The fold growth in this region is not controlled by major thrust faults but the shortening of the Paleozoic to Cenozoic passive margin sediments of the Arabian plate occurred mainly by detachment folding. The sub-cylindrical anticlines with hinge-parallel lengths of more than 50 km have not developed from single sub-cylindrical embryonic folds but they have merged from different fold segments that joined laterally during fold amplification and lateral fold growth. Linkage points are marked by geomorphological saddle points which are structurally the lowermost points of antiforms and points of principal curvatures with opposite sign. Linkage points can significantly influence the migration of mineral-rich fluids and hydrocarbons and are therefore of great economic importance.