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Reactivation of a syn-growth unconformity during flexural-slip folding (Bóixols Anticline, Pyrenees, Spain)

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The contractive growth strata of the Bóixols anticline (Spanish Pyrenees) include a major Upper Cretaceous syn-kinematic unconformity outstandingly exposed at the anticline forelimb. The unconformity divides and decouples the growth-sequence in two units of contrasting geometry. In the outer sector of the forelimb, the unconformity preserves its stratigraphic attitude, showing an angle of less than 20º and separating near-vertical to south-dipping upper and lower unit syn-kinematic strata. In the central portion of the forelimb, the multilayered lower unit acquires a near-vertical attitude, whereas layers of the upper unit become shallow-dipping. The angular unconformity there is about 90° and the unconformity is affected by meso-faults and S-C structures providing a top to the foreland shear sense. Such a shear zone is offset by high-angle reverse faults propagating from the underlying layer-parallel faults of the lower syn-kinematic unit. In the inner sector of the forelimb, strata of the lower and upper units are overturned and near-vertical, respectively. Still, the unconformable contact represents a shear zone, indicating a top to the crest shear sense.
Shear senses along with relative timing and cross-sectional distribution of deformation structures, indicate flexural-slip folding in the growth sequence. Layer-parallel anisotropies oblique to each other were active at the same time and only during the later stage of folding, when layers of the lower unit were becoming orthogonal to those of the upper package, the flexural-slip mechanism arrested in the upper package. These observations point out that, regardless of its orientation, layering in the growth sequence of the Bóixols anticline promoted stress channeling, with the maximum stress keeping about parallel to beds almost for the entire folding process.