Mechanical Stratigraphic Control on Deformation in a Fault-Propagation Fold, Gobbler Anticline, Sacramento Mountains, NM

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ABSTRACT

To date, insufficient analog data exist to aid prediction of the style, intensity, and distribution of critical strain elements in tightly folded structures. Prediction of strain distribution is especially problematic within interstratified carbonate and siliciclastic/argillaceous lithologies that create strong mechanical anisotropies. Documentation of the structural processes and stratigraphic architecture on a full spectrum of scales and across a well-constrained structure was conducted to provide a more complete understanding of deformation styles. The fold geometry and structural mechanisms associated with growth of the Gobbler Anticline, a north-trending, doubly plunging, fault-propagation fold above a blind, basement-rooted reverse fault with en echelon tear faults was constrained via a balanced cross section, virtual outcrop models and orthomosaic photographs. The Gobbler anticline consists of tightly folded and faulted mixed lithofacies; specifically, thick-bedded limestones intercalated with thin-bedded clay-rich intervals, characteristic of the Bug Scuffle Member of the Gobbler Fm. Measured sections (470 m) assess the distribution of facies while mechanical rock property analyses document the unconfined compressive strength of the rocks. Thin sections and X-Ray fluorescence provide improved understandings of lithological controls on deformational mechanisms. Pre-Permian uniformities and thinning of the overlying mid-upper Pennsylvanian strata indicate shallow overburden at the time of initial deformation and constrain the syn-Gobbler (Missourian, 307 ma) timing for development of the Gobbler Anticline. We find that argillaceous wackestones are disproportionately weakened when involved in folding soon after deposition and mechanical layering is a dominant control on fracture development in more deformed areas. This study illustrates the value of a tightly constrained mechanical stratigraphic model for prediction of fracture distribution and fold geometry.

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