Constraining fold geometry by application of airborne laser swath mapping at Sheep Mountain anticline, Wyoming

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Sheep Mountain anticline (SMA), Wyoming, is an asymmetric fold resulting from Laramide compression accommodated by an underlying basement-cored thrust fault. Excellent outcrop exposures, as well as a wealth of data including detailed mapping and interpretation of fractures, make SMA an ideal site for studies relating the mechanics of fold evolution to present day fold geometry and fracture patterns. One of many challenges in relating folding to fracturing arises because most fractures are below the resolution of industry standard seismic imaging, and imaging quality deteriorates rapidly in regions of high topography typical of reservoir-scale folds with quality outcrop exposures. Therefore, alternative methods must be found to constrain fold geometry at sites where outcrop fracture data is available. To constrain fold geometry at SMA we have obtained an airborne laser swath mapping (ALSM) digital elevation model (DEM) from the National Center for Airborne Laser Mapping (NCALM). We present the DEM, on which we have mapped bedding-plane exposures of several prominent stratigraphic horizons. We use differential geometry to characterize the curvature of these outcrop exposures, considering both principle curvatures, and classifying the surfaces into 8 different fundamental shapes. Future work with this data will include the construction of a 3D model of fold geometry by interpolation of mapped bedding exposures, subsequent mechanical analysis of folding induced stress perturbations throughout structural growth, and the analysis of these stress perturbations as they relate to observed fractures.