I. Introduction

The Stillwell anticline is a significant structure in the western Texas fold belt, providing insight into the tectonic processes that shaped the region. This study focuses on understanding the interactions between folds and faults, particularly the erosional forces that have exposed cross-sectional views of the fold at different locations along the anticline.

II. Tectonic History of the Big Bend Region and the Stillwell Anticline

The geologic history of the Big Bend Region, including the Stillwell anticline, is characterized by a series of tectonic events dating back to the Neoproterozoic. The anticline shows gently sloping limestone layers, with a long, sub-horizontal midlimb and a steeply-dipping backlimb. The backlimb dips shallowly toward the SW, and the midlimb is long and gently-foreland-dipping.

III. Fault-propagation Folding and the Trishear Model

Fault-propagation folding is a key mechanism in the formation of anticlines. The Stillwell anticline exemplifies this process, with an asymmetrical fold that is more than 8 km long. The limestone units that form the forelimb dip steeply toward the northeast, similar to the gently-dipping backlimb, a long, gently-foreland-dipping midlimb, and a steeply-dipping less displacement along the fault.

IV. Variations in Fold Geometry

The study of fold-fault interactions reveals thickly-bedded limestone units that are gently bent along the hinge zone of the anticline. The intensity of fracturing is significantly greater adjacent to the more significant faults, such as those shown in Figure 10. The diversity of geologic formations found in the Stillwell anticline is evident in Figures 9 and 11, showing fault-bedding relationships as exposed in Cretaceous units.

V. Photogrammetric 3D Modeling

Photogrammetry was utilized to produce a 3D model of an exposed section of the Stillwell anticline. The model enabled the manipulation of the outcrop in three dimensions, permitting the observation and documentation of areas that were previously inaccessible. This model confirms the short, poorly-defined midlimb and the medium length backlimb.

VI. Mechanisms of Strain Accommodation in Hinge-zone and Forelimb

Understanding the mechanisms of strain accommodation in the hinge and forelimb areas is crucial. The study of fault-propagation fold evolution, as seen in Figure 13, suggests that planes of weakness (intra-bed bedding faults) may contribute to fluid flow rates, as observed in Figures 10 and 11. The role of mechanical stratigraphy in fault-propagation fold evolution is further emphasized by the simulations shown in Figures 10 and 11.

VII. Implications for Fluid Flow

Interpreting the effects of fluid flow on the Stillwell anticline, Figures 10 and 11 show fault-bedding relationships exposed in Cretaceous units in the second location. Fluid flow rates rely on the connectivity of fractures, and the model suggests that the forelimb and hinge zones are critical areas for fluid flow.

VIII. Interpretations and Conclusions

The role of mechanical stratigraphy in fault-propagation fold evolution is highlighted in Figures 10 and 11. The model supports our view that flat-ramp geometries accommodate a significant percentage of the shear within the forelimb and hinge zone of the anticline system.

Acknowledgments

The authors acknowledge the hospitality and logistical support of the Stillwell Anticline Project participants, who contributed to the success of this study. Special thanks to Allmendinger, R. W., 1998, Inverse and forward numerical modeling of trishear fault-propagation folds, Tectonics, v. 17, p. 640-656.