The Role of Mechanical Stratigraphy in Fault-Propagation Fold Evolution: A Case Study

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Introduction

Previous studies have demonstrated the influence of mechanical stratigraphy on fold development, suggesting that strain fields and deformation patterns can vary significantly between stratigraphic units (e.g., Moustafa and Maler, 1990; Moustafa, 1983; Moustafa, 1988). This study examines the relationship between mechanical stratigraphy and deformation patterns in the Stillwell anticline, where field observations and theoretical modeling have suggested that the mechanical stratigraphy of the Santa Elena limestone is critical to understanding the evolution of this structure.

Geologic Background

The Stillwell anticline is a north-south-trending fold in the Laramide fold belt of West Texas, USA. The fold is approximately 15 km long and 5 km wide, and is located in the San Andres uplift, which is a significant structural feature in the region.

Mechanical Stratigraphy of the Santa Elena Limestone

To evaluate the mechanical stratigraphy within the Santa Elena anticline, we performed field-based analyses of the stratigraphy exposed within the fold system. We observed that the Santa Elena limestone contains a variety of lithologies, including thick-bedded limestone, thin-bedded limestone, and shale. These different lithologies have different mechanical properties, and their distribution can influence the deformation patterns within the fold system.

Hinge Zone Deformation and Mechanical Behavior

The hinge zone of the Stillwell anticline is a region of intense deformation, where the rock is subjected to high strains. This region is characterized by the development of faults and shear zones, which can cause significant changes in the mechanical properties of the rock.

Modeling

Kinematic forward computer modeling of the coupled fault-fold system beneath the Stillwell anticline was performed to better understand the relationship between mechanical stratigraphy and deformation patterns.

Conclusions

The present study suggests that mechanical stratigraphy plays a critical role in the development of fault-propagation fold systems. Understanding the mechanical properties of stratigraphic units is crucial for predicting the evolution of these structures.

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References


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