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Geometric Properties of Active Piercement Structures: Geologic Insights from 3-D Kinematic Models

Three-dimensional forward modeling is used to describe a geometrically viable evolution of faulted salt domes. Field evidence indicates that faulting above piercement salt domes initiates with two or three crossing master faults. Forward kinematic modeling shows that simultaneous movement on the master faults causes them to be mutually offsetting. A critical control on the structural style of model dome is whether the top of salt is faulted or not. Model results imply that if the top of the salt is faulted, there is a greater chance of small-scale faults developed in the major flank grabens bounded by master normal faults. Cross sections cut from models indicate that structural patterns of three-dimensional structures like active salt domes are very variable when observed in two-dimensional cross sections. A single dome is very asymmetrical in perpendicular sections, but symmetrical in parallel sections, and in both parallel and perpendicular cross sections, structural patterns change significantly when the position of section planes changes. Model results suggest that when interpreting active salt domes, structural patterns determined from one seismic line might not be applicable to the adjacent section. Field example and model dome indicate that the central graben of active salt dome is commonly highly deformed and always show unrestorable structural thinning because of out-of-plane volume transport. Model results have been applied to give insight into the potential problems of the interpretation of the Clay Creek dome, Texas and provide alternatives.