AAPG Search and Discovery Article #90007©2002 AAPG Annual Meeting, Houston, Texas, March 1-13, 2002

AAPG Annual Meeting
March 10-13, 2002
Houston, Texas

Nathan J. Kuhle[1], Judith S. Chester[1], Frederick M. Chester[1] (1) Texas A&M University, College Station, TX

Fault and Fracture Fabrics of Inversion Structures: Effect of Burial History and Rock Ductility

Mechanical properties of sedimentary strata, such as relative ductility (ability to flow), influence faulting and folding within inverted basins. Ductility depends on lithology, and varies with time as a result of burial, exhumation, compaction, lithification, fluid pressurization, and tectonic loading. We use physical models constructed of rock and deformed at elevated confining pressure to investigate the effect of rock ductility on development of inversion structures. Models consist of a limestone layer above a 708 dipping fault in a rigid medium that is subjected to layer-parallel extension followed by coaxial contraction. Models are scaled for faulting and folding of sedimentary strata exhibiting elastic-plastic behavior where gravity driven stress gradients are insignificant.

During extension, the curvature and complexity of normal faults increase with ductility. For low ductility, extensional faults weaken, becoming dilatant zones relative to surrounding rock. These faults are preferred for reverse-reactivation during subsequent contraction. For high ductility, normal faults strain-harden, promoting the formation of new reverse faults upon contraction. In general, a monocline above a fault-bounded, upthrusted wedge forms, but the geometry greatly depends on ductility during the contraction phase. The fracture fabric is dominated by subvertical fractures produced in the hanging wall and footwall during extension, and subhorizontal fractures produced in the footwall during contraction. The resulting fracture fabric reflects a superposition of extensional and contractional fabrics in the footwall and fault-bounded wedge. Model results may be useful to the analysis of complex traps in inverted basins and to the prediction of fault and fracture geometries in the subsurface.