Geophysical Research Abstracts
Vol. 13, EGU2011-10809, 2011
EGU General Assembly 2011

Constraints on mechanical modelling of folding provided by matrix deformation and fracture network analysis: The case of Split Mountain (Utah, USA)

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The Split mountain anticline (Utah, USA) is a well-exposed, basement-cored anticline that formed during the Laramide orogeny in the early Tertiary. Combined assessments of anisotropy of magnetic susceptibility (AMS), anisotropy of P-wave velocity (APWV) and Fry strain analyses at the matrix scale, were carried out to reconstruct the framework of the diagenetic and macroscopic fracture network evolution. A scenario of strain record is proposed based on the correlation of (1) fracture sets orientations, (2) cementation and dissolution history, (3) paleostresses directions and (4) distribution of matrix based magnetic susceptibility anisotropy. The diagenetic evolution of the rock petrophysical properties and the evolution of the fracture network, in terms of creation and reactivation of fracture sets, are confronted and tentatively explained. Following the Sevier orogeny and N120 fracture set development, fractures forming at N035 in strike and AMS signal were recording the Laramide Layer Parallel Shortening phase. In detail, local deviation along pre-existing structures, and a recorded partitioning of the strain during early folding can be documented, with a maximum horizontal stress axis perpendicular to the fold E-W bounding faults. A series of finite element's mechanical models of the folding scenarii for Split Mountain Anticline and the Weber Sandstone Formation demonstrates the need for an evolving constitutive law, which integrates the role of preexisting fracture set during folding.
The example of the Split Mountain folding provide excellent structural and sedimentological data sets and offer consistent observations to better understand the possible diagenetic and mechanical scenarii for the development of folding.
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