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Mechanical Reconstruction of Fracture Development in Weber Sandstone Formation, Split Mountain (Utah)

A technique is presented to constrain the prediction of natural fractures which could be linked to reservoir simulations. It uses an original elasto-plasticity model in combination with a 3-D restoration tool to simulate the activation of pervasive fracture sets during a fold deformation history. The issue is to bring a comprehensive scheme for ranking the various type of discontinuities which have influenced flow properties in the reservoir. The advantages of this methodology are illustrated on a reservoir analogue in the Permian Weber formation, outcropping at Split Mountain anticline (Utah). A field study was performed in 2002 to gather data on the nature and geometry of discontinuities observed in the anticline termination, crest and limbs. Among the various type of structures observed (minor reverse faults, joints, normal faults and shear bands) a marked fracture set is striking WNW-ESE, obliquely to the fold major axis. An open question is to determine the relative chronology between this fracture set and the Laramide fold development. Starting with the 3-D restoration of Split Mountain anticline, a series of 3-D finite-element models of the folding are analyzed, assuming or not the presence of the dominant fracture set before the folding. Depending on this initial fracture configuration, the fracture patterns obtained are drastically changed. The modeling also provide constraints on the chronology of opening and sliding of other fracture sets over the whole domain. Comparison with field data helps to select the best scenario. For application to sub-surface reservoirs, a list of recommendations is provided.