Geophysical Research Abstracts
Vol. 13, EGU2011-5614, 2011
EGU General Assembly 2011

The sedimento-diagenetic control on the multiscale fracturing of a carbonate reservoir, the Madison Formation (Sheep Mountain, Wyoming, USA)

Mickael Barbier (2), Jean-Paul Callot (1), Jean-Marc Daniel (1), and Youri Hamon (1)

(1) IFP énergies nouvelles, Département Géologie, Géochimie, Géophysique, 1-4 avenue Bois Préau 92852 Rueil Malmaison, France (mickael.barbier@ifpenergiesnouvelles.fr), (2) Laboratoire de Géologie des Systèmes et Réservoirs Carbonatés, EA 4234, Université de Provence, 13331 Marseille, France (mickael.barbier@etud.univ-provence.fr)

This study aims at to understand the geometric evolution of the fracture network at Sheep Mountain Anticline (Wyoming, USA). In order to properly identify and understand the influence of sedimento-diagenetic evolution on the fracturing facies within a carbonate reservoir analogue, we choose the case study of the Madison Limestone (Wyoming), outcropping in the core of Sheep Mountain. From petrographical and diagenetic analyses, we demonstrate that the diagenetic processes are differently expressed depending on sedimentary facies: mudstones present an intense early dolomitisation, and mud-supported facies are partially dolomitized, whereas grainstones display early calcite cements.

The far stress field of the Sevier Orogeny involved mostly the formation of microstructures within the Bighorn Basin, associated to a N130 strike slip stress and the formation of a first fracture set along the incipient Sheep Mountain fold. Set I fractures are partly persistent and are formed during the end of the burial history, and are reactivated latter as shear-band zones, during Laramide folding. Secondly, the compressive Laramide stress field is mainly expressed by flexural slip and by the formation of two macroscopic fracture sets. Set II corresponds to vertical veins perpendicular to the fold orientation, accomodating layer parallel shortening. These fractures are mostly developed in the hinge, nose and backlimb of the fold during the Laramide compression. They are mainly bed-confined, exhibits a very poorly develop fracture network at the first and second order of fracturing. On the contrary, Set III is composed of highly connecting fractures striking N130°E (parallel to the fold orientation) and is considered to have developed during folding in response to bending. They are mostly localized in the hinge and the crest of the anticline and show a large vertical extend. At the microscale, pressure-solution cleavage and grain-scale deformation (e.g., mechanical compaction, inter/intra grain fracturing, twinning in calcite grains) complement this scenario of fracture network development related to evolution of the fold as defined by the macroscale informations.

The fracture distribution show (1) a clear impact of dolomitisation on the fracture pattern at small scale. Fracturation is more diffuse, less persistent in the dolostone, while it appears more localized and well connected in limestones and especially in oolitic grainstones; (2) at large scale, density, shape and vertical persistence of fractures are influenced by the initial sedimentary facies and its diagenetic imprint. First order mechanical units, composed of through-going persistent joints, are partly controlled by the main stratigraphic surfaces and major faciologic and texture changes. Smaller mechanical units at bed-scale directly relate to the coupled effect of sedimentary facies and diagenetic property modifications.