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3-D Multi-Scale Characterization of Fractured Carbonates in Field Analogues on the Maltese Islands: Workflow and Preliminary Results

Mattia Martinelli[1], Andrea Bistacchi[1], Silvia Mittempergher[1], Fabrizio Balsamo[2], Andrea Succo[2], Fabrizio Storti[2], Pierre-Olivier Bruna[3], Giovanni Bertotti[3], and Marco Meda[4]

[1]University of Milan, Milan, Italy.
[2]Università di Parma, Parma, Italy.
[3]Delft University of Technology, Delft, Netherlands.
[4]ENI, San Donato Milanese, Italy.

ABSTRACT

Fluid transport and storage properties in fractured carbonates are controlled by the distribution of fractures, particularly at the 1-m to 100-m scale. However, fractures are poorly imaged in seismics at this scale, and wells provide just a sparse 1D sample in a 3D volume. Quantitative studies on field analogues of reservoirs allow to characterize the fracture patterns in relation with geodynamic history, mechanical stratigraphy and structural geology. Well constrained and statistically significant field data provide the opportunity to elaborate predictive laws to be applied in subsurface reservoirs. In the Maltese Islands the Late Oligocene-Early Messinian carbonatic sequence was affected in the Miocene by a N-S extension that resulted in two sets of normal faults trending N50° and N120°, with stratigraphic separation up to 150m. The approach proposed in this project integrates a rich outcrop analogue dataset, with 3D geostatistical modelling that allows upscaling the fracture parameters at the reservoir scale. We selected key outcrops in different units to quantitatively characterize the fracture pattern and its variability within different mechanic/stratigraphic facies. We collect fracture data using scanlines and/or 3D Digital Outcrop Models (DOM) based on photogrammetric surveys, and we integrate into the dataset additional structural observations allowing a proper kinematic characterization of fractures/faults/veins. At the same time we develop 3D geological models at the scale of the whole islands (c. 10km), hence at the reservoir scale. The geological and structural model is based on surface geology and on a rich database of > 150 boreholes. Here we present the modelling workflow and preliminary results obtained populating the 3D model with fracture properties, testing different geostatistical approaches.