Geophysical Research Abstracts
Vol. 18, EGU2016-13501, 2016
EGU General Assembly 2016

3D modelling of a dolomitized syn-sedimentary structure: an exhumed potential analogue of hydrocarbon reservoir.

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The decrease in discoveries of new hydrocarbon reservoirs has twofold implications: i) the need to improve our knowledge of classic reservoirs, such as traps within extensional syn-sedimentary structures, and ii) enhanced efforts aimed at better understanding complex type of reservoirs. In particular, in the last few years, fault related dolomitized bodies, often associated to extensional faults, received worldwide attention thanks to the capability of dolomitizing fluids to improve the pore network. However, the shape and geometries of the dolomitized bodies within complex fault network as well as the related porosity distribution and evolution is difficult to predict. The study of outcrop analogues can help to solve these issues.
In this work, we focused our attention on the Early Jurassic carbonate sediments of the Calcari Grigi Group deposited on the Trento Platform (Italian Southern Alps). The stratigraphic succession encompasses (from bottom to top): the peritidal limestones of the Monte Zugna Formation, the initially highly porous Loppio Oolitic Limestone and the nearly tight marls and marly limestones of the lower Rotzo Formation.
During Early Jurassic, after the deposition of the Loppio Oolitic Limestone, the Trento Platform underwent syn-sedimentary extensional tectonics, which caused the formation of numerous tilted blocks. Differential subsidence of these blocks is testified by abrupt thickness changes in Rotzo Formation. This created a structural framework favourable to the formation of syn-sedimentary extensional traps (with the Loppio Oolitic Limestone as reservoir and Rotzo Formation as seal).
In the Tertiary, Alpine compressional tectonics caused the reactivation of the Jurassic faults with a strike slip kinematics and was associated with the circulation of dolomitizing fluids. The combination of these events led to the formation of secondary fault-related dolomitized bodies. The enhanced pore network in correspondence of the dolomitized dykes further increase the potential creation of potential hydrocarbon traps.
These complex conditions are visible in a syn-sedimentary structure spectacularly exposed on the Monte Testo (Trentino, Italy). In this contribution, we present a 3D geo-model of this structure, obtained with SKUA-gOcad, based on 3D photogrammetric modelling, detailed geological mapping and structural analysis, porosity analysis carried out on representative sections, and geostatistical simulation of porosity on dolomitized bodies.
Thanks to the 3D model we obtained: i) a thickness map of the Rotzo Formation that allow us to understand which faults were active during the deposition of the formation and which areas could have been more suitable for hydrocarbon accumulation; ii) a geometric and volumetric model of the structure that permitted us to study the porosity distribution and to define the potential volume of hydrocarbons that could be hosted by a similar structure. These results were eventually extrapolated to the entire platform, providing clues on the hydrocarbon potential of similar buried geologic bodies.