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Controls on dolomitization of the Latemar platform (Dolomites, northern Italy)

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The Anisian-Ladinian Latemar platform presents a spectacularly exposed outcrop analogue for carbonate reservoirs in close relation to fracture controlled igneous influence and dolomitization.Although the Latemar is one of the best studied carbonate platforms worldwide, reservoir characteristics of the dolomite units were not yet explored and dolomite distribution description was based on a limited (stratigraphic) portion of the platform outcrops (Carmichael, 2006-2008). This study extends the previous studies to the complete exposed interval in which dolomite bodies occur (including the less accessible Valsorda valley).

LiDAR technology is used in order to overcome field accessibility limitations. Field observations and measurements are combined with LiDAR scanning and high resolution photography into a 3D digital outcrop model. Furthermore additional lithology information can be derived from the obtained 3D digital outcrop model, based on rock colour, at high resolution with high accuracy. The resulting dataset can be used for an objective mathematical description of the dolomite distribution. Additionally measured dolomite reservoir characteristic variation can be studied for the whole platform.

The Latemar platform is crosscut by numerous sub-parallel mafic dikes, associated to the Predazzo intrusion complex (∼238 Ma), located few kilometres to the south. The emplacement of the dikes comprises around 7% of the present day bulk rock volume. Surrounding the dikes contact metamorphism has locally caused impermeable marble aureoles with a thickness up to 1 meter. Approximately 26% of the bulk rock volume consists of replacive matrix dolomite. Large dolomite bodies (50 m wide, 100 m high) are bounded by dikes. Locally, the marble aureoles shielded the surrounding limestone from the dolomitizing fluid. Due to this aureole the dolomitization only occurred there where the ‘protective’ marble lithology was missing or crosscut by fractures. Inside the dikes and along the dike-carbonate contact, abundant dolomite veins are present that are geochemically related to the surrounding matrix dolomite occurrences and thus represent the dolomitizing fluid circulation. These veins occur along the whole length of the dikes from below the studied interval to the top of the Latemar. Based on the geometrical relationships it is concluded that dikes formed the pathway for the dolomitizing fluids, as well as functioned boundaries for the dolomite bodies.

With a high resolution 3D lithology dataset in place, geostatistical methods could be extended to 3D. By means of real 3D variography (not just the combination of 2D horizontal + 1D vertical) the occurrence and geometry of dolomite bodies were described mathematically and reveal (an)isotropy of lithology variability. The resulting small-scale (<200 m) geometries are vertical and horizontal pipe-like dolomite bodies that are often crosscutting each other. They thus form a complex reservoir geometry. The orientation of the dolomite bodies corresponds perfectly to the averaged dike orientation. Larger scale (>200 m) lithology variation indicates an important control of stratigraphy on the relative position of dolomite bodies. Kriging interpolation of lithology based on the 3D lithology description in combination of porosity and permeability data, allows constructing accurate reservoir models of potential dolomite reservoir development.