

Title: Testing reflux model of dolomitization on large scale outcrops from the Sorrento Peninsula, (Italy, Cretaceous)

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Research program

Dolomitization is one of the most important and debated diagenetic process of carbonate rocks. Its importance is not only scientific (dolomite rocks are at least half of the carbonate worldwide and is more abundant in the geological past) but also economic (the largest and more productive hydrocarbon reservoirs are hosted in dolomitized carbonates).

As all dolomites are a replacement product, the investigation of dolomitization processes involve generally three components: a carbonate matrix, a dolomitizing fluid and a viable mechanism to transport this fluid across the host rock. Various models have been conceived to move large quantities of water through carbonate beds during any phase of the diagenesis. One of the most popular is the “reflux model”. It assumes that during sedimentation marine waters in a shallow water lagoon become denser as a result of evaporation and start to percolate through the underlying beds. The conceptual model was envisaged in the ‘50’s when studying the perfectly exposed Capitan platform of Permian age. In more recent time, the model has been reproduced digitally with several mathematical methods and using the reactive transport model (Jones et al., 2005; Garcia Fresca et al. 2012; Al Helal et al., 2012; Gabellone et al., 2016). However, still several problems persist when mathematical simulations are compared with field data (Manche and Kaczmarek, 2019).

In this respect, the analysis of large-scale outcrops still remains as a basic need to feed new theoretical understating of the process and to build predictive tools useful in hydrocarbon production and/or carbon storage.

The project is based on outcrops at Monte Faito, in the Sorrento peninsula, which have been already intensely studied in the last decade in the frame of studies aimed at characterizing this area as an analog of the Basilicata reservoirs. At Monte Faito, a Valanginian to Albian succession of carbonates is perfectly exposed along a 5 Km long transect. Limestones and dolomites are interbedded at various scale. Previous studied included field logging, petrographic and stable isotope studies and structural studies helped by VOM models (Corradetti et al., 2018). Available data clearly indicate that dolomitization during early Cretaceous was very early diagenetic and its intensity was modulated by changing salinity of marine derived fluids as a result of climatic changes (Vinci et al., 2018). In the last paper, a reflux model was assumed as the most likely explanation for the origin and distribution of dolomite beds within the stratified succession.

Proposal for a PhD position

The proposed research will be aimed at scrutinizing the details of the hypothesized model with a very detailed sampling of the whole outcrops, both vertically and horizontally. The project planning is as follow:

- studying the previous data to select the sampling area;
- perform a careful sampling based on vertical and horizontal transects;
- carry out a petrographic (slab and large peels) XRF and geochemical analysis (trace elements and O, C, Sr isotopes) of the selected samples;

- compare the data with data published on comparable platforms (Glen Rose, San Andres and Madison Formations) and with digital models. This part of the study will be performed during a stage abroad.

The results are expected to further clarify the exact mechanism which formed the dolomites of Monte Faito and analogous dolomites of the same age in the peri-Adriatic carbonate platforms and provide useful constraints to assist future refinements of the reflux dolomitization model

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