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Dolomitization Processes and their Relationships with the Evolution of an Orogenic Belt (Central Italy)

M.V. Murgia, P. Ronchi
ENI-AGIP Division, Via Emilia 1, S.Donato Milanese, Italy

In the Jurassic sequence of Central Apennines and their Foreland (onshore and offshore Marche - Abruzzi regions), the dolomitization processes enhanced the petrophysical properties of the carbonate platform and related basin series.

In the studied area the Liassic carbonate platform (Calcare Massiccio Fm, Hettangian - Sinemurian) underwent extensional tectonics that established the southern Apulian - Apennine persisting platforms and the northern Umbria-Marche basin, where the basinal series developed starting with the Corniola Fm (Pliensbachian); within the basin differential subsidence rates created faulted horst characterised by condensed series.

Dolomitised bodies are mainly located at the platforms edge and in the palaeohigh areas, particularly in the Calcare Massiccio Fm and Corniola Fm with minor extension to younger basinal series (up to Maiolica Fm).

The petrographic observations evidenced a multiphase dolomitization consisting of several stages of alternated dolomite replacement, dissolution and recrystallization.

The carbon and oxygen isotopic data ($\delta^{18}O$ ranges from –3,9 up to 2,64 per mil and $\delta^{13}C$ ranges from 1,48 up to 4,81 per mil) suggest a seawater derived diagenesis in a wide temperature range; this is confirmed by the fluid inclusion analyses that detected few stages of dolomitization events occurred during a progressive heating of the carbonate series.

The reconstructed paragenetic sequence is almost the same in all the studied series, both in outcrop and subsurface. The main phases consist of:

- **dolomite 1** that is represented by turbid crystal cores which are the first calcite replacement occurred at low temperature (F.I. data suggest Th about 50-60°C); those temperatures were reached during burial first in basin and then in paleohigh series;
- **dolomite 2 and 4** that are limpid dolomite cement growth around the corroded and recrystallized crystal cores. F.I. data indicate homogenisation temperatures ranging from 60° up to 110°C that are higher than those observed at total depth in many Foreland wells. This fact indicates that this dolomite precipitation occurred in presence of hot Mg rich fluids, which can be interpreted as coming from the Apennines belt subthrust;
- **dolomite 3** is the recrystallized phase of dolomite 2;
- **saddle dolomite** crystals can be locally observed in the overthrust belt in vugs and fractures.

The relationship between the dolomitization process and the fluid migration, driven by the oncoming orogenic wave, can be confirmed by comparing the data collected in the outcrops (chain), and offshore foreland; in fact in the inner part of the studied area the processes started and ended earlier than in the outer part.

Dolomite 1 generation, that is due to the increasing burial depth, occurred in the whole area during Jurassic to Cretaceous ages, depending on the subsidence rate. Dolomite recrystallization (Dolomite 3) started during Paleogene and lasted till Miocene in the Foreland; in the same time the dolomite cement precipitation (Dolomite 4) began in the Orogenic Belt.

In the overthrust area, in Messinian to Pliocene times, saddle dolomite precipitated from hydrothermal fluids migrated along the fault planes; it can be observed that in the same time Dolomite 4 crystallized in the Foreland, due to the fluid migration coming from underthrust.

The last diagenetic phases are represented by fresh water dissolution related to subaereal exposure in the orogenic area and by calcite precipitation in the foreland.

In the end, studying the dolomitization processes timing with regard of tectonic regional phases can be useful to forecast dolomite and, as a consequence, porosity distribution.