[PS]Diagenesis of Microbial Carbonates: A Case History from the Norian of the Italian Peninsula*

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Abstract

A diagenetic study was accomplished on Norian dolomites from Southern Italy along a carbonate platform-to-slope transect. The succession, formed in a shallow water carbonate platform dissected by stressed intra-platform troughs, bear widespread microbial mounds. Despite the complex diagenesis and burial history, this study aims to characterise timing and conditions of early to late cementation including dolomitization and silification.

The studied outcrops comprise different facies: a) peritidal, cyclic back-margin with dasycladales and bivalves grainstones, planar stromatolites with fenestral porosity, mega tepees and cemented neptunian dikes; b) margin to upper slope build-ups showing thrombolitic, stromatolitic and oncoidal structures, surrounding serpulids and calcareous sponges; c) middle to lower slope dark and laminated dolomudstone with graded bedding and gravity-driven deposits.

Early calcite and aragonite cements pre-dated the main dolomitisation, which is pervasive, mimic in all facies, and comprise different replacive and void-filling phases. Two dolomite populations were geochemically distinguished: one includes replacive and early cements of inner-margin facies (positive $\delta^{18}O$), whereas the other comprises replacive and void-filling dolomites of build-ups and slope facies and late cements of inner-margin facies (lower $\delta^{18}O$). Similar geochemical trends are recorded in Dolomia Principale of Apennines, Alps and Hungary. An early diagenetic evaporative to reflux process better matches the dolomites of inner margin facies, whereas different scenarios can justify the geochemical signature of the other facies:1) an early process by more diluted brines, coeval with the inner margin dolomitisation, the difference in salinity being related to the different settings (restricted back-margin versus more open margin-to-slope); 2) geochemical evolution of the reflux dolomitizing fluid at shallow depth with decreasing $\delta^{18}O$ values away from the source of the brine; 3) a later shallow burial process from fluids with geochemical signature of Rhaetian seawater.
Silica occurs both as early low temperature chalcedony incrustations and as late burial mega quartz including fabric selective replacive and void-filling phases, which plumb the remaining porosity. The occurrence of chalcedony mainly in the microbial facies suggests a genesis related to the peculiar restricted and eutrophic deposition environments of the microbial buildups.

Diagenesis of Microbial Carbonates: a case history from the Norian of the Italian Peninsula

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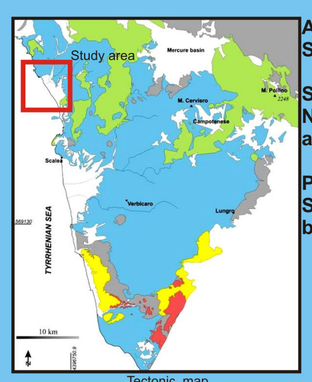
Introduction

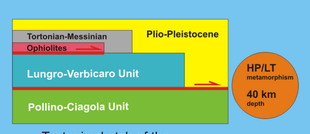


Tectonic map
(modified from Iannace et al.,2007)

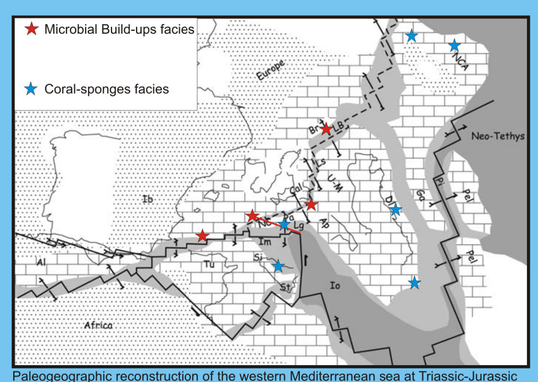
AIM:
Studing diagenesis across a platform margin with microbial build-ups

SELECTED OUTCROPS:
Norian (Dolomia Principale-type Fm.)completely dolomitized succession at the Calabria-Lucania border, in southern Apennines (Italy).

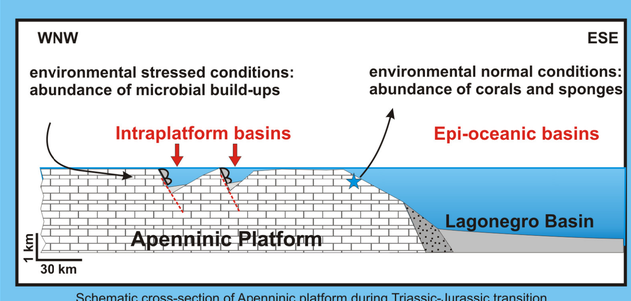
PALEOENVIRONMENTAL FRAMEWORK:
Small intraplatform basins within wide shallow pericontinental seas that bordered the western closure of the Triassic Paleo-Tethys.



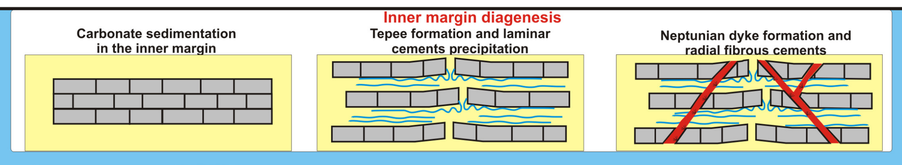
Tectonic sketch of the
main nappes

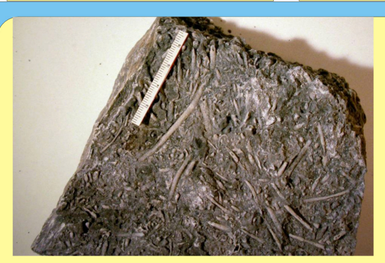


Paleogeographic reconstruction of the western Mediterranean sea at Triassic-Jurassic transition (modified from Senowbari et al.,2009).
Red line indicates the location of the cross-section reported sideways.



Schematic cross-section of Apenninic platform during Triassic-Jurassic transition



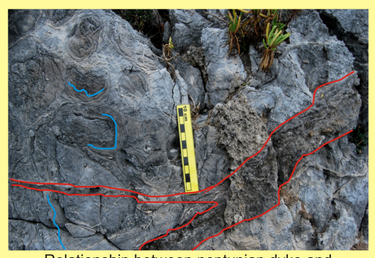


Grainstone with dasiclad

Pendant-laminated cements

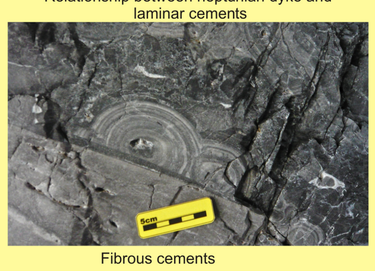
Host rock clasts encrustated by laminar cements

Neptunian dyke

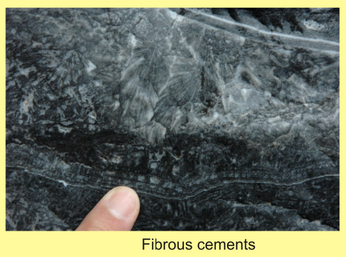


Relationship between neptunian dyke and laminar cements

Microdigitate structures



Fibrous cements



Fibrous cements

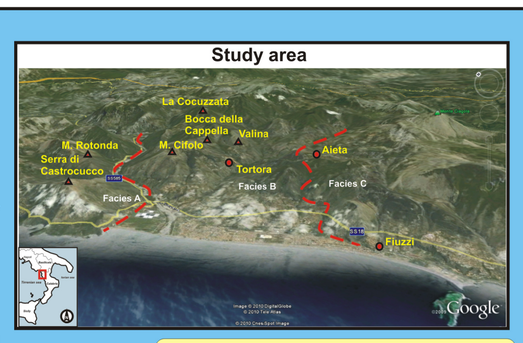
Facies Analysis

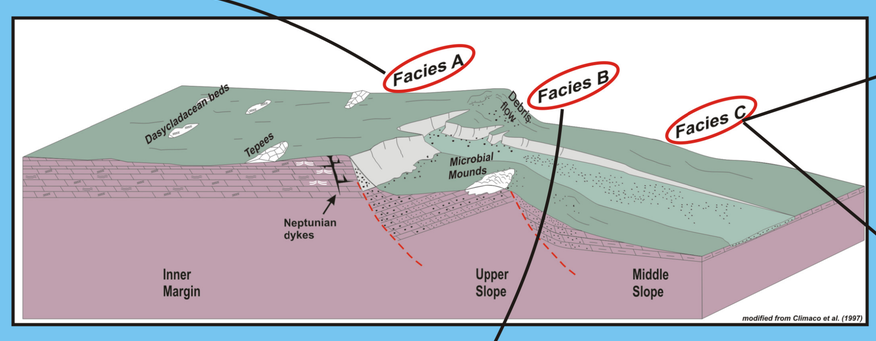
The studied outcrops comprise different facies:

A) peritidal, cyclic back-margin with dasycladales and bivalves, grainstones, planar stromatolites with fenestral porosity, mega tepees and cemented neptunian dikes;

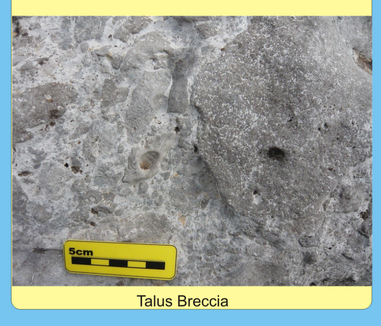
B) margin to upper slope build-ups showing thrombolitic, stromatolitic and oncoidal structures, surrounding serpulids and calcareous sponges;

C) middle to lower slope dark and laminated dolomudstone with graded bedding and gravity-driven deposits.



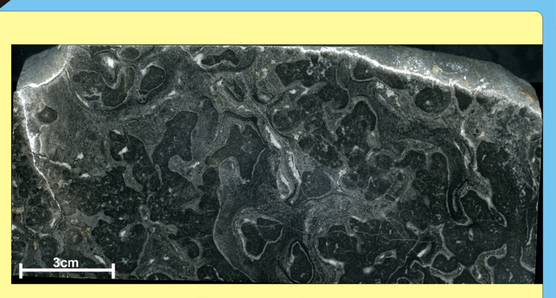


Laminated dolomudstones



Talus Breccia

Thrombolitic build-ups



Thrombolitic build-ups

Geochemical and Mineralogical Analysis

Two main dolomite populations :

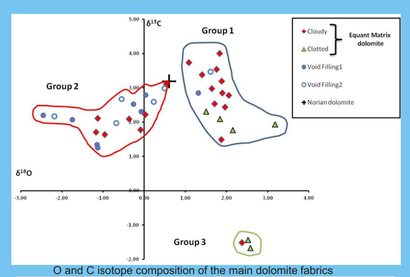
Replacive and early cements of inner-margin facies (positive δ18O)and marine strontium isotopes

Replacive and void-filling dolomites of build-ups and slope facies and late cements of inner-margin facies (lower δ18O).

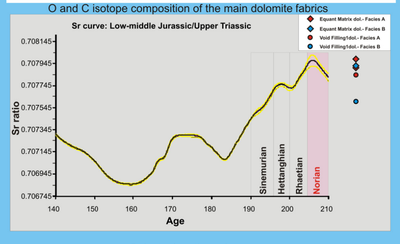
Dolomitisation scenario:

mainly controlled by surface related processes and conveying a petrographic-geochemical signature non reset by burial processes, HP-LT metamorphism.

The petrographic and geochemical signatures are strikingly similar to the ones described in Norian Dolomia Principale of Apennines, Southern Alps and Hungary, despite totally different

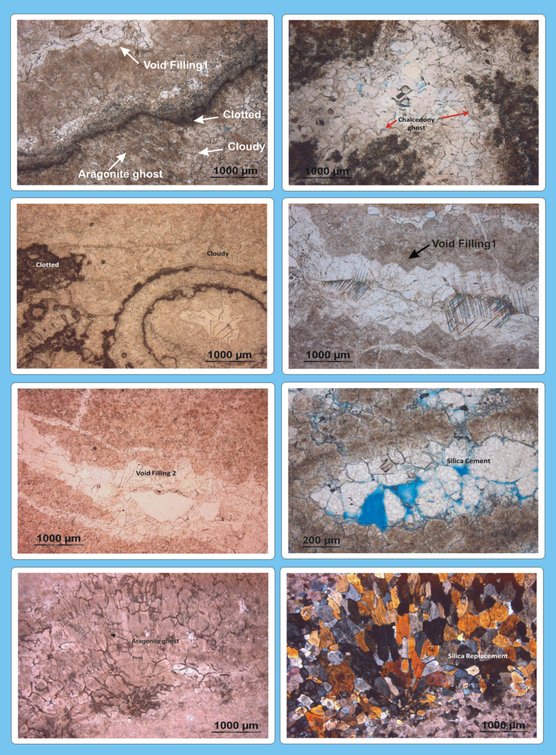


O and C isotope composition of the main dolomite fabrics



Sr isotopic ratio vs Age.

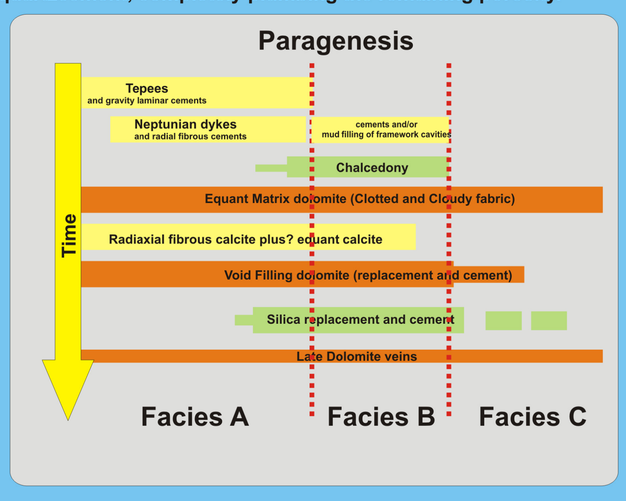
Petrographic Study



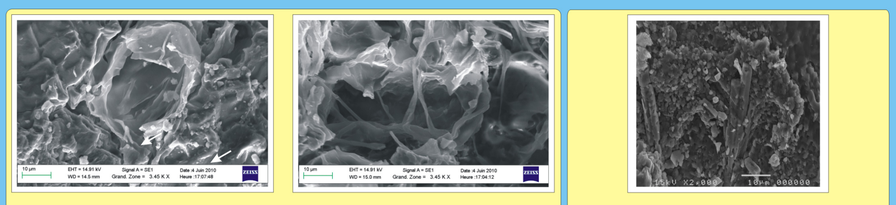
Dolomitisation is complete and generally mimic in all facies.

Different replacive dolomites were distinguished, together with dolomite cements.
A main phase of dolomite replacement certainly post-dates the cements filling the neptunian dykes. A very early phase of dolomitization is mainly indicated on geochemical ground.

Silicification is locally abundant and includes fabric selective silica replacing carbonates, as well as large crystals of quartzcement, completely plumbing the remaining porosity.



SEM



SEM analysis performed on build-ups samples allow to identify only scattered biological relicts (fungi?)

Apatite crystal growth on microquartz crystals

Conclusion

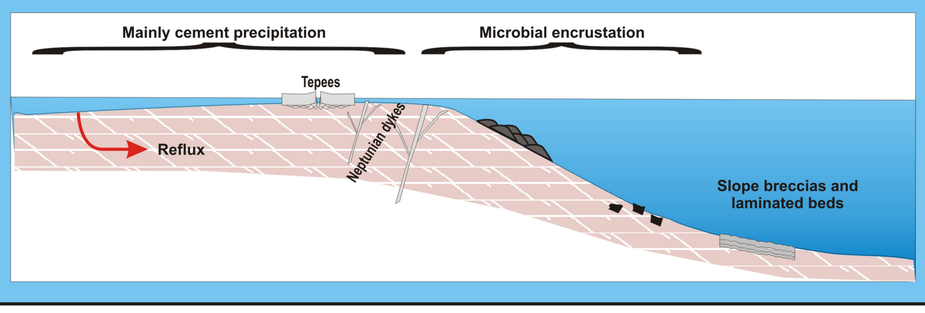
The Norian succession is characterized by widespread microbial build-ups and precipitation of large amount of cements in the inner platform margin.

Dolomitisation is pervasive and irrespective of facies and mainly related to surface waters (longlasting reflux of concetrated waters).

Microbial matter possibly helped but do not exert a fundamental role in dolomitisation.

However:
- **Development of microbialites**
- **Abundant cement precipitation**
- **Pervasive longlasting dolomitization**
- **Silica diagenesis**

are common to all the coeval intraplatform basins and suggest a genetic link: sedimentary enironment characterized by concentrated, possibly alkaline and eutrophic marine waters



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