Paleoecology and timing of the middle Triassic microbial mats to sponge-microbial buildups, and bio-events in the Briançonnais epeiric sea, links to the Permian–Triassic crisis aftermath

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Recent works on classic stromatolite (Lee & Riding, 2020), on sponge take over following the end-Permian mass extinction (Baud et al., 2021) and the possible extension of the sponge-microbial buildups in the Germanic basin Triassic carbonate (Pei & Reitner, 2022), led us to question and actualize the so called “algal mats, crypto-sponge and mudmound” of our published work on the middle Triassic carbonate of the neighboring Briançonnais epeiric sea (Baud, 1987; Baud et al., 2016). In this adjacent sea, recorded from central Switzerland to Franco-Italian maritime Alps, a first marine transgression occurred during the Lower-Middle Triassic transition about 247 My ago, characterized by a very large scale, dolomitic microbial mat deposition (a, fig. 1) a first similarity with the post extinction basal Triassic stromatolites of the Tethys. But the presence of nonspicular demosponges in the Briançonnais stromatolites with a mutualistic relationship is here to be resolved.

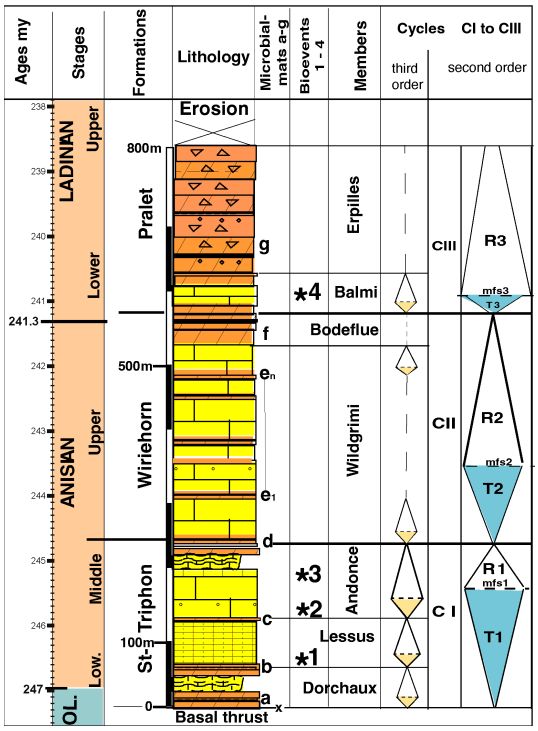

Figure 1: Stratigraphical sketch of the Middle Triassic succession of the Briançonnais domain in Western Switzerland with microbial mats levels and bioevents. Captions: limestone in yellow and dolomite in braun. T=transgressive system-track; R=regressive s-t; mfs=main flooding surface; Absolute ages in millions of years (My) according to recent chronostratigraphic charts.

During the Lower Anisian time (247-246 My), a new, large scale dolomitic microbial mat, caps (b, fig. 1) the open shallow marine deposition of the 20m

thick vermicular limestone of the Dorchaux Member. The next third order transgressive cycle (Lessus Member) is showing a first bio-event (*1, fig. 1) with the lower Anisian sudden recovery of abundant calcareous algae, which disappeared during the end-Permian great extinction and were absent during Early Triassic time. At the top this Lessus Member (middle Anisian about 246 My ago), a local dolomitic microbial mat was well recorded (c, fig. 1). The new transgressive system track of the Andonce Member brought two bio-events (*2 and *3, fig. 1): the first concerns the resurgence and abundance of siliceous sponges, bio-event at the origin of the first chert bands in the limestones. Due to an Ammonoid finding, the second bio-event is well dated of the middle Anisian *B. cadoricus* zone and consists of the recovery of a corals type *Thamnastrea*, and of calcareous and non-calcareous spicular sponges' growth. Also, unique and close in time, a level of a thrombolitic buildup up to 4 m thick were found in the Rothorn section, all described in Baud, 1987, "mudmound" showing similarity to the post extinction basal Triassic sponge microbial buildups (Baud et al., 2021).
At the middle-upper Anisian transition between 245 and 244 My ago, the regressive top of the Saint-Triphon Formation is characterized by a very large scale, dolomitic microbial mats deposition (d, fig. 1) recorded within the whole Briançonnais domain. The overlying Wildgrimmi Member of the Wiriehorn Formation consists of a 220 to 340 m succession of peritidal carbonate deposits with a shift to decametric scale shallowing-upward cycles, each topped by a dolomite bed possibly of microbial origin (e_1 to e_n, fig. 1), like to same age South Alpine lagoonal Latemar shorter cycles. The upper regressive part of the Wiriehorn Formation is characterized by dolomitic beds partly built by stromatolites (f, fig. 1). In the following transgressive part of the Pralet Formation, the recorded conodont *trumpyi* allowed us to date the upper bio-event (*4 *fig. 1*) of the basal Lower Ladinien, about 241 My ago. It consists of a short living rich assemblage of crinoids, gastropods, brachiopods, bivalves, and siliceous sponges. Then due to aridity and higher salinity, the carbonate factory moves to dolomitic production with increase in microbial activities (g, fig. 1) and loss of skeletal material in the upper Pralet Formation still Ladinien in age (240-238 My).

References

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Baud, A., Richoz, S., Brandner, R., Krystyn, L., Heindel, K., Mohtat, T., Mohtat-Aghai, P., and Horacek, M., 2021. Sponge takeover from End-Permian mass extinction to early Induan time: Records in Central Iran microbial buildups, Front. Earth Sci., 9, 1-23.
Lee, J. H., & Riding, R. (2021). The 'classic stromatolite 'Cryptozoön is a keratose sponge-microbial consortium. Geobiology, 19(2), 189-198.
Pei, Y., Hagdorn, H., Voigt, T., Duda, J. P., & Reitner, J. (2022). Palaeoecological Implications of Lower-Middle Triassic Stromatolites and Microbe-Metazoan Build-Ups in the Germanic Basin: Insights into the Aftermath of the Permian–Triassic Crisis. Geosciences, 12(3), 1-19.

Paleoecology and timing of the middle Triassic microbial mats to sponge-microbial buildups, and bio- events in the Briançonnais epeiric sea, links to the Permian–Triassic crisis aftermath

by Aymon Baud[1]

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1 Introduction

Recent works on classic stromatolite (1=Lee & Riding, 2020), on sponge take over following the end-Permian mass extinction (2=Baud et al., 2021) and the possible extension of the sponge-microbial buildups in the Germanic basin Triassic carbonate (3=Pei & Reitner, 2022), led us to question and actualize the so called "algal mats, crypto-sponge and mudmound" of our published work on the middle Triassic carbonate of the neighboring Briançonnais epeiric sea (Baud, 1987; Baud et al., 2016).

1


ORIGINAL ARTICLE

gebiology WILEY

The 'classic stromatolite' *Cryptozoön* is a keratose sponge-microbial consortium

Jeong-Hyun Lee[1] | Robert Riding[2]

2


frontiers

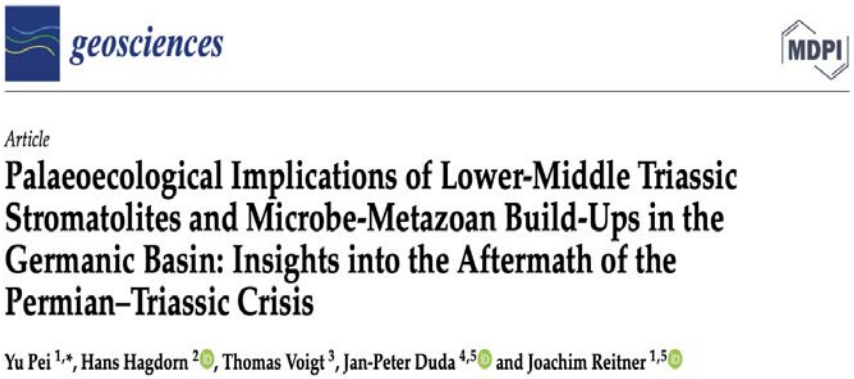
ORIGINAL RESEARCH
published: 28 May 2021
frt.2021.586210

Sponge Takeover from End-Permian Mass Extinction to Early Induan Time: Records in Central Iran Microbial Buildups

Aymon Baud[1], Sylvain Richoz[2], Rainer Brandner[3], Leopold Krystyn[4], Katrin Heindel[5], Tayebeh Mohtat[6], Parvin Mohtat-Aghai[3] and Micha Horacek[7]*

According to these authors, Keratosan-microbial consortia may have been mistaken for stromatolites throughout the record of the past 500 million years, and possibly longer.

3


geosciences

MDPI

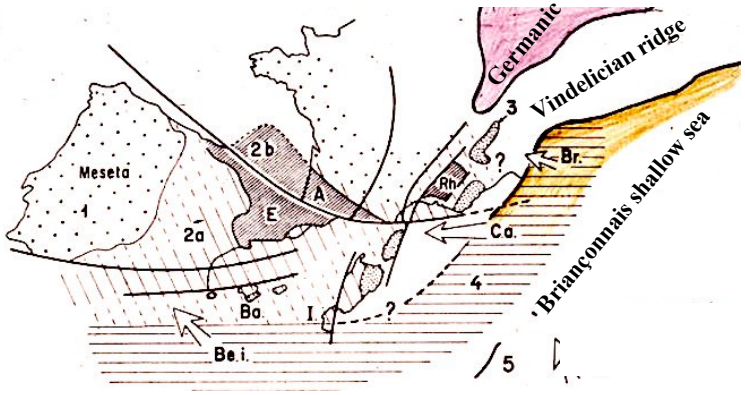
Article

Palaeoecological Implications of Lower-Middle Triassic Stromatolites and Microbe-Metazoan Build-Ups in the Germanic Basin: Insights into the Aftermath of the Permian–Triassic Crisis

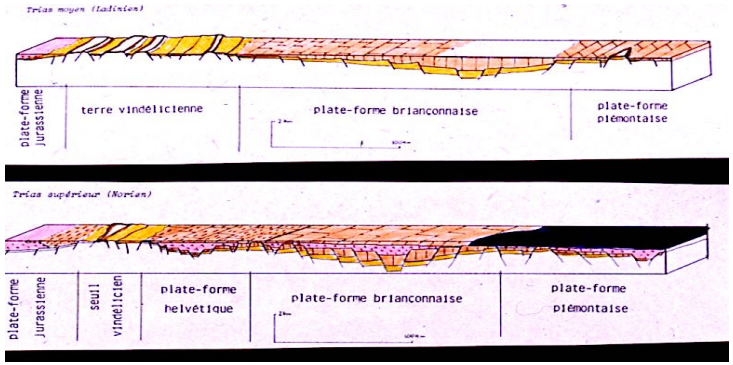
Yu Pei [1,*], Hans Hagdorn [2], Thomas Voigt [3], Jan-Peter Duda [4,5] and Joachim Reitner [1,5]

2 The Briançonnais epeiric sea

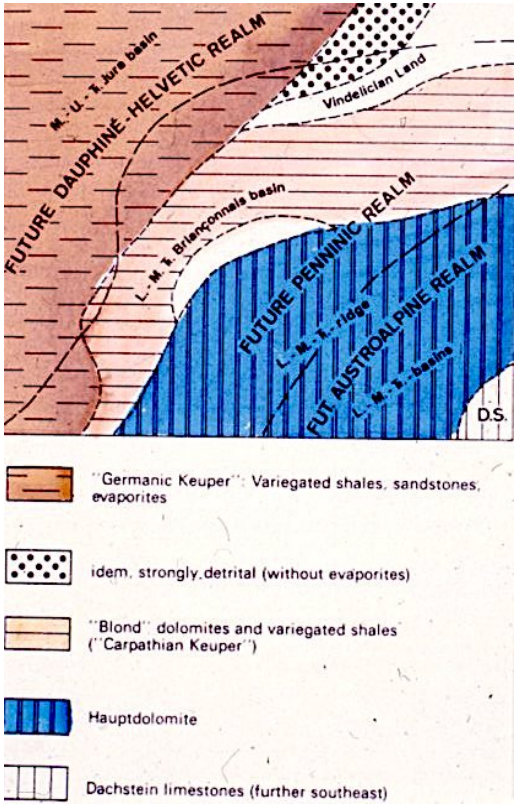
In this adjacent sea, recorded from central Switzerland to Franco-Italian maritime Alps, a first marine transgression occurred during the Lower-Middle Triassic transition about 247 My ago.



Paleogeographic scheme of the Briançonnais realm

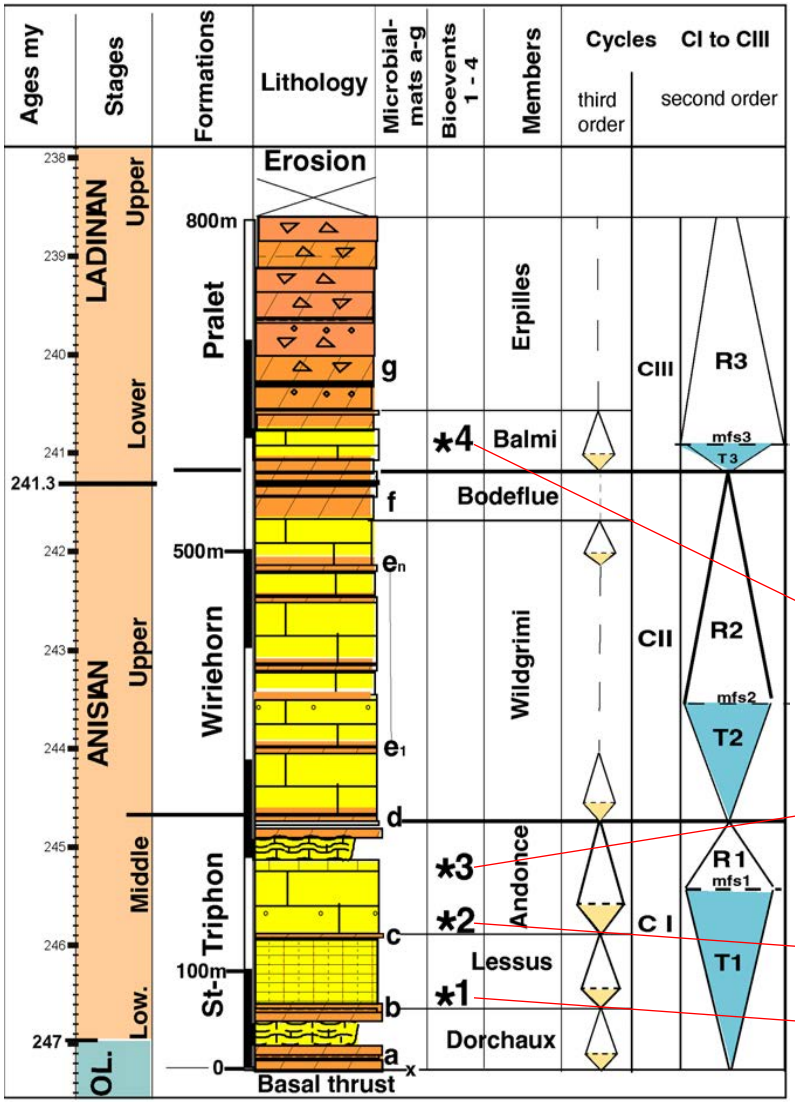


Paleogeographic Triassic sections through NW Alps



Paleogeographic Triassic scheme through W Alps

2 The Briançonnais epeiric sea and elements for biochronology



Stratigraphical sketch of the Middle Triassic succession of the Briançonnais domain in Western Switzerland with microbial mats levels and bioevents.

Captions: limestone in yellow and dolomite in braun. T=transgressive system-track; R=regressive s-t; mfs=main flooding surface; Absolute ages in millions of years (My) according to recent chronostratigraphic charts. a to g= dolomite levels.

Bio-events

4* basal Ladinian short living rich shells assemblage with crinoid and conodont.

3* sponge – microbial mudmound -corals recovery.

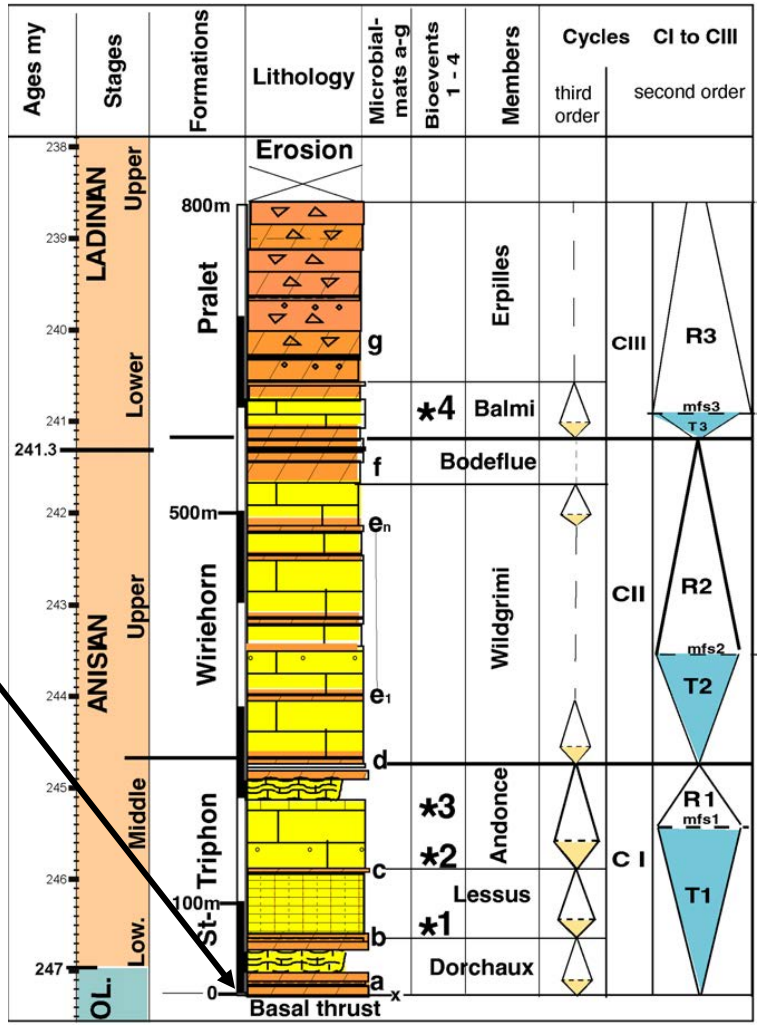
2* siliceous sponge recovery.

1* lower Anisian recovery of calcareous algae.

3 The Triassic marine transgression and dolomitic microbialites a

A first marine transgression occurred during the Lower-Middle Triassic transition about 247 My ago, characterized by a very large scale, dolomitic microbial mat deposition (level a).

View on microbial dolomite level **a,** overlying the wineyard of Chalex sur Ollon, close to Saint-Triphon.



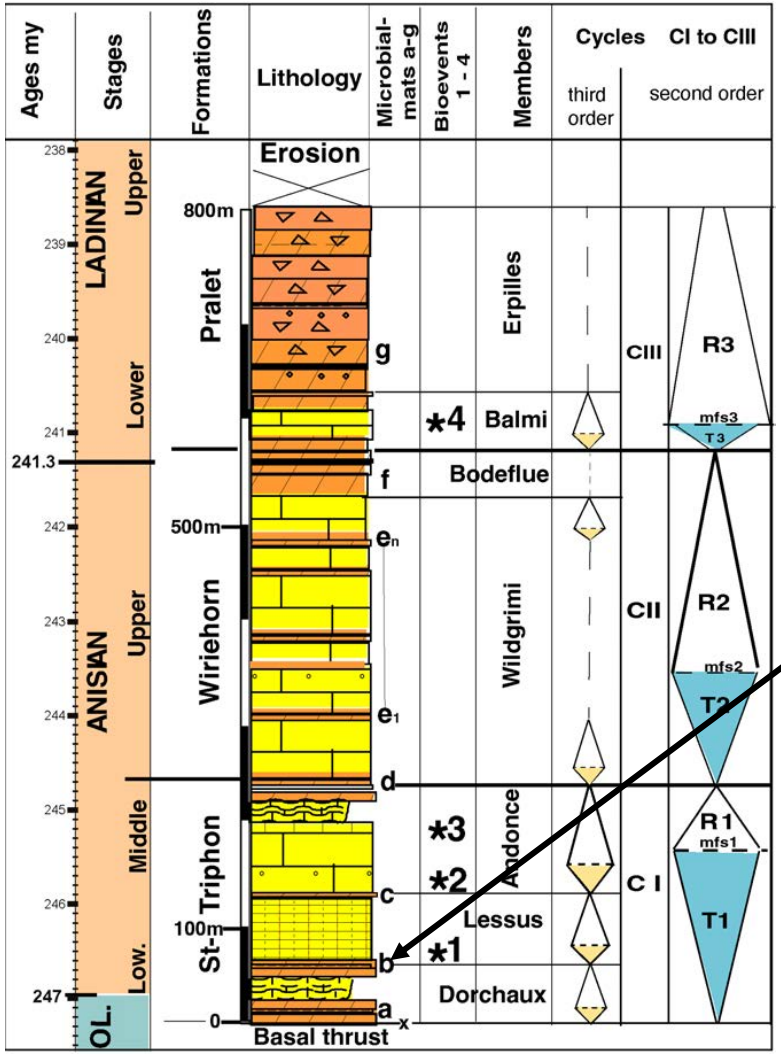
Briançonnais Middle Triassic Stratigraphical sketch.

3 The Triassic marine transgression and dolomitic microbialites a

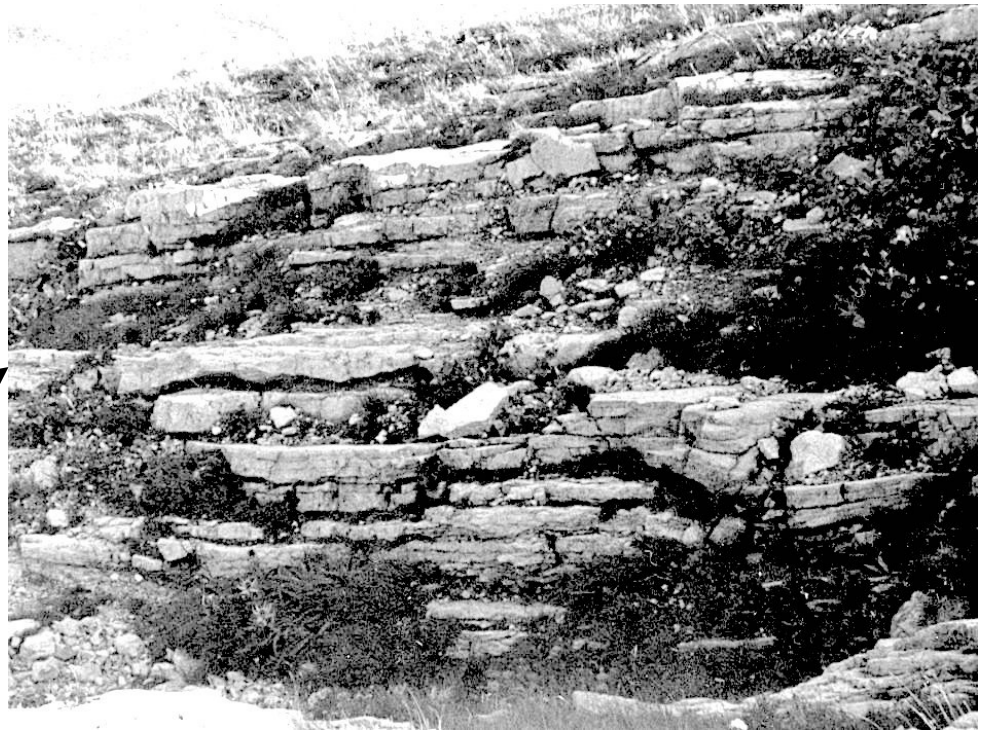
Detailed view on microbial dolomite level **a,** with microbial laminites and domal structures

4 The following, younger dolomitic microbialites b

During the Lower Anisian time (247-246 My), a new, large scale dolomitic microbial mat, caps (b, fig. below) the open shallow marine deposition of the 20m thick vermicular limestone of the Dorchaux Member.



Briançonnais Middle Triassic Stratigraphical sketch.

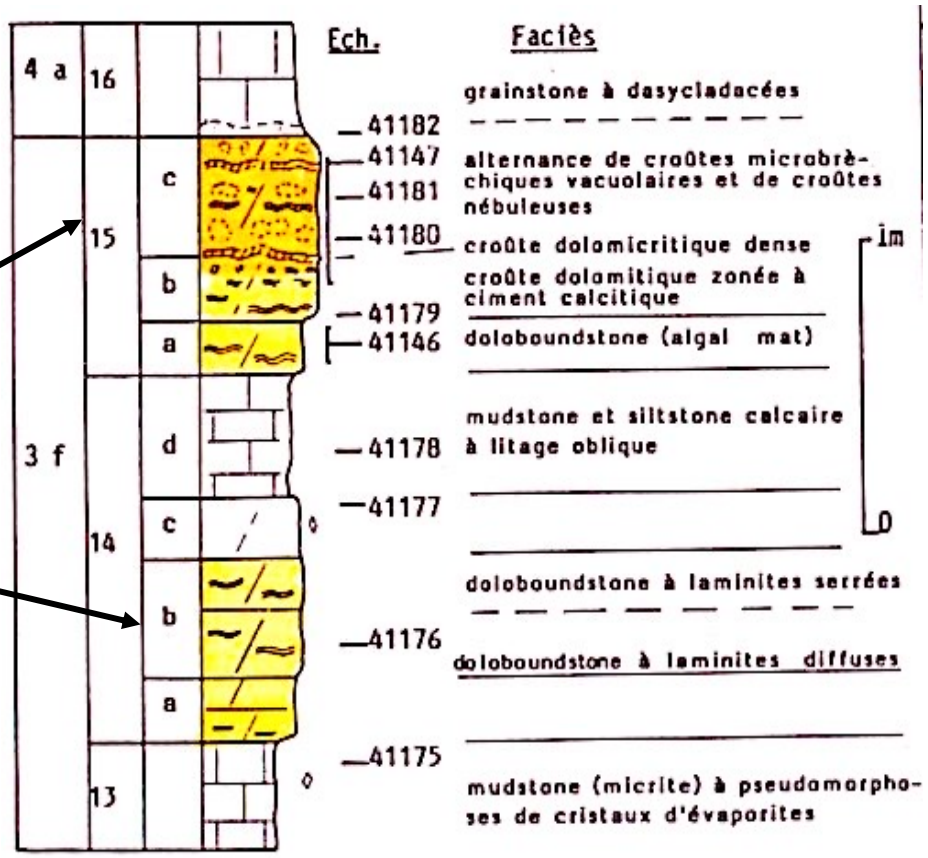


View on microbial dolomite level **b** at the Dorchaux section type locality of the Dorchaux Member.

4 The following, younger dolomitic microbialites c

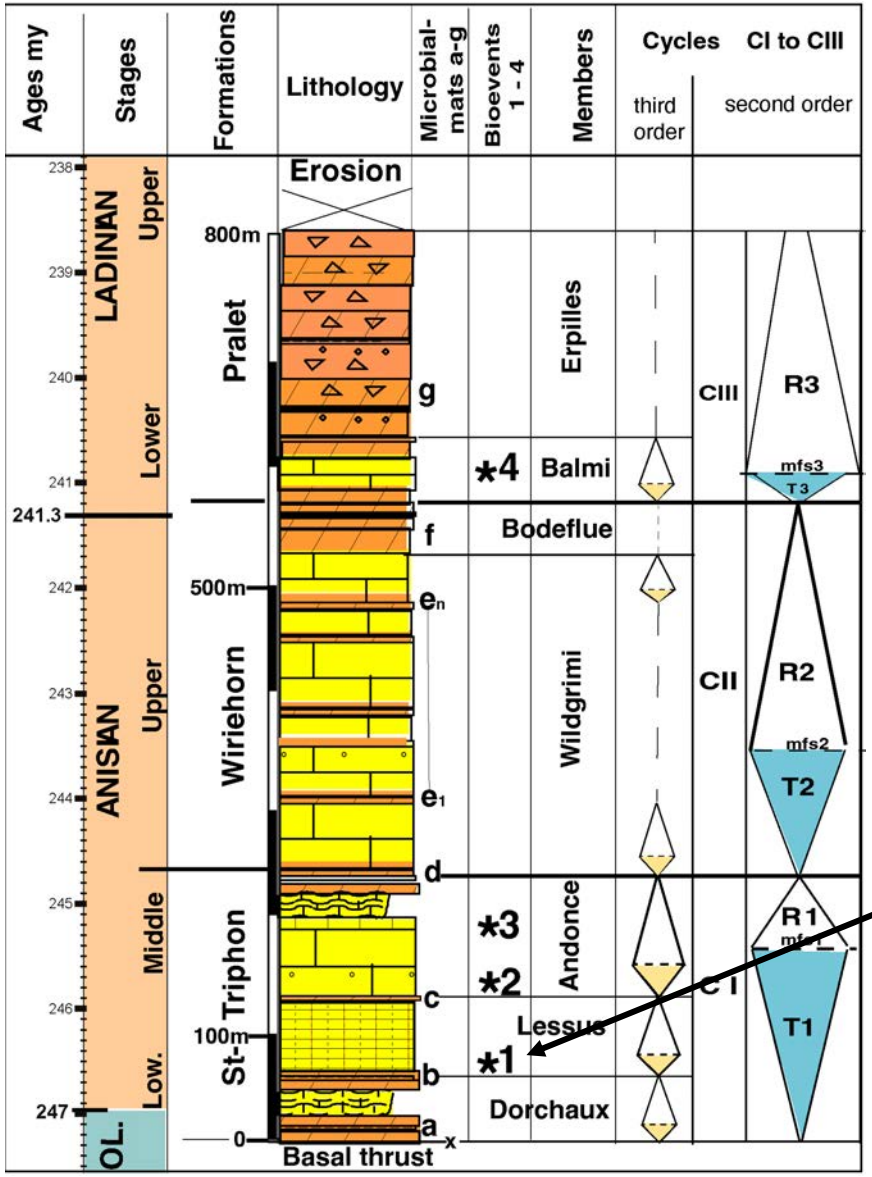
At the top of the Lessus Member (middle Anisian about 246 My ago), a local dolomitic microbial mat was well recorded (c, fig.).

The Lessus quarry with 2 light dolomitic beds.



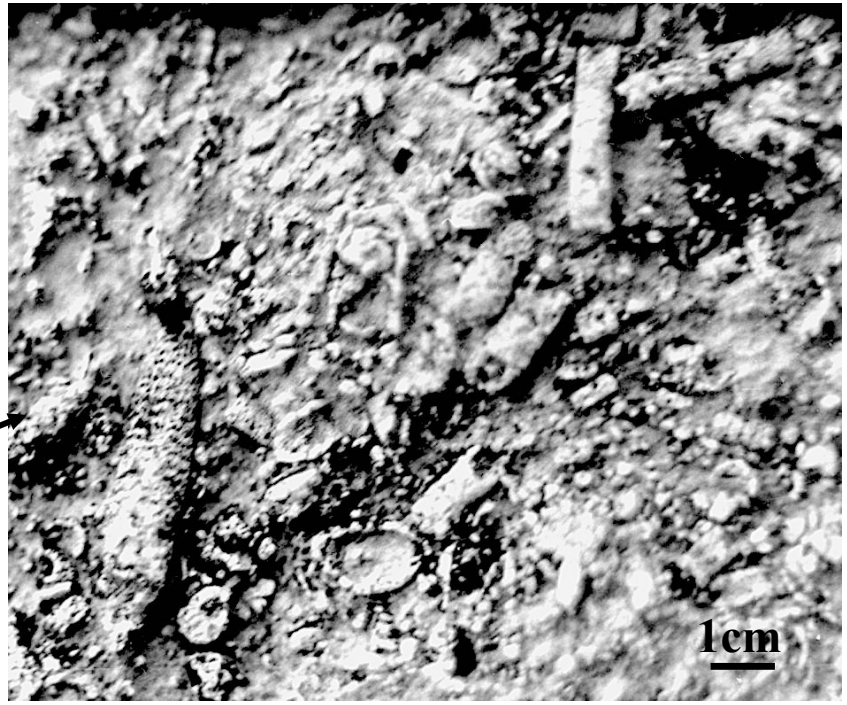
Litholog sketch of the light dolomitic beds Lessus quarry.

5 The Anisian bio-events



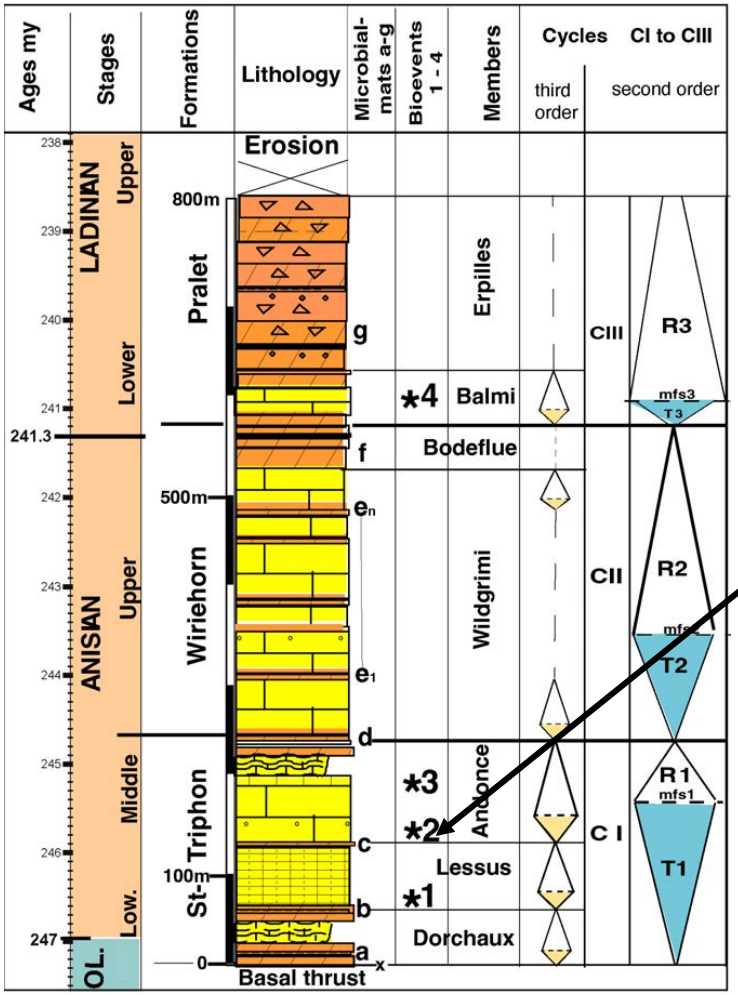
Briançonnais Middle Triassic Stratigraphical sketch.

The next third order transgressive cycle (Lessus Member) is showing a first bio-event (*1, + fig. below) with the lower Anisian sudden recovery of abundant calcareous algae, which disappeared during the end-Permian great extinction and were absent during Early Triassic time.



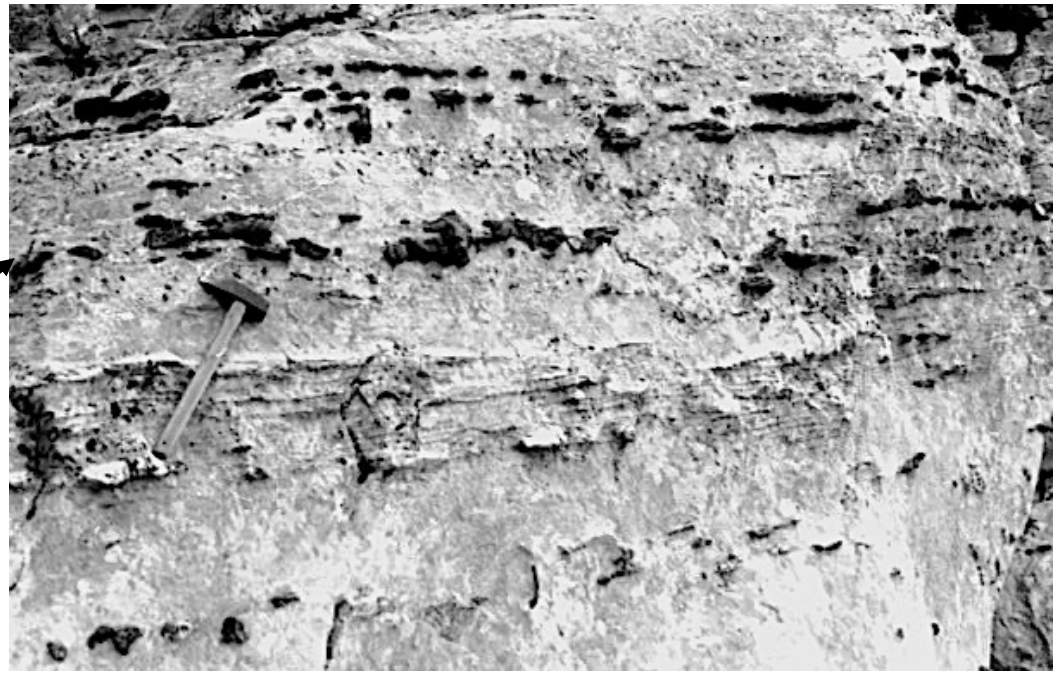
Rock surface with calcareous algae cylindrical sleeves.

5 The Anisian bio-events *2



Briançonnais Middle Triassic Stratigraphical sketch.

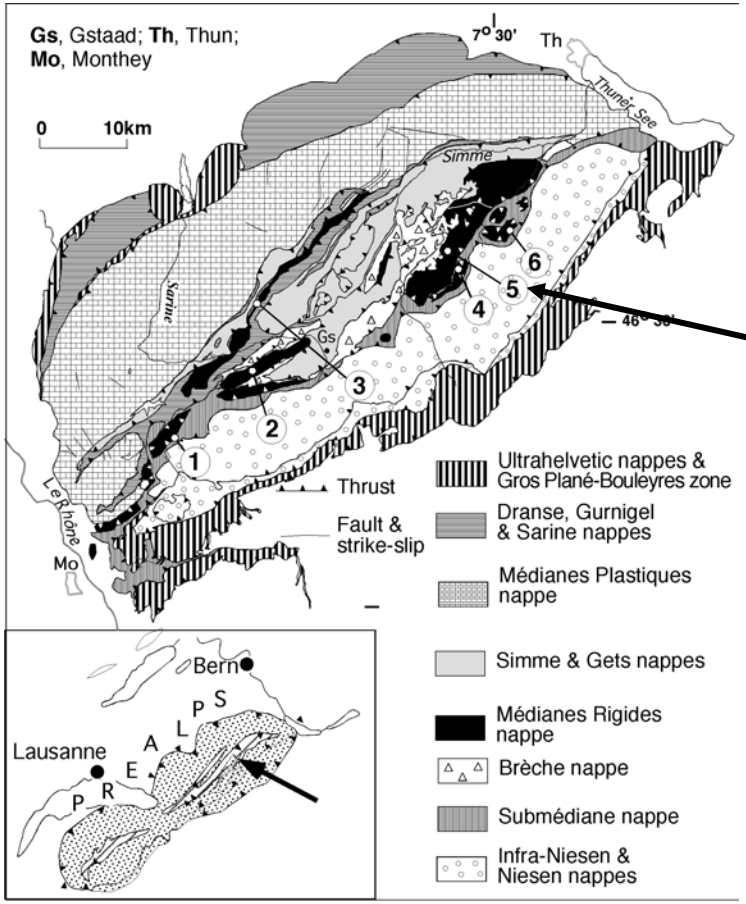
The new transgressive system track of the Andonce Member brought two bio-events (*2 and *3, fig. 1): the first concerns the resurgence and abundance of siliceous sponges, bio-event at the origin of the first chert bands in the limestones.



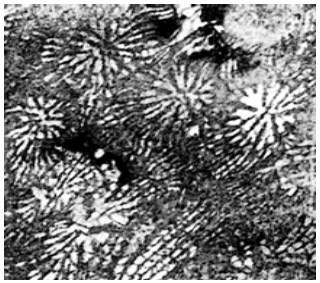
The first chert bands in the Andonce Member, Saint-Triphon.

5 The Anisian bio-event *3

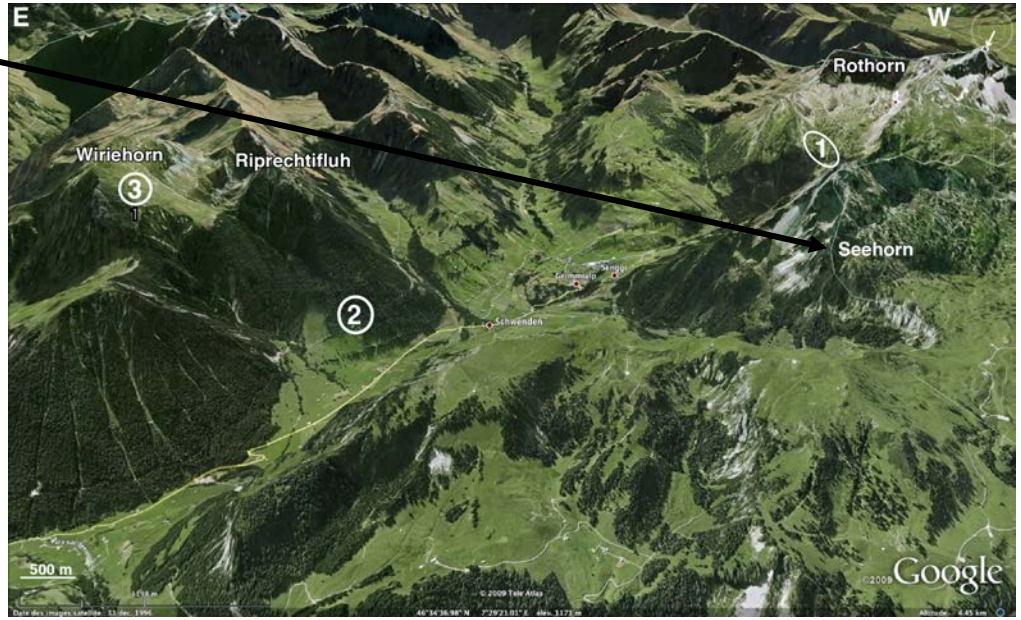
Due to an Ammonoid finding in the Dientigtal (4 on the map below), the bio-event 3* is well dated of the middle Anisian *B. cadoricus* zone and consists of the recovery of a corals type *Thamnastrea* as illustrated by Genge, 1952, in his Anisian Seehorn section.



Swiss Prealps geological sketch map.



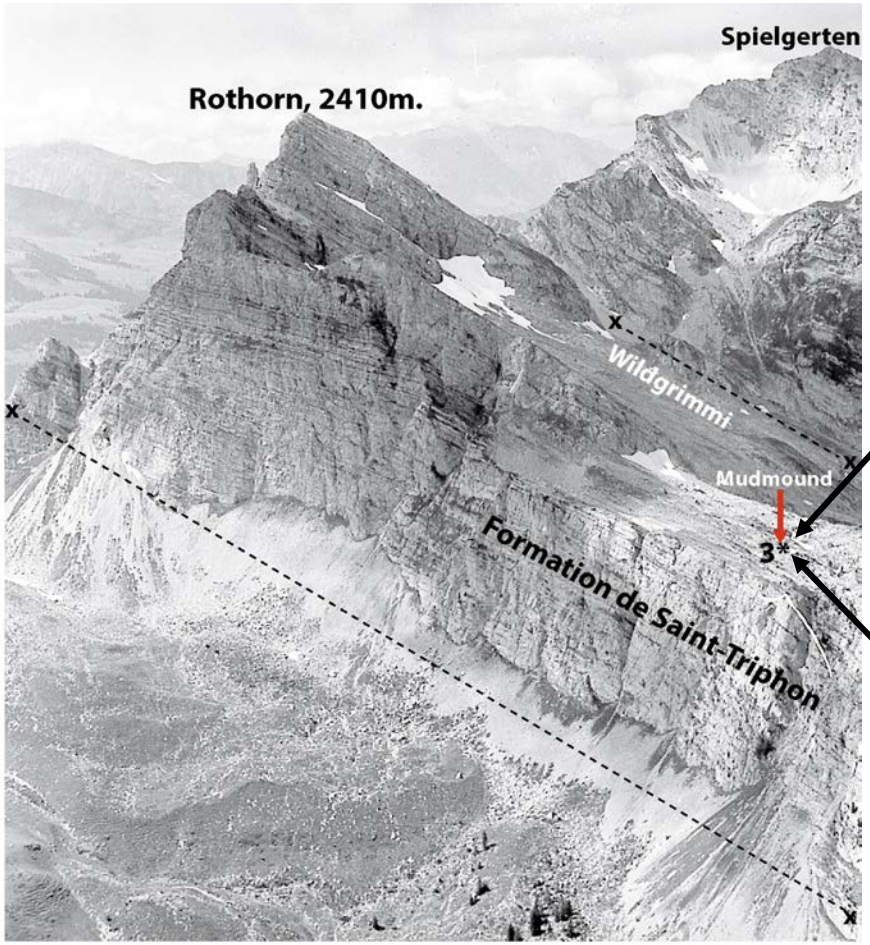
Thamnastrea sp. as illustrated by Genge, 1952



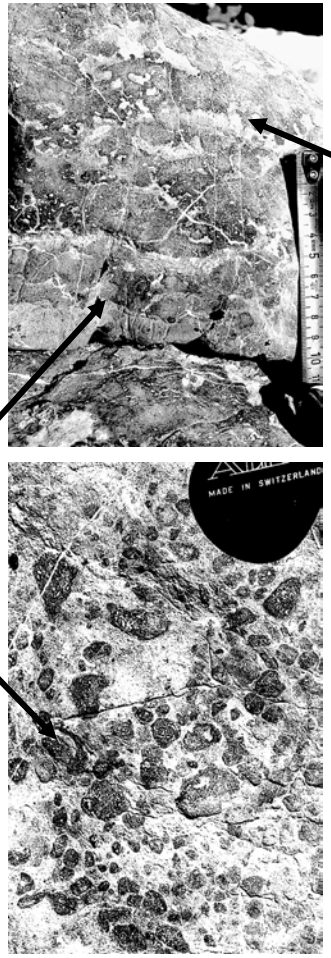
GoogleEarth view on Diemtigtal with position of the main summits.

5 The Anisian bioevent *3

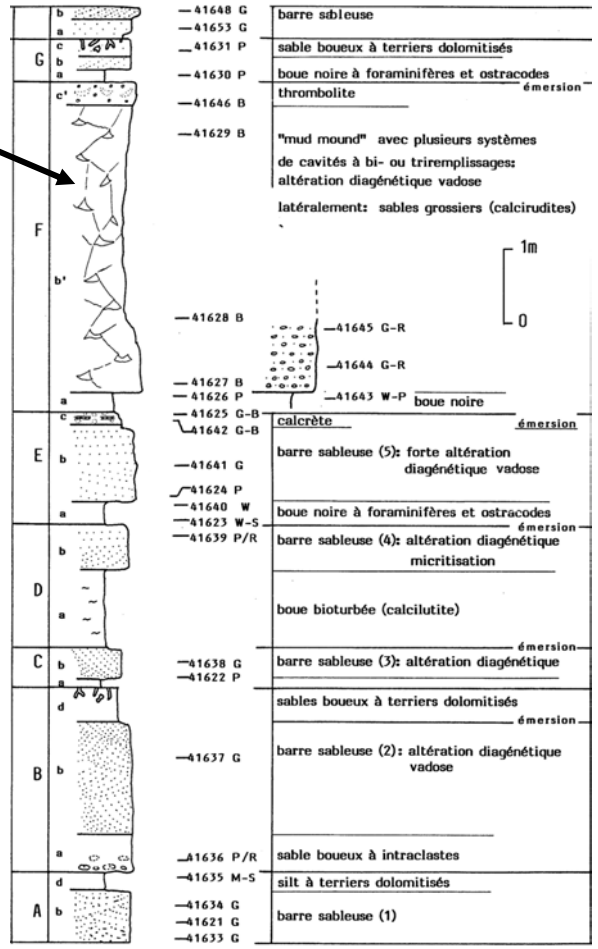
In the *cadoricus* zone, a level of a thrombolitic buildup up to 4 m thick were found in the Rothorn section, a 4 m. thick "mudmound" showing similarity to the post extinction basal Triassic sponge microbial buildups.



Swisstopo photo of the Rothorn area with position of the middle Anisian mudmound.



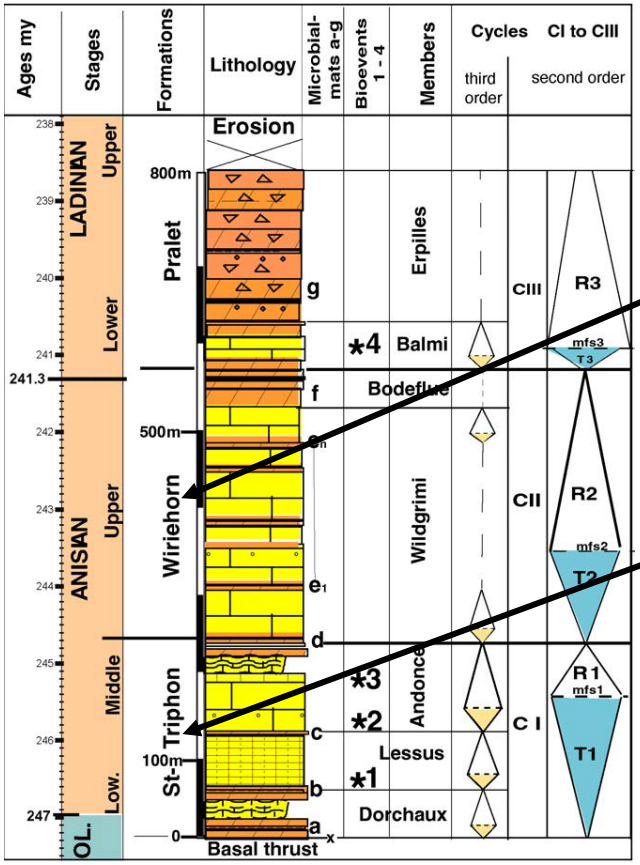
Field photos of the mudmound.



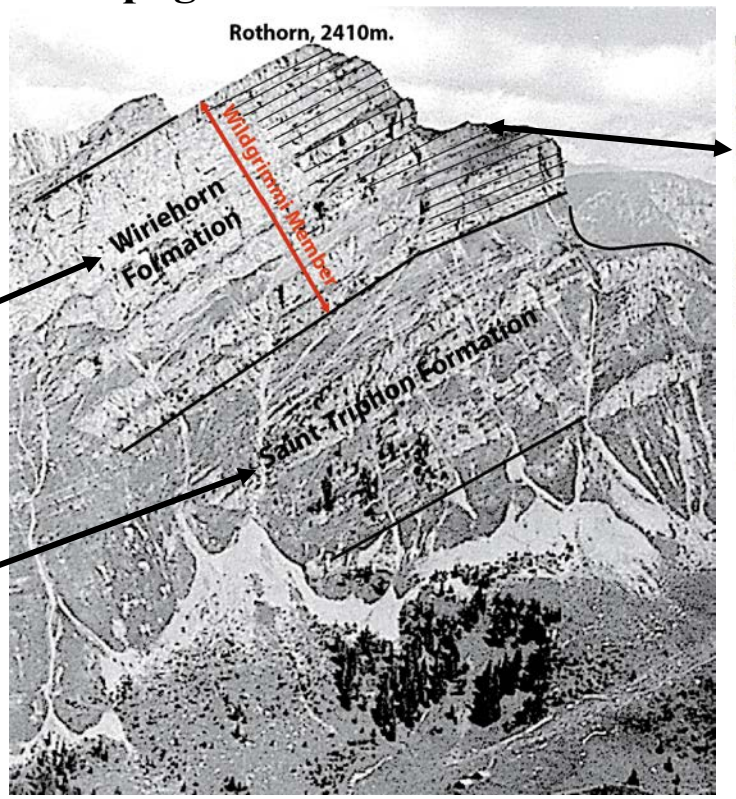
Lithological sketch of mudmound section.

6 The upper Anisian Wildgrimmi cyclic sedimentation

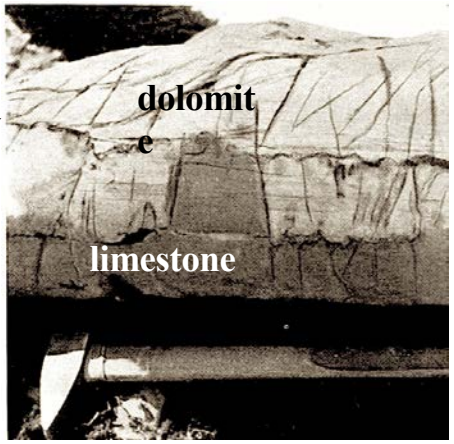
The overlying upper Anisian Wildgrimmi Member of the Wiriehorn Formation consists of a 220 to 340 m succession of peritidal carbonate deposits with a shift to pluri-metric scale shallowing-upward cycles, each topped by a dolomite bed possibly of microbial origin. We found same type in same age Latemar cyclic sedimentation as shown in the next page.



Briançonnais Middle Triassic Stratigraphical sketch.



The Rothorn cliff view from the West

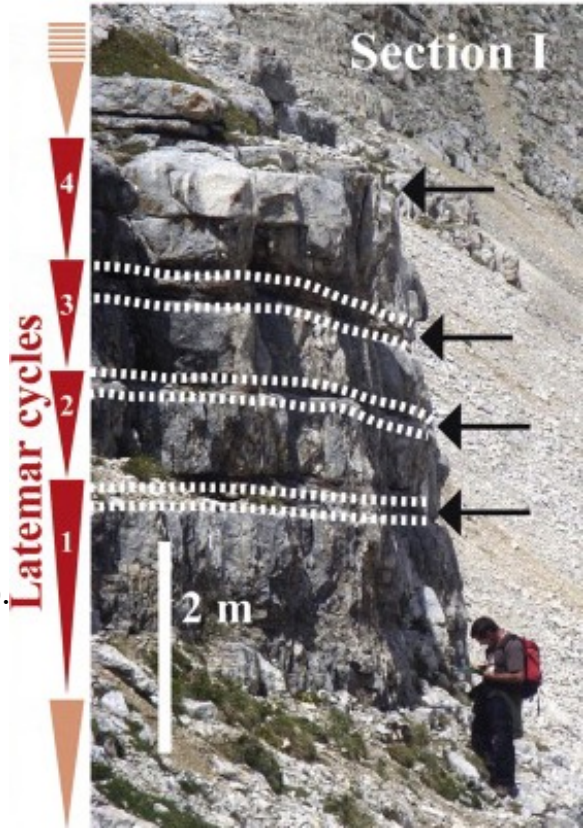


Top limestone cycle with light dolomitic microbial bed.

6 The same age upper Anisian Latemar cyclic sedimentation

Metric to pluri-metric scale shallowing-upward carbonate cycles, each topped by a dolomite bed of microbial origin.

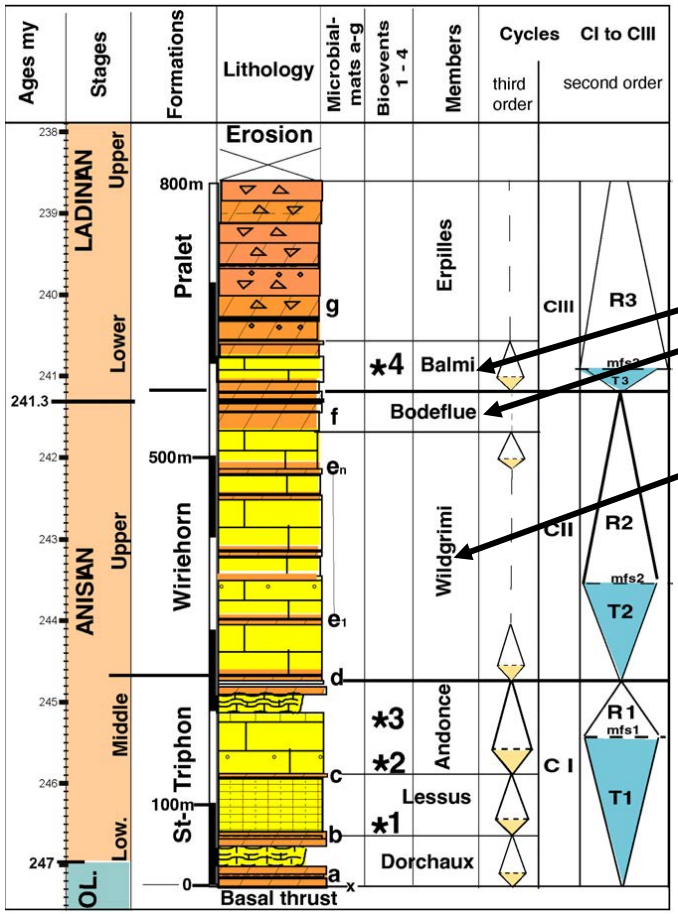
Latemar mountain view with cyclic carbonate sedimentation(internet illustration).



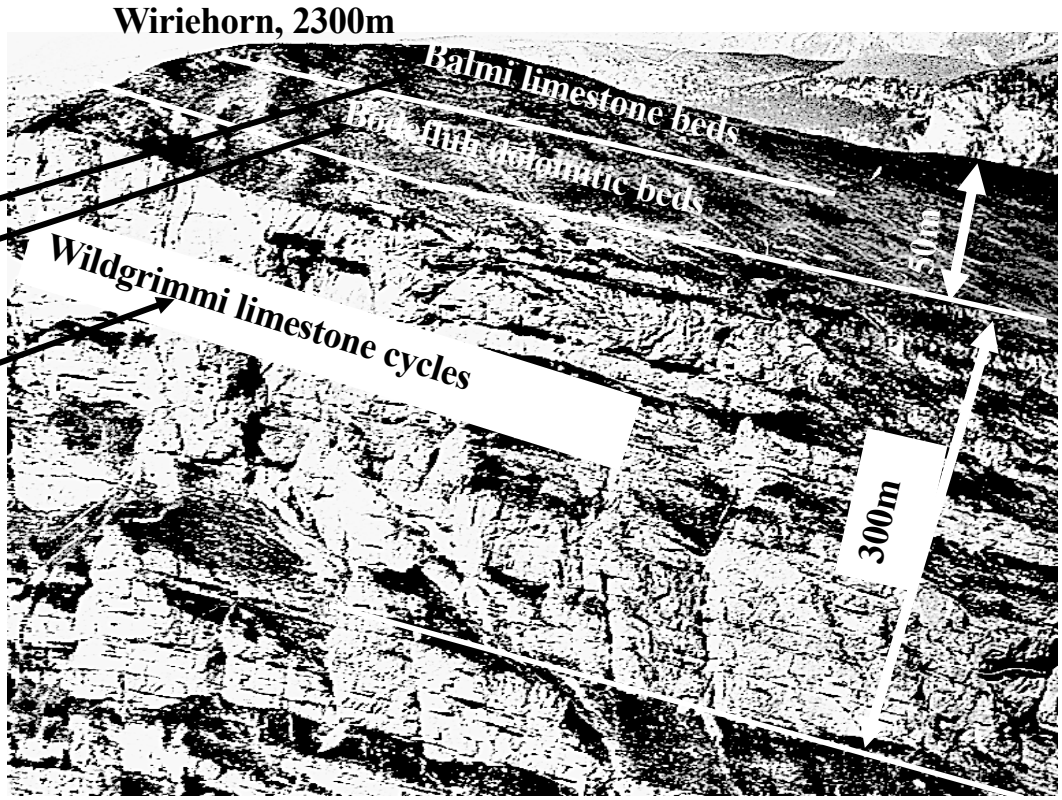
Late Anisian Latemar limestone cycles illustrated by Christ et al., 2012, Sedim. Geol. fig.3.

7 The upper Anisian dolomitic Bodefluh Member

The upper regressive part of the Wiriehorn Formation, the Bodefluh Member, is characterized by dolomitic beds built by microbialites (f on fig.).



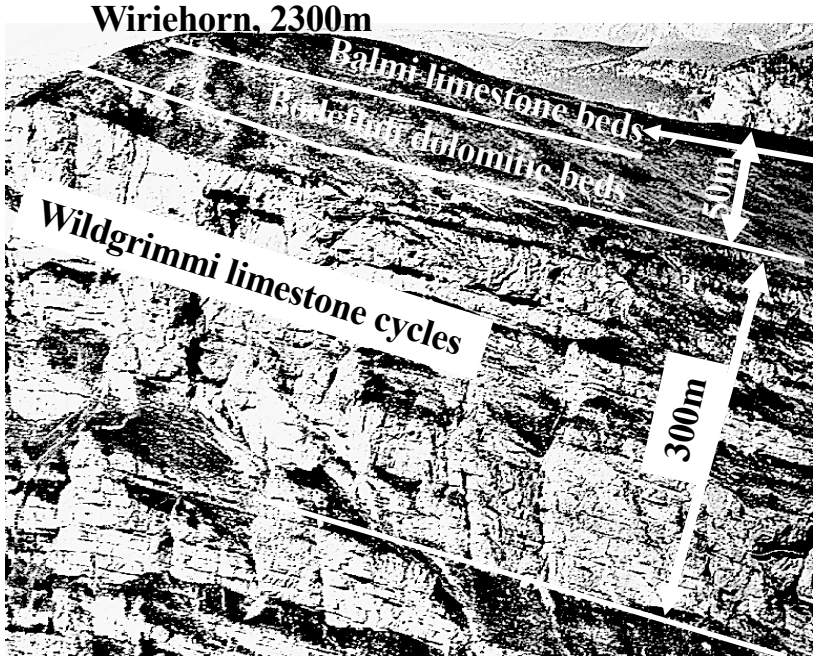
Briançonnais Middle Triassic Stratigraphical sketch.



Upper part of the Wiriehorn cliff from the South.

8 The Lower Ladinian Pralet Formation

The following transgressive part of the Pralet Formation, the Balmi Member, the recorded conodont *trumpyi* allowed us to date the upper bio-event (*4 in fig.) of the basal Ladinien, about 241 My ago. It consists of a short living rich assemblage of crinoids, gastropods, brachiopods, bivalves, and siliceous sponges at the origin of the second cherty limestone level. This fossil rich assemblage is called the *Costatoria goldfussi* bio-event .



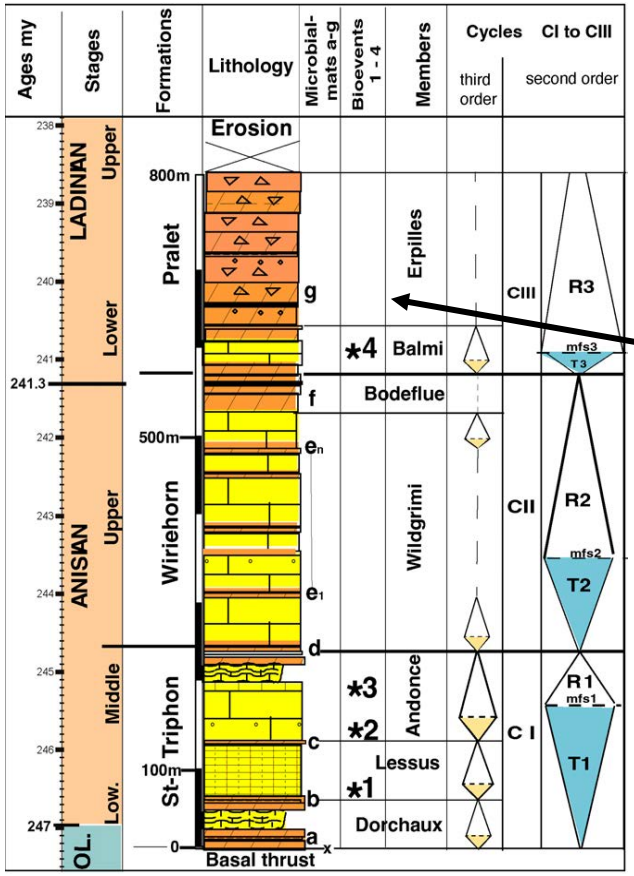
Upper part of the Wiriehorn cliff from the South.

Chert beds at the base of the Balmi Member.

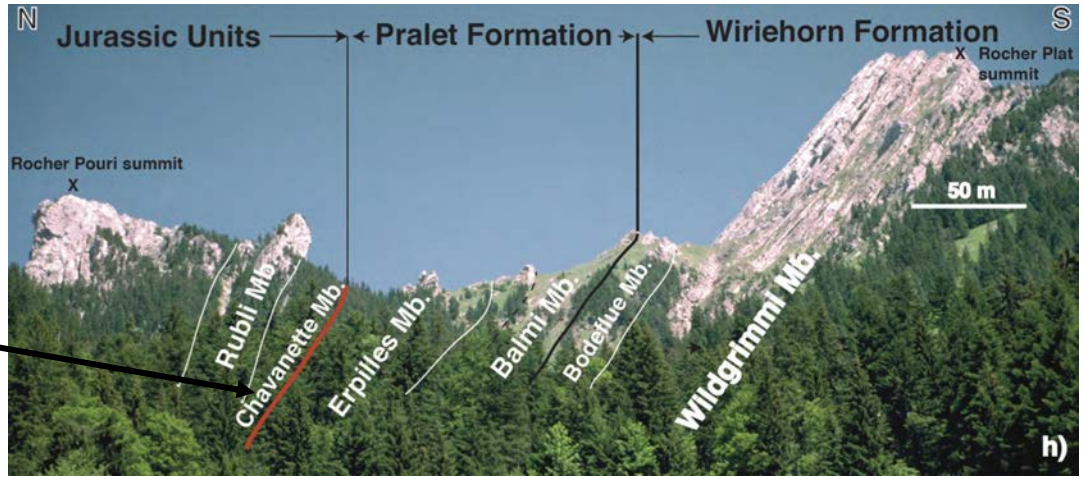
Centimetric *Costatoria goldfussi* shells

8 The Lower Ladinian Pralet Formation

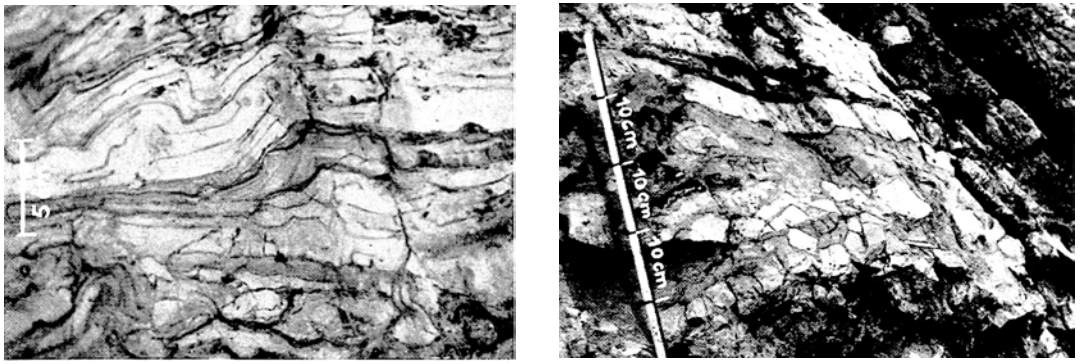
Then due to aridity and higher salinity, the carbonate factory moves to dolomitic production with increase in microbial activities (g, fig. 1) and loss of skeletal material in the upper Pralet Formation, the Erpilles Member, still Ladinien in age (240-238 My).



Briançonnais Middle Triassic Stratigraphical sketch.



View on the type locality (stratotype) of the Pralet Formation



Microbial dolomite and mircrobial dolomite breccia of the Erpilles Member of the Pralet Formation.

9 To resume

1- During the end of the Lower Triassic time a hudge marine trangression filled the Briançonnais marginal basin with non skeletal carbonate deposition due to a microblial bloom, possibly associated with Demosponge, with some similarities with the basal Triassic transgression following the end-Permian mass extinction (EPME).

2- The microblial blooms with a strong dolomite biomineralization capacity are at the origin of the dolomite beds numbered a to g in the 600m thick skeletal limestone succession.

3- Bio-events concerns marine skeletal organism recovery with after the EPME.

-The first one concerns the calcareous Algae blooms in the lower and middle Anisian

-The second one concerns the siliceous sponge blooms at the origin of the first chert beds in the middle Anisian

-The next one concerns the isolate coral recovery in the middle Anisian.

-The unique ammonoid finding of *B. cadoricus*, allowed a precise middle Anisian datation of the upper Andonce Member.

-The younger one concerns the well dated lower Ladinian fossil rich limestone beds.

4- In the start of the late Anisian time, the oxic carbonate environement shift to a retricted cyclic carbonate succession.

5- During younger Ladinian time, restricted, sulfate rich and anoxic environement favorized microbial blooms and dolomite deposition.