SIX MAIN FACIES IN THE POST-EXTINCTION BASAL TRIASSIC (GRIESBACHIAN) OF OMAN, FROM DEEP TO SHALLOW AND FROM EUXINIC TO WELL OXYGENATED

Complementary and additional text

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This resumed my sedimentological approach and view, that results from field works done first with Sylvain Richoz and some part of it with Hugo Bucher, with his past Zurich PhD students and PostDoc assistants, with colleagues from France, Austria, Germany, and Canada.

EUXINIC

Facies 1: light calcareous shale and platy lime mudstone beds

Facies 2: laminated papery limestones

Facies 3: light thin bedded dolomudstone

WELL OXYGENATED

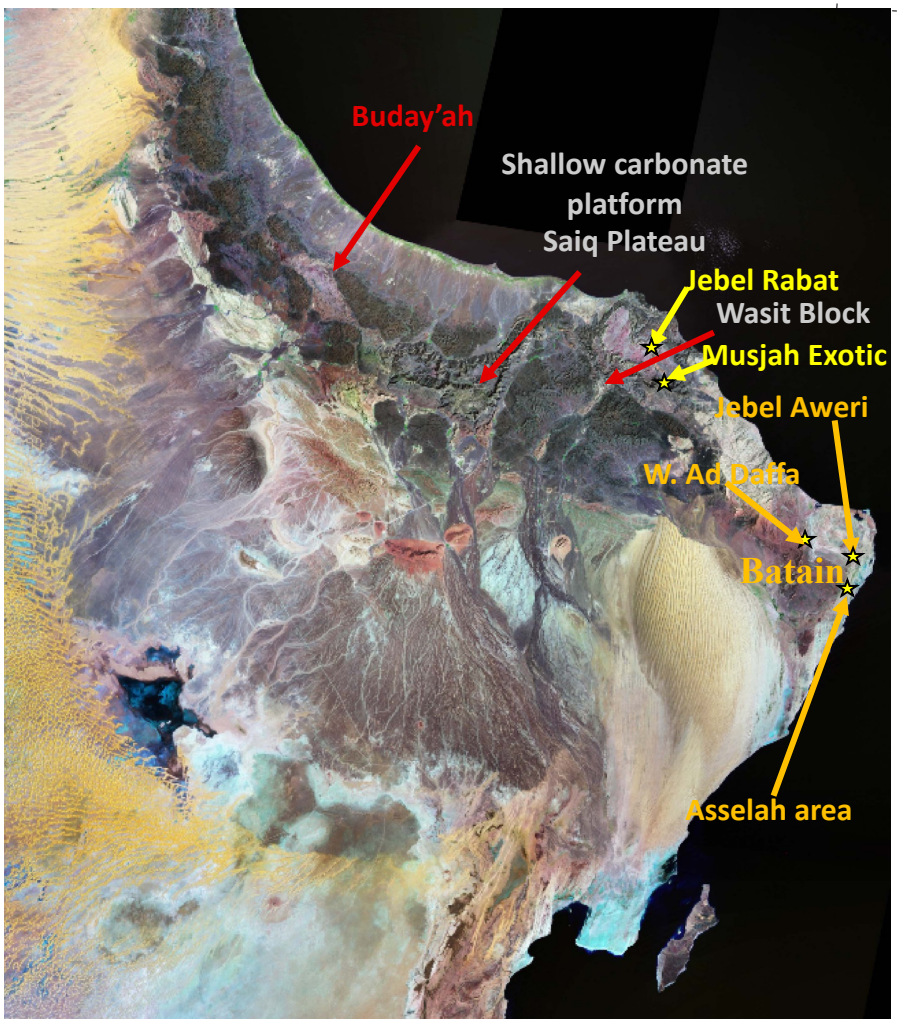
Facies 4: bivalve bioherm overlain by a Bivalve biostrome

Facies 5: crinoidal lime-packstone

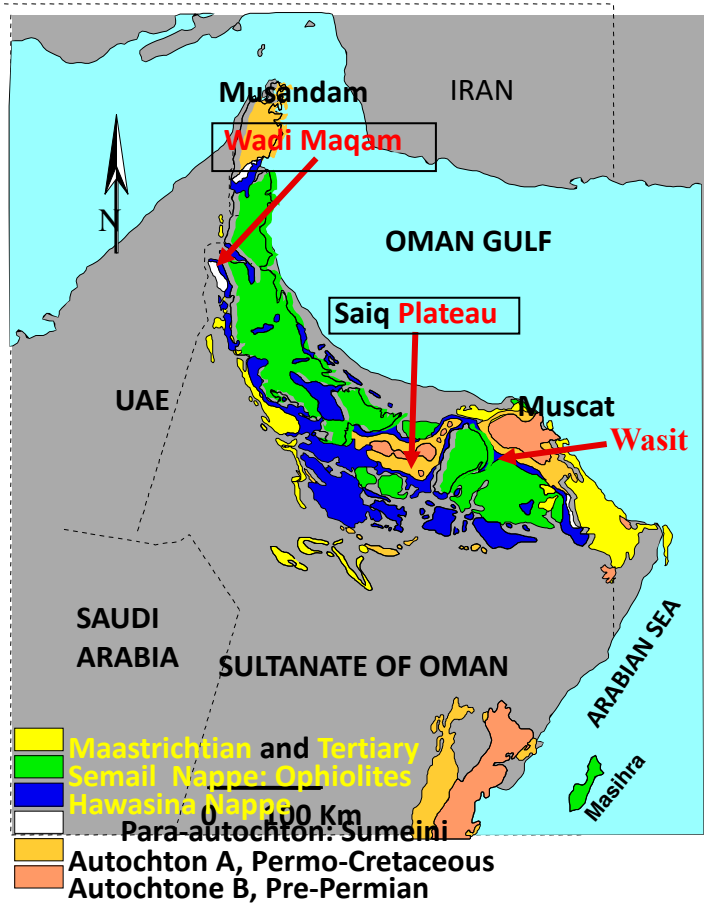
Facies 6: stromatactis pelagic Hallstatt-type limestone studied by H. Bucher and T. Bruhwiler

1 Introduction

The Oman Mountains expose the Middle Permian to Lower Triassic Buday'ah section of oceanic sediments belonging to the south margin of Tethys. Located in the northeast part of the Hawasina window this locality is among the only places were true Tethyan Permian radiolarites are exposed.

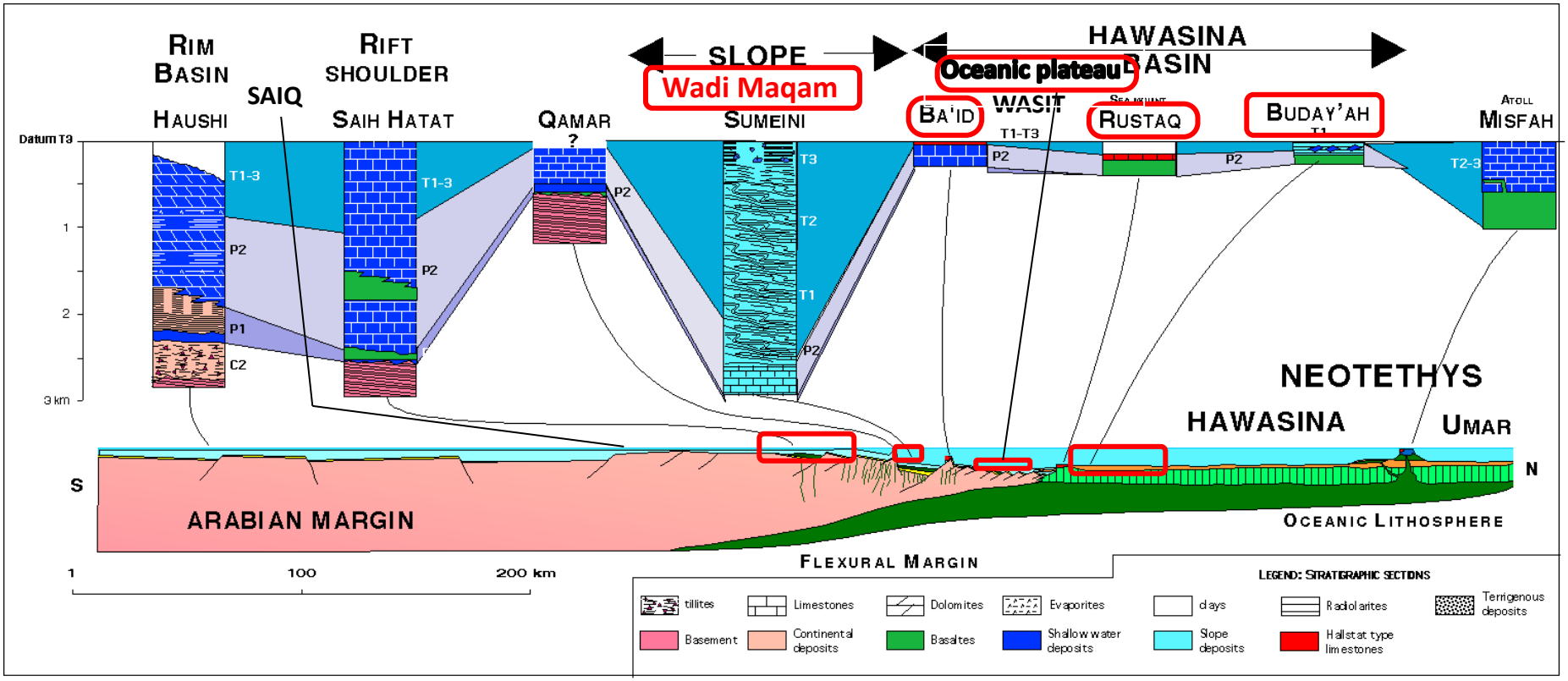


Investigated area, NE Oman



1 Introduction

The Gondwana margin Oman



THE EUXINIC FACIES

Facies 1: light calcareous shale and platy lime mudstone beds

During the Permian-Triassic transition (PTt) the calcite compensation depth (CCD) is marked by a rise from deep to shallower depth in the paleo-oceanic Buda'yah section (Baud et al., 2012), showing a basal Triassic facies of light calcareous shale and platy lime mudstone beds overlying dark late Permian radiolarite chert beds and siliceous shales. The platy lime mudstone beds (5) include an Upper Griesbachian bloom of calcite filled spheres (radiolarians?) that marks a potential world-wide event.

The overturned Buday'ah section

Facies 1: light calcareous shale and platy lime mudstone beds

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The Buday'ah Formation, Sultanate of Oman: A Middle Permian to Early Triassic oceanic record of the Neotethys and the late Induan microsphere bloom

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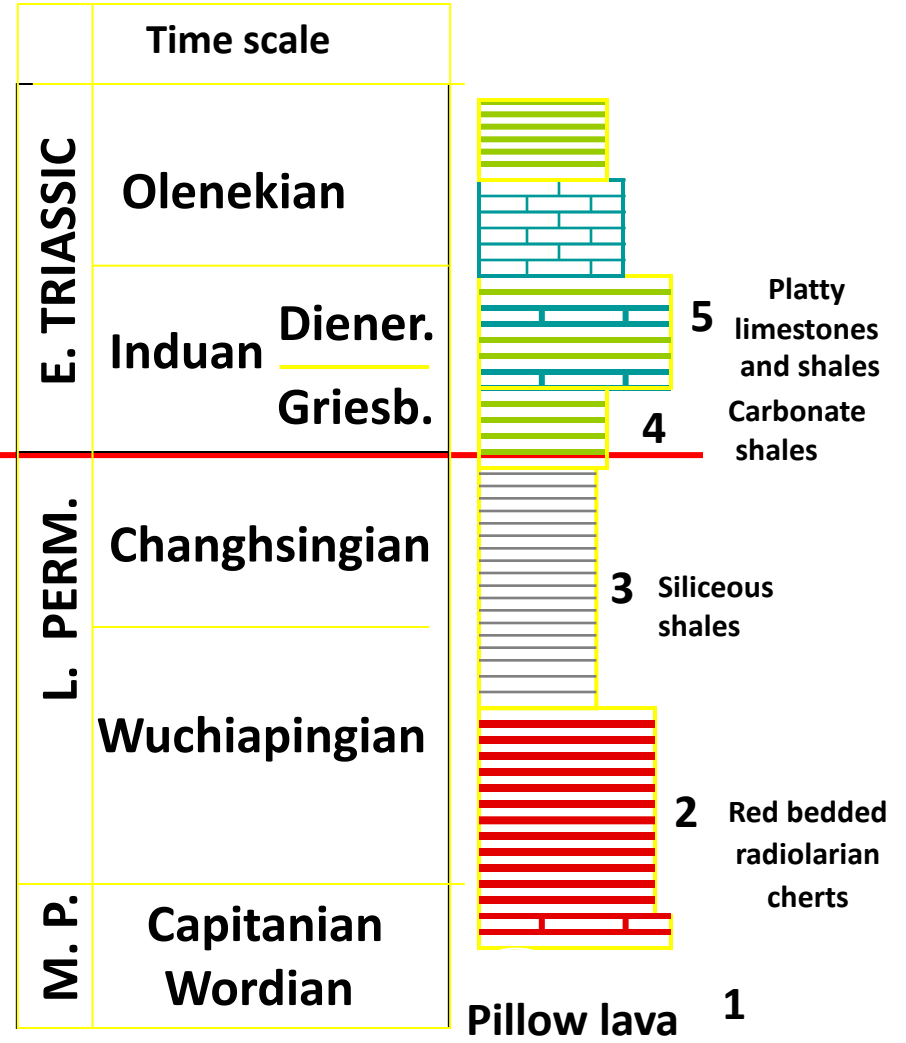
Facies 1: light calcareous shale and platy lime mudstone beds

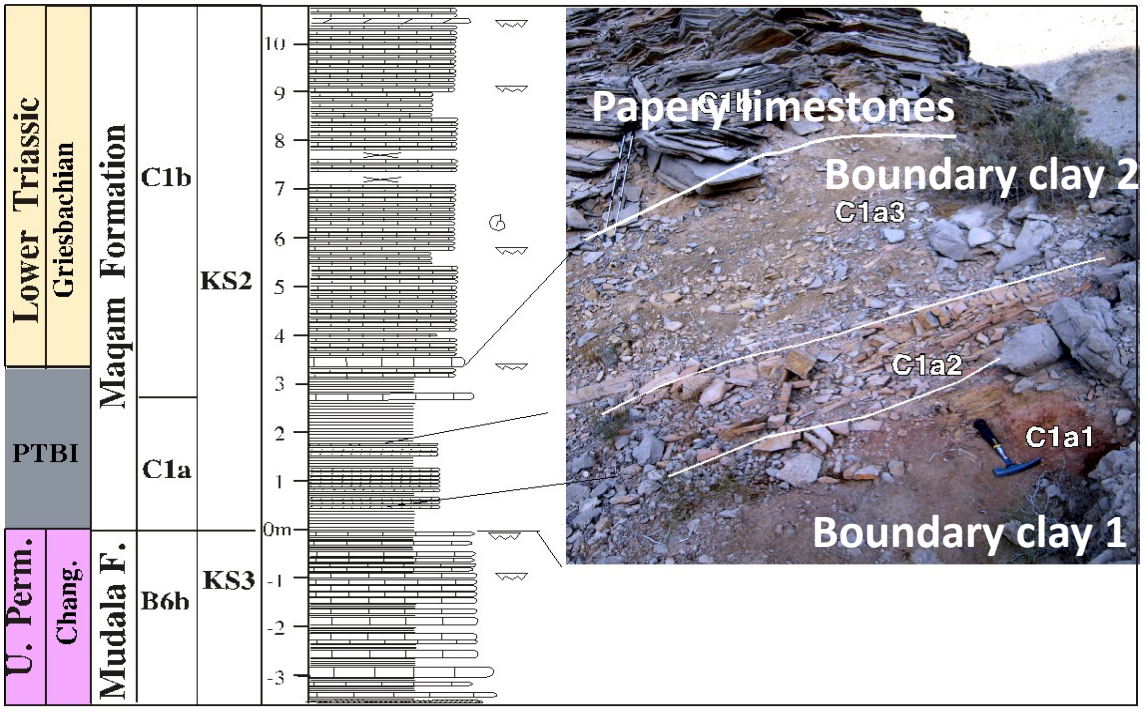
Monotonous thin bedded dark grey shales about 2 m thick comprises litho-unit 4. Near the base a conodont sample provided C. cf. *meishanensis* of latest Permian age and at the top a C.cf. *zhejiangensis* (det. C. Henderson) that cross the Permian-Triassic boundary.



Buday'ah section: the P-T transition

Facies 2: laminated papery limestones

The next main facies occur on the continental-slope deposit of the Wadi Maqam section (Richoz et al., 2010, 2012) where we observe the same CCD rise, here from chert bands in Late Permian dolomite beds to 3 m thick boundary calcareous shales and up to 9 m of basal Triassic laminated papery limestones and stromatolite deposits in euxinic environment.

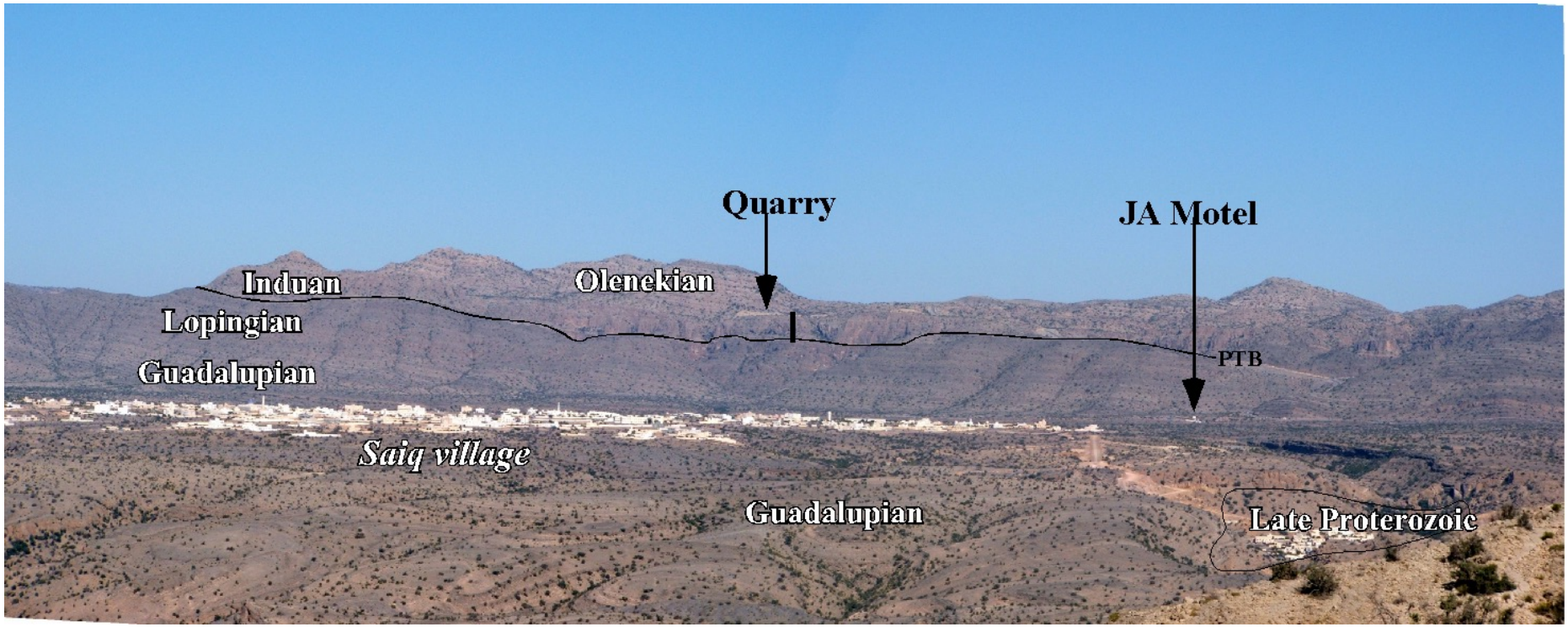


Stromatolite dolomitic facies

The Permian-Triassic boundary in the Wadi Maqam worked with Sylvain Richoz and Benoit Beauchamp

Facies 3: light thin bedded dolomudstone

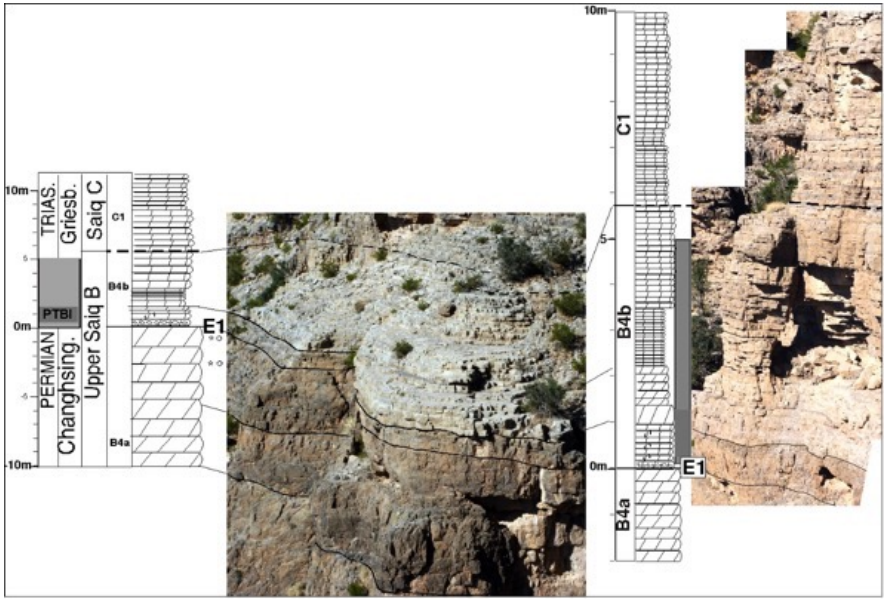
If apparently continuous deposits during PTt occur on shallow continental margin cropping out in the autochthonous, dolomitized Permian-Triassic water carbonate succession, gaps are present in the Saih Hatat (Weidlich & Bernecker, 2011) as in the Djebel Akhdar (North Oman mountains).



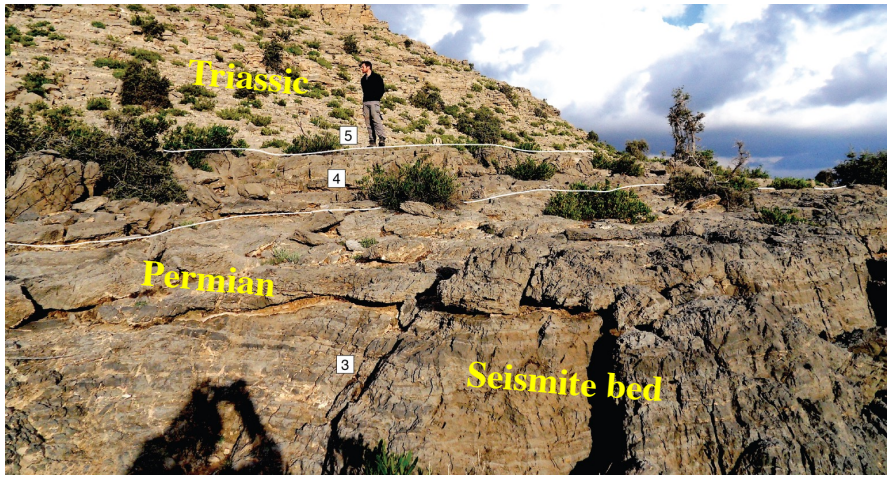
In the Djebel Akhdar, panorama of the Saiq plateau with age of the Permian-Triassic units.

Facies 3: light thin bedded dolomudstone

The main basal Triassic facies on the Saiq Plateau sections consists of light thin bedded dolomudstone overlying brown azoique dolomudstone with disrupted and deformed beds (seismite, described in Baud et al., 2016).



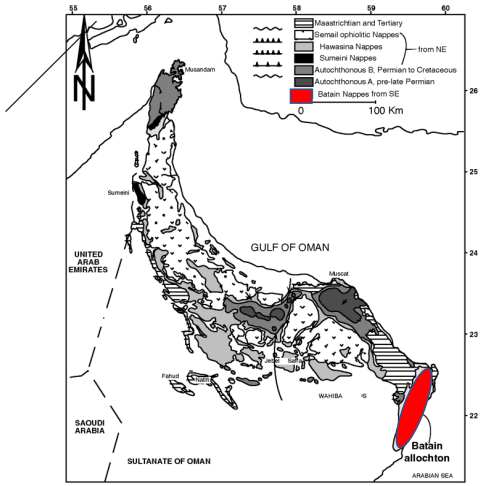
The Permian-Triassic transition : note the change of color between the late Permian braun fossiliferous dolostone and the basal Triassic light dolomudstone .

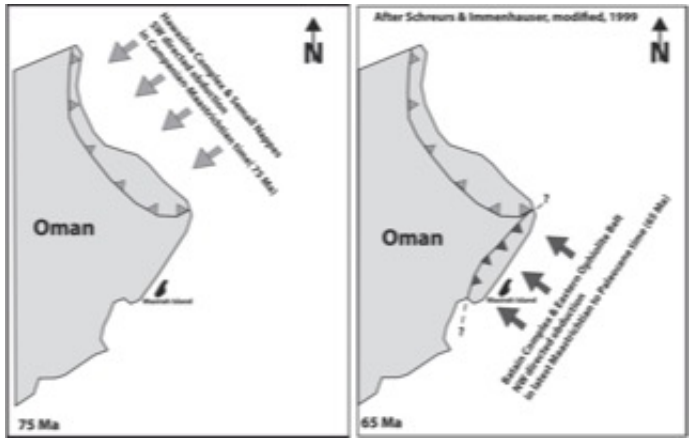


Close view of the Permian-Triassic transition, with disrupted and deformed beds of the seismite level (3) overlain by a high energy dolo-arenite (4) and basal Triassic light dol-mudstone (5).

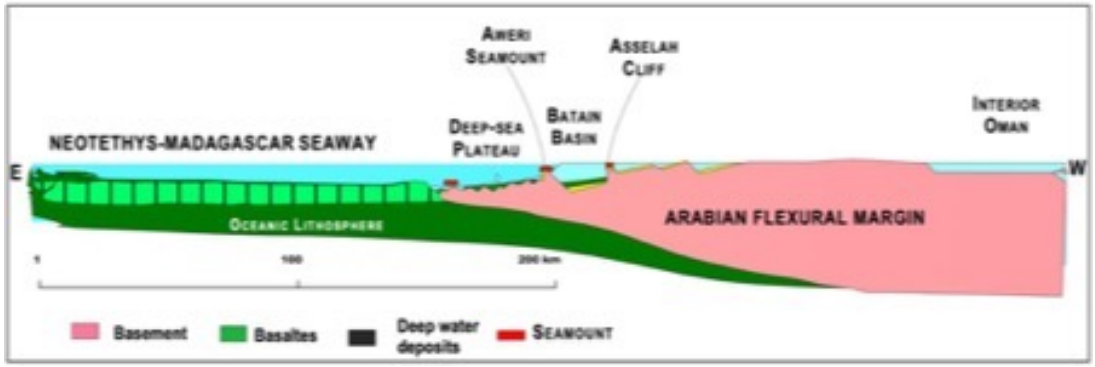
WELL OXYGENATED FACIES

During Triassic and Lower Jurassic times the Hawasina and Batain basins have been the sites of large-scale debris flows and olistostromes. Within the great number of reworked blocks, the discovery of basal Triassic highly fossiliferous boulders, revealed three new facies of Griesbachian limestones built, for two of them, by skeletal accumulations in well oxygenated water. These facies are in marked contrast with the euxinic muddy carbonate (dolomudstone) of the shallow water platform sediments. Their origins are from seamount or oceanic plateau, above fair-weather wave base.





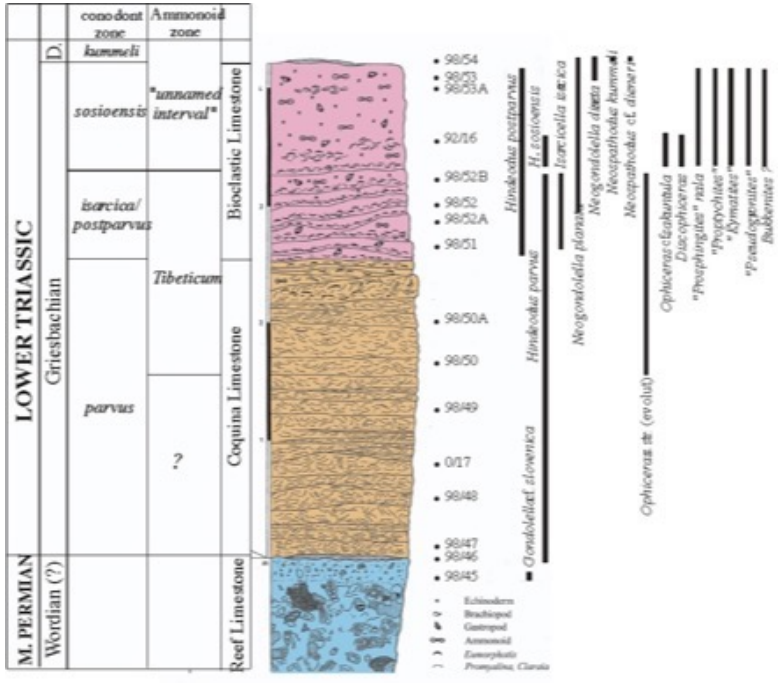
After Schreurs & Immenhauser, modified, 1999.



Paleo-emplacement of the Batain Formations

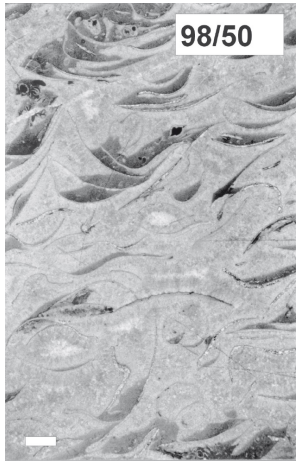
Facies 4: bivalve bioherm overlain by a Bivalve biostrome

The first of these three facies consist of a bivalve bioherm overlain by a Bivalve biostrome with rare Brachiopod, Gastropod and a new type of Crinoid, well dated by conodonts and characterize the **Griesbachian Wasit block** facies described by Krystyn et al., (2003) and Twitchett et al., (2004). A similar Griesbachian coquina facies occur in the not yet described Naksi block in the Wadi Wasit and another coquina block in the Asselah area (Batain).



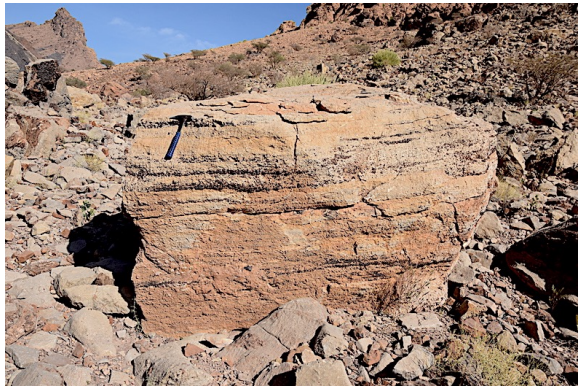
Wasit block: Krystyn et al., (2003).

microfacies

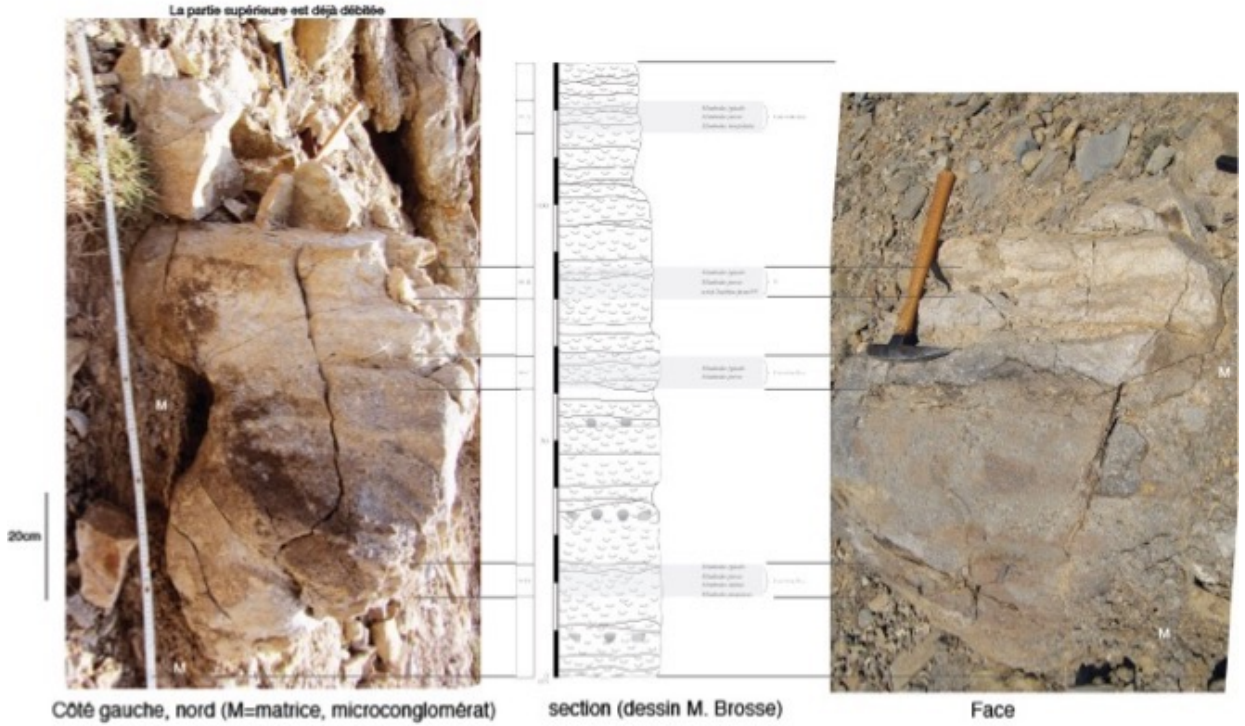


Wasit block.

Facies 4: bivalve bioherm overlain by a Bivalve biostrome



Naksi, Griesbachian coquina limestone block Wadi Wasit



Côté gauche, nord (M=matrice, microconglomérat) section (dessin M. Brosse) Face

Batain, Assela 4= Block 58, an other Griesbachian boulder, a bivalve biostrome, Brosse et al. still not published.

Facies 5: crinoidal lime-packstone

New data from Oman indicate benthic high biomass productivity coupled with low taxonomic diversity in the aftermath of the Permian–Triassic Boundary mass extinction

MORGANE BROSSE, HUGO BUCHER, AYMON BAUD, ÅSA M. FRISK, NICOLAS GOUDEMAND, HANS HAGDORN, ALEXANDER NÜTZEL, DAVID WARE AND MICHAEL HAUTMANN

LETHAIA

Brosse, M., Bucher, H., Baud, A., Frisk, A.M., Goudemand, N., Hagdorn, H., Nützel, A., Ware, D. & Hautmann, M. 2018: New data from Oman indicate benthic high biomass productivity coupled with low taxonomic diversity in the aftermath of the Permian–Triassic Boundary mass extinction. *Lethaia*, https://doi.org/10.1111/let.12281.

Jean Guex, Leo. Krystyn and the author in Asselah hills, SE Oman

Facies 5: crinoidal lime-packstone

The second facies is a crinoidal lime-packstone discovered in an Asselah block described by Brosse et al. (2018) and showing among crinoids a rich assemblage of bivalves, gastropods and ammonoides.

Crinoidal limestone surface

Right: close vew of the boulder surface with an accumulation of skeletal shells and crinoid stems

Facies 6: stromatactis pelagic Hallstatt-type limestone studied by H. Bucher and T. Brühwiler

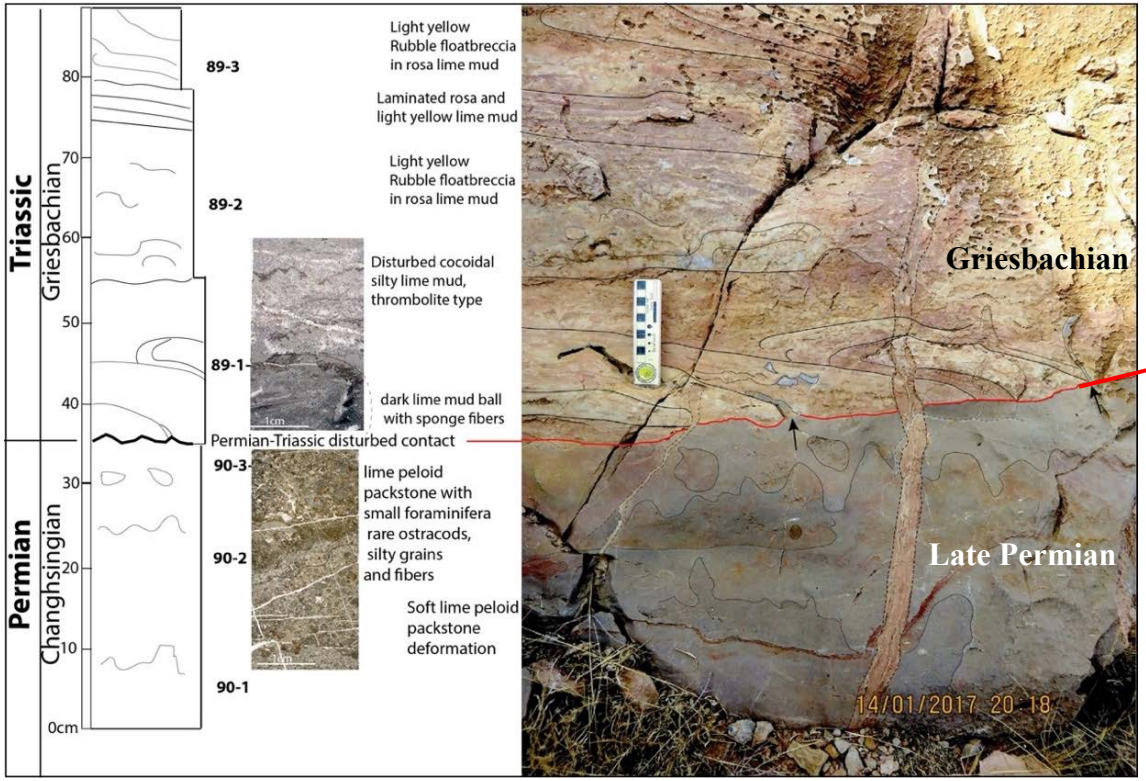
The third facies show for the first-time a stromatactis pelagic Hallstatt-type limestone of Griesbachian age. It has been discovered by H. Bucher in a 30m thick reworked block (RAA) comprising Late Permian and Early Triassic carbonate succession in Djebel Rabat.

Hugo Bucher, who do fieldwork description and the outcrop picture, asked me to do a preliminary sedimentological study, that I report here with the help of Edward Oluwaseun who prepare all thin sections photos and of Louis Dudit who digitize the field section drawed by Hugo Bucher.

Djebel Rabat view. The RAA block is behind the crest on the left.

Facies 6: stromatactis pelagic Hallstatt-type limestone studied by H. Bucher and T. Brühwiler

It is interesting to note the disrupted and deformed beds at the Permian-Triassic contact, due to possible seismite.



microfacies with stromatactis
Size 2x3cm

The Permian-Triassic disturbed contact at the base of the RAA limestone succession.
Drawn by **T. Brühwiler**

CONCLUSIONS

In these post extinction Griesbachian sediments, a marked contrast appears between the euxinic, near azoic shallow water carbonate platform, slope and basinal sediments, and the well oxygenated open sea high or plateau built of shell beds or skeletal accumulations that may have functioned as refuge or oases.

These Oman neritic oceanic plateau records an early episode of marine ecosystem recovery and new insights into the ecology and diversity during Griesbachian time .

The unique Griesbachian Hallstatt type stromatactis limestone appear after the drowning of an offshore shallow Permian carbonate platform and the Jebel Rabat block, discovered and worked by Hugo Bucher's team, shows the early evolution of Hallstatt type limestone and suspected seismite at the PTr transition

Some references

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