Reef Constructors of the Wuchiapingian Jablonna Buildup (Western Poland)*

Tadeusz M. Peryt[1], Pawel Raczynski[2], and Danuta Peryt[3]

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Abstract

The Jablonna buildup, one of the system of isolated reefs that was developed in Wuchiapingian times on paleohighs in the basinal zone of the Polish part of the Southern Permian Basin in Europe, is characterized by quite irregular outlines and consists of three separate reef bodies (c. 0.5-1.5 km^2 each; the thickness of reef complex is usually >60 m). Bryozoans were the main reef-forming organisms. Their relative ecological flexibility combined with lack of essential competition from other organisms such as sponges and corals made it possible to dominate the environment. The ability to fast bioaccumulation combined with a possibility of quick restoring of colonies after the catastrophic events such as strong storms and rapid change of relative sea level, enabled to control the reef growth for a long time in varied environmental conditions. They show two distinct phases of bryozoan reef development during the Zechstein Limestone deposition. The first one was characterized by the dominant branched bryozoans (mostly Acanthocladia) and occurred early in the depositional history. During this phase, botryoidal aragonitic cementation played a very important role in the reef formation. Although the early massive aragonitic cementation was of prime importance for the buildup construction, encrusting foraminifers have played an essential role prior to the cementation. They were are equally common in cryptic and light-exposed habitats. The first phase of bryozoan reef development terminated suddenly due to changes in sea level that disturbed the upwelling circulation. The δ13C curves suggest that the boundary of the Acanthocladia biofacies and overlying mollusc-crinoid biofacies is roughly isochronous. Consequently, the bioclastic deposition of mollusc-crinoid and then brachiopod-bryozoan biofacies was prevailing for quite a long time until the second phase of bryozoan reef development occurred, with dominant reticular fenestellids bryozoans (Rectifenestella biofacies). The presence of echinoderms and strophomenid brachiopods indicates that until the lower part of the Rectifenestella biofacies the conditions were clearly stenohaline. Subsequent elimination of stenohaline organisms and progressively poorer taxonomic differentiation of fauna assemblage is characteristic for slight, gradual rise of salinity. Subsequently, microbial reefs developed which abound in the upper part of the Zechstein Limestone sections.

References Cited

Peryt, T.M., P. Raczynski, and K. Chlódek, 2012, Upper Permian Reef Complex in the Basinal Facies of the Zechstein Limestone (Ca1) Wolsztyn High, Western Poland: AAPG Annual Convention and Exhibition, Long Beach, California, USA, April 22-25, 2012, Search and Discovery Article #50673 (2012), Web accessed July 2016.

Peryt, T.M., M.C. Geluk, A. Mathiesen, J. Paul, and K. Smith, 2010, Zechstein, *in* J.C. Doornenbal and A.G. Stevenson (eds.), Petroleum Geological Atlas of the Southern Permian Basin Area, EAGE Publications, Houston, TX, p. 123-147.

AAPG Annual Convention & Exhibition – Calgary, June 22, 2016
Theme 2: Geobiology of Carbonate Systems (SEPM)

Reef Constructors of the Wuchiapingian Jabłonna Buildup (Western Poland)

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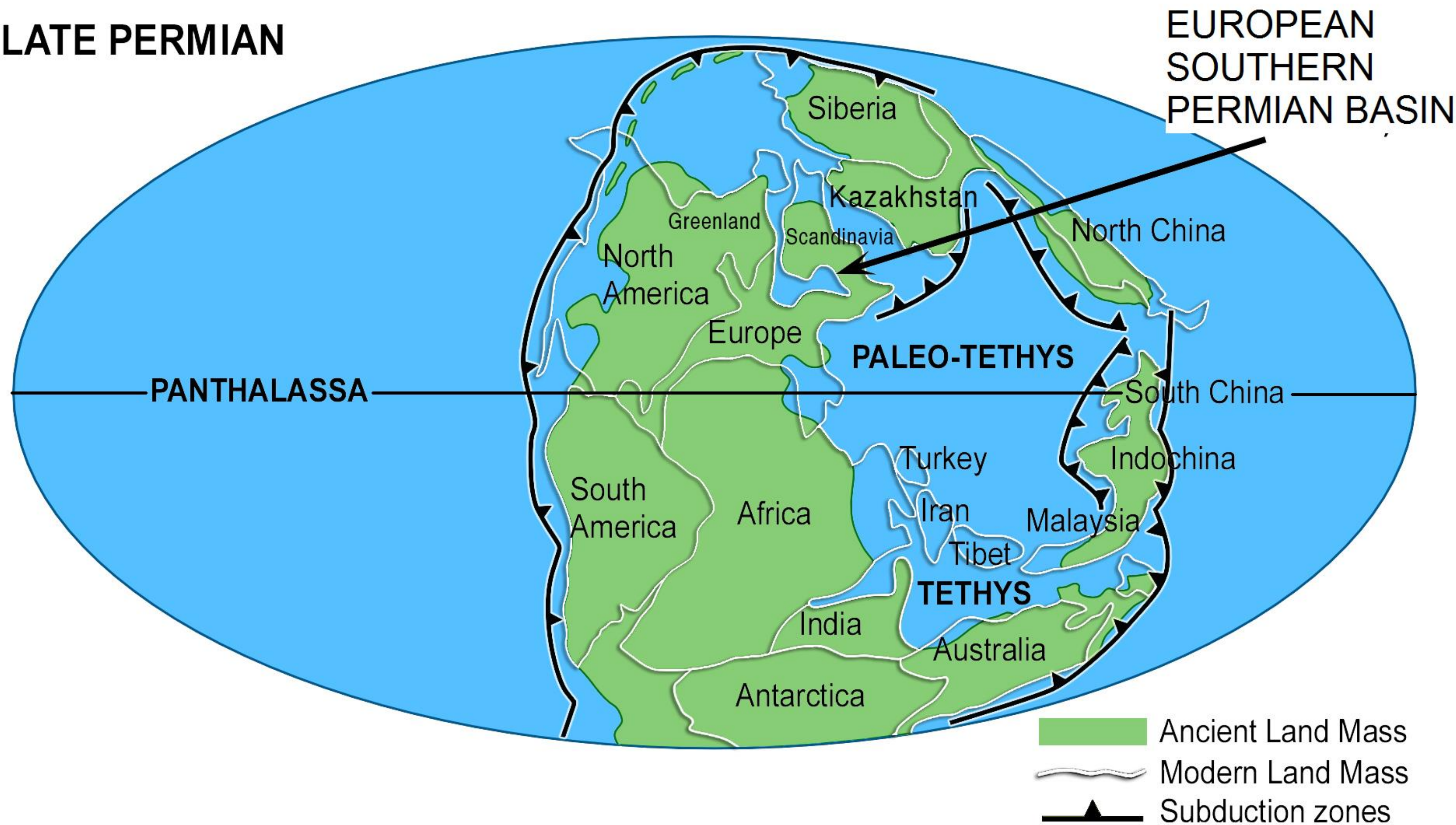
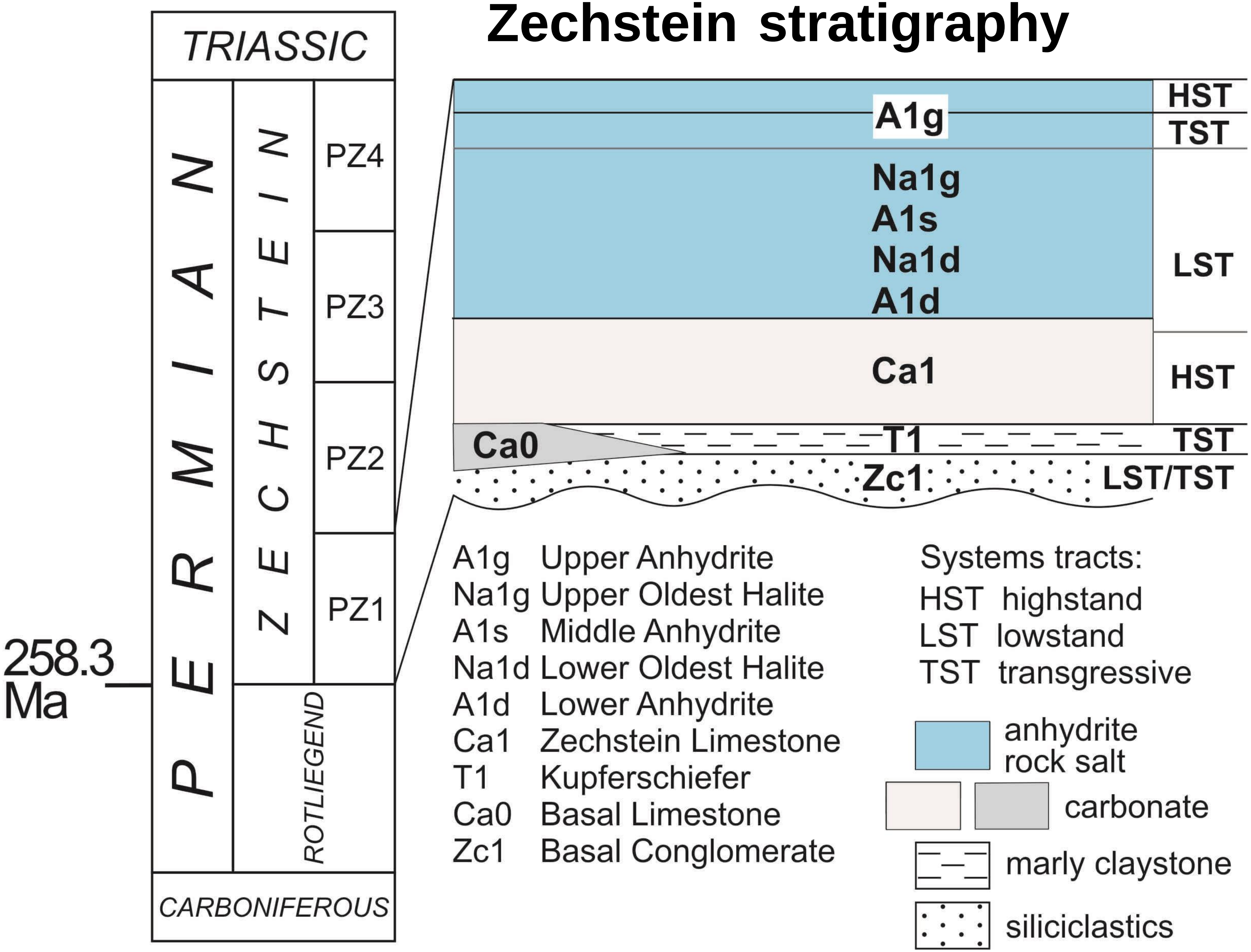
LATE PERMIAN

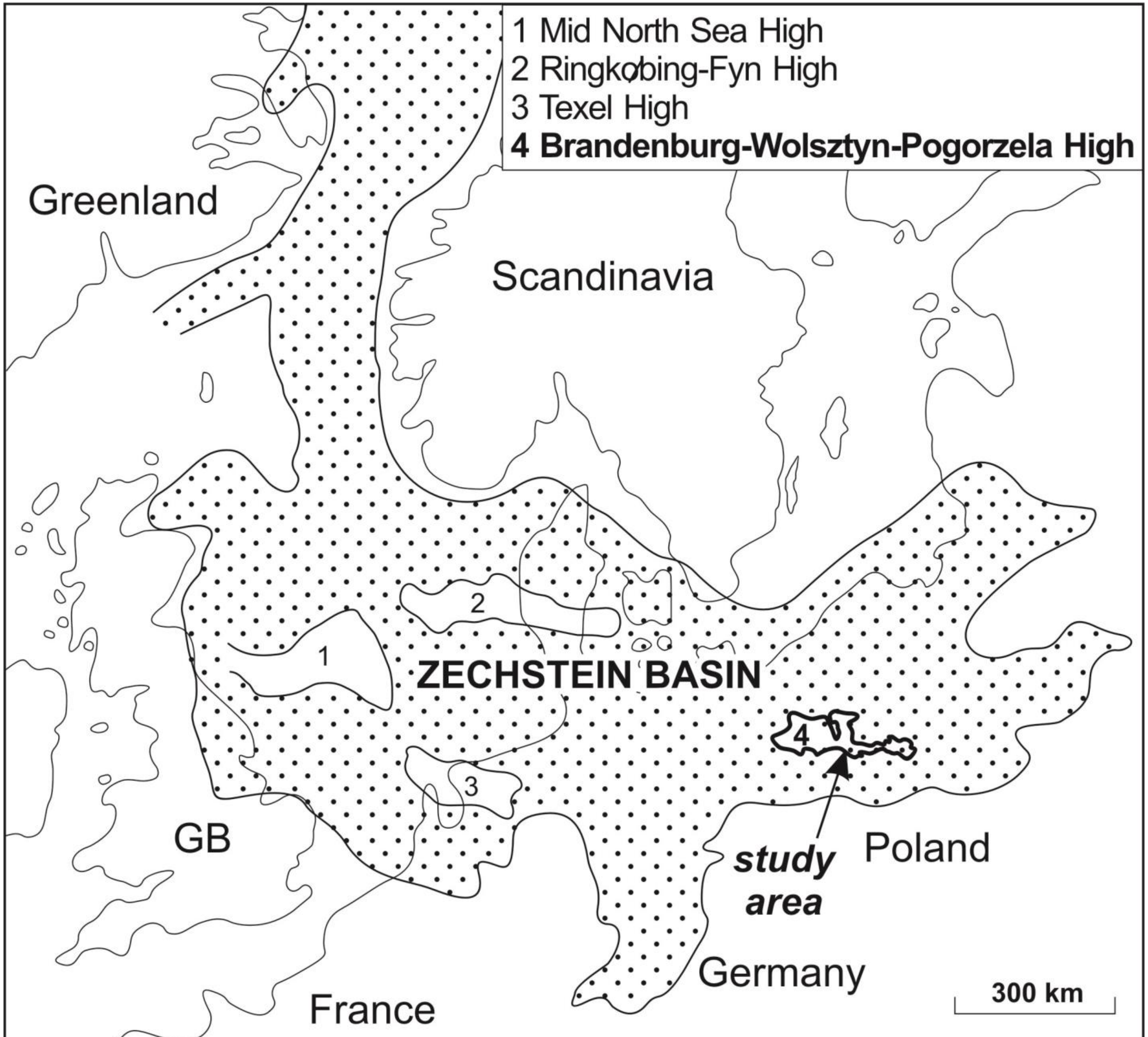


after Chris Scotese

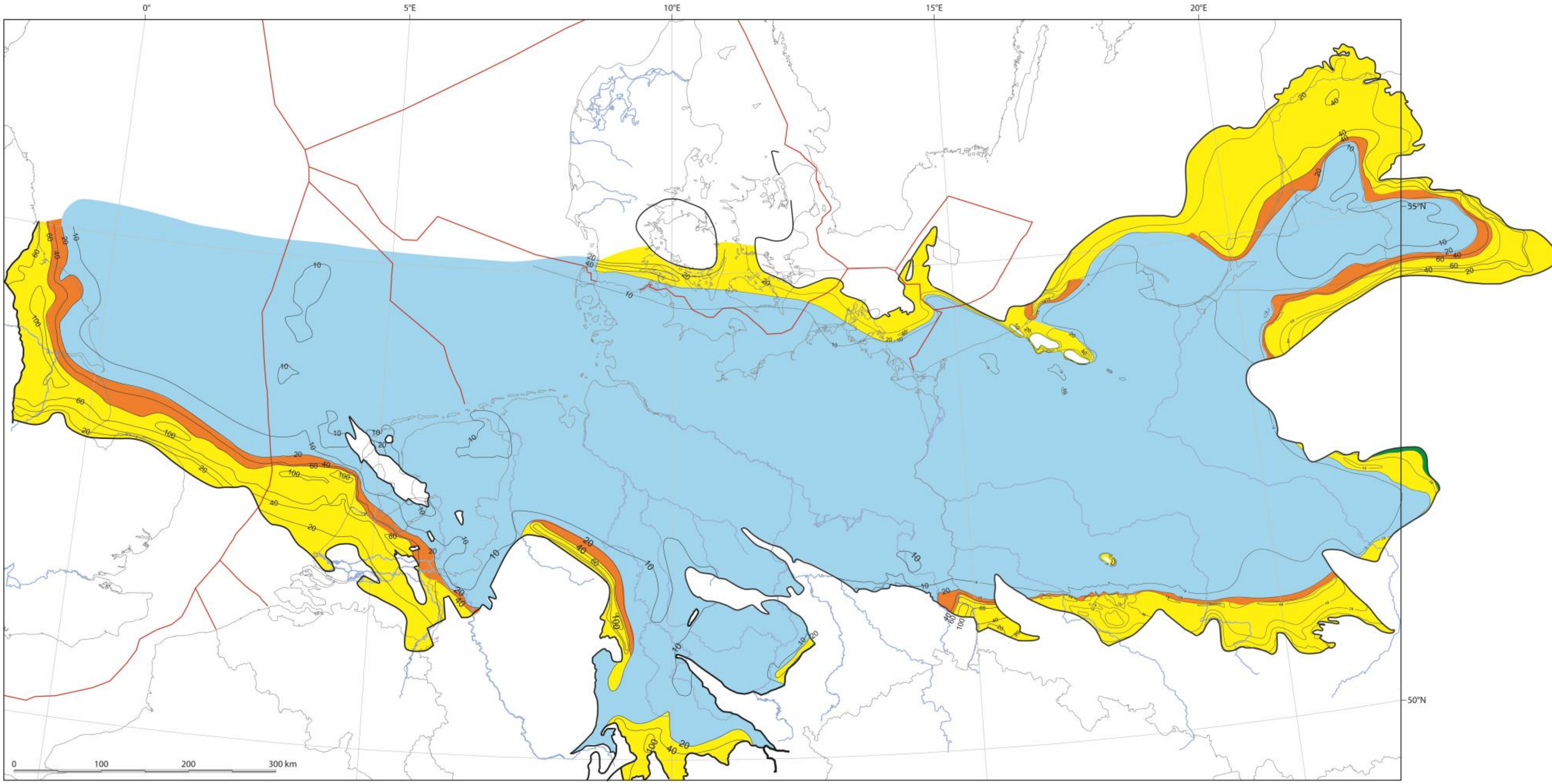
Zechstein stratigraphy



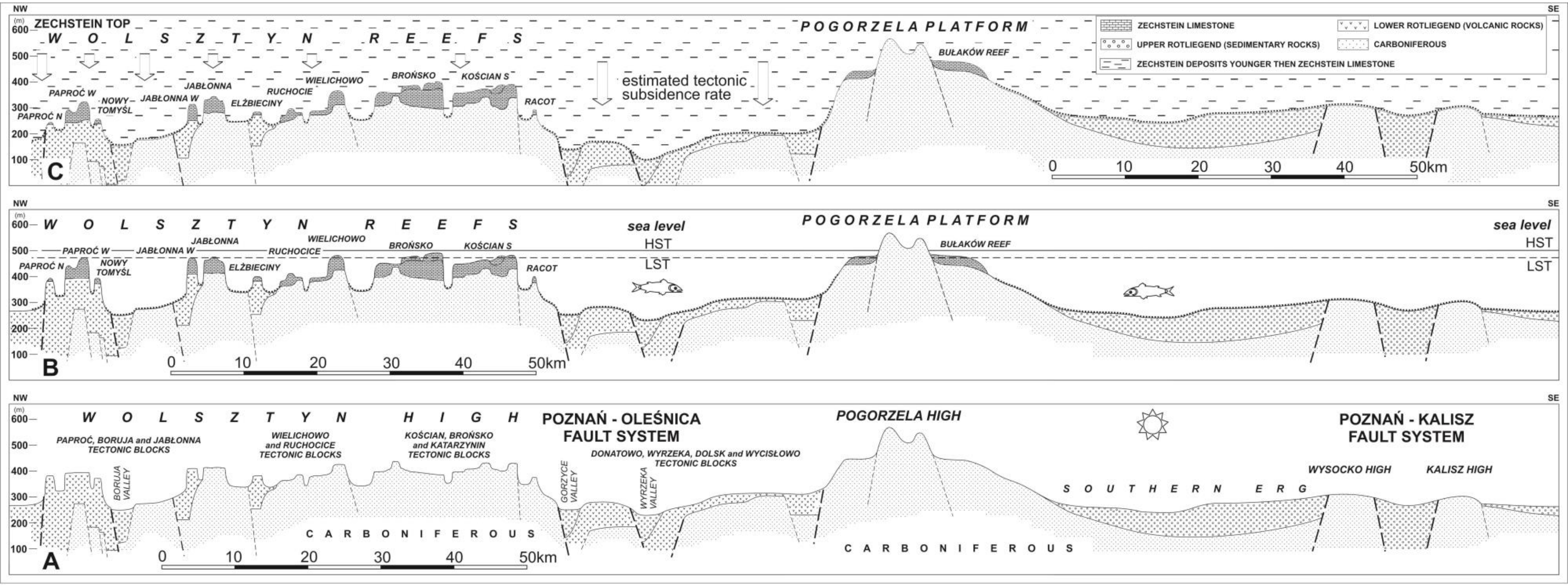
Position of the Brandenburg–Wolsztyn-Pogorzela paleo-High

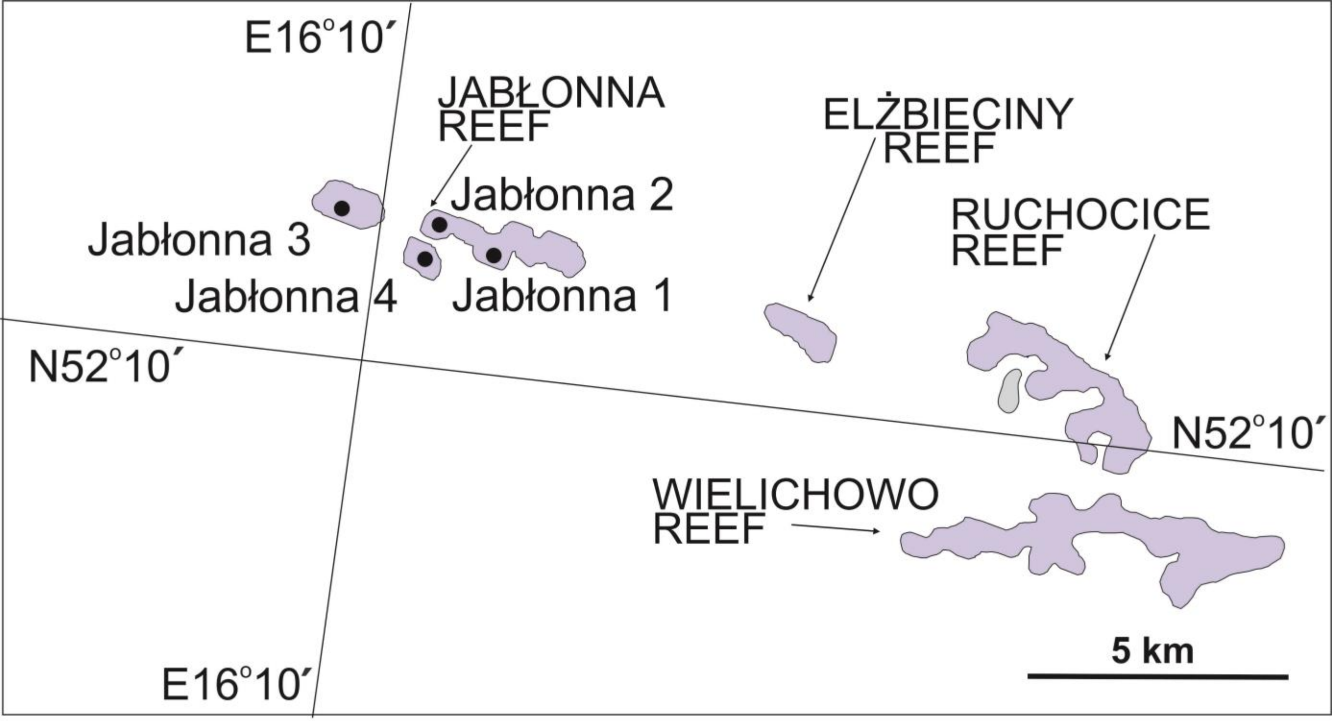


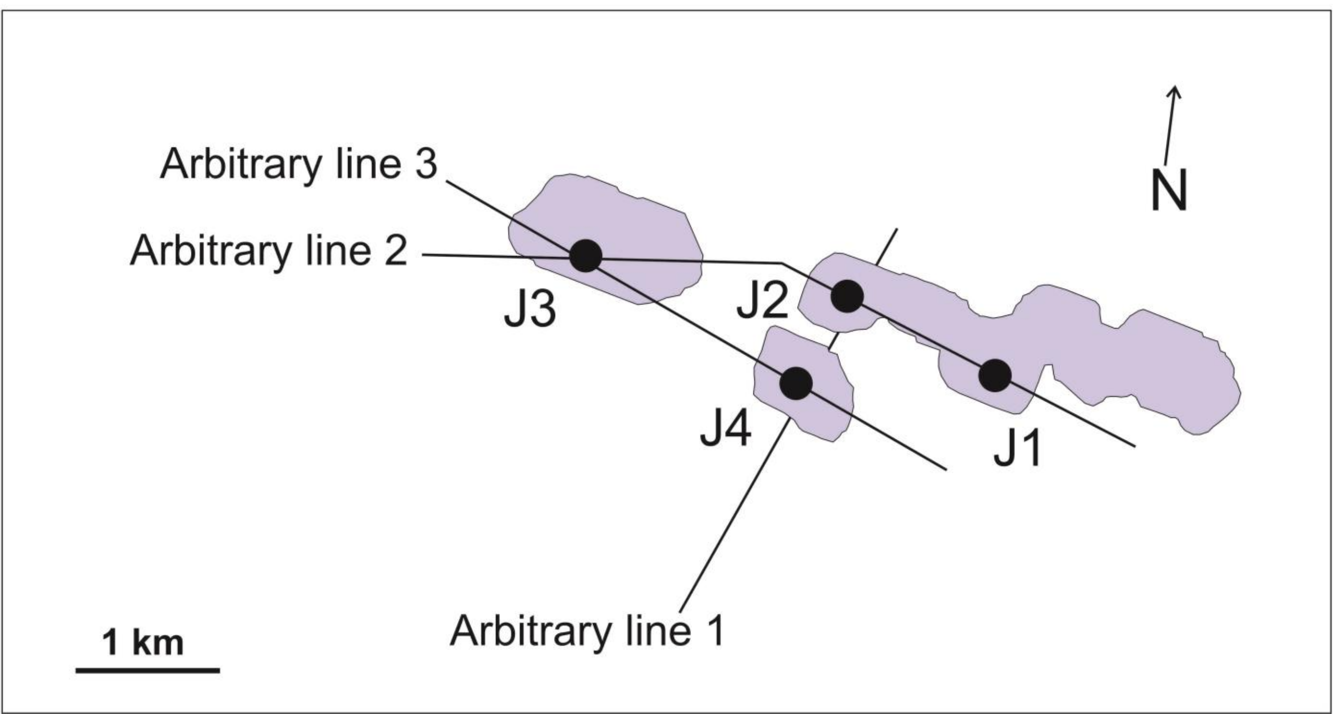
The Zechstein Limestone (Ca1) basin (after Peryt et al., 2010, Southern Permian Basin Atlas)



A - Final stage of the Rotliegend development
B - A reef complex developed on various basement blocks
C - final stage of the Zechstein development

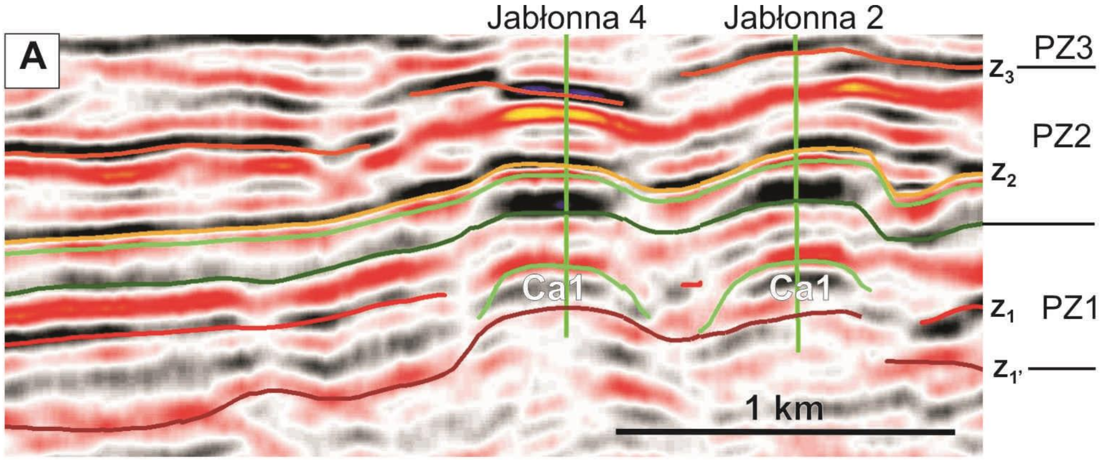


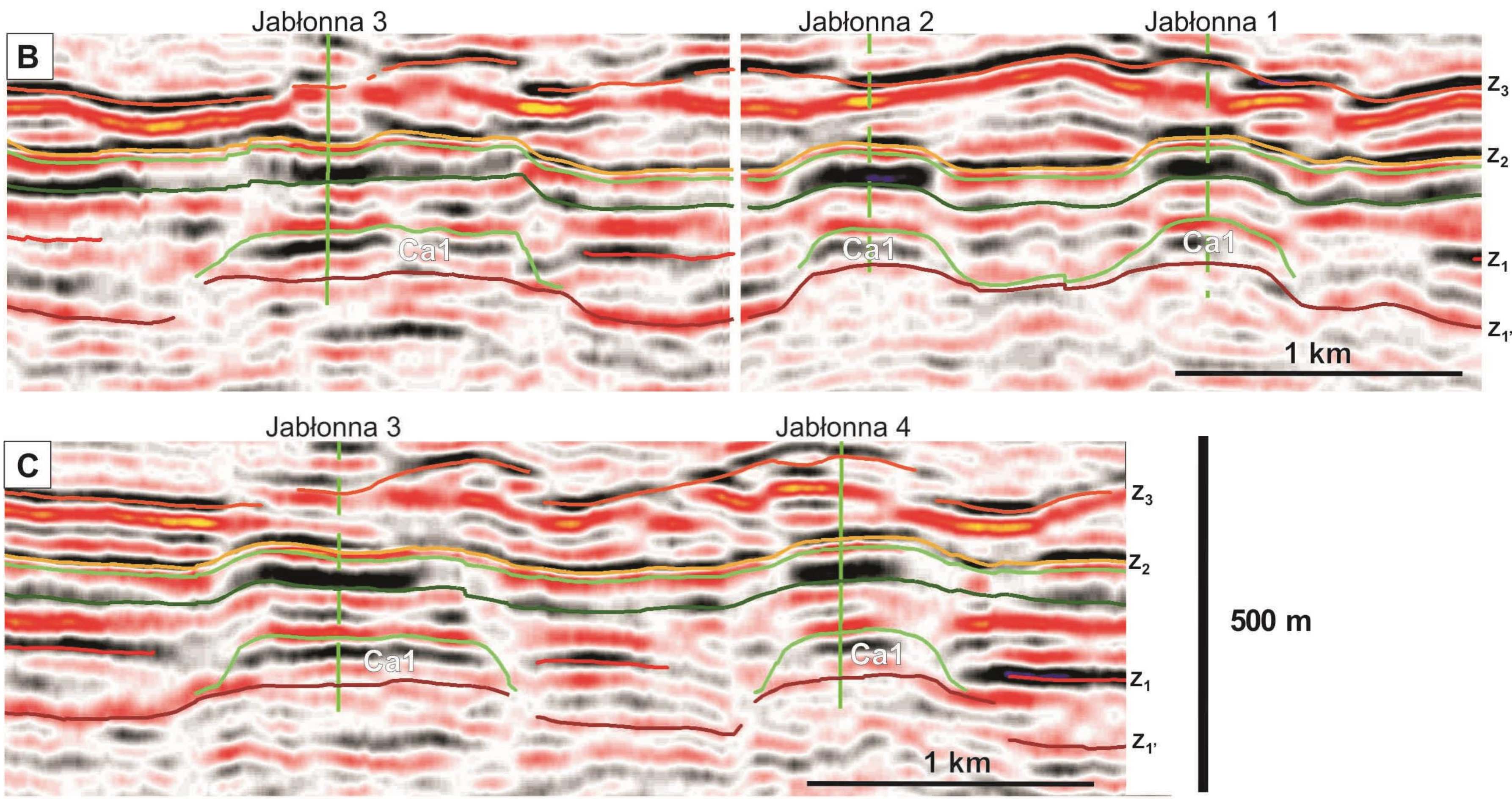




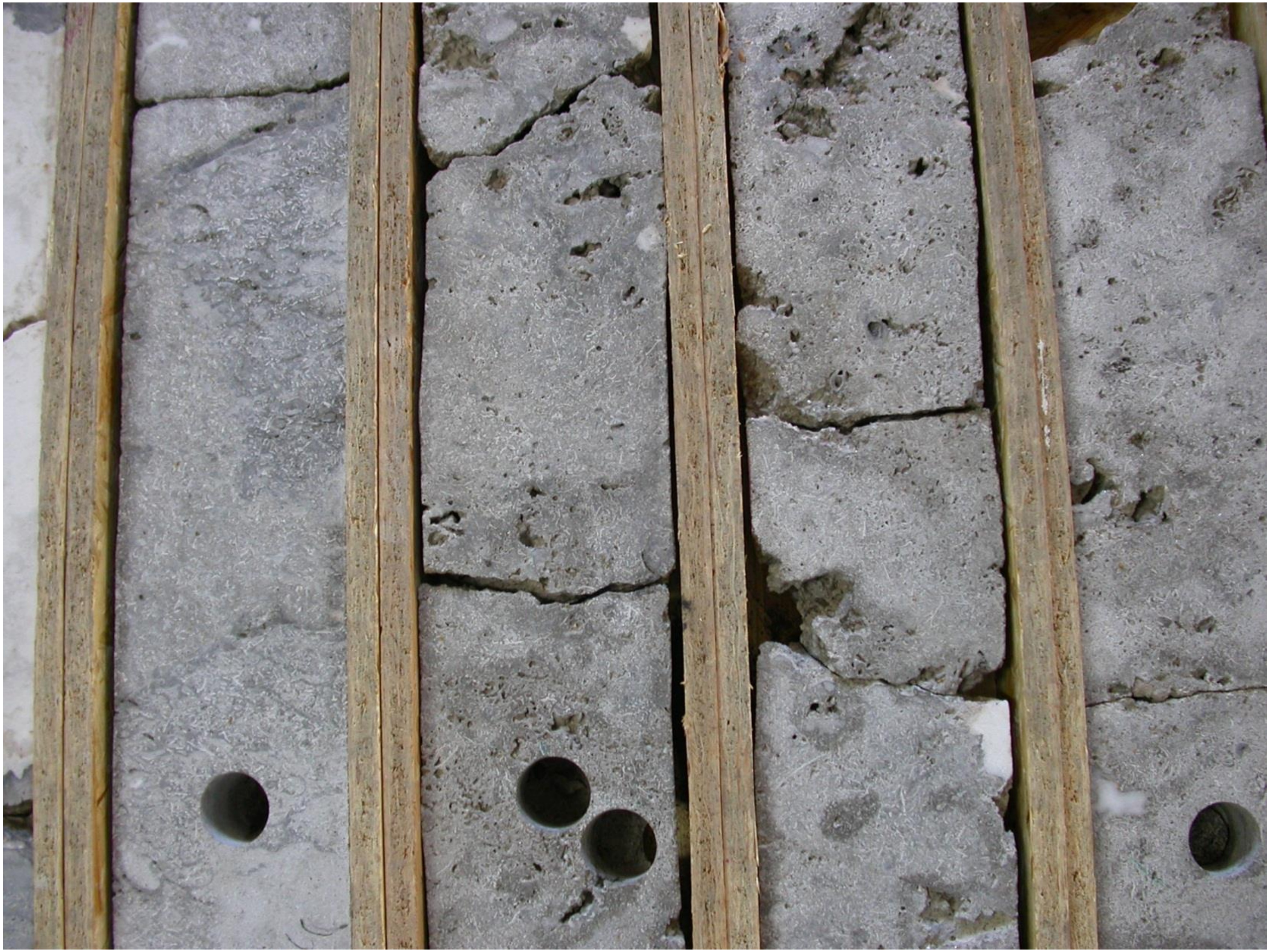
The Jabłonna buildup, one of the system of isolated reefs that was developed in Wuchiapingian times on paleohighs in the basinal zone of the Polish part of the Southern Permian Basin in Europe, is characterized by quite irregular outlines and consists of three separate reef bodies (c. 0.5-1.5 km^2 each; the thickness of reef complex is usually >60 m).

3D seismic sections comprising the depth intervals of 2,000-2,500 m; Correlation of reflectors related to the boundaries of rocks with high acoustic impendence and rocks with lower acoustic impendence and their relation to the Zechstein cycles PZ1-PZ3.



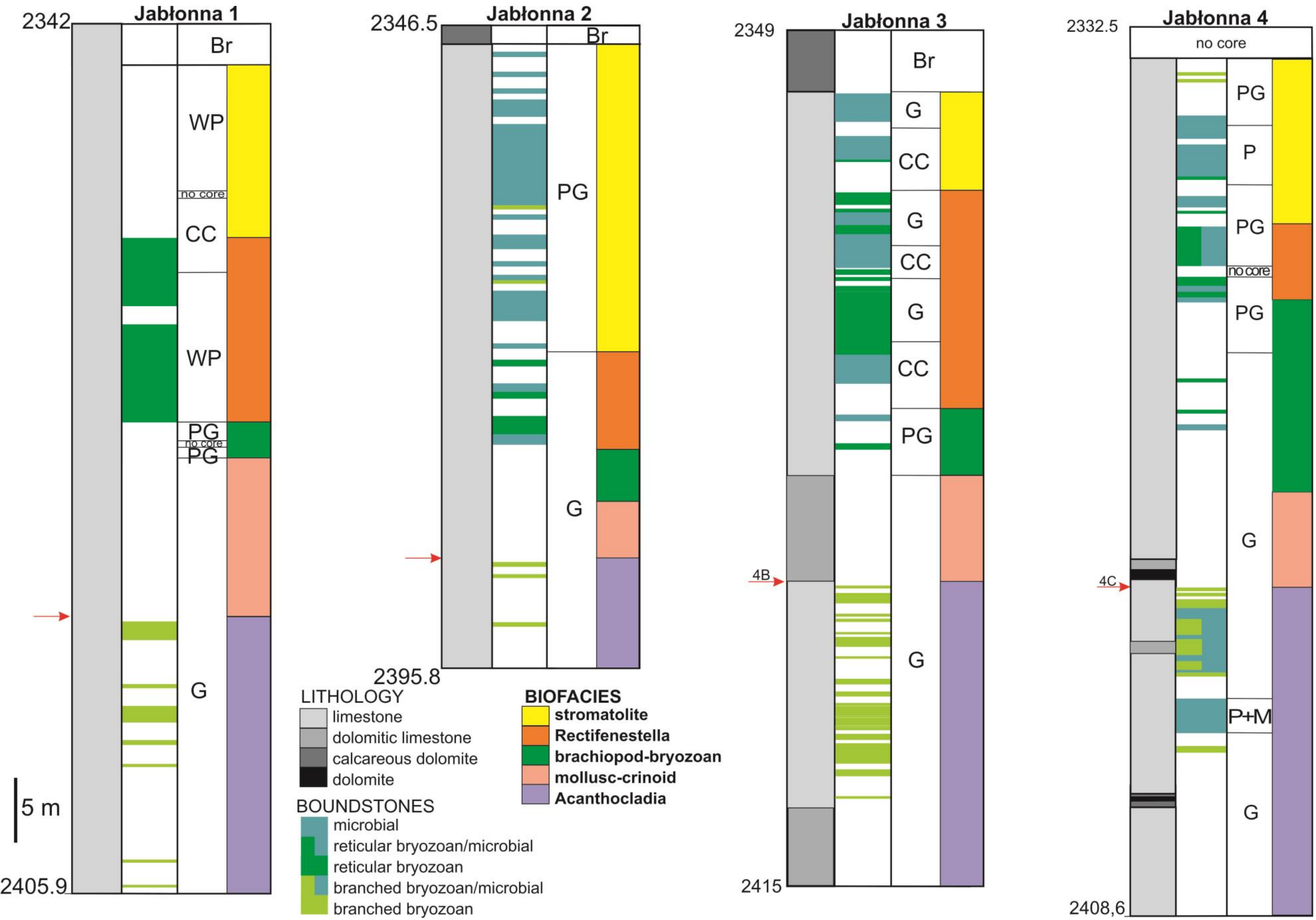


Jabłonna Reef (middle part)

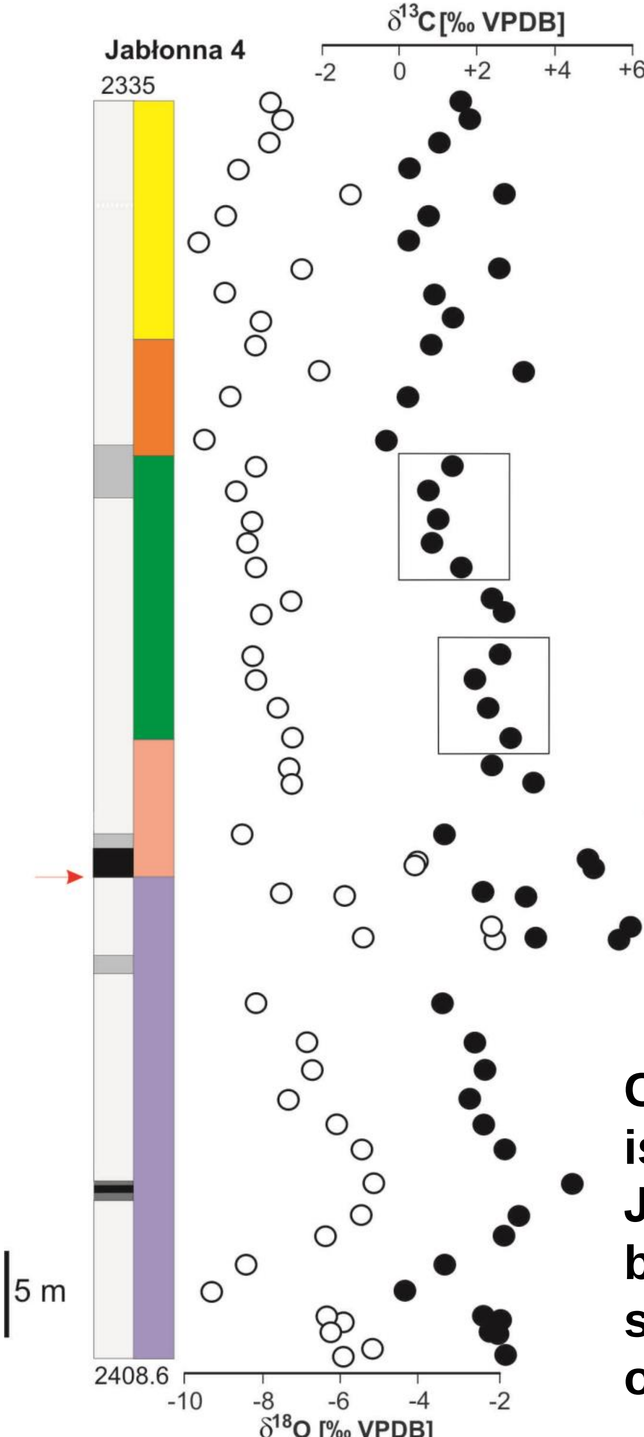


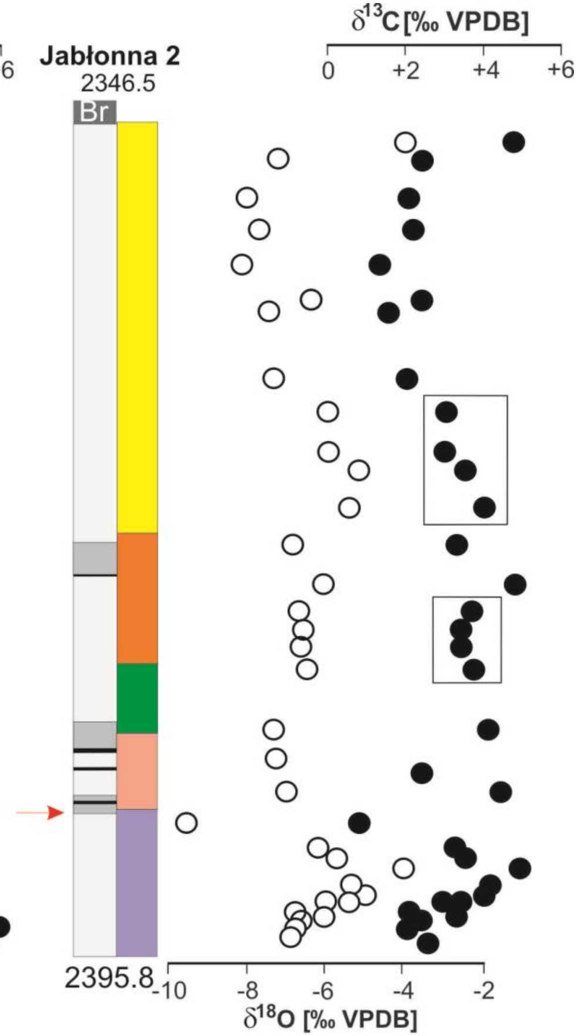
Biofacies	**Fossil groups** (0 means the lack and 5 indicates the greatest number of representatives)	**Environment energy**	**Water depth**	**Position in the reef**
stromatolite	stromatolites 5 (0-5); bryozoans 3 (0-5); brachiopods 1 (0-5); molluscs (bivalves and gastropods) 1 (1-3)	low (occasion-nally high)	shallow to very shallow (decreasing)	reef flat
Rectifenestella	bryozoans 4 (3-5); stromatolites 5 (4-5); crinoids 2 (0-3); molluscs (bivalves and gastropods) 1 (1-3)	low	shallow (slowly decreasing)	lagoon – reef flat
brachiopod-bryozoan	brachiopods 4 (2-4); bryozoans 4 (2-5); crinoids 3 (1-3); molluscs 2 (1-3); foraminifers 3 (2-3)	low-medium	moderate/deep to shallow (decreasing)	lagoon
mollusc-crinoid	bivalves 2 (0-2); crinoids 2 (0-5); gastropods 1 (0-2); bryozoans 3 (1-4); brachiopods 1 (0-2); foraminifers 3 (1-4)	very high-medium	deep to moderate (decreasing)	back reef
Acanthocladia	branched bryozoans 5 (3-5); columnar bryozoans 1 (0-1); bivalves 2 (0-4) ; terebratulid brachiopods 2 (0-3); stropho-menid brachiopods 1 (0-2)	high-medium	moderate to deep and then to moderate (increasing and then decreasing)	reef core

Water depth: shallow – above normal wave base (or ≤5m in Rectifenestella and stromatolite biofacies); moderate – between normal and storm wave base; deep – below storm wave base


Jabłonna 1
2342
2405.9
Br
WP
no core
CC
WP
PG
no core
PG
G
5 m
Jabłonna 2
2346.5
2395.8
Br
PG
G
Jabłonna 3
2349
2415
Br
G
CC
G
CC
G
CC
PG
G
4B
Jabłonna 4
2332.5
2408,6
no core
PG
P
PG
no core
PG
G
4C
P+M
G
LITHOLOGY
limestone
dolomitic limestone
calcareous dolomite
dolomite
BOUNDSTONES
microbial
reticular bryozoan/microbial
reticular bryozoan
branched bryozoan/microbial
branched bryozoan
BIOFACIES
stromatolite
Rectifenestella
brachiopod-bryozoan
mollusc-crinoid
Acanthocladia

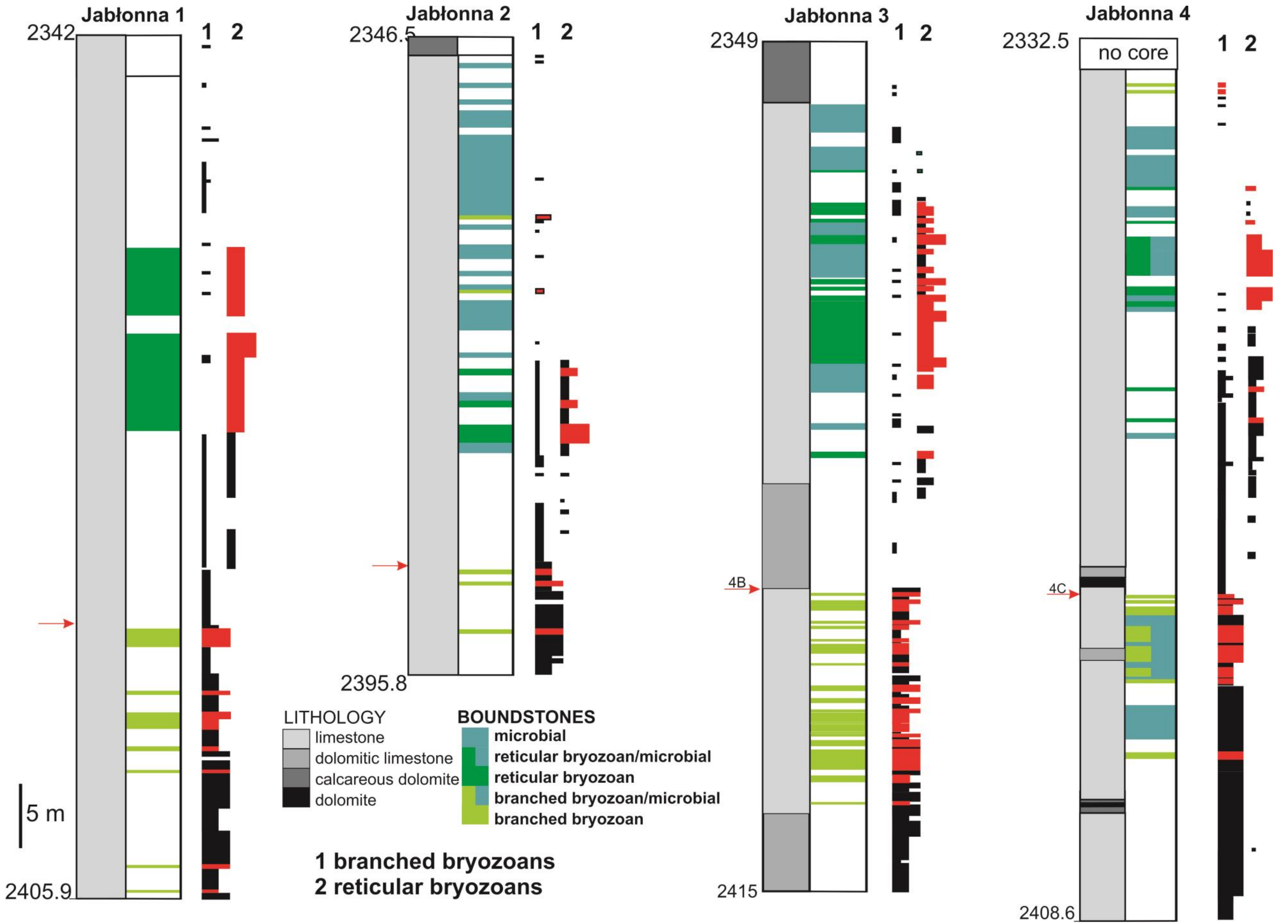
Five biofacies are distinguished in the Jabłonna Reef sections: Acanthocladia at the base, then mollusc-crinoid, brachiopod-bryozoan, Rectifenestella and, at the top, stromatolite. They represent shallowing-upward cycle, possibly with some important fluctuation recorded by the characteristic lithofacies boundary corresponding to the Acanthocladia/ mollusc-crinoid biofacies boundary. The $\delta^{13}C$ curves of the Jabłonna 2 and Jabłonna 4 boreholes enable to correlate the trends in the middle parts of both sections and confirm the strong diachroneity of biofacies boundaries except of the Acanthocladia/mollusc-crinoid biofacies boundary that is roughly isochronous.
The presence of echinoderms and strophomenid brachiopods indicates that until the lower part of the Rectifenestella biofacies the conditions were clearly stenohaline. Subsequent elimination of stenohaline organisms and progressively poorer taxonomic differentiation of fauna assemblage is characteristic for slight, gradual rise of salinity. Taxonomic composition of organisms forming the Jabłonna Reef shows similarity to reefs described from England, Germany as well as the marginal carbonate platform of SW Poland. Filled fissures were recorded in the lower part of the Jabłonna Reef. Aragonite cementation recorded in some fissure fillings implies that they originated in rocks exposed on the sea floor and are neptunian dykes.





Carbon and oxygen isotope values of the Jabłonna 2 and 4 boreholes. The polygons show the results that are of correlation potential.

The mean $\delta^{13}C$ values (Jabłonna 2: 3.2±1.1‰, Jabłonna 4: 2.4±1.6‰) and $\delta^{18}O$ values (Jabłonna 2: -6.3±1.3‰, Jabłonna 4: -7.0±2.0‰) are roughly similar to, although distinctly lower than, the ranges and means of $\delta^{13}C$ and $\delta^{18}O$ values in other Zechstein Limestone reefs of the Wolsztyn paleo-High. The $\delta^{13}C$ curves enable to correlate the trends in the middle parts of both sections and confirm the strong diachroneity of biofacies boundaries except of the Acanthocladia/mollusc-crinoid biofacies boundary that is roughly isochronous.


Jabłonna 1
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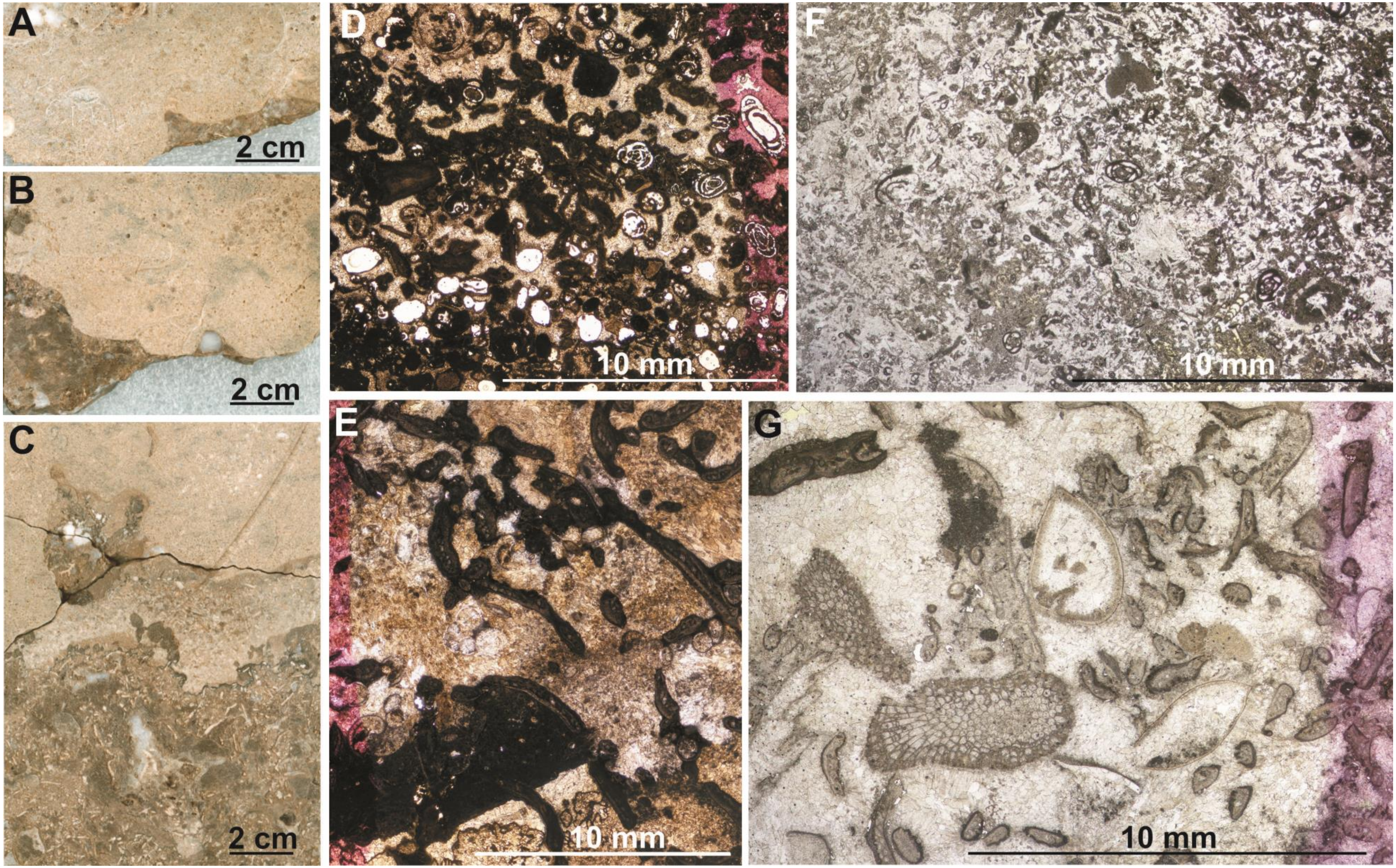
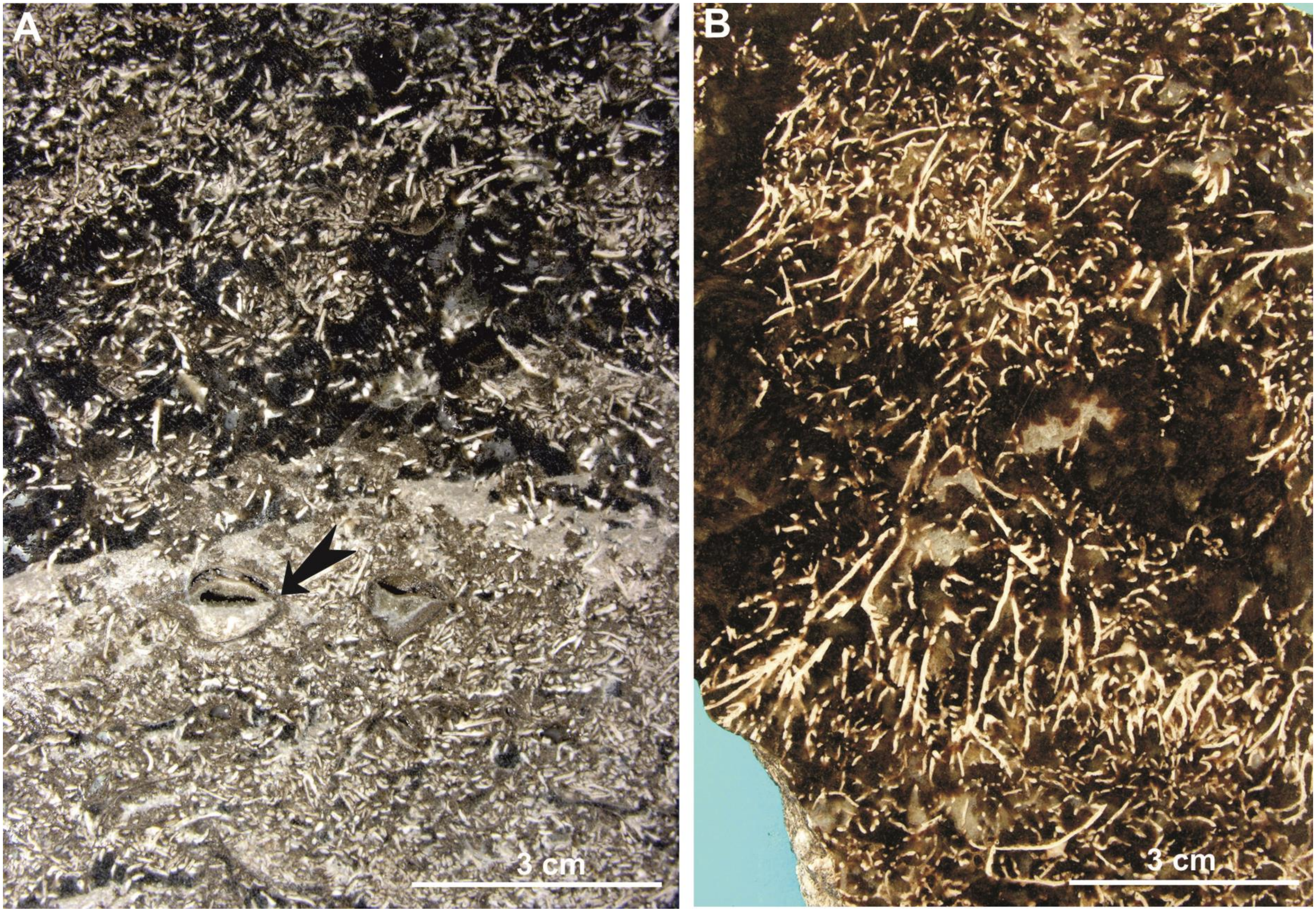
2405.9
1 2
Jabłonna 2
2346.5
2395.8
Jabłonna 3
2349
2415
4B
Jabłonna 4
2332.5
no core
2408.6
4C
5 m
LITHOLOGY
limestone
dolomitic limestone
calcareous dolomite
dolomite
BOUNDSTONES
microbial
reticular bryozoan/microbial
reticular bryozoan
branched bryozoan/microbial
branched bryozoan
1 branched bryozoans
2 reticular bryozoans

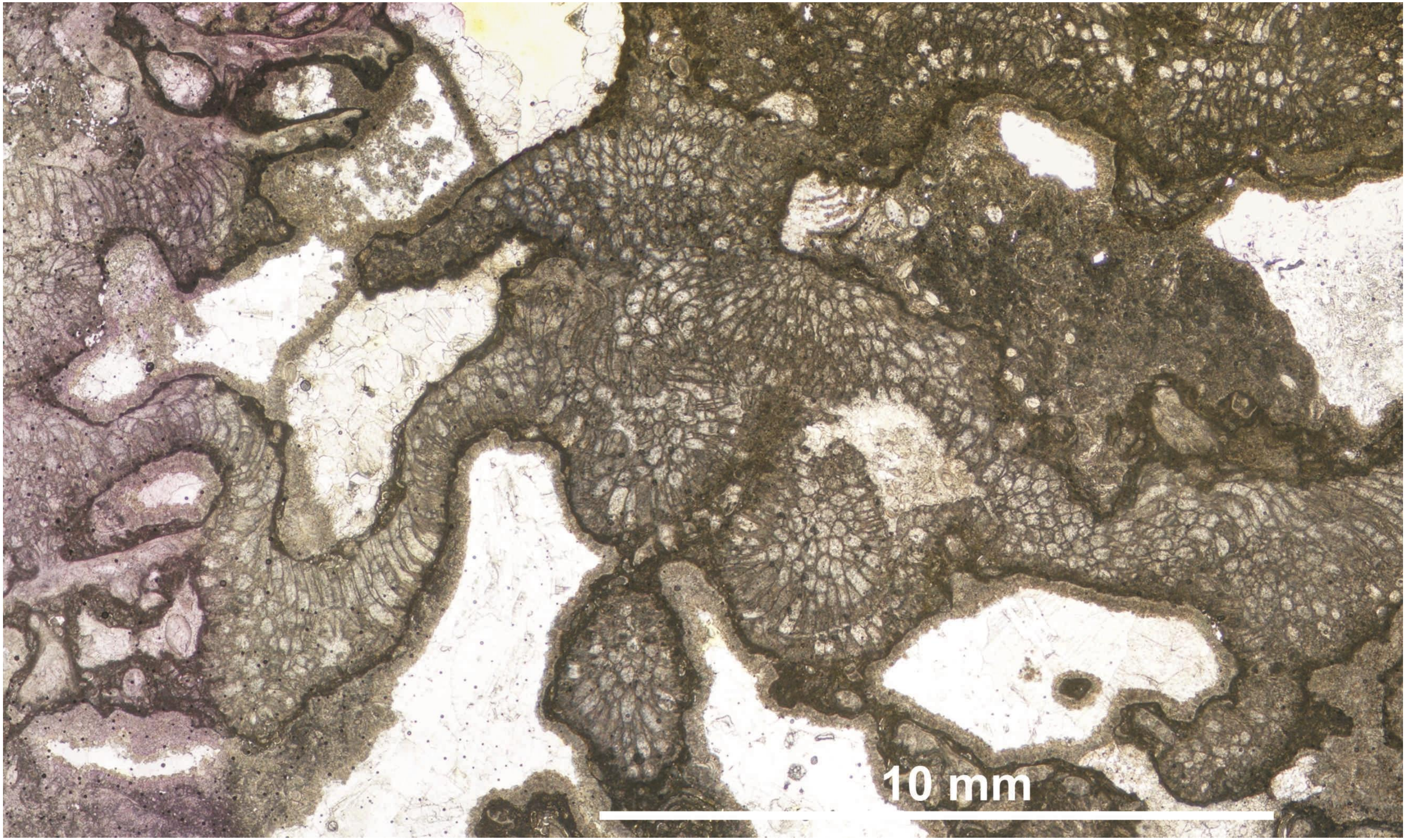
A characteristic correlation surface: bioclastic grainstone above and bryozoan bafflestone/grainstone with originally aragonitic botryoidal cement below



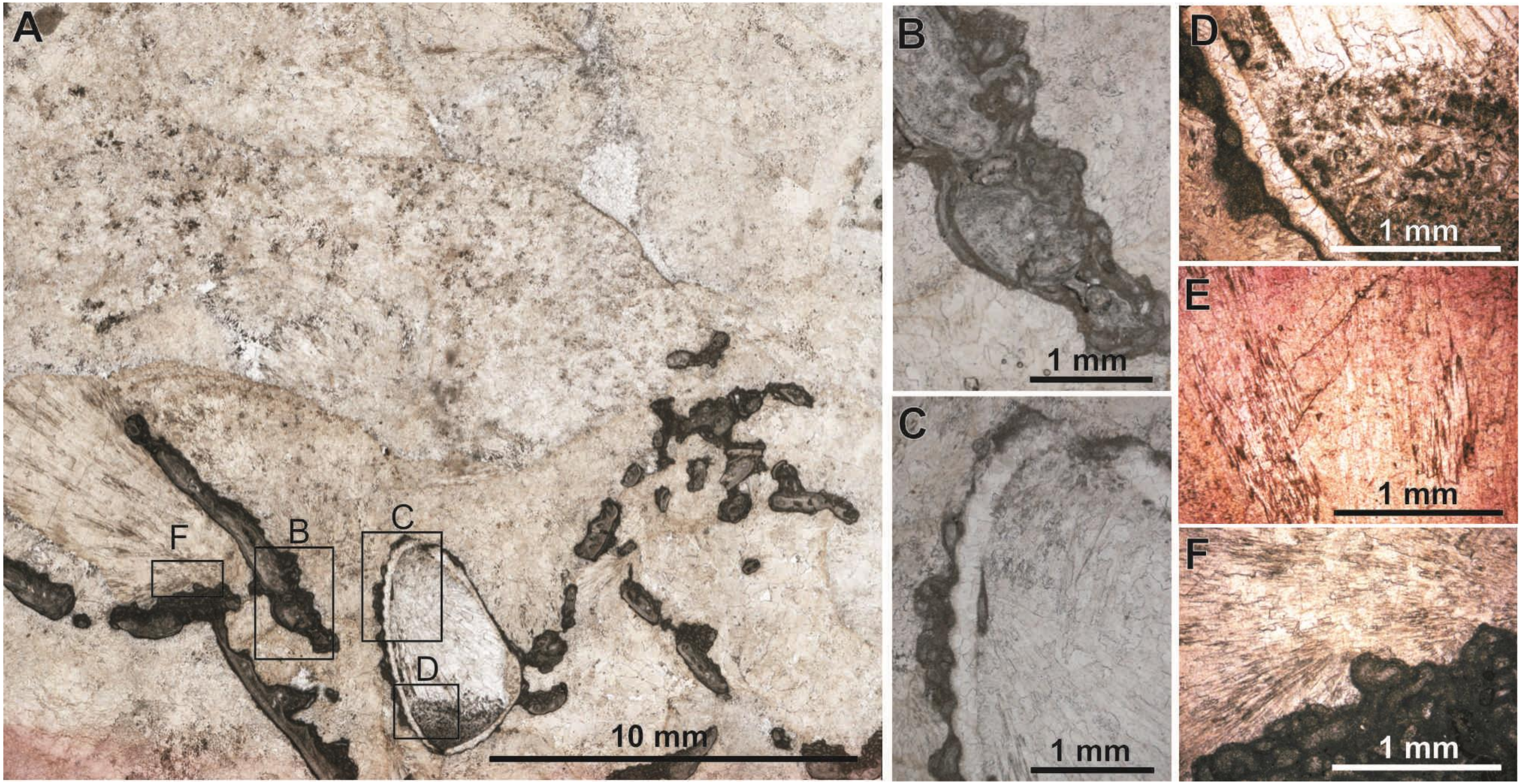
Acanthocladia biofacies. A – Debris of *Acanthocladia* zoaria. Black arrow – bivalve shell with geopetal infilling. B – *Acanthocladia* in life position with primary aragonitic cement (dark) preserving the original shape of zoaria.



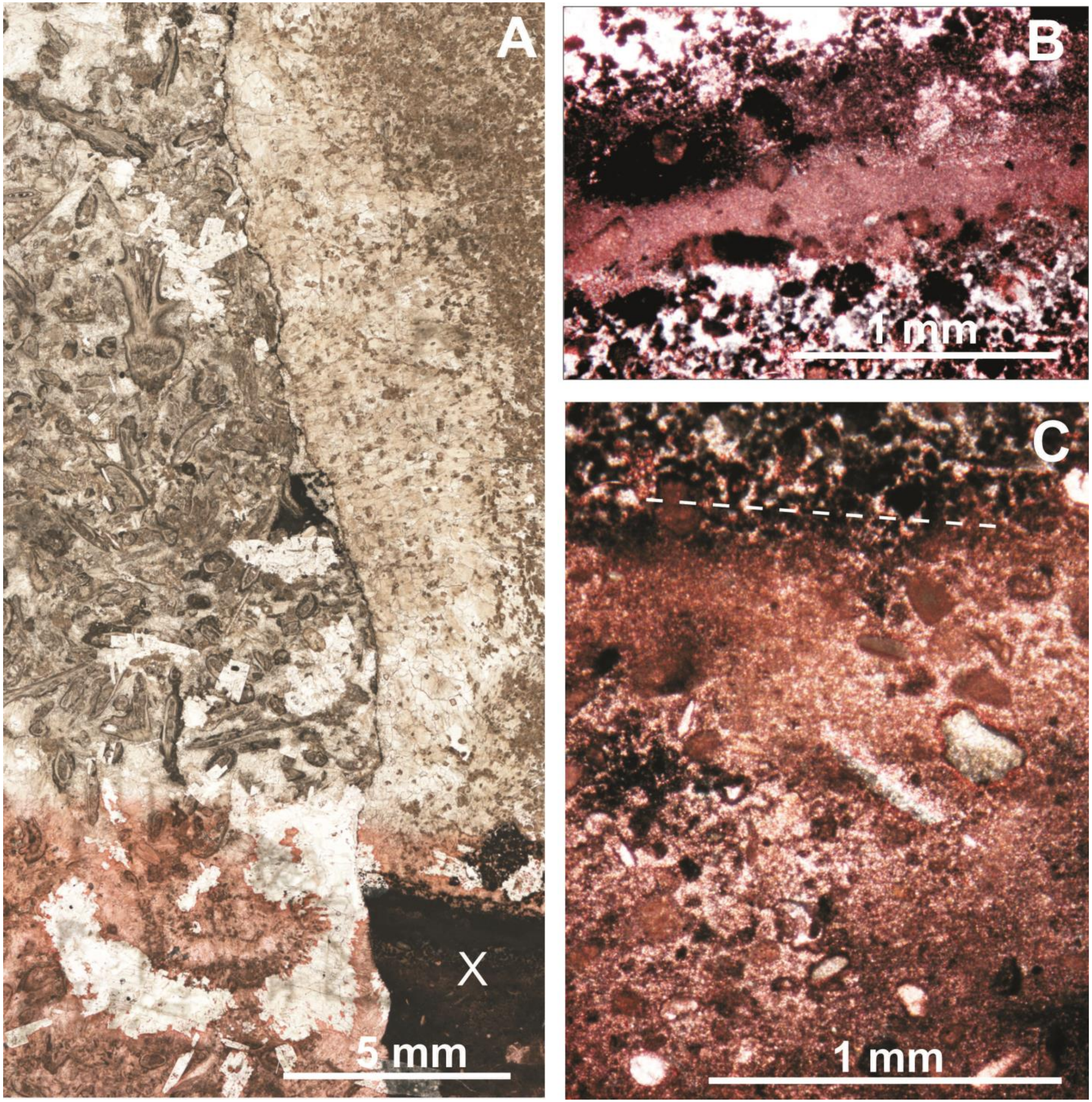
Bryozoan bafflestone/cementstone; bryozoans encrusted by sessile foraminifers are then coated by marine isopachous cements. Caverns (white) are filled by anhydrite and blocky calcite



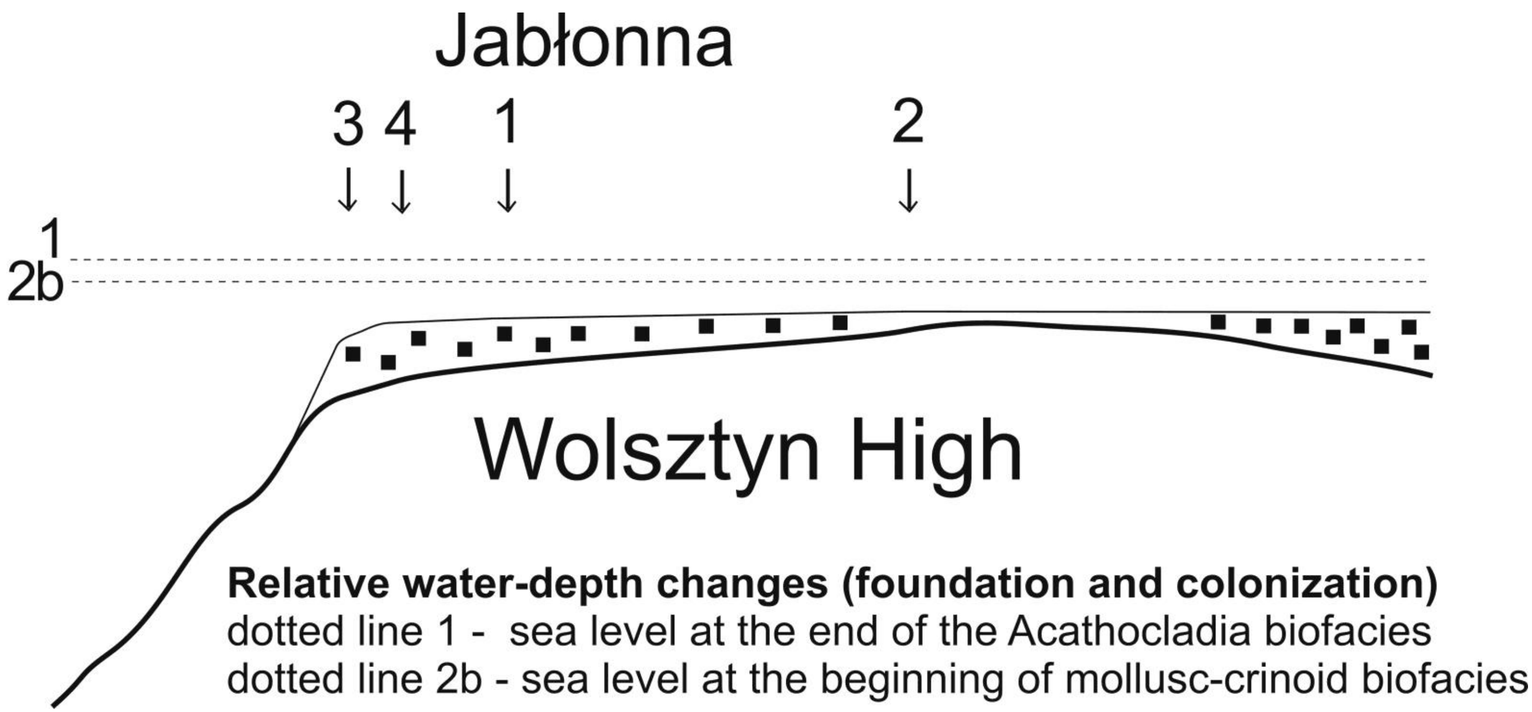
Sparite with many botryoidal fans (A, C-F) and bryozoan zoaria (A, B, F) and bivalve shell (A, C, D) heavily encrusted by foraminifers. The inner part of bivalve shell encrusted by foraminifers, and in the lower part of the shell bioclastic (ostracod) packstone occurs (D).



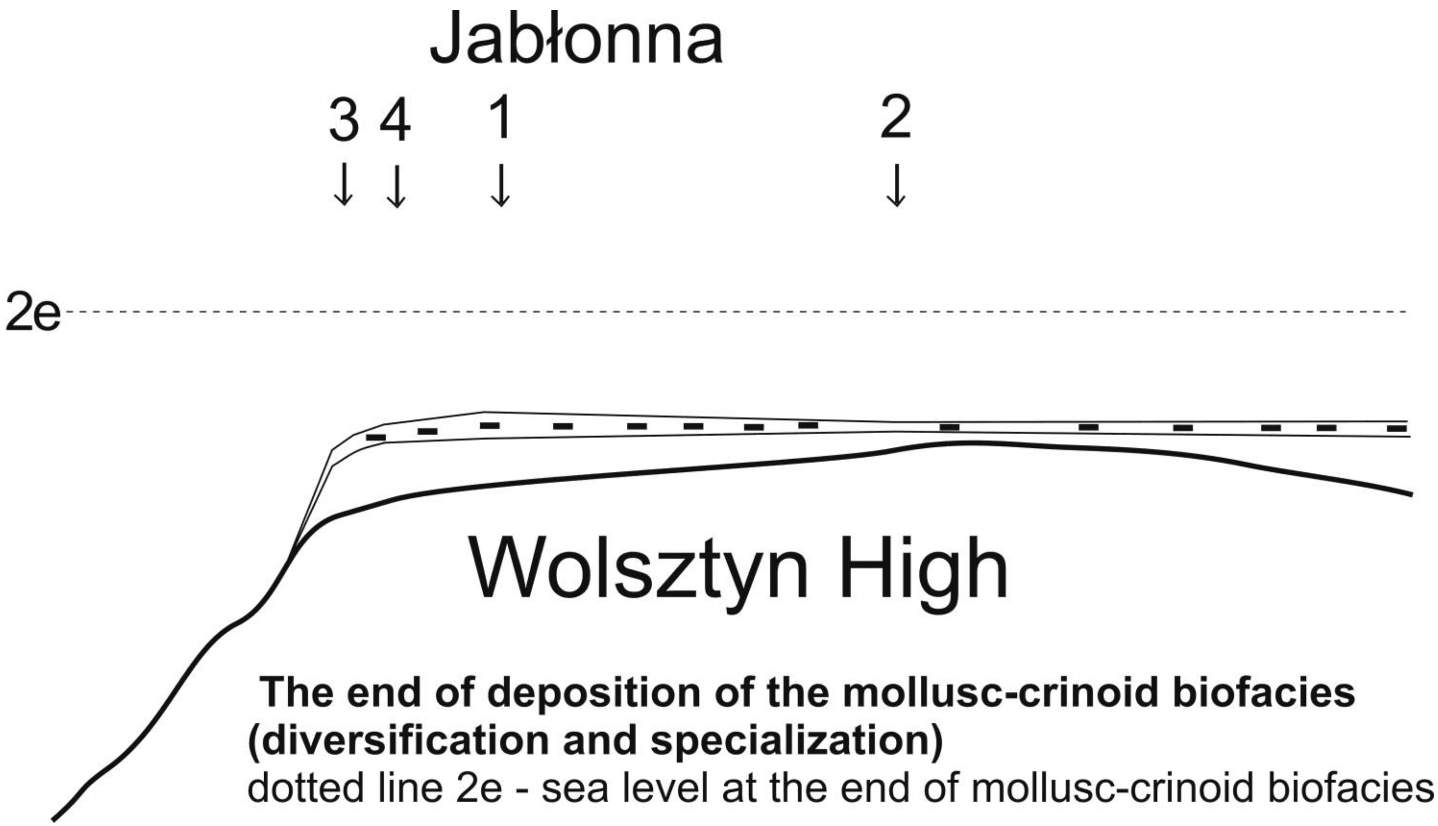

burrows



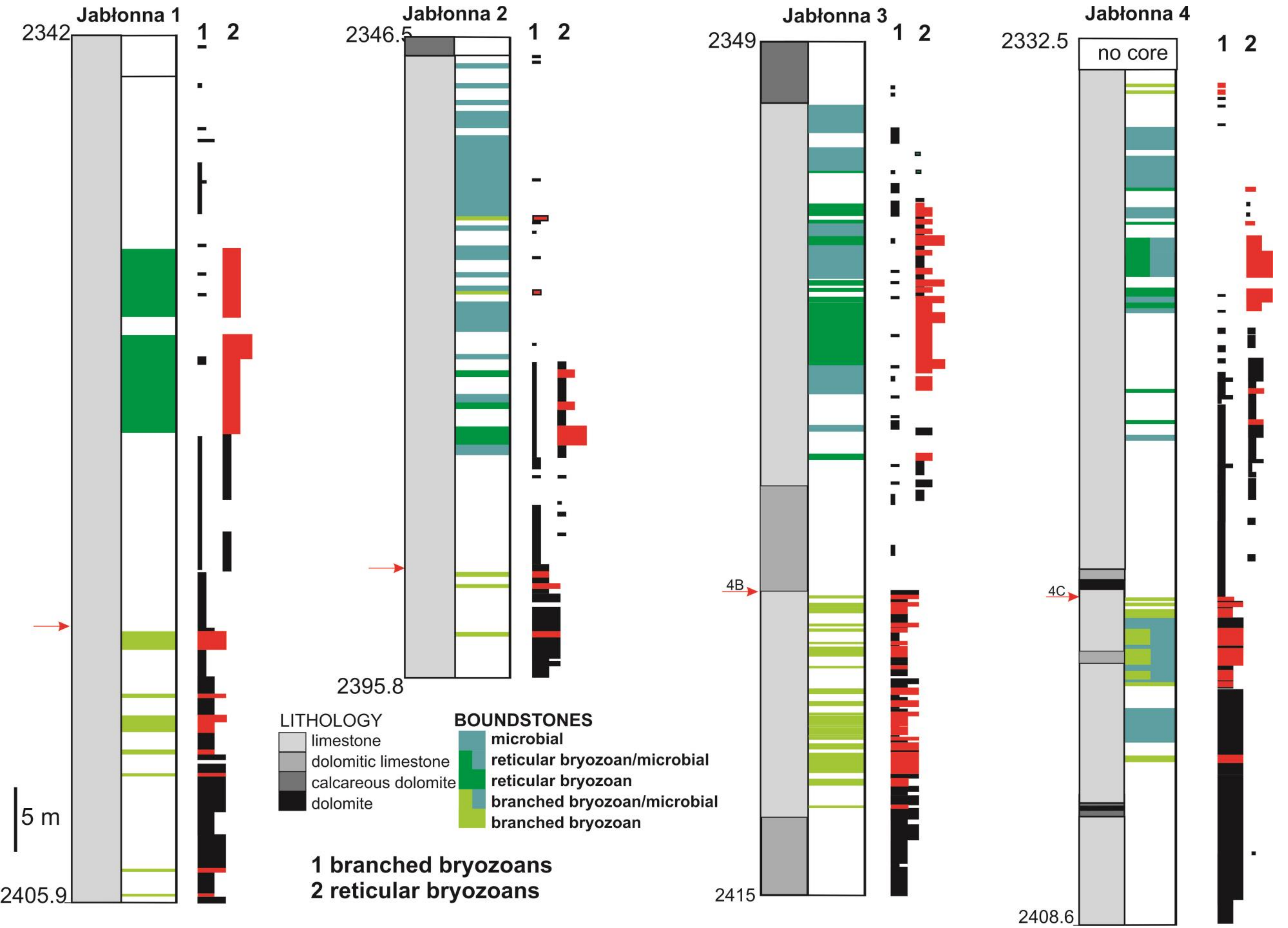
B, **C** - peloidal filling of the fissure in Jabłonna 4 (X in **A**); the dotted line in **C** corresponds to the scale bar line in **B**



There are two distinct phases of bryozoan reef development. The first one occurred early in the depositional history and botryoidal aragonitic cementation played a very important role in the reef formation. This phase of bryozoan reef development terminated suddenly; one possible reason was that the relative change of sea level – first the fall and then the rise, disturbed the upwelling circulation. Consequently, the bioclastic deposition was prevailing for quite a long time until the second phase of bryozoan reef development occurred, but it was not accompanied by a dubious early cementation. During this second phase, reticular fenestellids bryozoans were dominating forms.



Consequently, the bioclastic deposition was prevailing for quite a long time until the second phase of bryozoan reef development occurred, but it was not accompanied by a dubious early cementation. During this second phase, reticular fenestellids bryozoans were dominating forms.



Jabłonna 1
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Jabłonna 2
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dolomitic limestone
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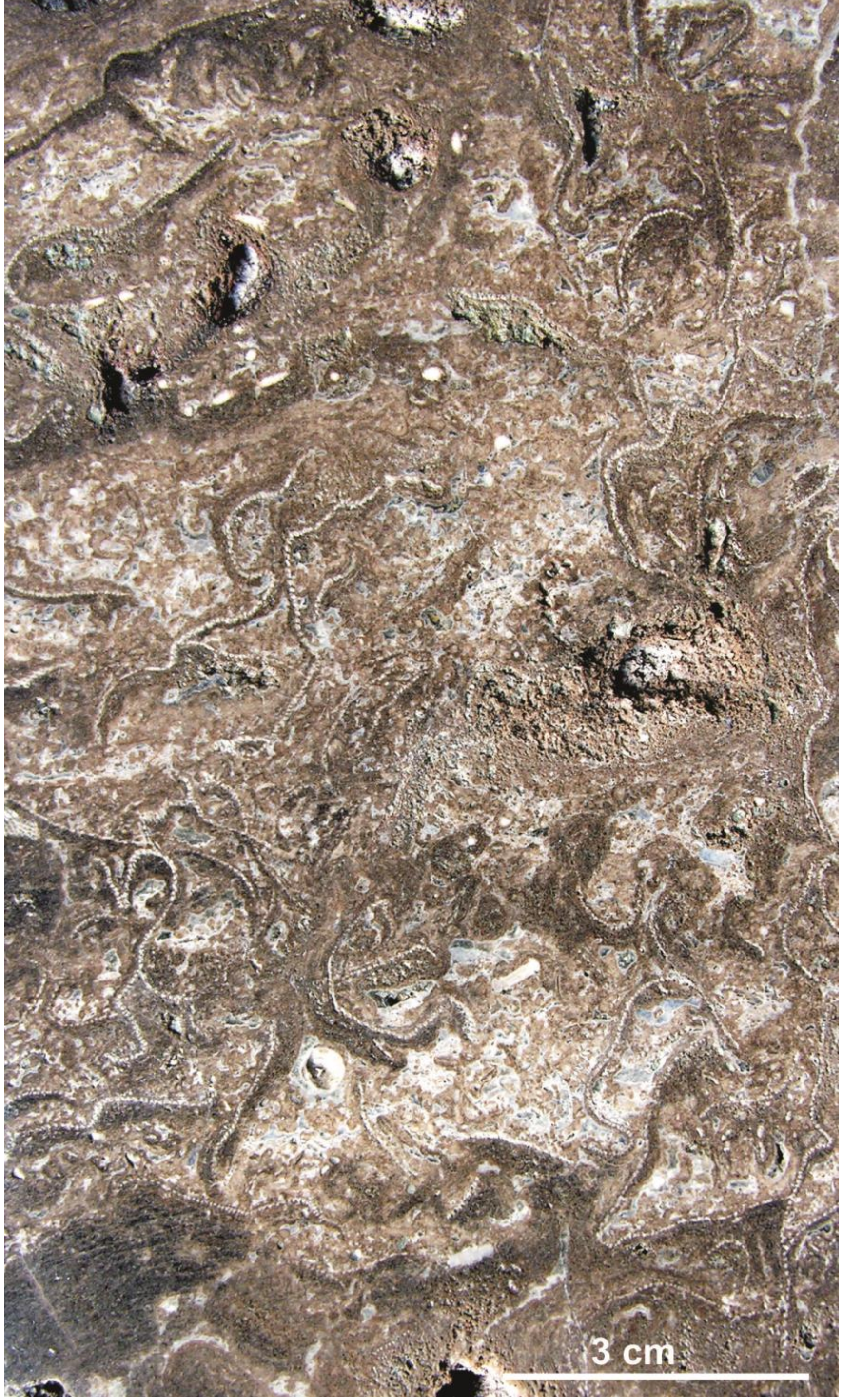
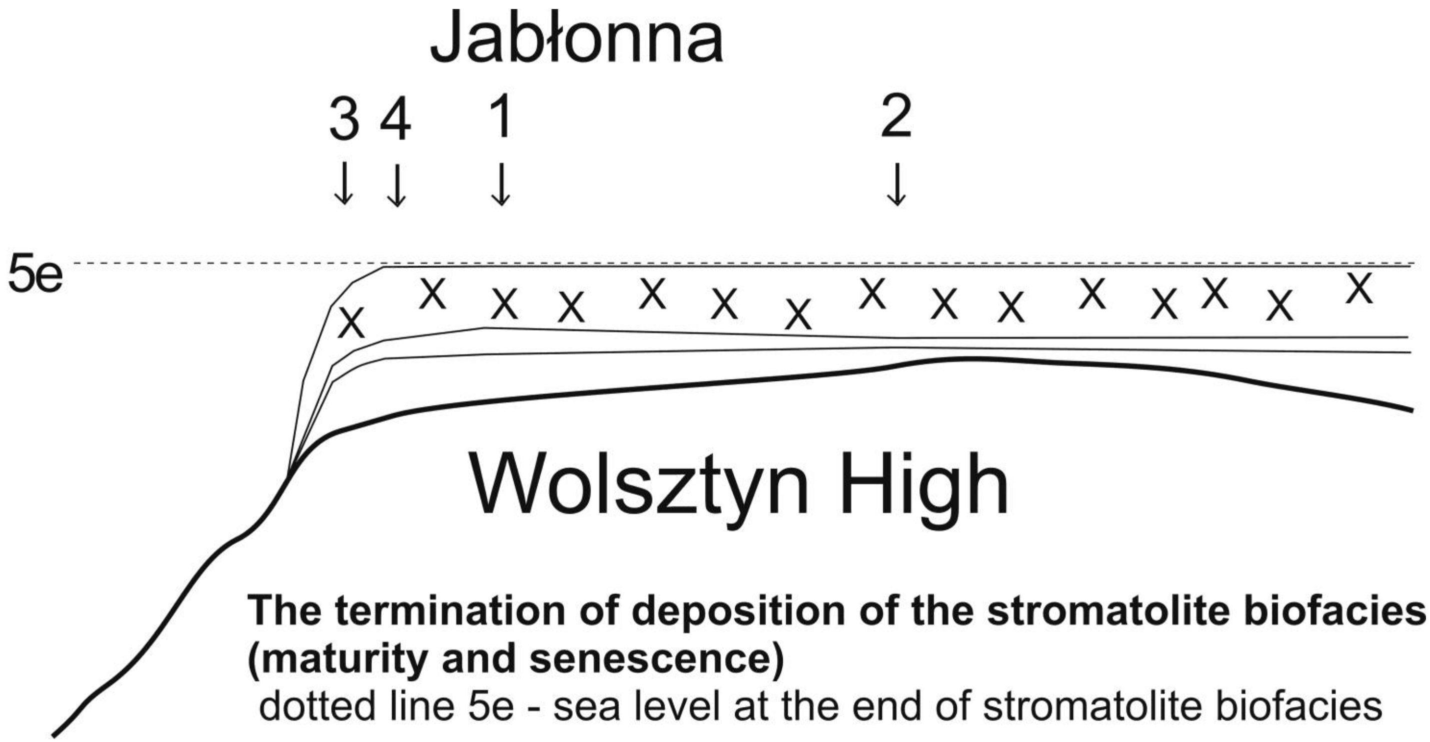
reticular bryozoan/microbial
reticular bryozoan
branched bryozoan/microbial
branched bryozoan
5 m
1 branched bryozoans
2 reticular bryozoans

Many *Rectifenestella* zoaria in microbial limestone.



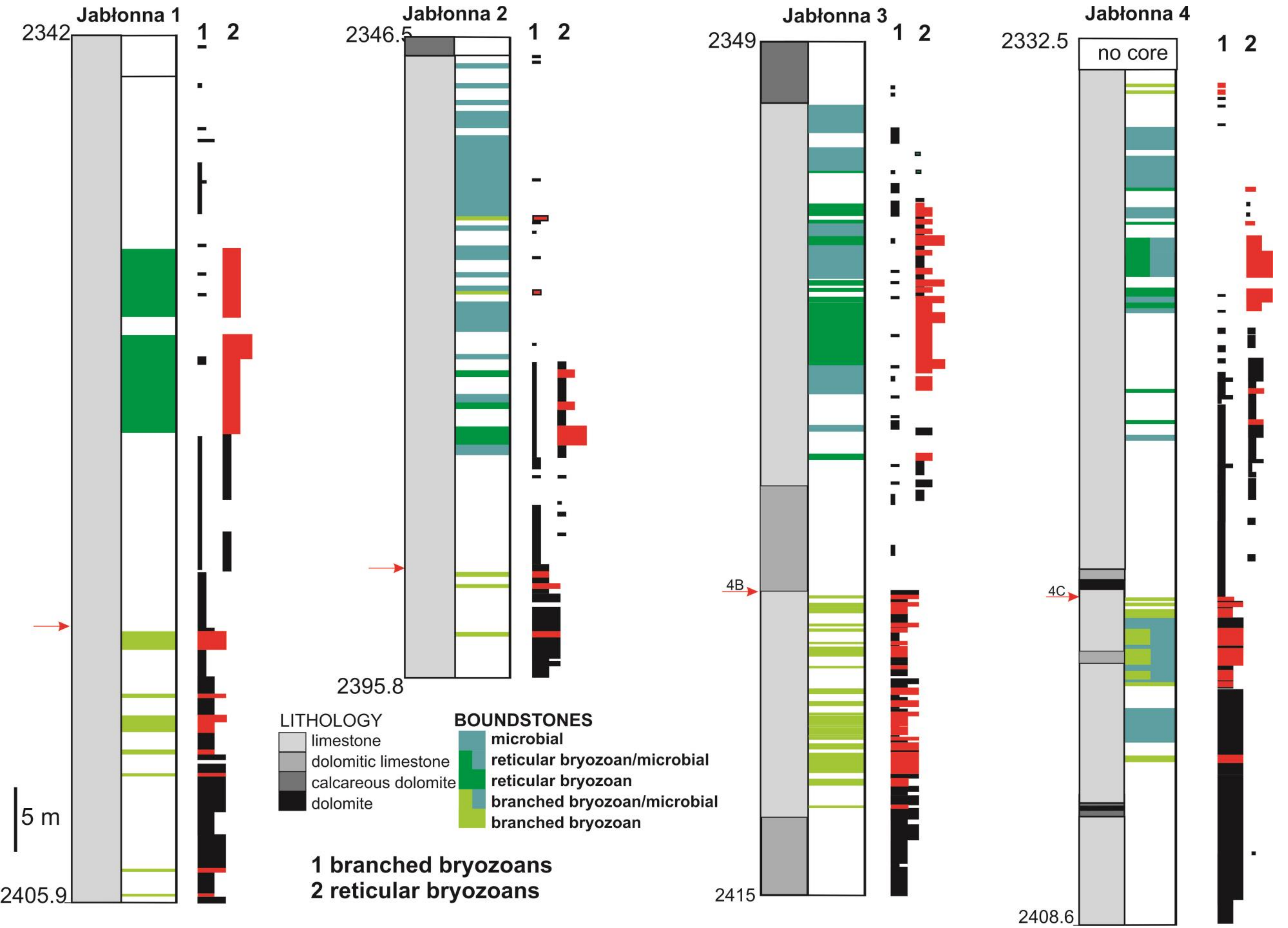
Subsequently, microbial reefs developed.

The general shallowing-upward nature of deposition in the Jabłonna Reef area resulted in that the reef-flat conditions characterized by ubiquitous microbial deposits, first became characteristic for centrally-positioned boreholes. Then, the reef-flat started to prograde and eventually the entire Jabłonna Reef area became the place where a very shallow subaqueous deposition occurred.



The termination of deposition of the stromatolite biofacies (maturity and senescence)

dotted line 5e - sea level at the end of stromatolite biofacies



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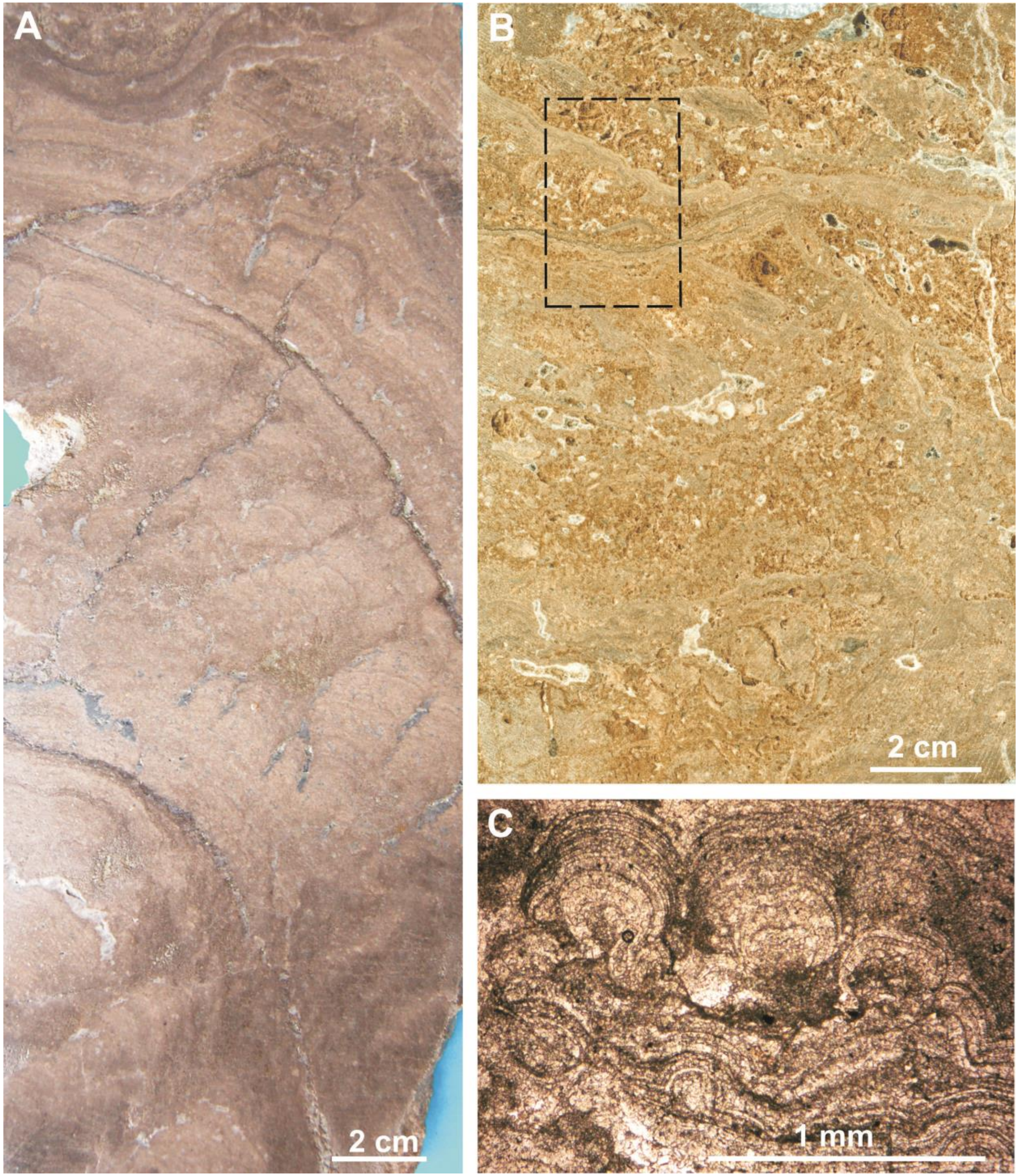
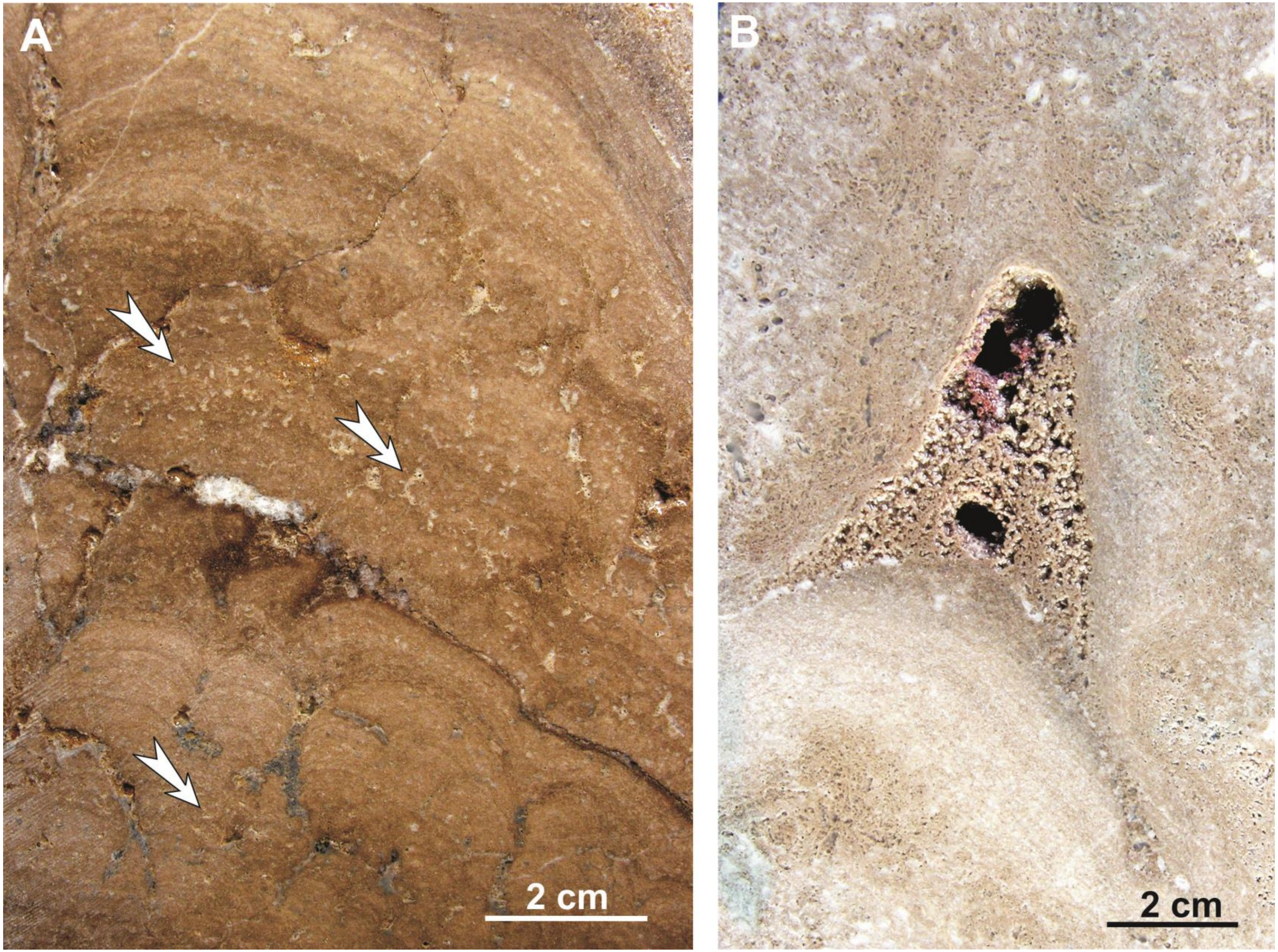
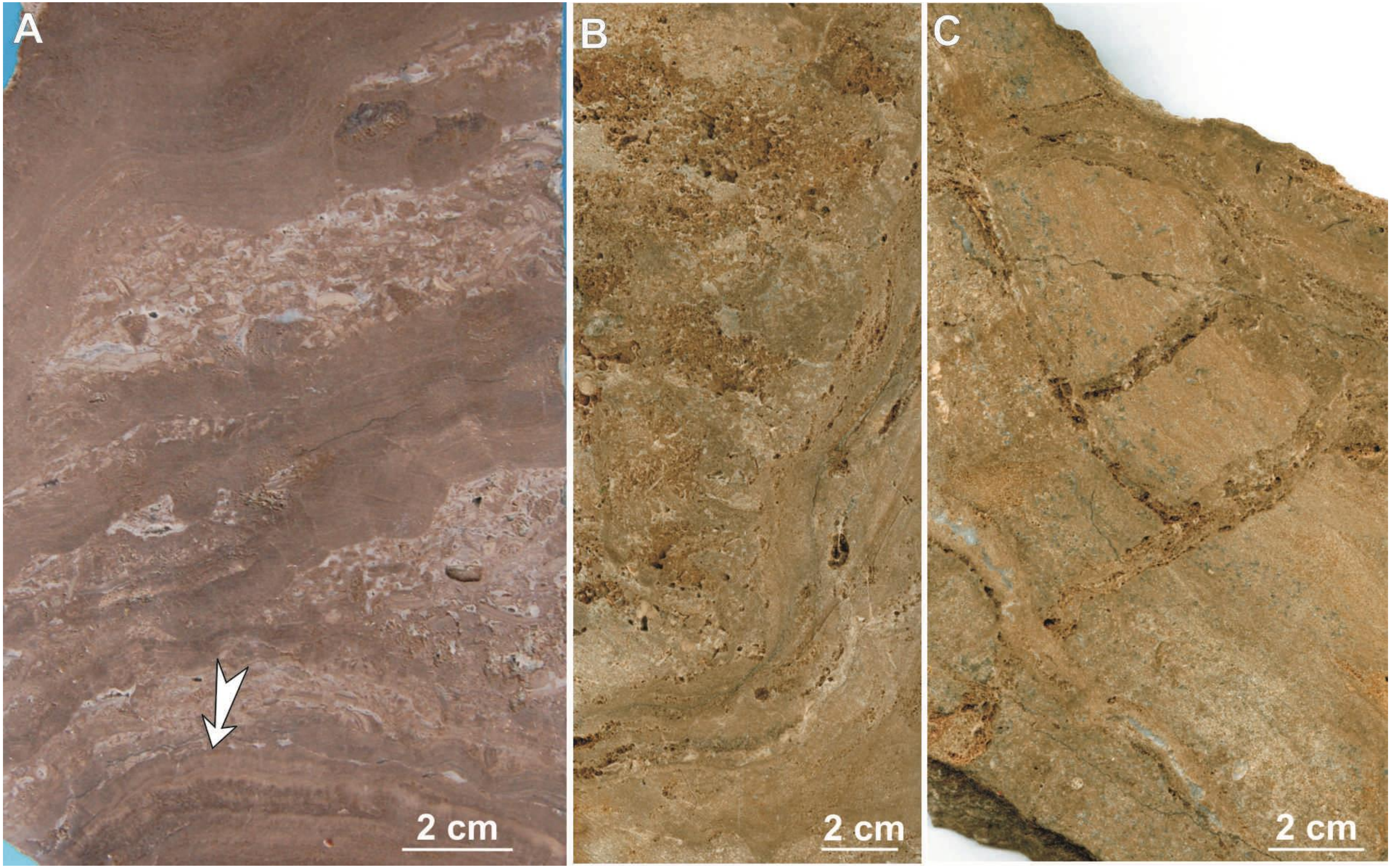


A – Columnar stromatolites of variable inclination of columns, eventually passing into planar forms; B-C – recrystallized granular deposit with common subhorizontal microbial planar encrustations. The dotted quadrangle in B shows the place of thin section whose fragment is shown in C (thinly-laminated microdomes and mats).

A – Columnar stromatolite with abundant bryozoans (arrows); upper part of sample shown in previous slide; B – Columnar stromatolite, its central part porous, strongly recrystallized.



Microbial encrustations. A – Approximately horizontal microbial encrustations of grainstone; notice microcolumnar fabrics (arrowed); B, C – steep to subvertical encrustations (cracked in C) of grainstone.



CONCLUSIONS

Bryozoans were the main reef-forming organisms. Their relative ecological flexibility combined with lack of essential competition from other organisms such as sponges and corals made it possible to dominate the environment. The ability to fast bioaccumulation combined with a possibility of quick restoring of colonies after the catastrophic events such as strong storms and rapid change of relative sea level, enabled to control the reef growth for a long time in varied environmental conditions. They show two distinct phases of bryozoan reef development. The first one was characterized by the dominant branched bryozoans (mostly *Acanthocladia*) and occurred early in the depositional history. During this phase, botryoidal aragonitic cementation played a very important role in the reef formation. Although the early massive aragonitic cementation was of prime importance for the buildup construction, encrusting foraminifers have played an essential role prior to the cementation. They were are equally common in cryptic and light-exposed habitats. The first phase of bryozoan reef development terminated suddenly due to changes in sea level that disturbed the upwelling circulation. Consequently, the bioclastic deposition of mollusc-crinoid and then brachiopod-bryozoan biofacies was prevailing for quite a long time until the second phase of bryozoan reef development occurred, with dominant reticular fenestellids bryozoans (*Rectifenestella*). The presence of echinoderms and strophomenid brachiopods indicates that until the lower part of the Rectifenestella biofacies the conditions were clearly stenohaline. Subsequent elimination of stenohaline organisms and progressively poorer taxonomic differentiation of fauna assemblage is characteristic for a slight, gradual rise of salinity. Subsequently, microbial reefs developed which abound in the upper part of the Zechstein Limestone sections.

Acknowledgements
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Thank you for your attention.