Cenozoic bryozoans from southeast Asia: a contribution to the origin of high tropical

Emanuela Di Martino

Supervisors

Paul D. Taylor Palaeontology Department NHM London

Lucas Lourens Utrecht University

cture.

QuickTime™ and a
decompressor
are needed to see this pi

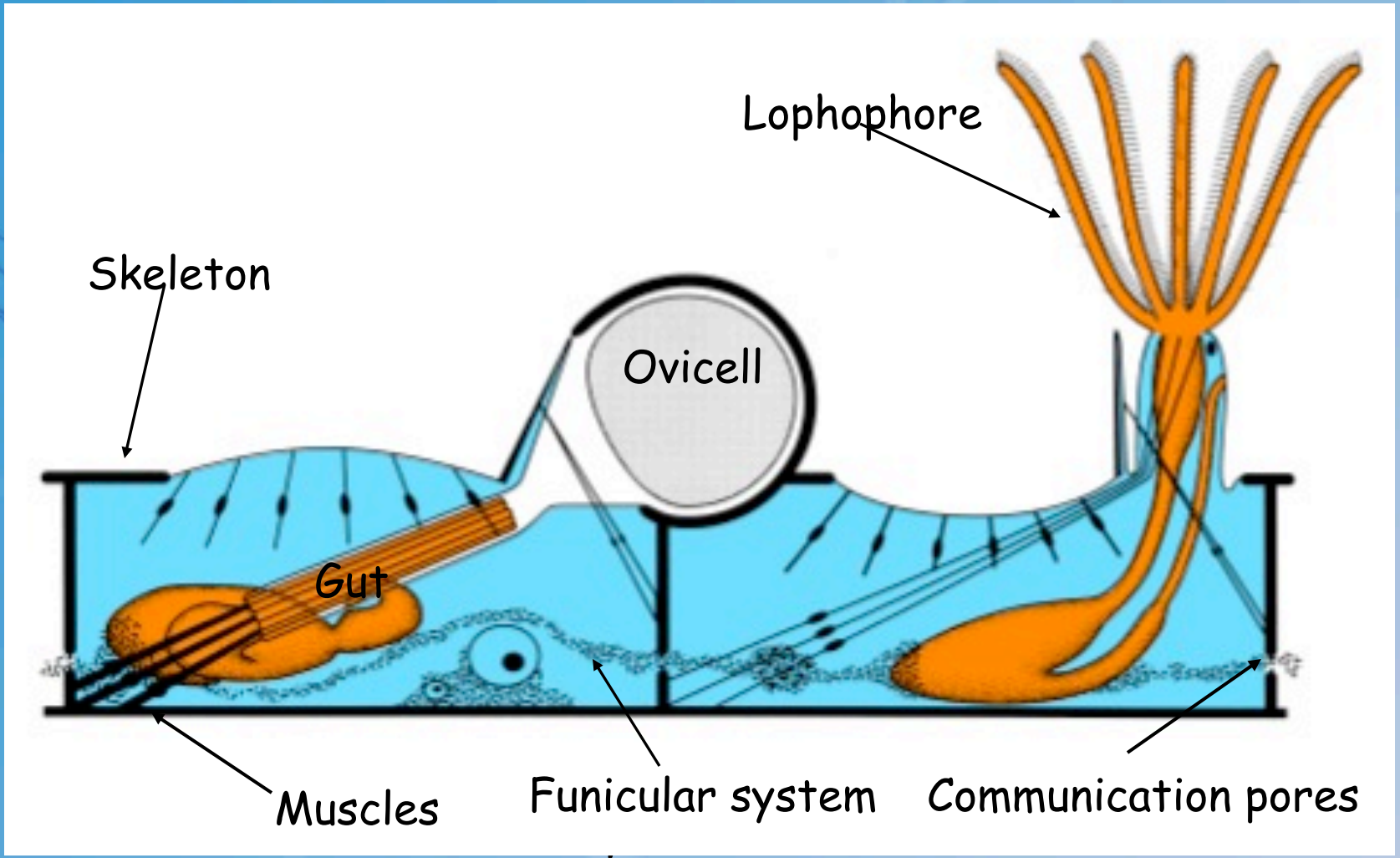
Contents

- What are bryozoans ?
- What do we already know about Cenozoic bryozoans from the Indonesian Archipelago?
- …about my project and my aims…

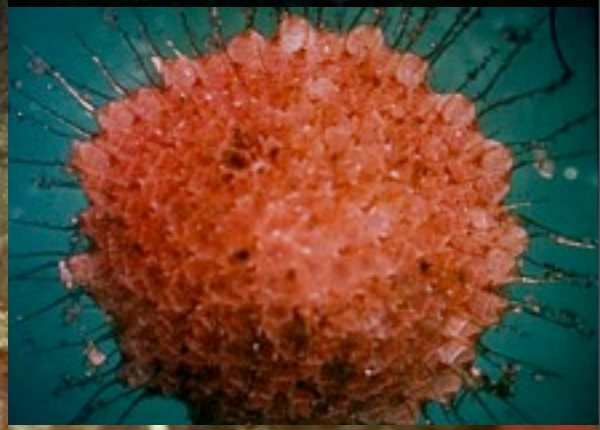
What are bryozoans?

- invertebrate phylum
- >6000 living species
- mainly marine
- intertidal to 8000 m depth
- suspension feeders
- all colonial
- usually sessile, benthic
- most have $CaCO_3$ skeletons
- Ordovician-Recent

Schematic anatomy of anascan cheilostome



Bryozoan colony-forms



Bryozoans are divided into three classes:

1. Phylactolaemata — entirely freshwater in distribution, uncalcified

Encyclopedia of life

Lophopus crystallinus (Pallas, 1768)

Bryozoans are divided into three classes:

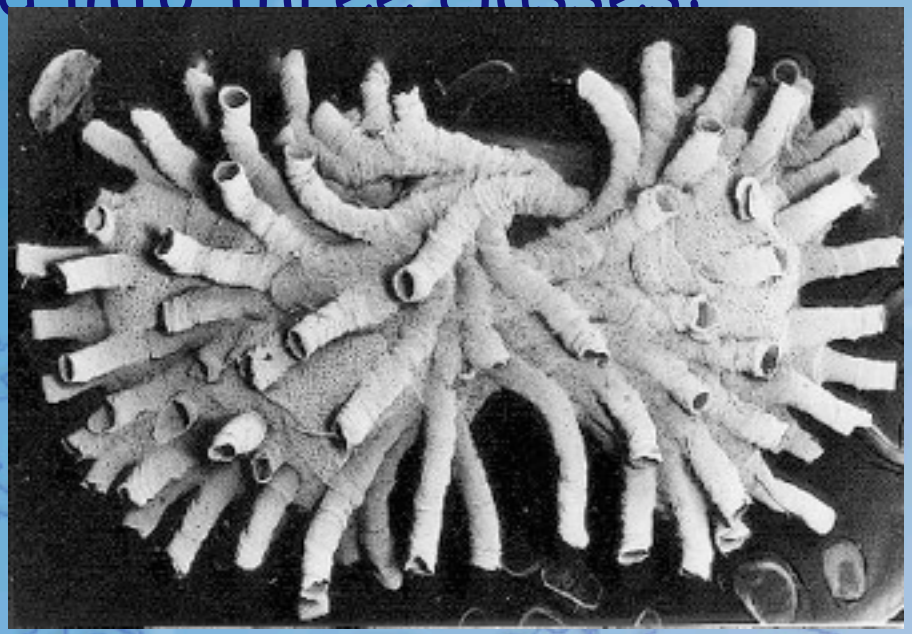
2. Stenolaemata (marine)

- Cryptostomida, Cystoporida and Fenestrida (Lower Ordovician - Upper Permian)
- Trepostomatida (Lower Ordovician to Upper Triassic)
- Cyclostomatida (Lower Ordovician - Recent)

Colonies encrusting or erect

Body wall calcified

Bryozoans are divided into three classes:



2. Stenolaemata (marine)

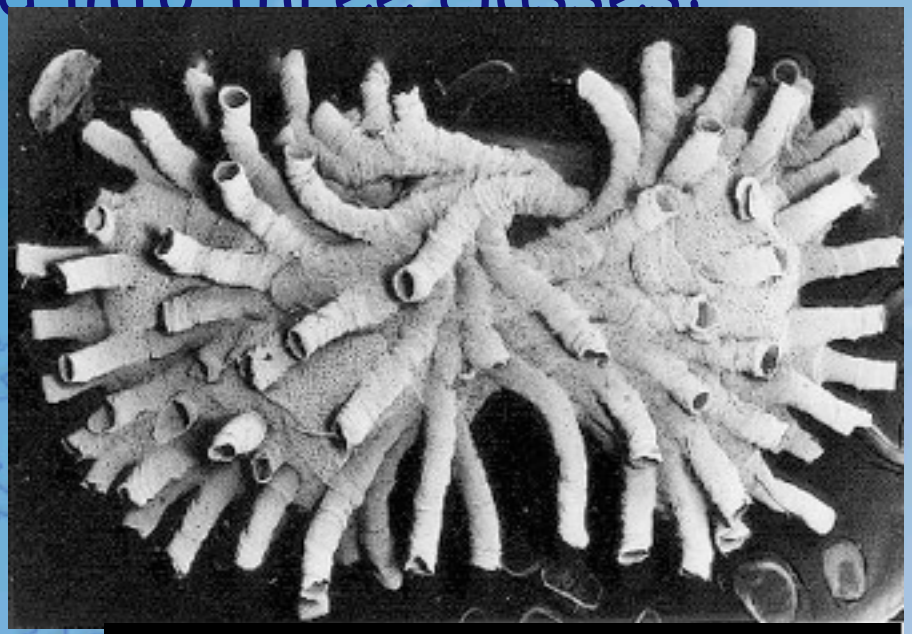
- Cryptostomida, Cystoporida and Fenestrida (Lower Ordovician - Upper Permian)
- Trepostomatida (Lower Ordovician to Upper Triassic)
- Cyclostomatida (Lower Ordovician - Recent)

Colonies encrusting or erect

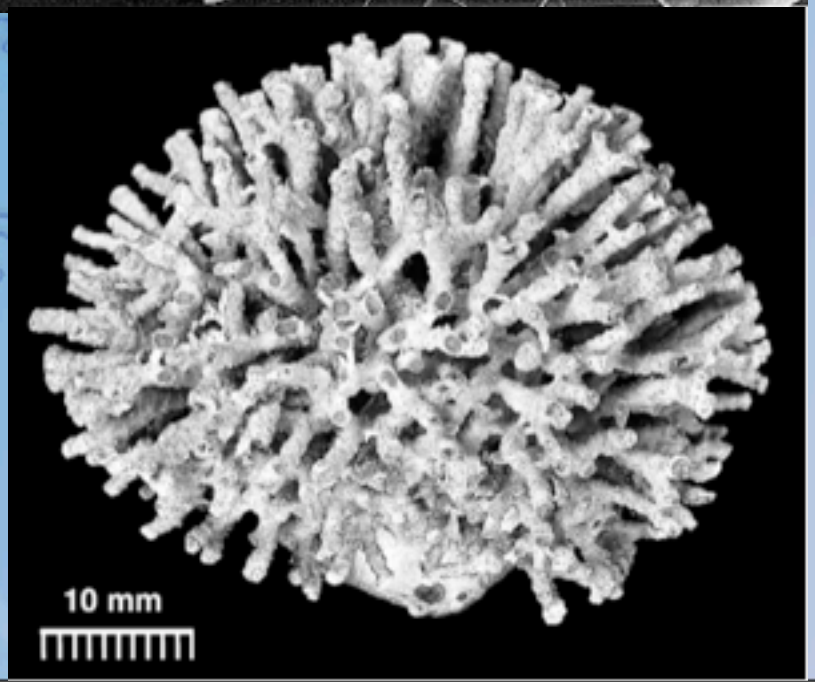
Body wall calcified

Bryozoans are divided into three classes:

2. Stenolaemata (marine)



- Cryptostomida, Cystoporida and Fenestrida (Lower Ordovician - Upper Permian)
- Trepostomatida (Lower Ordovician to Upper Triassic)
- Cyclostomatida (Lower Ordovician - Recent)



Colonies encrusting or erect

Body wall calcified

Bryozoans are divided into three classes:

3. Gymnolaemata

- Ctenostomata (Lower Ordovician - Recent), body wall membranous or gelatinous, mostly marine

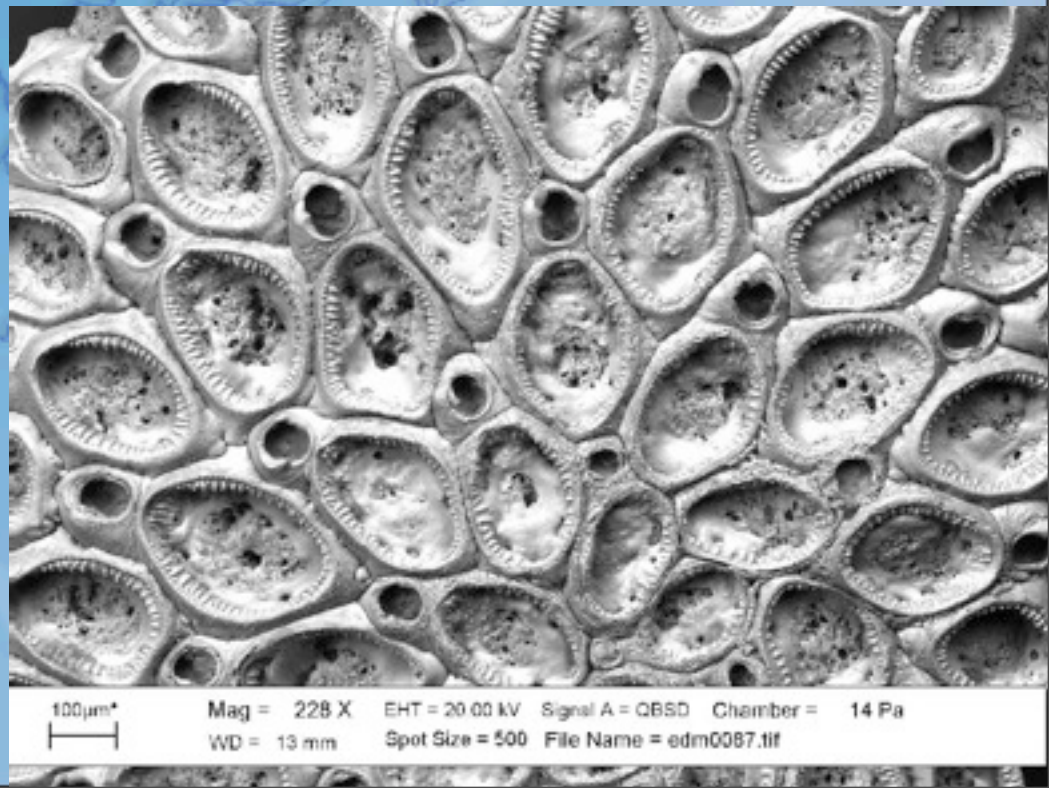
- Cheilostomata (Upper Jurassic - Recent), encrusting, erect or free living, zooids calcified, typically box-shaped, almost exclusively marine

Bryozoans are divided into three classes:

3. Gymnolaemata

- Ctenostomata (Lower Ordovician - Recent), body wall membranous or gelatinous, mostly marine

- Cheilostomata (Upper Jurassic - Recent), encrusting, erect or free living, zooids calcified, typically box-shaped, almost exclusively marine



Bryozoans are divided into three classes:

3. Gymnolaemata

- Ctenostomata (Lower Ordovician - Recent), body wall membranous or gelatinous, mostly marine

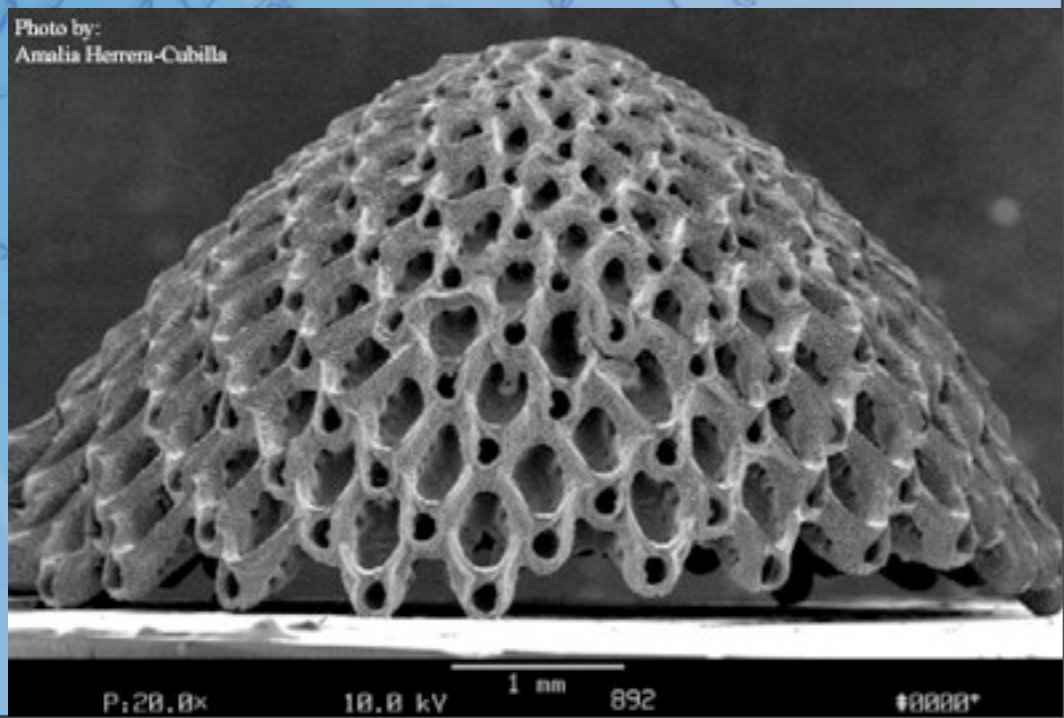
- Cheilostomata (Upper Jurassic - Recent), encrusting, erect or free living, zooids calcified, typically box-shaped, almost exclusively marine

Bryozoans are divided into three classes:

3. Gymnolaemata

- Ctenostomata (Lower Ordovician - Recent), body wall membranous or gelatinous, mostly marine

- Cheilostomata (Upper Jurassic - Recent), encrusting, erect or free living, zooids calcified, typically box-shaped, almost exclusively marine



What do we already know about Cenozoic bryozoans from Indonesia?

…Almost nothing…

The number of papers that cite Cenozoic bryozoans is restricted and occurrences are rare!

- First report Oppenoorth and Gerth (1929)

  "…part of the rich fauna of Nanggoelen beds…"
- Lagaaij (1968a; 1968b; 1969)
- Keij (1973)
- Cook and Lagaaij (1973; 1976)
- Franchino et al. (1988)
- Pouyet & Braga (1993)
- Braga (2001)

What do we already know about Cenozoic bryozoans from Indonesia?

Species	Age	Locality
Filisparsa sp.	Late Oligocene	Lombok
Exidmonea sp.	Late Oligocene	Lombok
Idmonea sp.	Lower Miocene	Malaysian Borneo
Crisia sp.	Lower - Middle Miocene	Malaysian Borneo, Madura
Lichenopora sp.	Middle Miocene	Madura
Nellia oculata	Miocene	East Java, Madura, Tanimbar
Nellia sp.	Late Oligocene	Lombok
Vincularia sp.	Miocene	East Borneo, East Java, Madura, Tanimbar
Canda sp.	Lower Miocene	Malaysian Borneo
Scrupocellaria sp.	Late Oligocene-M. Miocene	Lombok, Madura
Synnotum sp.	Lower Miocene	East Java, Madura
Poricellaria sp.	Middle Oligocene, Miocene	East Java, Madura, Tanimbar, M. Borneo
Steginoporella sp.	Middle Miocene	Madura
Thalamoporella sulawesiensis	Eocene	Sulawesi
Thalamoporella sp.	Middle Miocene	Madura
Chlidonia piriformis	Lower Miocene	East Java, Madura
Cellaria sp.	L. Miocene	Malaysian Borneo
Skylonia sarawakensis	Early Miocene	Malaysian Borneo
Skylonia thomasi thomasi	Middle Miocene	Malaysian Borneo, Madura
Skylonia thomasi madurensis	Middle Miocene	Madura
Crepis aff. *longipes*	Lower Miocene	East Java
Catenicella sp.	Miocene	East Java, Madura
Vasignyella cf. *otophora*	Middle Miocene	Madura
Savignyella sp.	Middle Miocene	Madura
Gemellipora sp.	Early Miocene	East Java, Madura
Pasythea sp.	Middle Miocene	Madura
Margaretta sp.	Lower-Middle Miocene	Malaysian Borneo, Madura
Reteporella sp.	Middle Miocene	Madura
Celleporidae sp.	Middle Miocene	Madura
Lacrimula asymmetrica	Miocene	W. Madura
Lacrimula grunaui	Miocene	E. Madura
Lacrimula similis	Miocene	W. Madura
Conescharellina sp.	Miocene	E. Madura

11 species

21 genera

Some authors only identified specimens to family level.

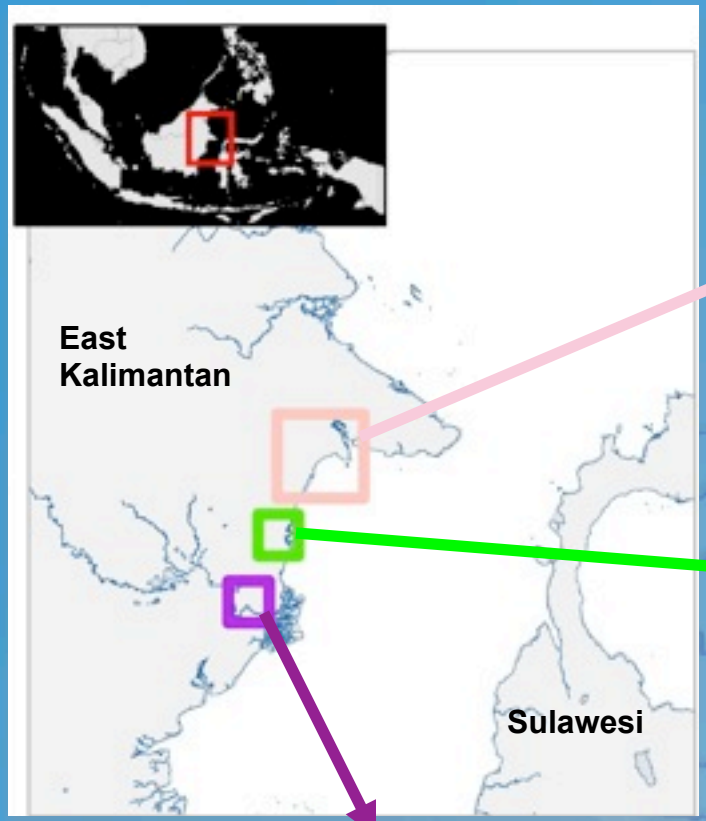
My aims…

1) Identify bryozoan taxa present in sampled sections

2) Track changes in bryozoan diversity and taxonomic composition and correlate these with facies changes

3) Estimate MART (mean annual range in temperature) values from within-colony variations in zooid size

Work accomplished in the field



14 sections

…74 samples

Bengalon-Sangkulirang

TF518 Langhian/Serravallian
TF522 Serravallian
TF511 Tortonian

Bontang

TF59 TF153 Burdigalian
TF126 TF501 Serravallian
TF504 Tortonian

Samarinda

TF79 TF76 TF52 TF56 Burdigalian
TF51 TF 57 Langhian

Batu Putih 1
TF 76

TF76
Encrusting bryozoans on the base of overturned platy coral

Top Reef Stadion in Mine TF 57

TF57

Colony of Steginoporella sp. on the base of a platy coral

My samples

Stadium sections Top Reef

TF 51

Lichenoporidae sp.
Parellisina sp.1
Calloporidae sp.1
Calloporidae sp.2
Steginoporella sp.1
Reptadeonella sp.1
Puellina sp.1
Ascophora sp.1
Ascophora sp.2
Ascophora sp.3
Hippopodina cf. feegensis
Phidoloporidae sp.1

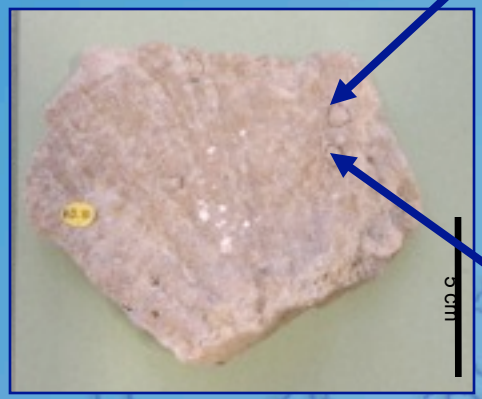
TF 57

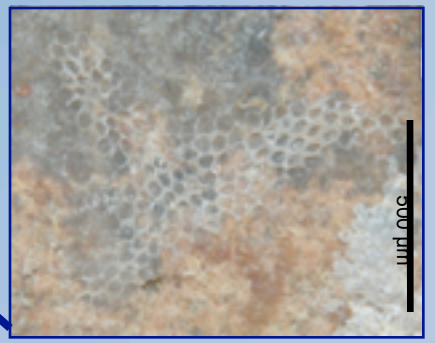
Calloporidae sp.2
Steginoporella sp.1
Puellina sp.1
Hippopodina cf. feegensis
Mucronella sp.1

14 species

NHM Collections

Late Oligocene
Malaysian Borneo

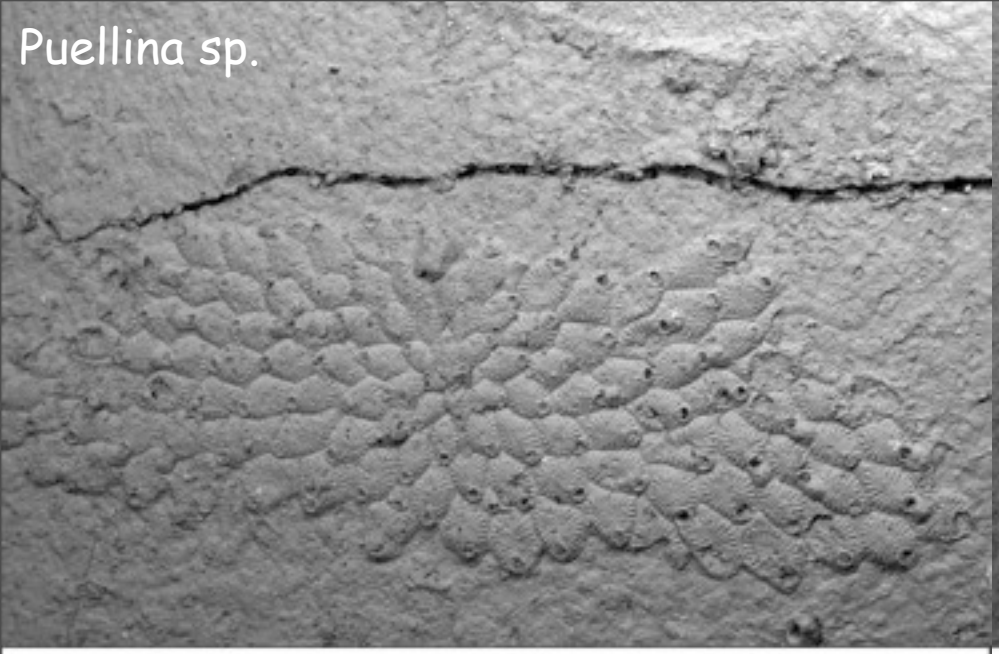




NHM Collections

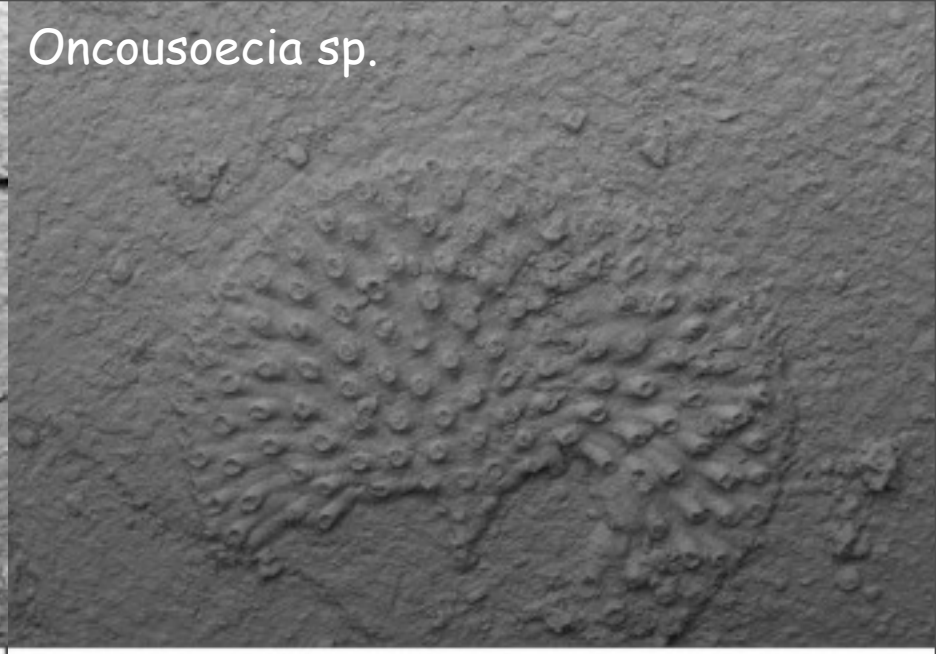
Late Oligocene
Malaysian Borneo

Puellina sp.



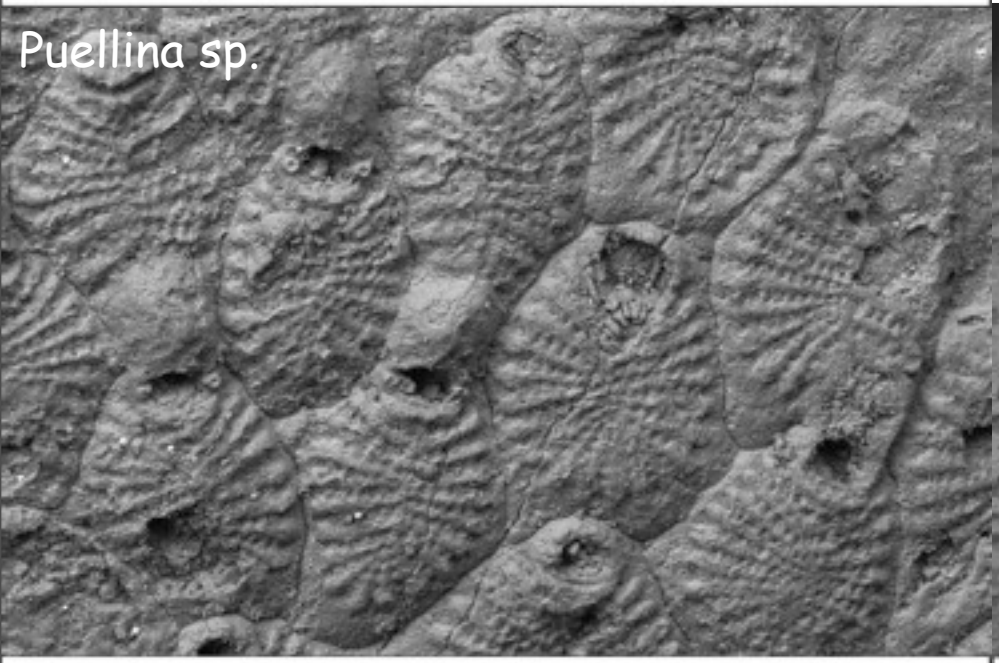
300µm* Mag = 62 X EHT = 20.00 kV Signal A = QBSD Chamber = 14 Pa
WD = 13 mm Spot Size = 500 File Name = edm0038.tif

Oncousoecia sp.



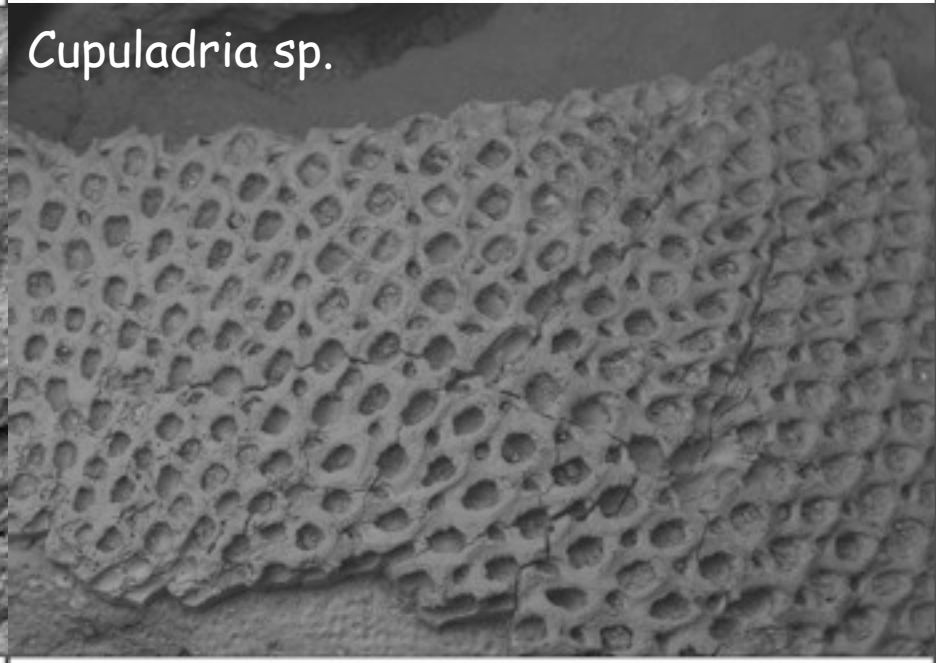
300µm* Mag = 64 X EHT = 20.00 kV Signal A = QBSD Chamber = 15 Pa
WD = 15 mm Spot Size = 500 File Name = edm0043.tif

Puellina sp.

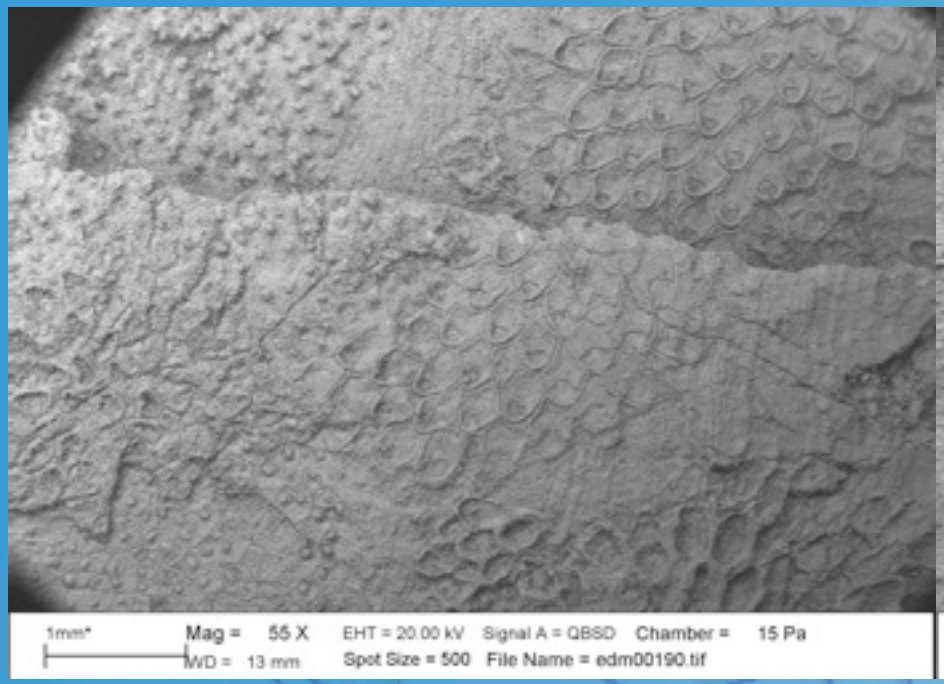


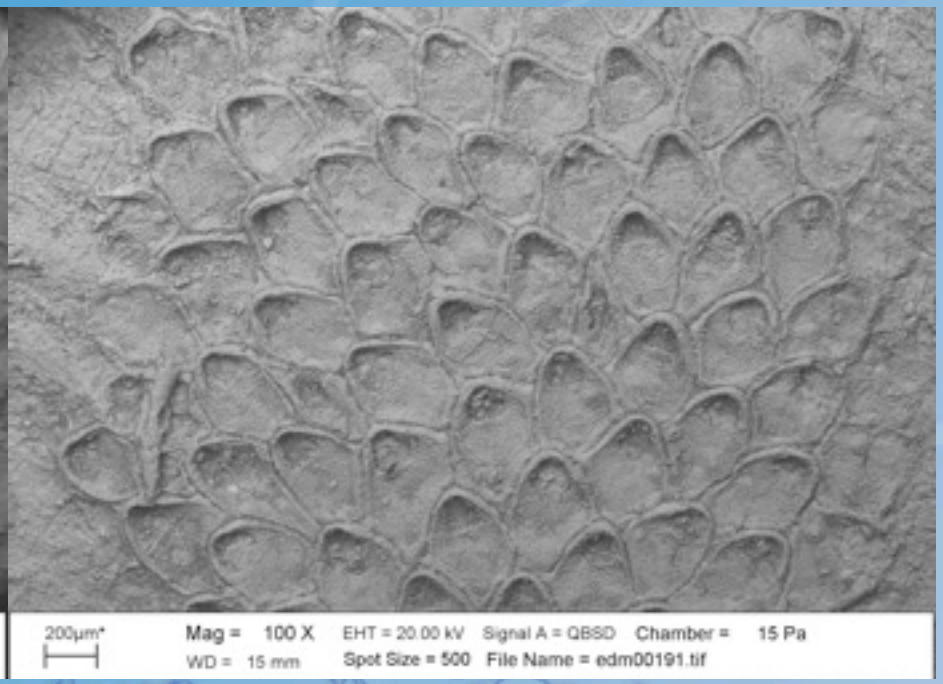
100µm* Mag = 293 X EHT = 20.00 kV Signal A = QBSD Chamber = 14 Pa
WD = 13 mm Spot Size = 500 File Name = edm0042.tif

Cupuladria sp.

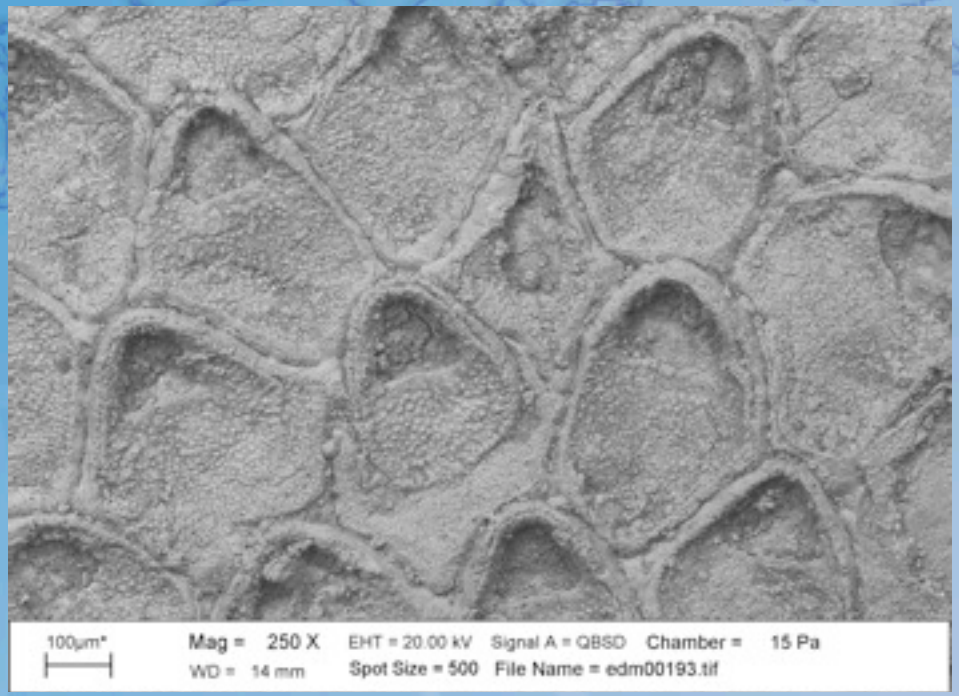


1mm* Mag = 49 X EHT = 20.00 kV Signal A = QBSD Chamber = 14 Pa
WD = 15 mm Spot Size = 500 File Name = edm0053.tif





Aechmella sp.



Species
Oncousoeciidae sp.
Annectocyma sp.
Crisia sp.
Lichenoporidae sp.
Calloporidae sp.
Nellia sp.
Cupuladria sp.
Aechmella sp.
Monoporella sp.
Puellina spp.
Chorizopora sp.
Trypostega sp.
Schizoporella cf. *geminipora*
Thalamoporella sp.
Margaretta sp.
Retelepralia cf. *mosaica*
Reteporella sp.
Celleporidae sp.
Conescharellina sp.

Age: Late Oligocene

Locality: Malaysian Borneo

19 genera

8 already cited in the literature

11 first records

MART analysis using within-colony variation in zooid size

MART = mean annual range in temperature

Cheilostome bryozoan zooid size is inversely correlated with ambient temperature at time of budding

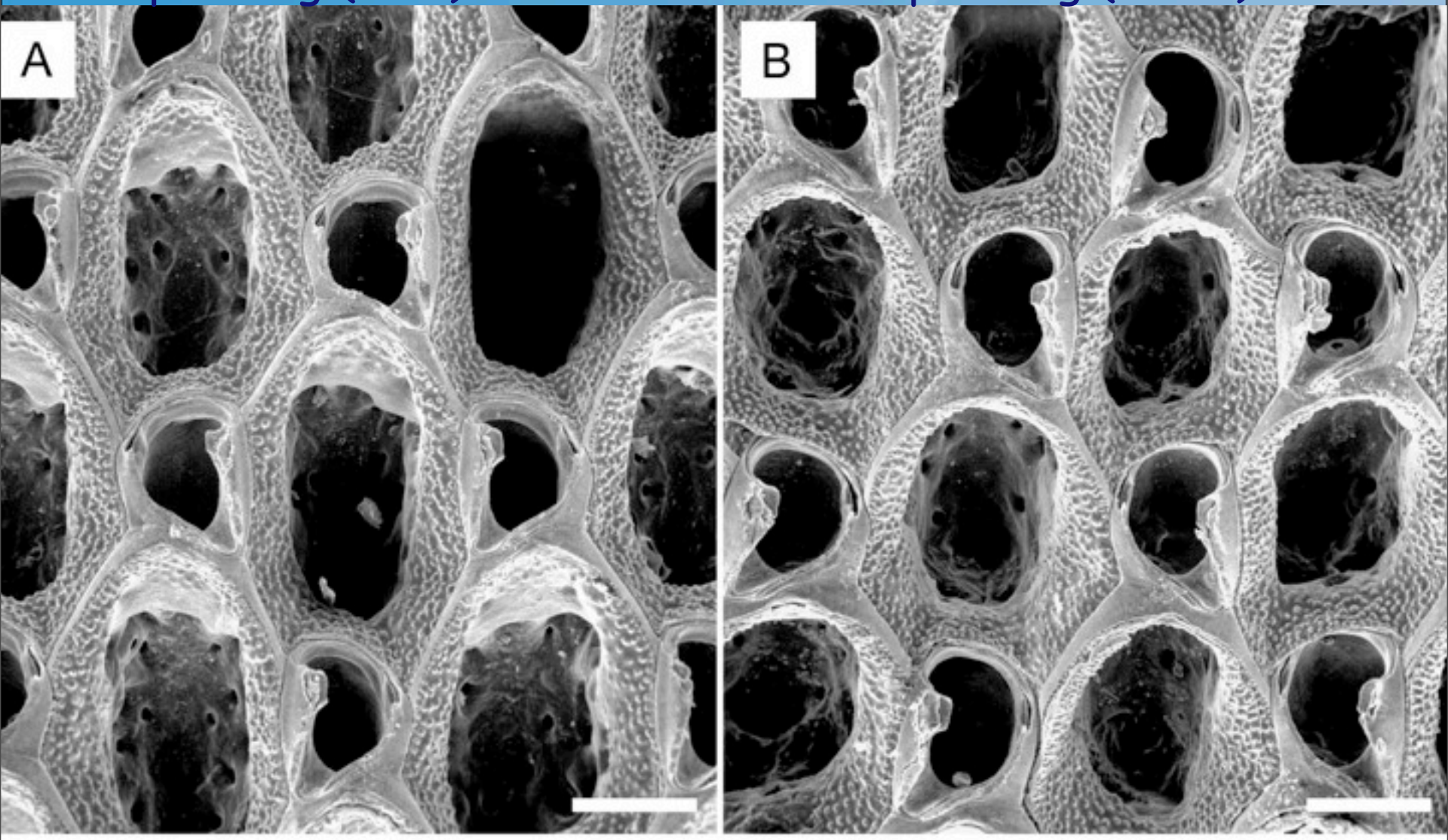
Bryozoans as palaeoenvironmental indicators

Cupuladria exfragminis

Okamura et al. 2011

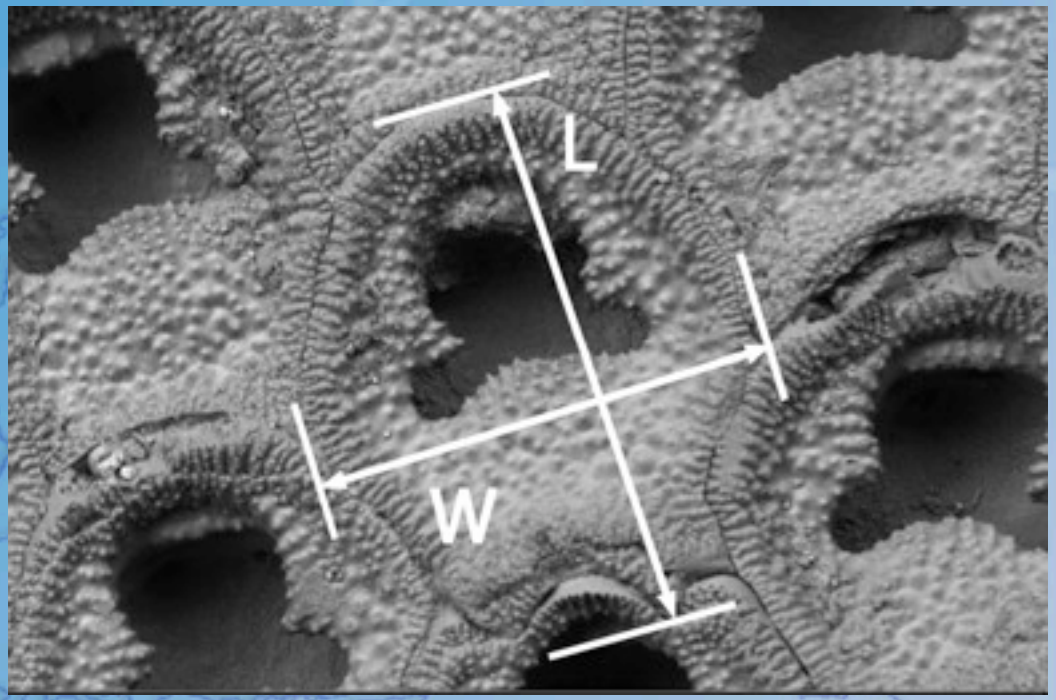
upwelling (cold) zooids

non-upwelling (warm) zooids

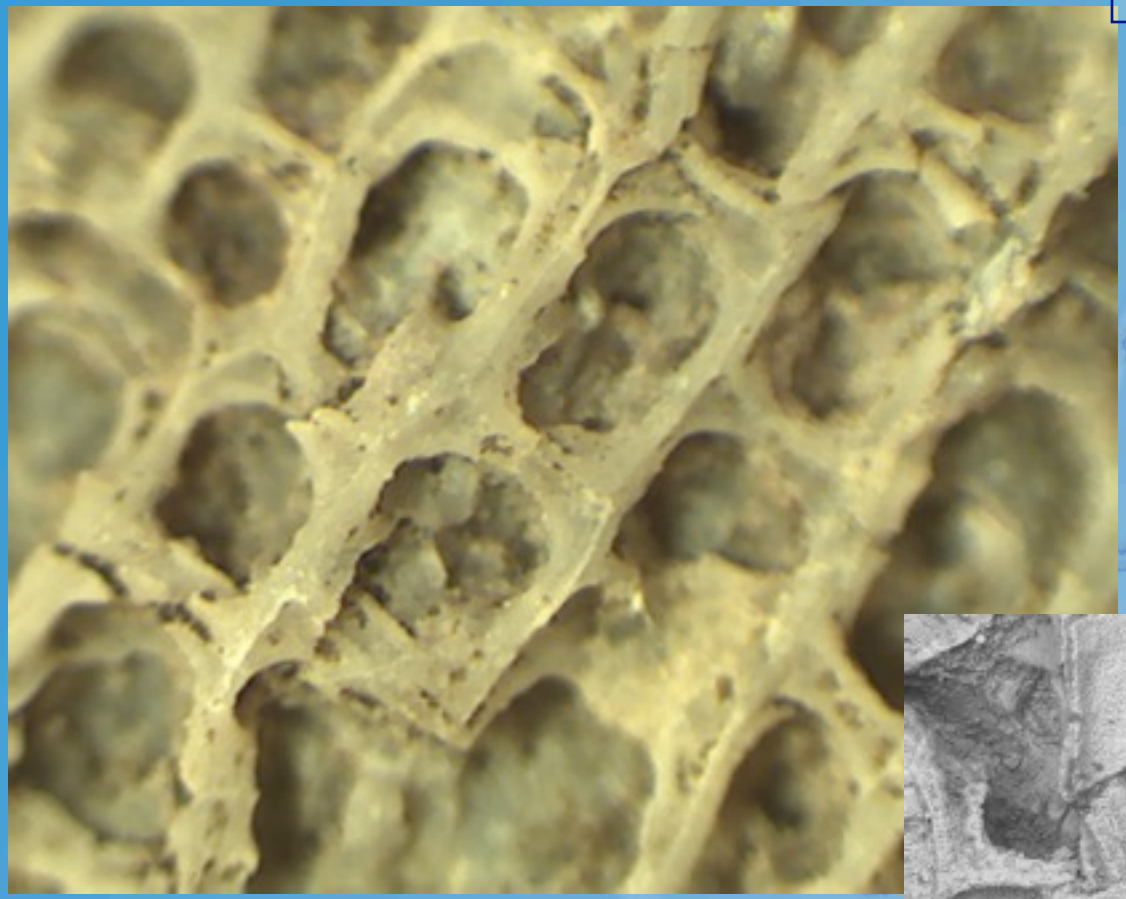


MART method

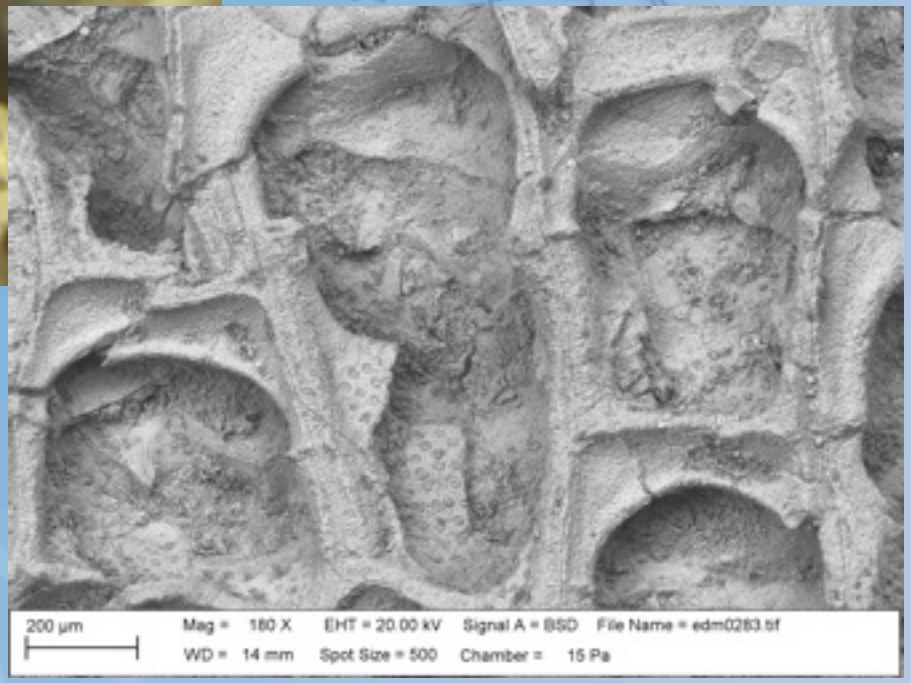
- randomly select 20 zooids
- avoid early zooids and areas of irregular growth
- measure zooid length and width
- calculate length x width (= area proxy)
- calculate CV (= SD/mean x 100)
- repeat in at least 4 more colonies



Steginoporella sp.



MART
5 colonies
20 zooids
vertical walls well preserved



Conclusions

- Indonesian bryozoans from the Miocene are associated with corals
- most are encrusting colonies; only a few erect taxa have been found
- biodiversity is considerably higher than appears from the literature