FACIES DISTRIBUTION BASED ON FORAMINIFERAL ASSEMBLAGES

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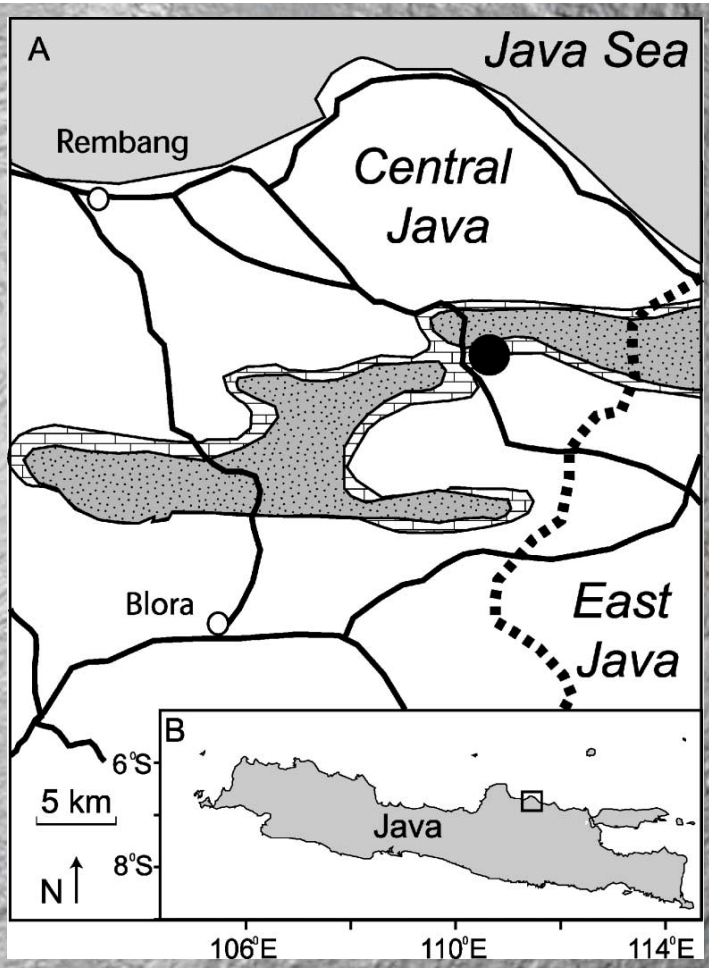
Current work

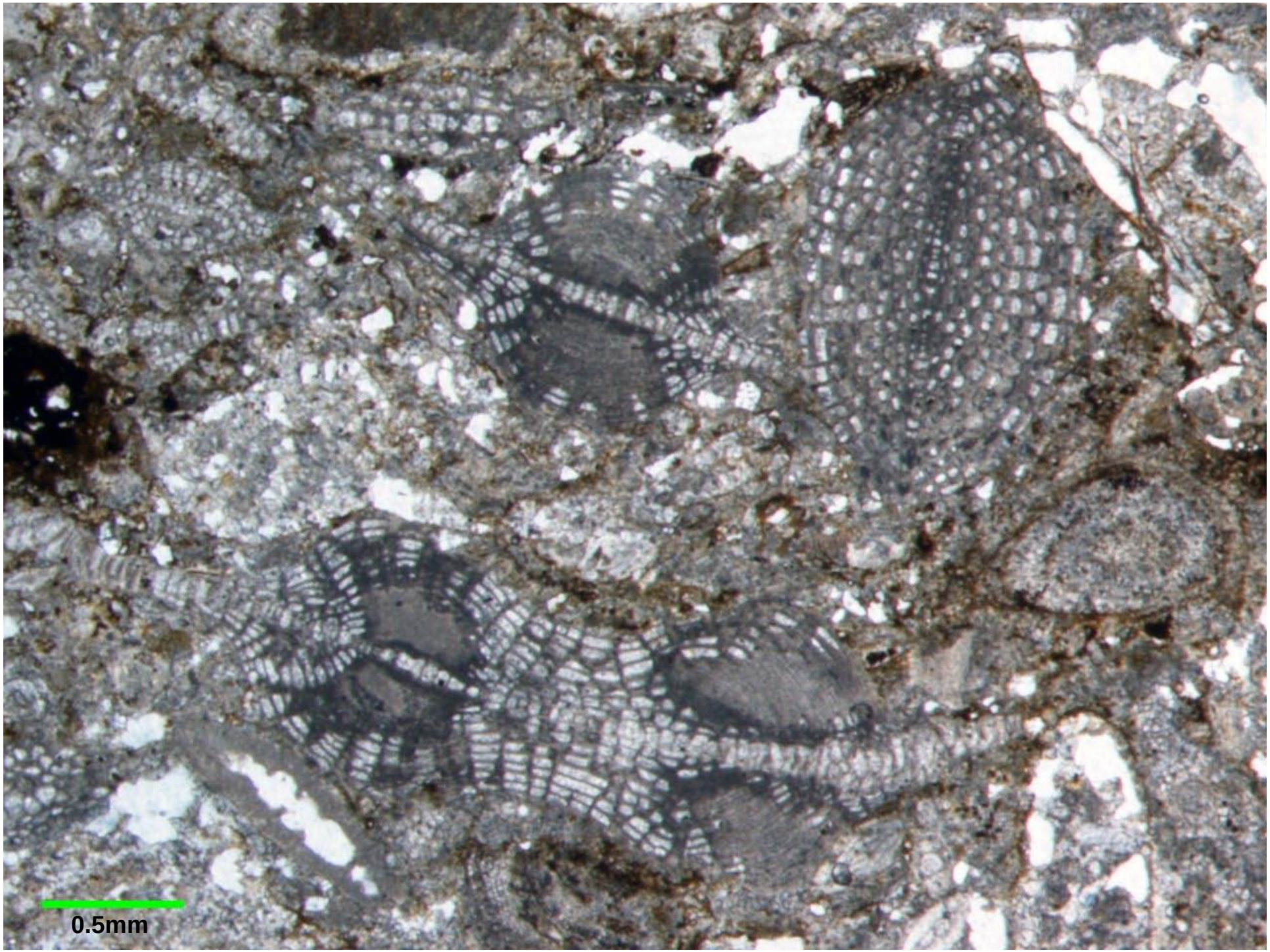
- samples from Bulu Formation, Central Java
- Two main lithology types:
  - well bedded carbonates rich in large benthic foraminifera and planar corals
  - sandy fossiliferous carbonates (Sharaf et al., 2005)
- thickness up to 200 m



Simplified map showing origin of samples; brick pattern – Bulu Formation (Donovan et al., 2010)

Bulu Formation

- abundance of LBF (*Cycloclypeus indopacificus, Katacycloclypeus annulatus, Amphistegina lessonii group, A. radiata group, Nephrolepidina sp., N. ferreroi, Miogypsina sp., Operculina sp., Operculinella sp., Heterostegina sp., Planorbulinella solida and Gypsina globulus* (Renema, research in progress)
- most important *Nephrolepidina ferreroi* group (extinct at the end of Tf2) and *Katacycloclypeus annulatus* (from late Tf1 to end of Tf2)
- age based on Sr-isotope : Tf2 (Middle Serravallian) - 12.98 Ma (Sharaf et al., 2005)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Bulu Formation

- 125 thin sections processed:
  - general lithology description
  - determination of LBF (mostly on genera level)
  - photographing (around 700 photos)
- dividing samples into different facies – according to environmental conditions with focus on LBF

Facies analyses

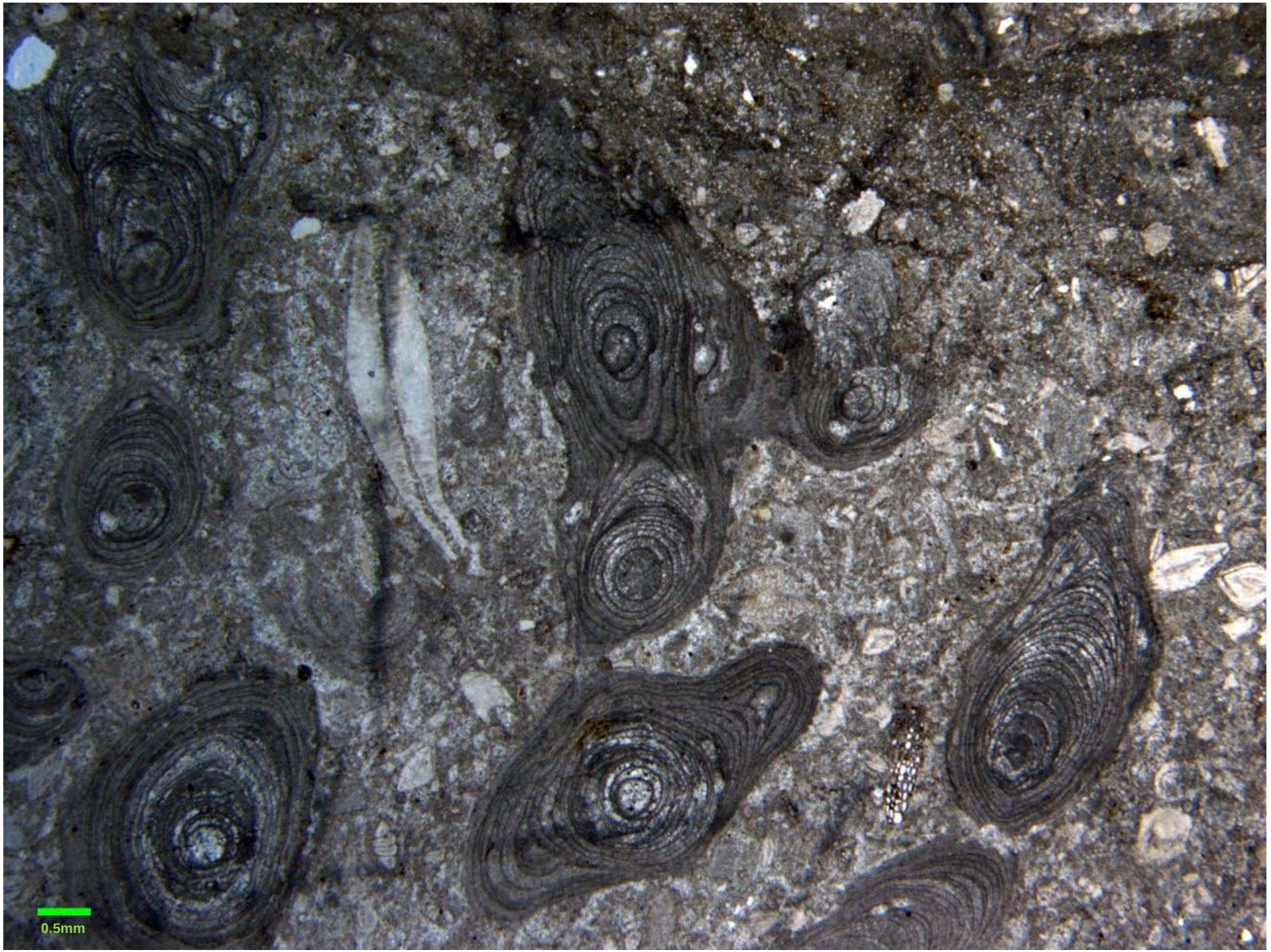
- facies analyses studies included:
  - general determination of lithology (including percentage of foraminifera in thin-section)
  - morphology of foraminifera tests
  - abundance and size of foraminiferal tests
  - size of grains in the matrix

Results

- 7 facies identified:
  - Algal facies
  - Calcarenite facies
  - Amphistegina facies
  - Transitional facies
  - Nephrolepidina facies
  - Cycloclypeus facies
  - Mudstone facies

Algal facies

- characterized by dominance of coralline algae
- two growth morphologies: one are building thin laminar crust, while the others are building rhodolits
- coralline algae and coral floatstone (Wilson, 2005)
- Red Algal-Larger Foraminiferal Packstone Facies (SF7) – deposited on algal-stabilized shallow open platform (Hallock & Glenn, 1986)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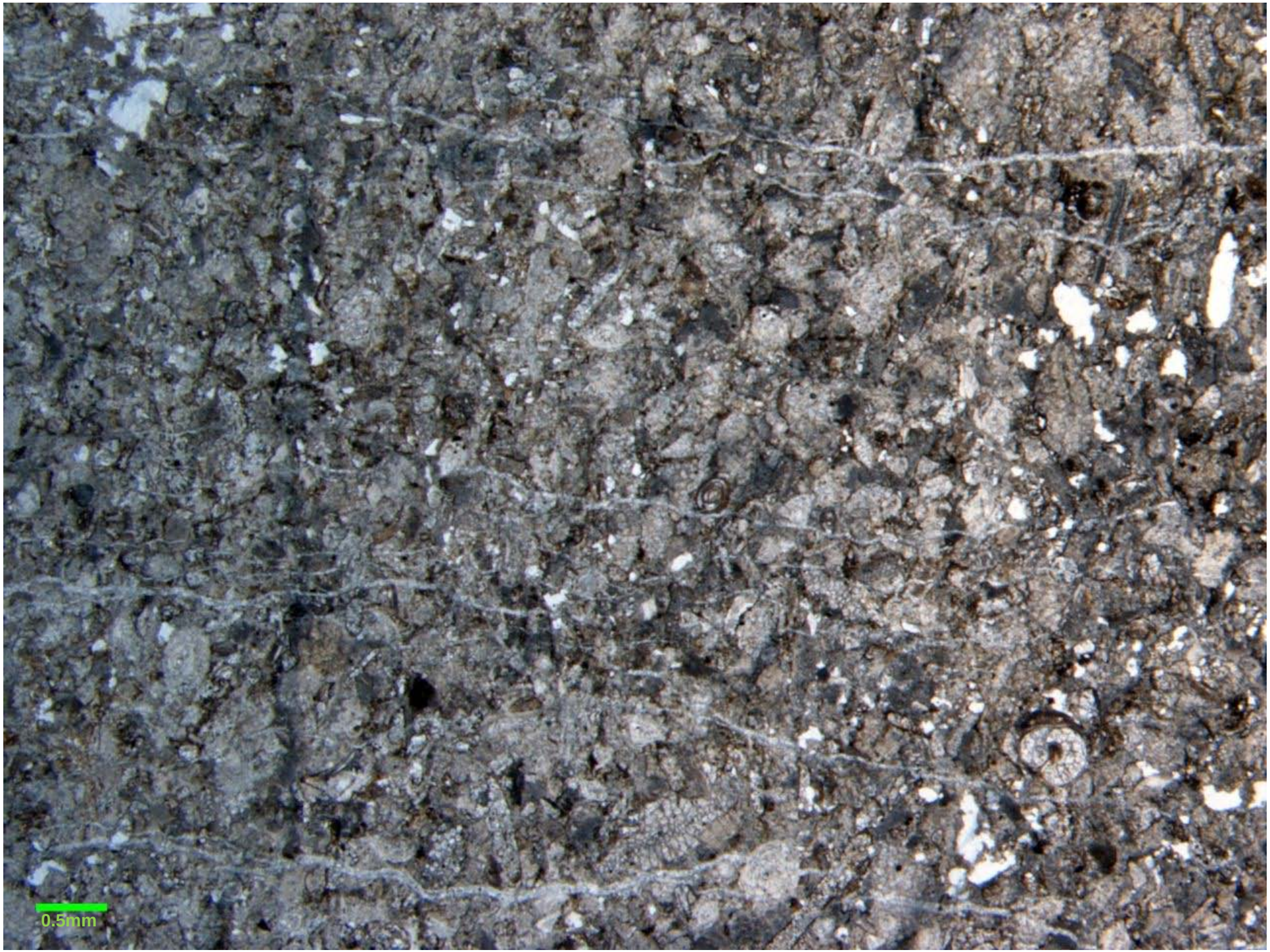
Calcarenite facies

- sediments composed of fragmented foraminifera, algae and other fossil content
- rare occurrences of small foraminifera, fragments of foraminiferal W inside of grainy matrix
- bioclastic sand facies – interbedded with siliciclastic facies at the margins of patch reefs (Wilson, 2005)
- SF6 –platform margin sand (Beavington-Penney and Racey, 2004)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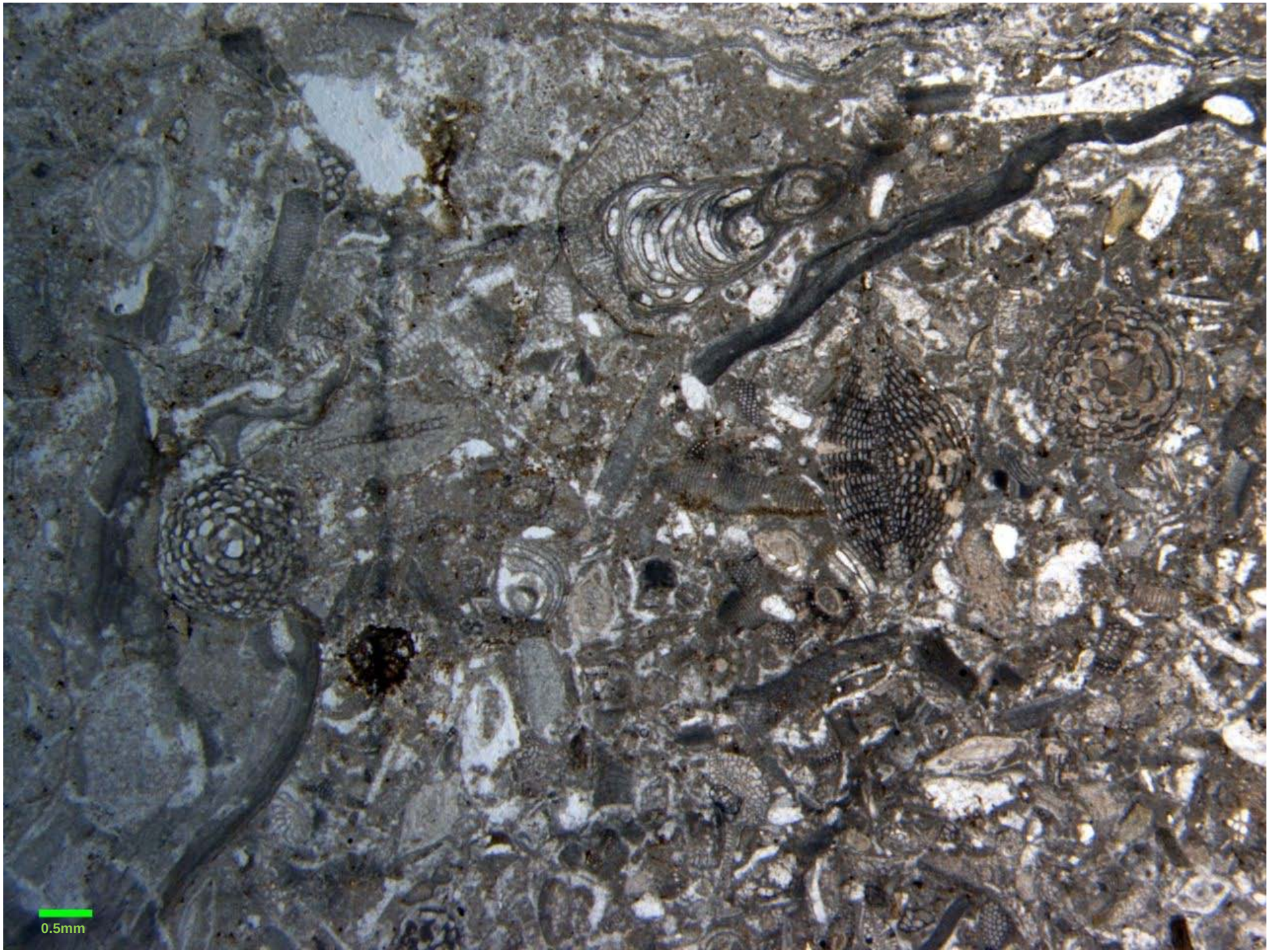
Amphistegina facies

- composed mostly from foraminifera with the dominance of Amphistegina specimens (up to 1mm in diameter)
- also present: Nephrolepidina, Cycloclypeus, Katacycloclupeus annulatus
- foraminifera and algae with larger test often fragmented to smaller pieces
- Standard Facies 5 – shallow, high energy, reef environments (Hallock & Glenn, 1986)


0.5mm

Transitional facies

- no distinct domination of either of the mentioned genera, but compared to other LBF present
- in different thin sections occurences of different LBF, algae and corals
- Standard Facies 5 to 4 –shallow platform margin reef foreslope to reef, characterized by heterogeneity (Hallock & Glenn, 1986)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Nephrolepidina facies

- characterized by the dominance of Nephrolepidina (including N. ferreroi group)
- some thinsections with more than 80% of Nephrolepidina
- T/D ratio within N. genus varies from 0.26 to 0.56 (0.39 on average, n=77)
- Larger Foraminifera Wackestone Facies (SF4) – reef foreslope deposition (Hallock & Glenn, 1986)


0.5mm

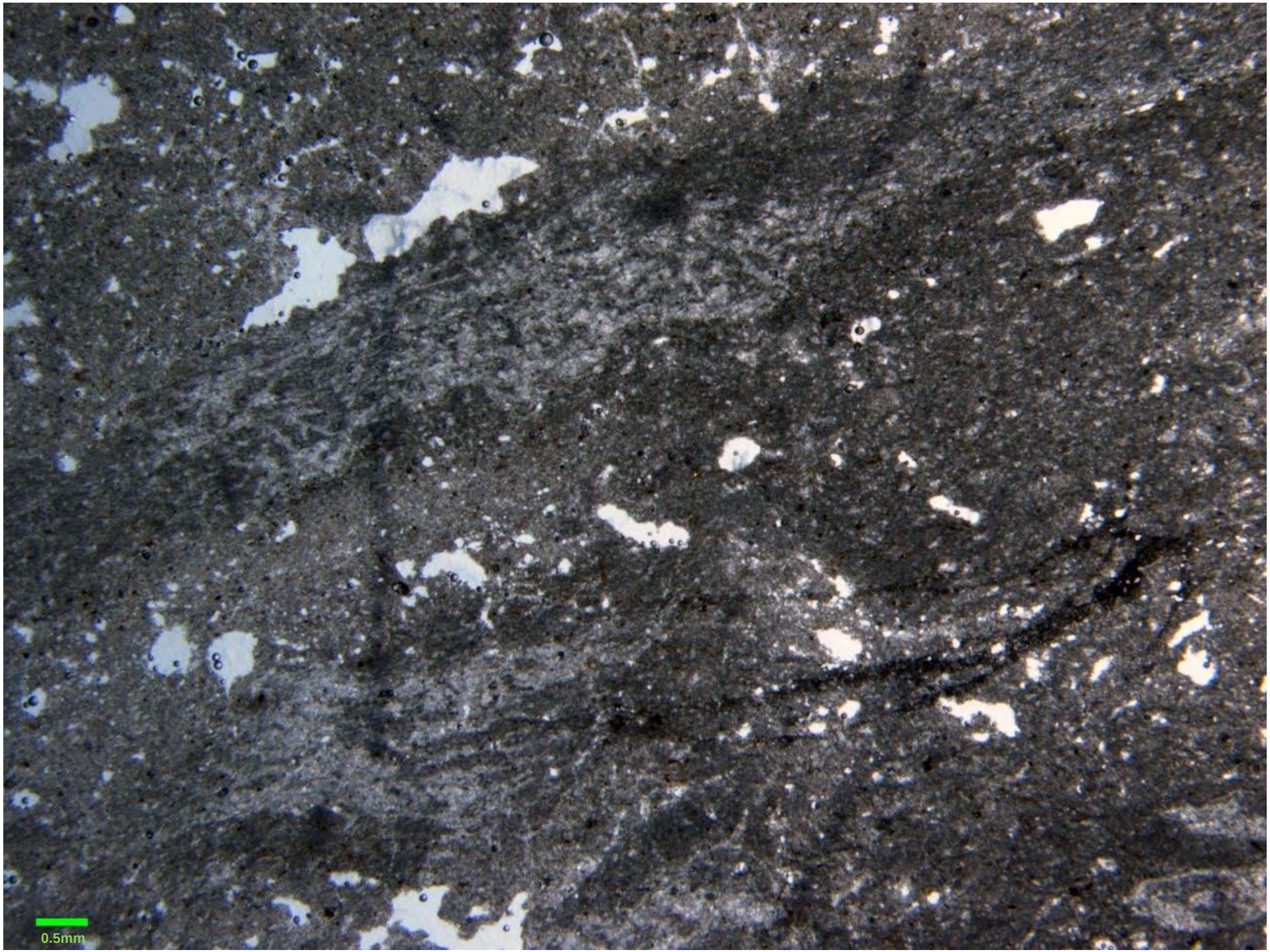
Cycloclypeus facies

- characterized by dominance of large elongated Cycloclypeus and Katacycloclypeus tests (up to 6mm in diameter)
- possible imbrication noticed
- Larger Foraminifera Wackestone Facies (SF3) – toe of slope (Hallock & Glenn, 1986)
- larger benthic foraminifera facies (Wilson, 2005)


0.5mm

Mudstone facies

- characterized by no (or very little) fossil content, only micritic grains
- some of the thin sections show significant siliciclastic component (possible thin sections of the underlying Ngrayong Sands)
- siliciclastic facies by Wilson (2005)
- Standard Facies 2 – open shelf by Hallock & Glenn (1986)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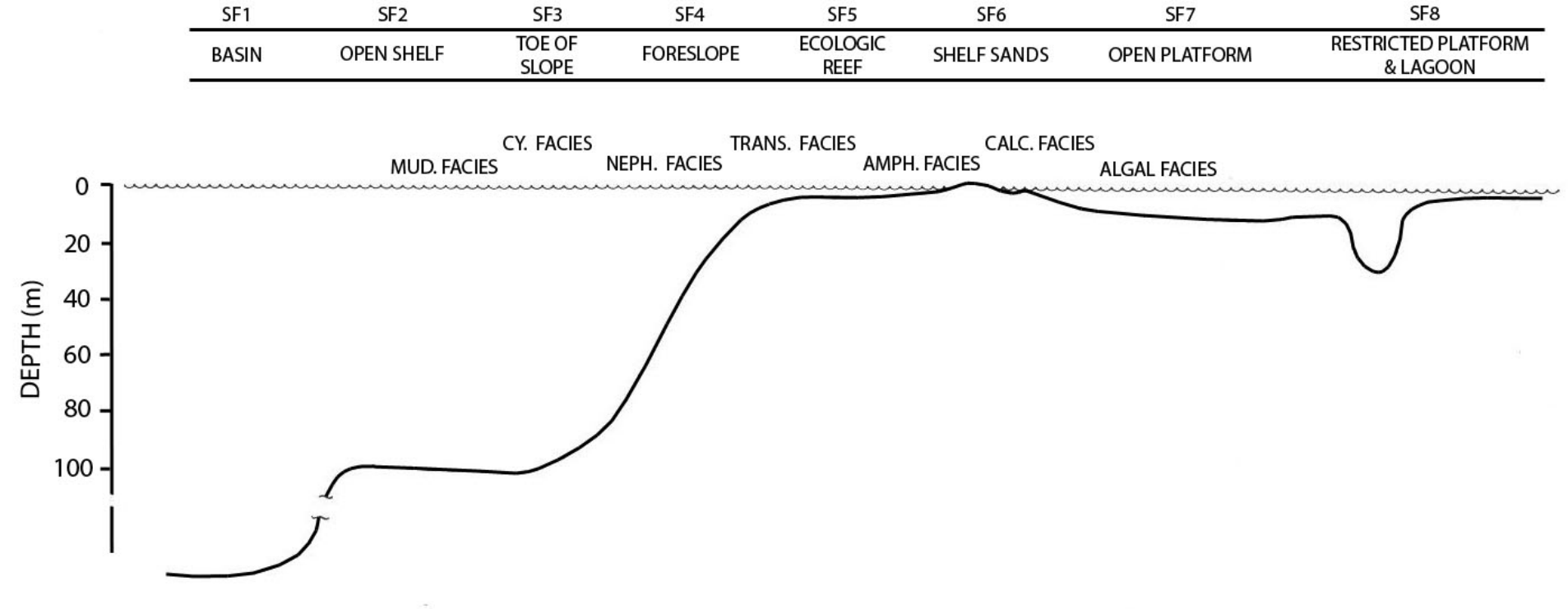
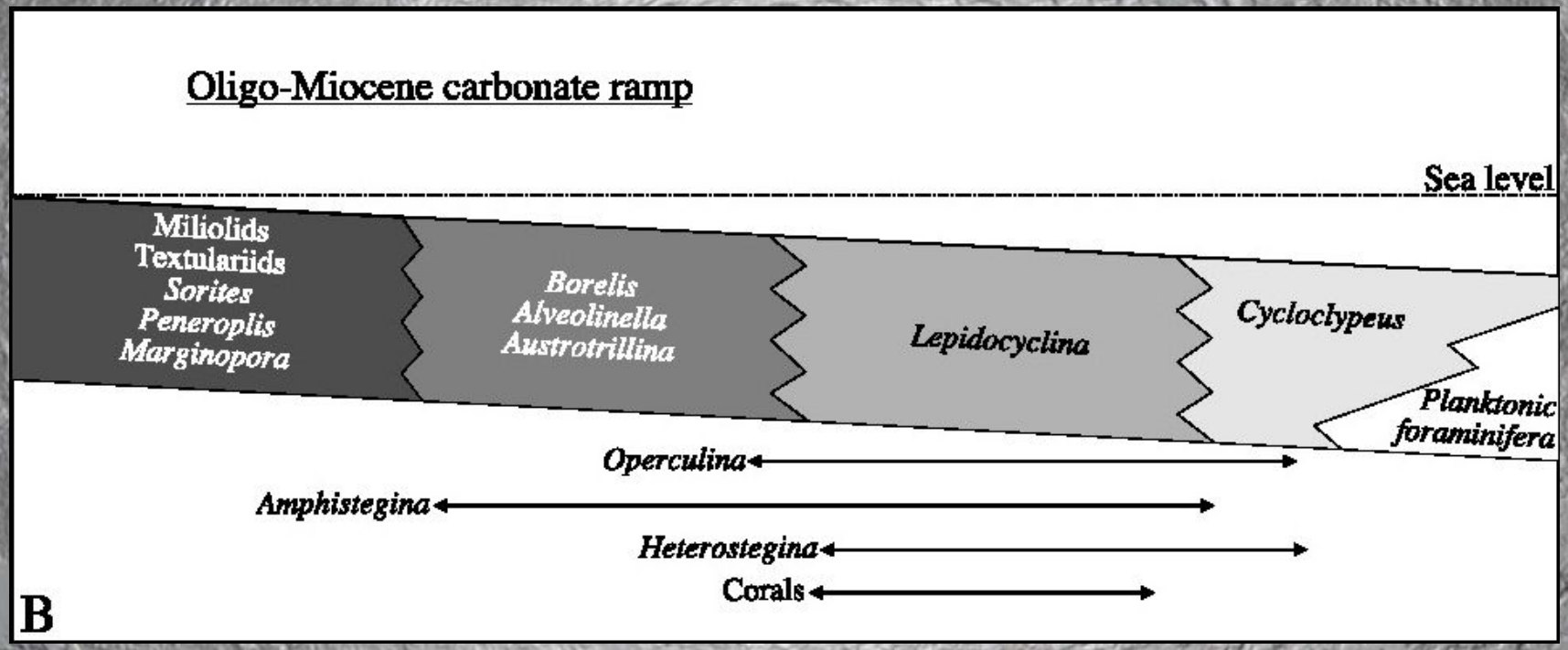
Paleoenvironmental interpretation



Distribution of identified facies in reef-associated environment; SF = Standard Facies (modified from Hallock & Glenn, 1986).

Paleoenvironmental interpretation



Faunal associations on carbonate ramp during Oligo-Miocene (Beavington-Penney & Racey, 2004)

NTA-2 Results

- 22 field days:
  - logging of 7 sections (52, 57, 51, 126, 154, 102, 128)
  - collected 238 samples:
    - detail sampling resolution – 52, 76, 79, 126
    - medium resolution sampling – 51, 57, 56, 59, 128, 153
    - low resolution sampling – 130
    - possible visit NTA-4 – 130, 101, 78, 60
  - 12 logs digitalized using SedLog

Plan for NTA-4

- find long continuous section with longest possible time range (Mangkalihat?)
- make stratigraphis time frame based on LBF
- Kari Orang karstic area
- facies analyses – both in conjunction with environment, age and fossil (primary LBF) content
- data needed – sedimentology, stratigraphy, magneto-stratigraphy, geochemistry (Sr-isotopes), algae and coral analyses

Conclusion

- current work on Bulu Formation – test model for analyzing new samples (collected during NTA-2 and NTA-4) and Naturalis collection
- facies analyses - see the environmental change
- environmental change and its affect on foraminiferal assemblages
- foraminifera biostratigraphy – set up stratigraphic frame

References

- Beavington-Penney, S.J. and Racey, A., 2004. Ecology of extant nummulitids and other larger benthic foraminifera: applications in palaeoenvironmental analysis. *Earth-Science Reviews*, 67, 3-4:219-265.
- Cosovic, V., Drobne, K. and Moro, A., 2004. Paleoenvironmental model for Eocene foraminiferal limestones of the Adriatic carbonate platform (Istrian Peninsula). Facies 50, 61-75.
- Donovan, S. K., Renema, W. and Lewis, D. N., 2010. A new species of Goniocidaris Desor (Echinoidea, Cidaroida) from the middle Miocene of Java. Alcheringa 34, 87-95.
- Hallock, P. and Glenn, C.E., 1986. Larger Foraminifera: A tool for paleoenvironmental analysis of Cenozoic carbonate depositional facies. Palaios 1, 55–64.
- Sharaf, E., BouDagher-Fadel, M.K., Simo, T.A. and Carroll, A.R., 2005. Biostratigraphy and strontium isotope dating of Oligocene-Miocene carbonates and siliciclastics, east Java, Indonesia. Stratigraphy 2,239-258.
- Wilson, M.E.J., 2005. Equatorial delta-front patch reef development during the Neogene, Borneo. Journal of Sedimentary Research 75, 116–134.