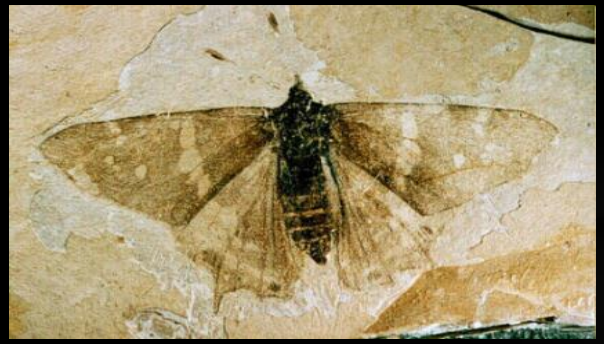
Residual Color Patterns in the Echinoid *Hemipatagus carolinensis* from the North Carolina Oligocene

Linda McCall, North Carolina Fossil Club

Louis Zachos, Department of Geology and Geological Engineering – University of Mississippi

Fossil Color Patterns



Older, more altered…..

Color Patterns in Fossil Ecinoderms

30 MA Fossils from North Topsail Beach

North Topsail Beach

December 18, 2014
to June 30, 2015

River Bend Formation- Oligocene

River Bend Formation – 30 Ma

Hemipatagus carolinensis

Diverse Ecosystem

Diagenetic Alteration….

External Mold

Internal Cast

30 MA Color Patterns

Old and Altered…

Lots of Color/Color Patterns

Hemipatagus carolinensis

Repeating Color Patterns - Aboral









Aboral Pattern – Petaloid Ambs

"Lined" Ambs

Color striping various widths inside adradiad sutures, perradid sutures clear

496 specimens

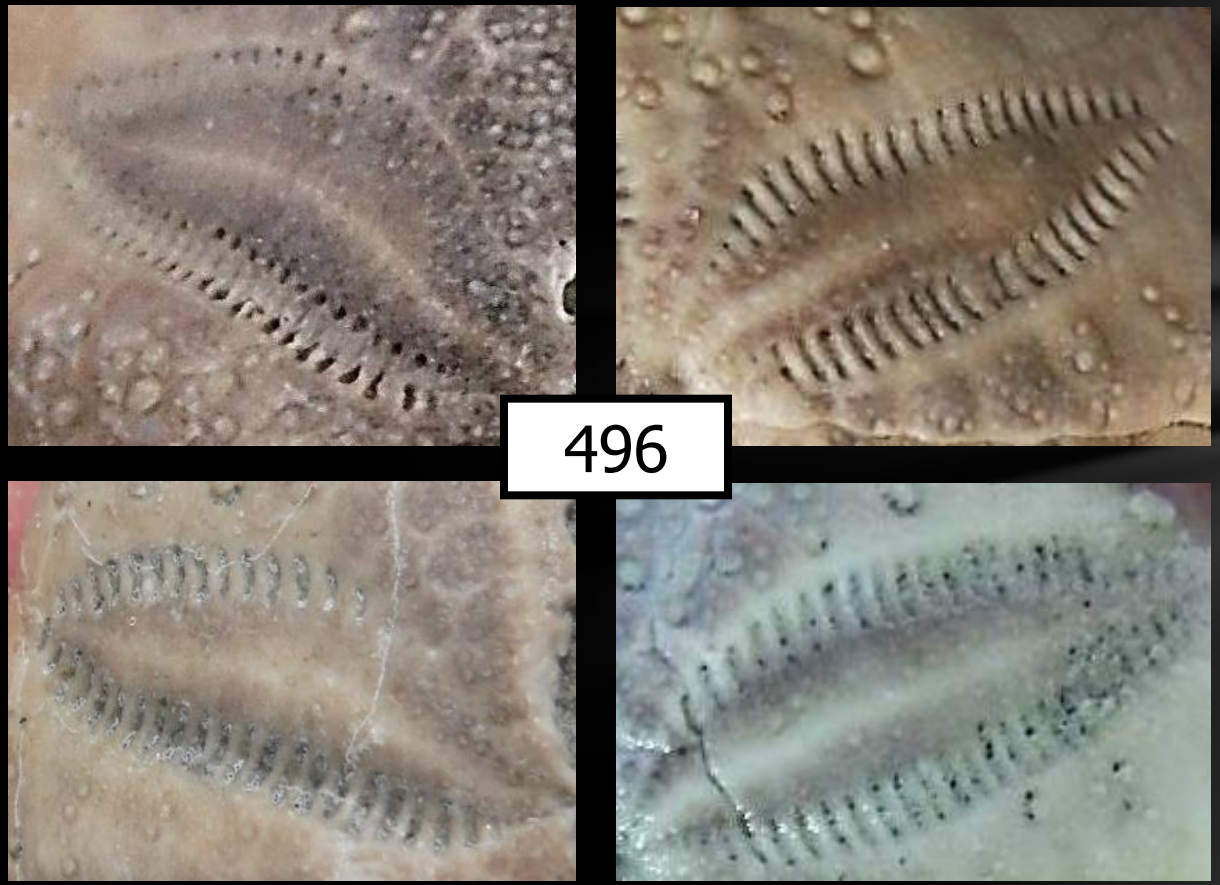
"Filled" Ambs

Petals entirely color filled

213 specimens

“Lined ambs”

“Filled ambs”



Aboral Pattern – Upper Test

"Dashed"

Ambulacral & interambulacral plates colored

All meridonal sutures lacking color

207 specimens

"Shaded"

All plates between the two upper adradiad sutures colored including most sutures

338 specimens

"Mixed"

As implied, a mix of "Dashed" and "Shaded" coloration

164 specimens

207

338

Pattern Correlation Ambs/Upper Test

Lined Ambs with Dashed tops

190 specimens

Lined Ambs with mixed tops

144 specimens

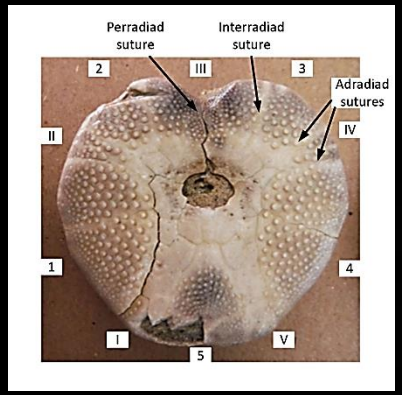
Lined Ambs with shaded tops

162 specimens

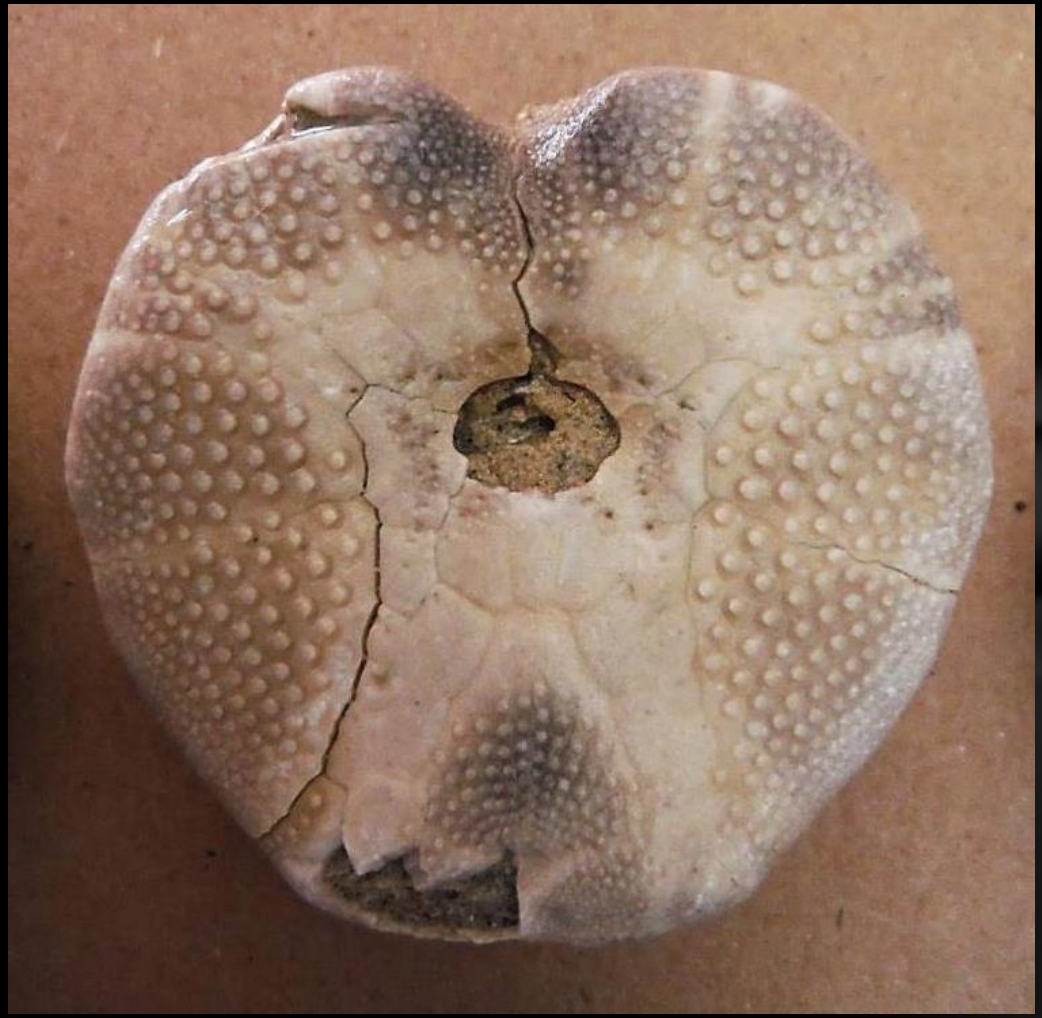
Filled Ambs with shaded tops

176 specimens (213 total)

Lined Ambs – Adoral Color Pattern



Patterns wrap around specimens



Maretia vs *Hemipatagus*

Maretia - extant



Maretia color

- Epidermal pigmentation
- Not present in mesodermal tissue
- Not retained in dead, cleaned specimens

Hemipatagus - extinct



Hemipatagus color

- Had to originate post mortem
- How?
- When?
- Why?

Maretia with Color on Test

Into the Realm of Speculation

- Wrap in cellophane? Unlikely
- Initial transfer, post-mortem, pre fossilization:
  - Rapid burial – alive or shortly after death
  - Fine non-permeable coating
  - Pressure
  - Allows transfer of colors into the pores in the test
- Transfer retained during diagenisis:
  - Recrystallization of the stereom microstructure of the plates (High Mg to Low Mg)
  - Minimal sediment permeability w/o significant fluid movement
- This also helps explain how the oysters and barnacles are retaining their color

Evidence of Rapid Burial

Echinoids with spines

More Evidence of Rapid Burial

Double valve oysters, barnacles with opercular valves, intact asteroids








Fine Silt Covering

"Cellophane" lock in/out allowing epidermal pigments stain test post-mortem

Additional Supporting Evidence

Frequently one side of the Hemipatagus retains better color than the other – gravity would pull the color down, giving the side facing up a better transfer.

Some Hemipatagus show incomplete color transfer, not a good seal – incomplete silt coating – not enough pressure above long enough for the transfer… Color can be great, blotchy, pale, or no color at all. Whether these issues occurred during the initial transfer or during subsequent digenesis needs to be researched.





Optimal Preservational Conditions

Mid-shelf location

Submerged– Oligocene – Modern, only exposed briefly during the Pliocene/Pleistocene

Silty coating

Rapid Removal from matrix

7’ auger rotating at 36 rpm

Sandblasted

- 30 in. pipe
- 3 miles
- 100 psi
- 30 – 45 min

Larger rock mostly hardground

- matrix below mostly disintegrated, fist sized & smaller
- sturdier fossils survived, though often damaged & “frosted”
- “spine hash”

30 MA Color Patterns

October 18, 2015

April 24, 2016

March 4, 2018

Summary

30 million year old color patterns?

- Compelling evidence of post-mortem color pattern transfer
  - Distinct, replicating patterns
  - Large # of specimens
  - Wrap around coloration
  - Evidence of rapid burial and encasing silt
  - Optimal preservational conditions and rapid matrix removal

Ongoing Research

Further physical and chemical analysis/testing needed

- Staining modern *Maretia* and leaching in varying conditions
- Thin sectioning *Hemipatagus* plates to view recrystallized stereom
- XRF analysis to determine elemental composition of staining
- Analyze composition of silt covering

Color is there…..





Thanks…

Specimens available in back for viewing at lunch break

Dr. James Sprinkle, University of Texas, Austin

Dr. Ann Molineux

William I. Ausich, Ohio State

Bret Bennington, Hofstra University

David Campbell, Lenoir-Rhyne University

Lyle Campbell, University of South Carolina

David Dockery, Mississippi Office of Geology

John Nance, Calvert Marine Museum

NCFC members

- Scott Chapman, Jim Mahoney, Diane Willis, Richard Chandler, Eric Sadorf

Adam Priest, Engineer Coastal, Ports and Marine Environmental & Infrastructure

Topsail Beach

- Stuart Turille, Town Manager
- Tom Best, Fire Marshal
- Bill Poe, Deputy Fire Chief

QUESTIONS?