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

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Fossil Color Patterns

Older, more altered.....
Color Patterns in Fossil Echinoderms
30 MA Fossils from North Topsail Beach
North Topsail Beach

December 18, 2014 to June 30, 2015

Offshore borrow area

3.5 miles
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”

496

213
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
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 diagenesis:**
  - 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
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
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?