Exceptional Color/Color Pattern Retention in 30 Million Year Old Oligocene, River Bend Formation Invertebrate Specimens from North Topsail Beach, NC

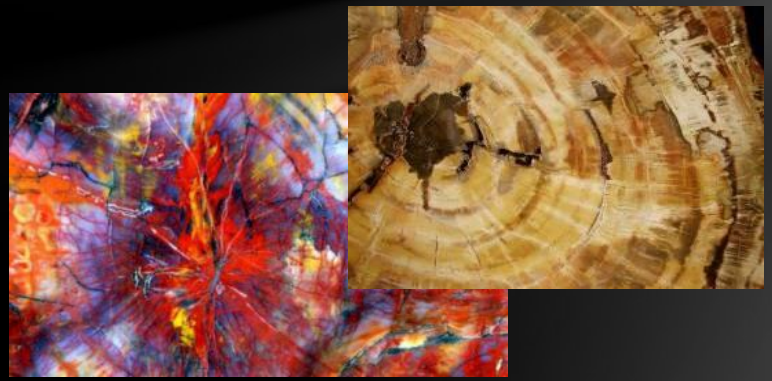
Linda McCall, NCFC; University of Texas – Austin

Fossil Color

Is preserving fossil color even possible??

Color is fragile and deteriorates quickly

Colors present typically are the result of minerals incorporated during diagenesis

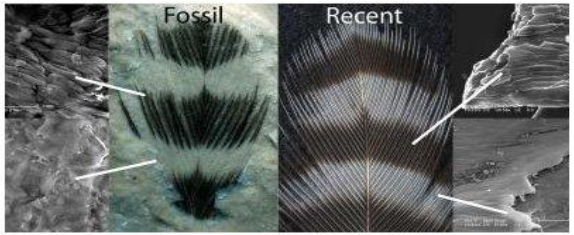


Fossil Color Patterns

Older, more altered…..

Fossil Color

Striped Fossil Feather and Recent Woodpecker Feather



Caption: Striped fossil feather and recent woodpecker feather. Under the scanning electron microscope there are melanosomes in the dark but not the light areas (left arrows) of the fossil. For comparison, melanosomes from a broken black feather and a white feather are shown (right arrows).

Credit: J.Vinther/Yale

Melanosomes

Proteins in *Ecphora*

Bleach and Black Light

North Topsail Beach

December 18, 2014
to June 30, 2015

River Bend Formation- Oligocene

River Bend Formation – 30 Ma

Hemipatagus carolinensis

Echinoderms, Oysters and more

Diagenetic Alteration….

External Mold

Internal Cast

30 Million Year Old Fossils with COLOR??

Pycnodonte paroxis (Oyster)








Balanus sp. (Acorn Barnacle)

30 MYA Barnacles

Hemipatagus carolinensis














Hemipatagus carolinensis







Hemipatagus carolinensis

Gagaria mossomi tests & spines

Brittle Stars

Crustacean Patterns

Something is going on here….
Real Color? Mineral Replacement??

Modern Acorn Barnacle

30 MYA Barnacle

Topsail Beach Barnacles

Modern Topsail Barnacle

30 MYA Topsail Barnacle

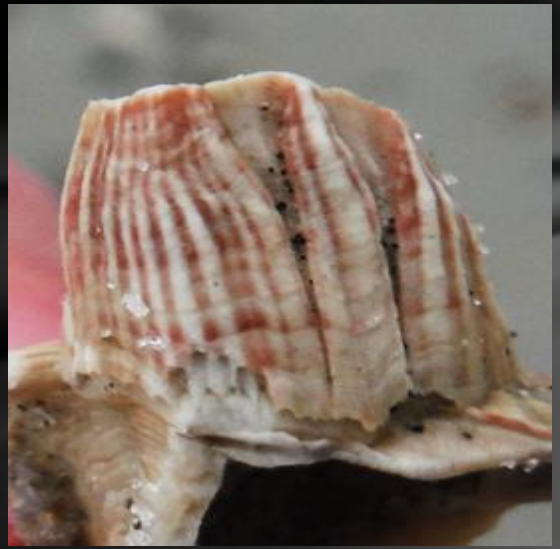
Close-ups

Modern Topsail Barnacle

30 MYA Topsail Barnacle

Topsail Beach Barnacles

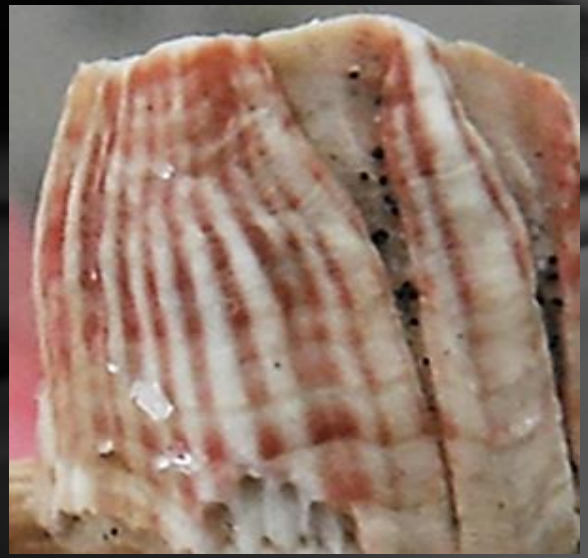
Modern Topsail Barnacle



30 MYA Topsail Barnacle

Close-ups

Modern Topsail Barnacle



30 MYA Topsail Barnacle

Topsail Beach Oysters




Modern Topsail Oysters




Extinct Topsail *Pycnodonte paroxis*

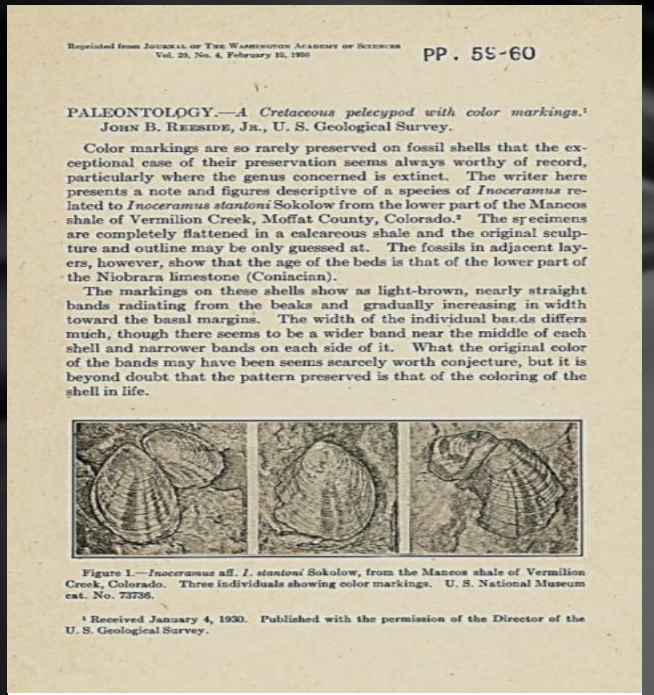
Close-ups

Other Fossil Oysters

Pycnodonte mutabilis
Ripley Formation / MS
Glauconitic sandstone
Late Cretaceous

Pycnodonte paroxis
River Bend Formation
Sandy, silty limestone
Oligocene / NC

Pycnodonte convexa
Navesink Fm. / NJ
Muddy glauconitic sands
Late Cretaceous



Reprinted from JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES
Vol. 20, No. 4, February 15, 1930

PP. 58-60

PALEONTOLOGY.—*A Cretaceous pelecypod with color markings.*[1]
JOHN B. REESIDE, JR., U. S. Geological Survey.

Color markings are so rarely preserved on fossil shells that the exceptional case of their preservation seems always worthy of record, particularly where the genus concerned is extinct. The writer here presents a note and figures descriptive of a species of *Inoceramus* related to *Inoceramus stantoni* Sokolow from the lower part of the Mancos shale of Vermilion Creek, Moffat County, Colorado.[2] The specimens are completely flattened in a calcareous shale and the original sculpture and outline may be only guessed at. The fossils in adjacent layers, however, show that the age of the beds is that of the lower part of the Niobrara limestone (Coniacian).

The markings on these shells show as light-brown, nearly straight bands radiating from the beaks and gradually increasing in width toward the basal margins. The width of the individual bands differs much, though there seems to be a wider band near the middle of each shell and narrower bands on each side of it. What the original color of the bands may have been seems scarcely worth conjecture, but it is beyond doubt that the pattern preserved is that of the coloring of the shell in life.

Figure 1.—*Inoceramus* aff. *I. stantoni* Sokolow, from the Mancos shale of Vermilion Creek, Colorado. Three individuals showing color markings. U. S. National Museum cat. No. 73736.

[1] Received January 4, 1930. Published with the permission of the Director of the U. S. Geological Survey.

Inoceramus sp.
Mancos shale / Vermilion Creek, CO
Mudrock
Late Cretaceous 1930

Maretia vs. *Hemipatagus*

Maretia

Hemipatagus

Close-ups

Black Light








Real color? Mineral Replacement? How Fragile?

More Stable than Thought

Colors Fade When Dry

Wet

Dry

Wet

Dry

Bleaching in the Sun

August 9, 2015

April 7, 2018

Real color? Mineral Replacement?

Bleaches in the sun

August 9, 2015

May 15, 2016

April 7, 2018

Real color? Mineral Replacement?

Bleaches in the sun

August 9, 2015

May 15, 2016

April 7, 2018

Common Theme - Calcite?

Calcite might to be a good medium for preserving color

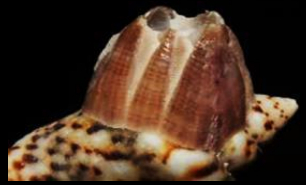
- Study of proteins in *Ecphora* concluded, "the organic material was able to be protected within the calcite"
  - Nance, et.al; 2015 European Assoc. of Geochemistry
- 340 Ma old organic molecules identified in crinoids
- All 6 Topsail species showing color/color patterns were calcitic
- Pigment remnants incorporated during diagenesis?

Ecphora
18Ma

What are the Right Conditions?

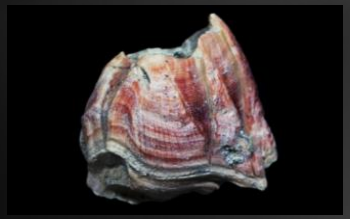
- Rapid burial
- Optimal preservational conditions
- Rapid matrix removal
- Rapid retrieval

Ecphora
18MYA



Modern Barnacle

James City Formation
2MYA



James City Formation
2MYA

River Bend Formation
30MYA

Topsail Rapid Burial

Echinoids with spines

- *Hemipatagus carolinensis* w/spines

Rapid Burial

Echinoids with spines

- *Gagaria mossomi* w/spines

Rapid Burial

90% Oysters double valved

Rapid Burial

Barnacles with opercular valves still intact

Rapid Burial

Asteroids remain intact

- Brittle stars and sea stars

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”

Rapid Retrieval

Erosional beach – each new tide uncovers new material

October 18, 2015

April 24, 2016

March 4, 2018

Summary

30 million year old color?

- Maybe – needs chemical analysis / Compelling evidence
  - Rapid burial
  - Optimal preservational conditions
  - Unorthodox rapid matrix removal
  - Rapid retrieval

Thanks…

Dedicated to: Dr. Ann Molineux late Director of Museum Operations for the Nonvertebrate Paleontology Laboratory, Jackson School of Geosciences, UT Austin

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

Dr. James Sprinkle, University of Texas, Austin

NCFC members

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Topsail Beach

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