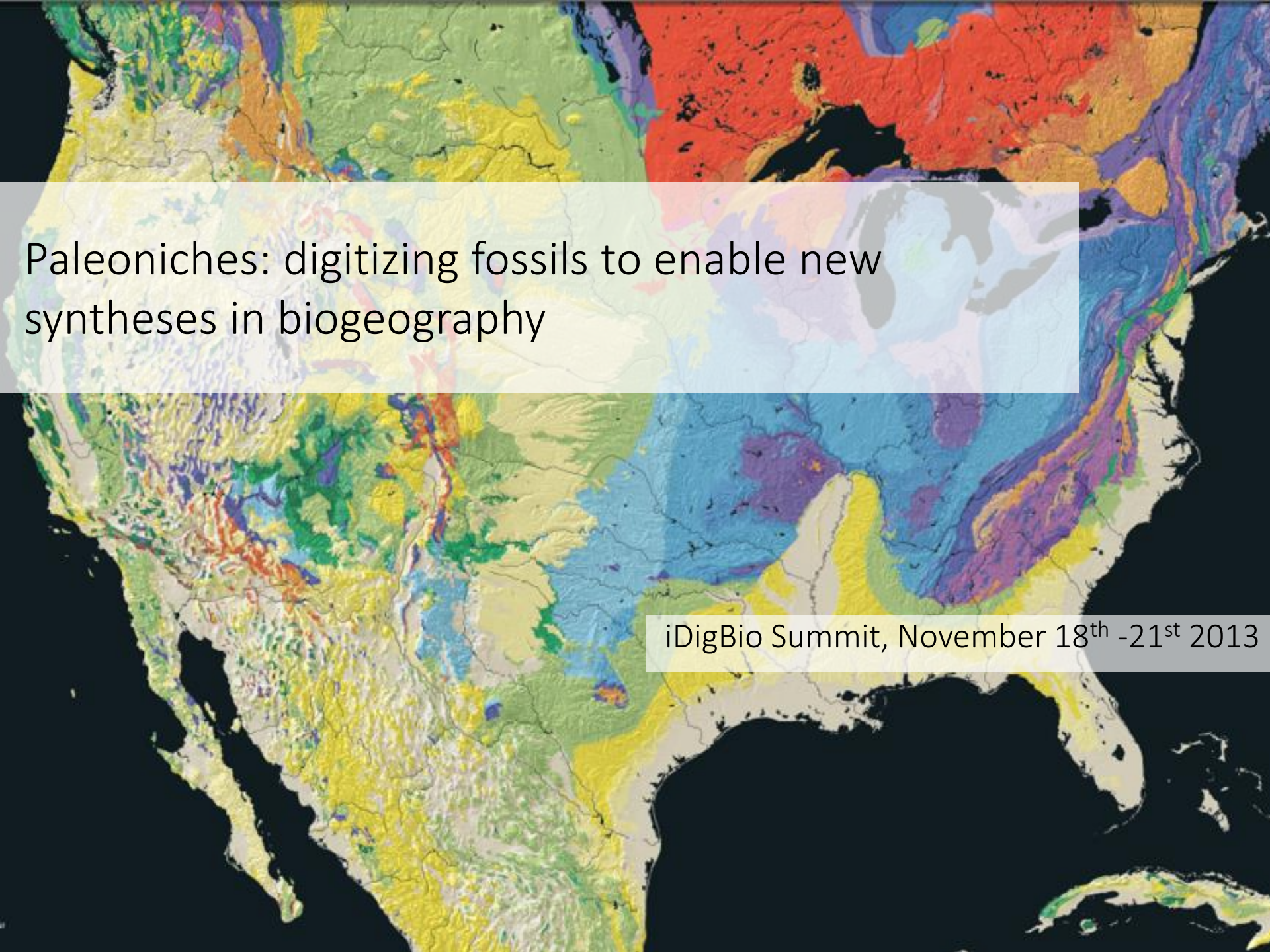


Paleoniches: digitizing fossils to enable new syntheses in biogeography

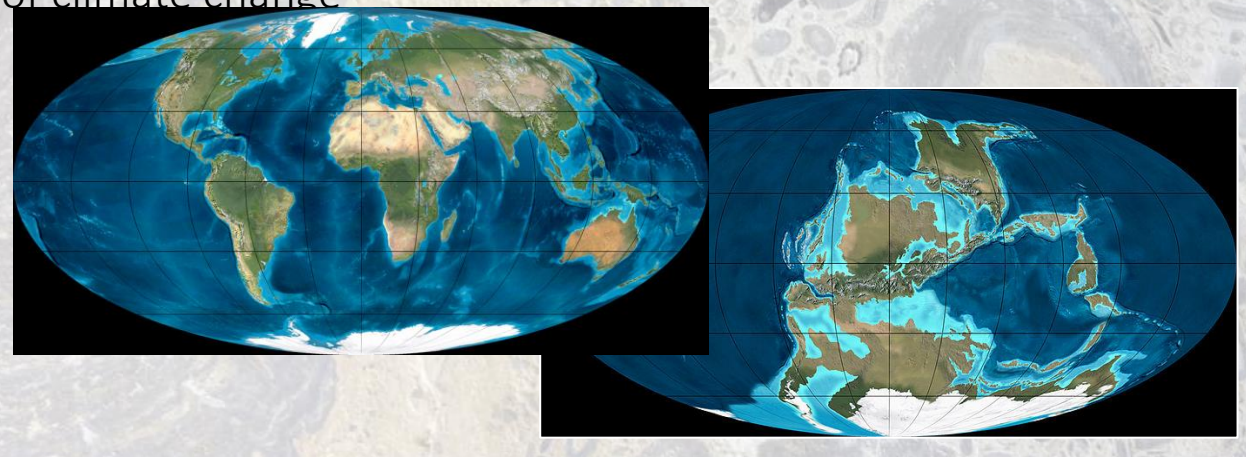
iDigBio Summit, November 18th -21st 2013

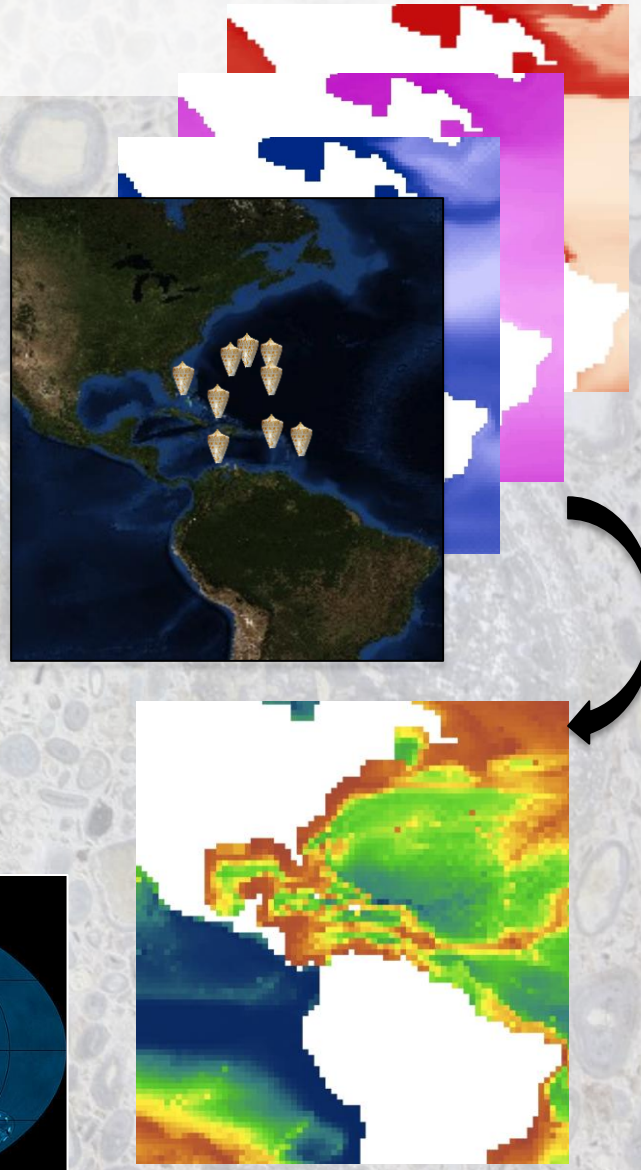
Biodiversity Science and Paleontology

How do species respond to environmental change through time?

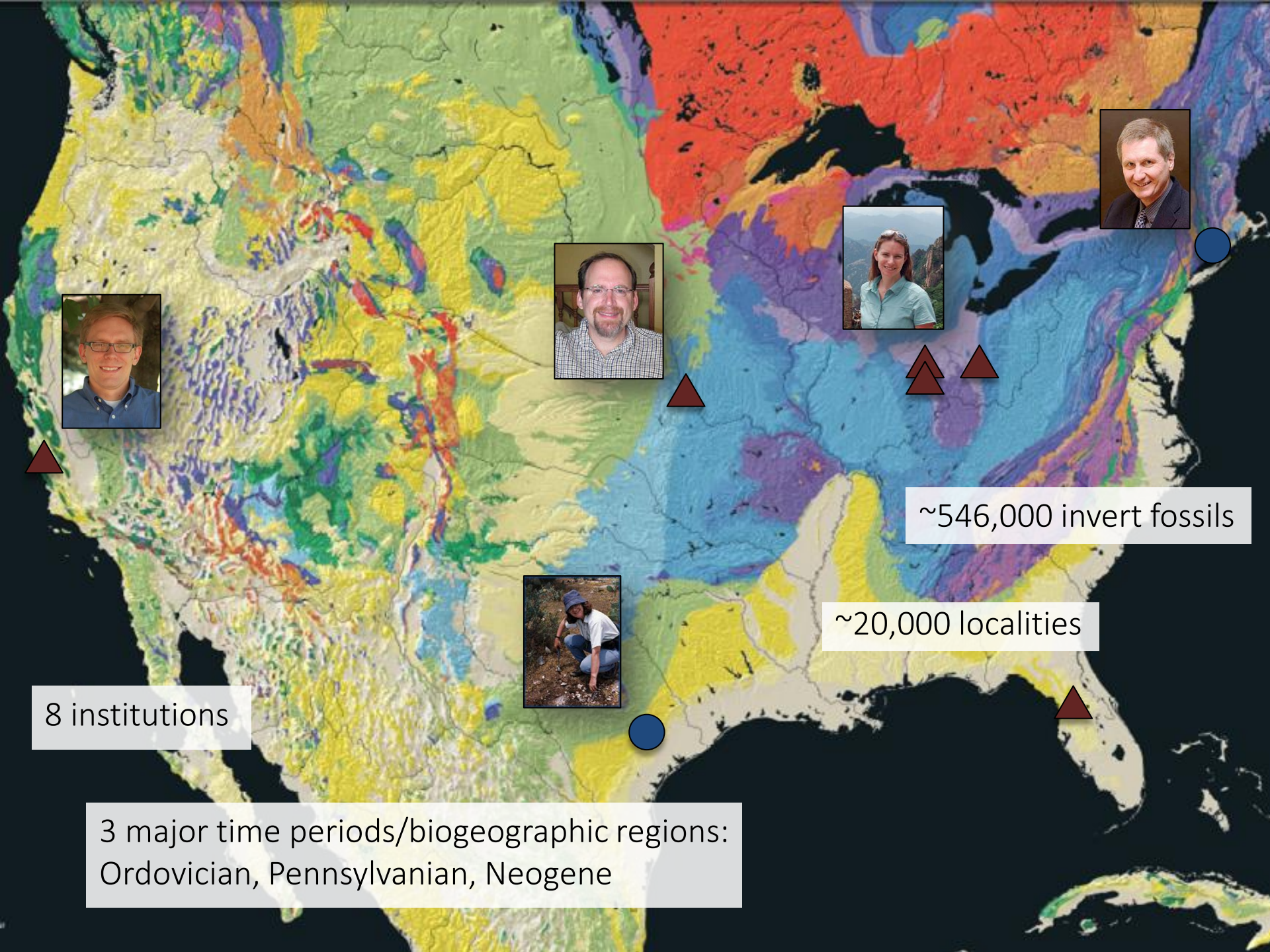
-What are the effects of abiotic versus biotic factors
-do species respond individually or as a community to changing environment?
-how do species niches evolve with changing climate?

Fossil record allows investigation of **long term** effects of climate change



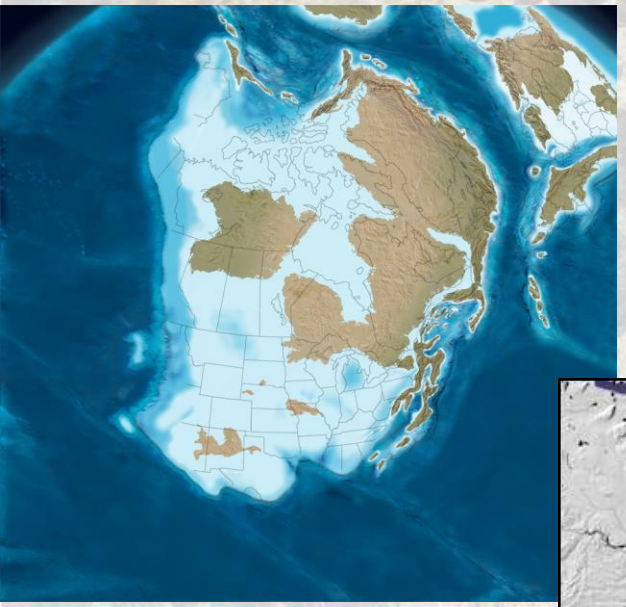


Saupe *et al.*, in review


~546,000 invert fossils
~20,000 localities
8 institutions
3 major time periods/biogeographic regions:
Ordovician, Pennsylvanian, Neogene

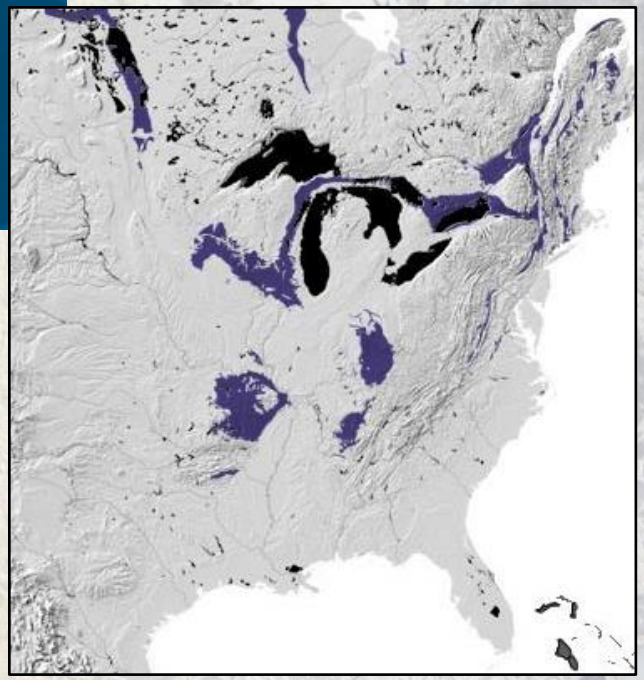
Ordovician – Cincinnati Region

485 - 443 Ma



Ordovician paleogeography

Ohio University Zoological Collections
Cincinnati Museum Center
Karl E. Limper Geology Museum (MUGM)
Yale Peabody Museum
Texas Natural Science Center



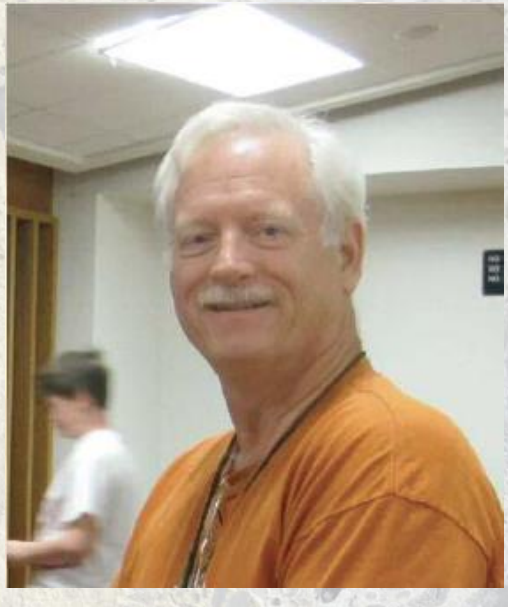
Ordovician geology

Ordovician – Cincinnati Region

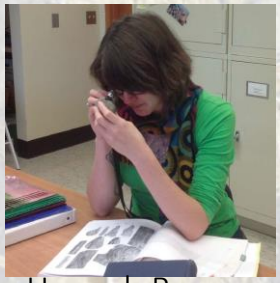
Ohio University Zoological Collection

Jack Kallmeyer Collection

2397 lots
12,271 specimens
268 species
115 unique localities



Dr. Alycia Stigall (PI)



Hannah Brame

Jen Bauer

and Neha Gupta, Rich Malizia, Diane Estes, Cody Contner

Brookville Dam Spillway in Brookville (courtesy H. Brame)

Step 1: Georeference Localities

Use written locality description to assign latitude, longitude, and uncertainty to each collecting site. iDigBio's georeferencing best practices and protocols were followed.

Step 2: Identify Specimens

Using field guides and species descriptions, each specimen was identified to the genus and species level when possible.

Step 3: Build Database Structure

Using Specify 6.4, the structure of our database was built, including taxonomic trees and geography. Also, the content of forms for each type of record was established.

Step 4: Create Digital Records

Each specimen was cataloged, creating a digital record of all geologic, geographic, and taxonomic information. Each specimen was assigned a unique catalog number.

Step 5: Label and Number

Each specimen was placed in a tray with a label and the unique catalog number was written on each.

Step 6: Organize and Store

The digitized and labeled specimens are organized by family and housed in Clippinger 217 (Dr. Stigall's Paleontology Lab).

Brame, Stigall and Bauer, GSA 2013

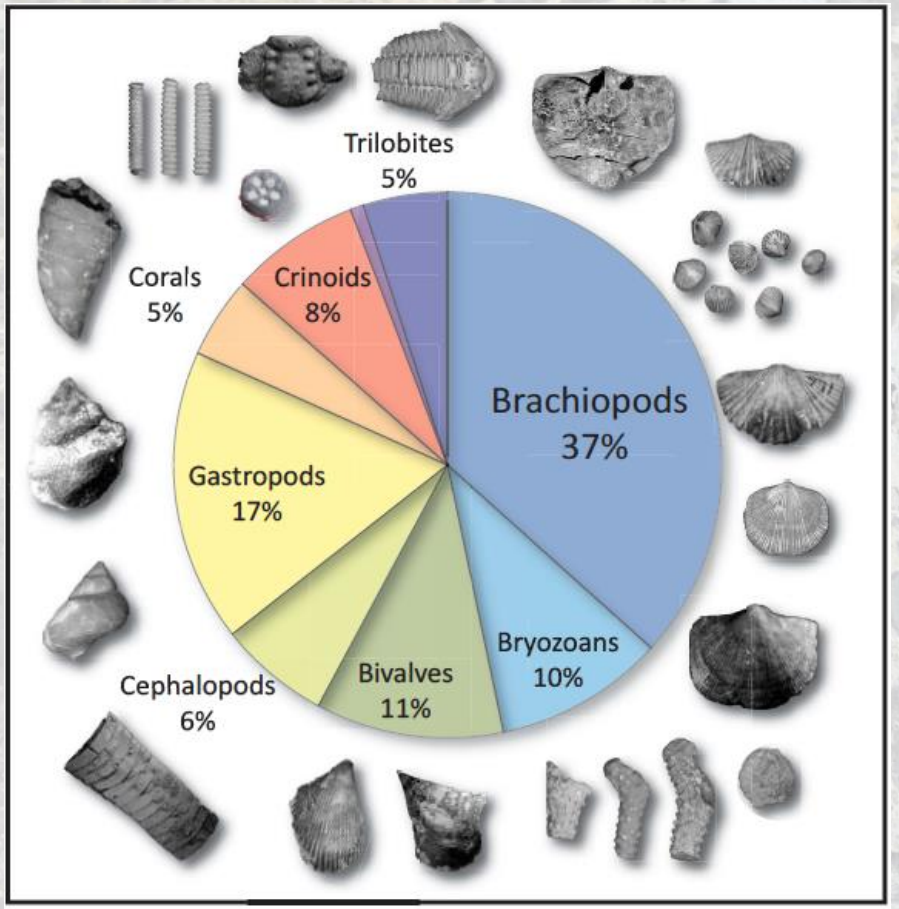
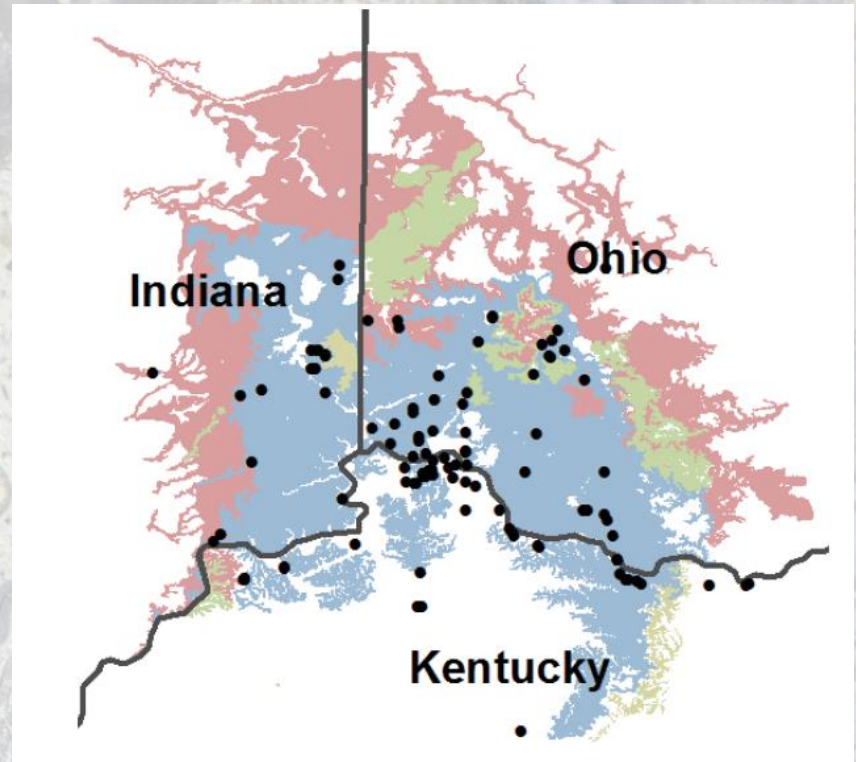
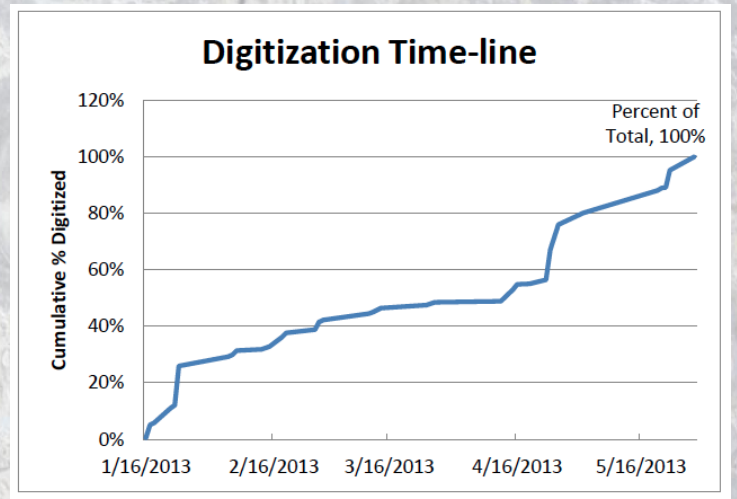


Figure 1. The diversity of the Kallmeyer Collection in % of total specimens





19 weeks to complete digitization

Brame, Stigall and Bauer, GSA 2013

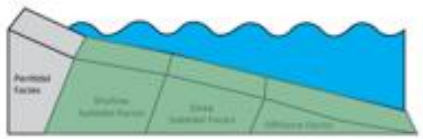
Vinlandostrophia ponderosa

Classification
Phylum: Brachiopoda
Class: Rhynchonellata
Order: Orthida
Family: Platystrophiidae
Genus: *Vinlandostrophia*
Species: *Vinlandostrophia ponderosa*
(Foerste, 1909)

Paleoecology

Extant/Extinct
Native/Invader
Stationary/Mobile
Colonial/Solitary
Filter/Deposit/Predator/Scavenger

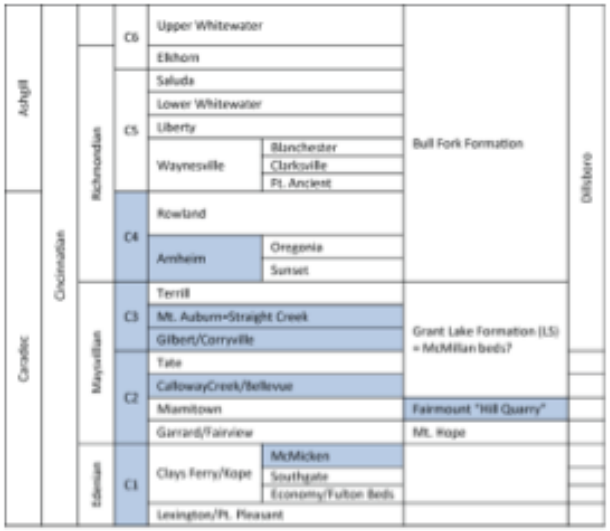
Habitat indicated in green



Taxonomic Details

This species was formerly assigned to the European brachiopod genus *Platystrophia*, but was subsequently transferred to *Vinlandostrophia* and identified as its type species by Zuykov and Harper in 2007. Most Cincinnatian paleontologists continue to refer to this species as *Platystrophia ponderosa*, at least colloquially.

Stratigraphic Occurrences



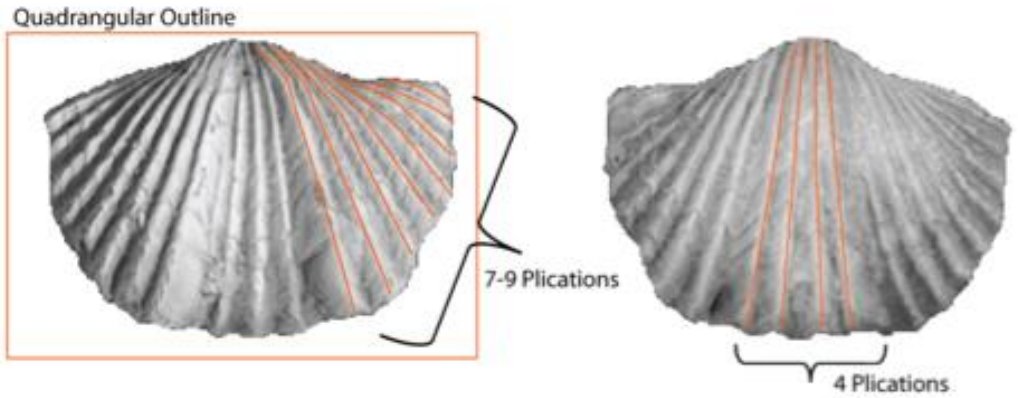
Stratigraphic Distribution

- C4 Sequence (Arnheim)
- C3 Sequence (Mount Auburn, Corryville)
- C2 Sequence (Bellevue, Fairmont)
- C1 Sequence (McMicken)

Identification in Hand Sample:

V. ponderosa is the among the most distinctive species in the Upper Ordovician in the Cincinnati area. It has a distinctly large size, quadrate (rectangular) outline, and crural cavity in the brachial valve. Its valves are distinctly thickened. The central plications number 4, with the plications numbering 7-9 on the lateral slopes.

- Large size, thick shell
- 7-9 plications on either side
- 4 plications on fold
- Quadrangular outline



Published Descriptions

Zuykov & Harper (2007)

- *Vinlandostrophia ponderosa* (Foerste, 1909) Plate II, figures 17-20; Figure 2A,B; Table 7
- *Holotype:* USNM 78814, Pl. II, figs 17, 18, complete shell, Maysvillian, Upper Ordovician, Indiana, USA.
- *Diagnosis: Vinlandostrophia* species having shells quadrate to subquadrate in outline, with maximum width in anterior third of shell; radial ornament of angular costate, three costae in sulcus, four on fold and six to eight costae on flanks of both valves; ventral sulcus and dorsal fold prominent, shallow to moderately deep; septalium V-shaped.
- *Remarks:* This species is the most abundant brachiopod taxon amongst Upper Ordovician shelly faunas in the Cincinnati area; it is also represented by numerous specimens in Upper Ordovician brachiopod collections in museums in North America and Europe. Alberstadt (1979, p. 17) stated that specimens are easily recognizable because of their distinctively large size, quadrate outline, and presence of a cruraliumlike structure in the brachial valve. He also noted that the presence of a V-shaped cross-section for the sessile septalium as illustrated in Fig. 2B and Pl. II, fig. 20 (see also discussion above) in some specimens is not obvious. This question also arises with comparison of individuals assigned to this species and illustrated in some publications (e.g. Schuchert & Cooper 1932, pl. XII, figs 25, 27). We investigated this uncertainty with reference to numerous specimens from collections in the USGS. We conclude that this is due to the different preservation modes of the studied specimens. Specimens showing a strong degree of shell dissolution of the dorsal internal surface (interiors of such valves aresharply crenulated and adductor scars are invisible) are characterized by a clearly visible V-shaped sessile septalium (Pl. II, fig. 20). Whereas in specimens (both old and young individuals) showing low amounts of shell dissolution, the features of the cardinalia are covered by additional secondary shell (Pl. II, fig. 19) and thus are less visible. However, in another species of *Vinlandostrophia*, the U-shaped form in the cross-section of the sessile septalium is clearly recognizable (Fig. 2G; Pl. III, fig. 2).

Davis (1998):

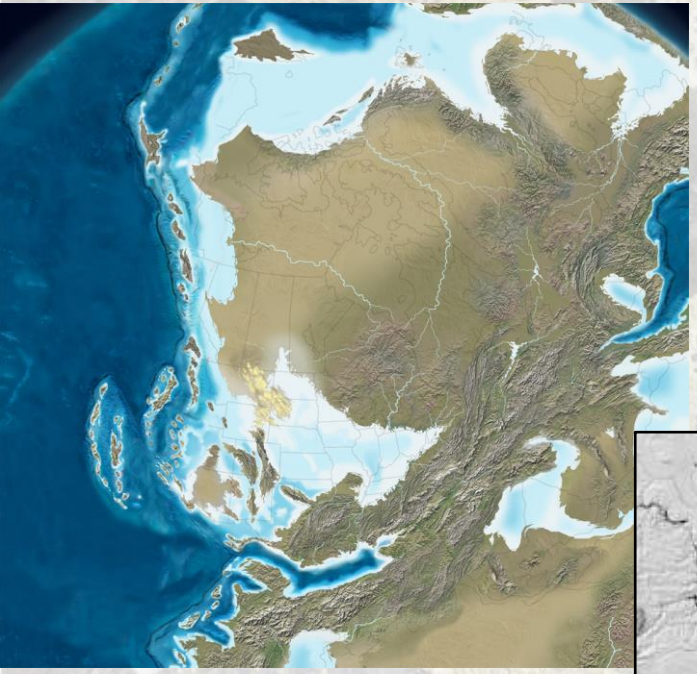
- Articulate brachiopod. This form differs from all other species of *Platystrophia* in the Cincinnatian by the size and thickness of the shell. Interior pedicle shows deep muscle impression and triangular pedicle opening.

McFarlan (1931):

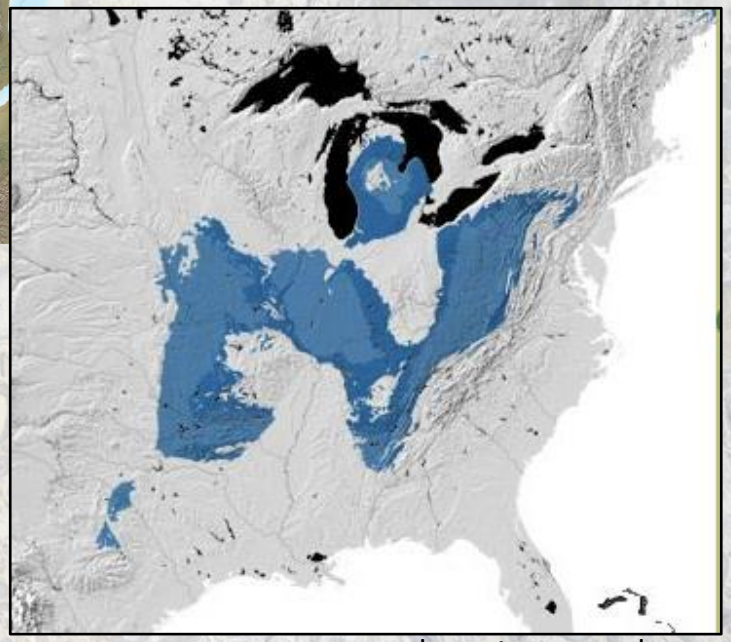
- Large size; greatly thickened valves; quadrangular outline; fold prominent, rounded, with usually 4 plications; 7-9 plications on lateral slopes.

Pennsylvanian – U.S. Midcontinent

323 - 298.9 Ma



Pennsylvanian paleogeography



Pennsylvanian geology

University of Kansas, Biodiversity Institute
Yale Peabody Museum
Texas Natural Science Center

Pennsylvanian – U.S. Midcontinent

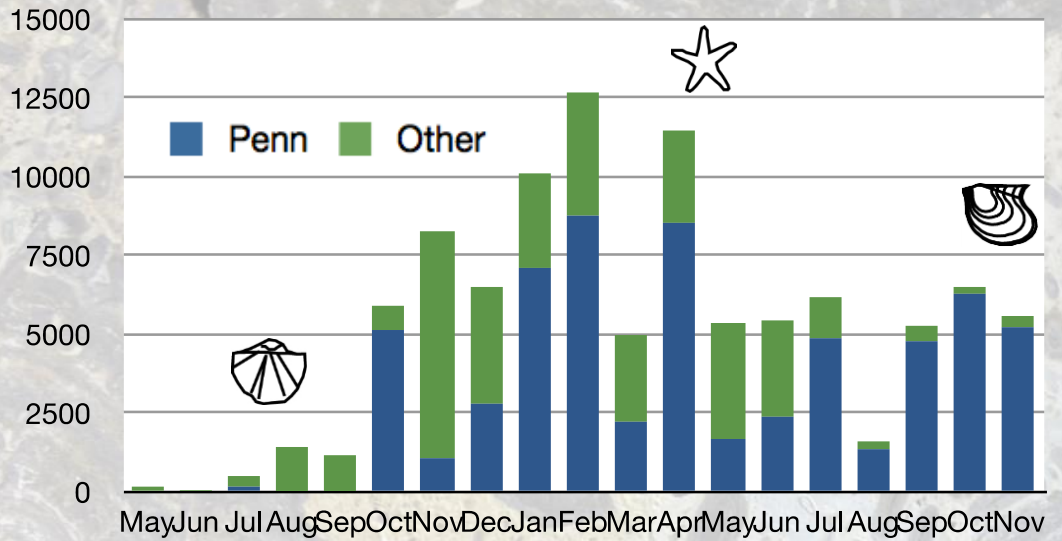
University of Kansas

Estimated 170,000 Pennsylvanian specimens, total collection ~850,000 specimens

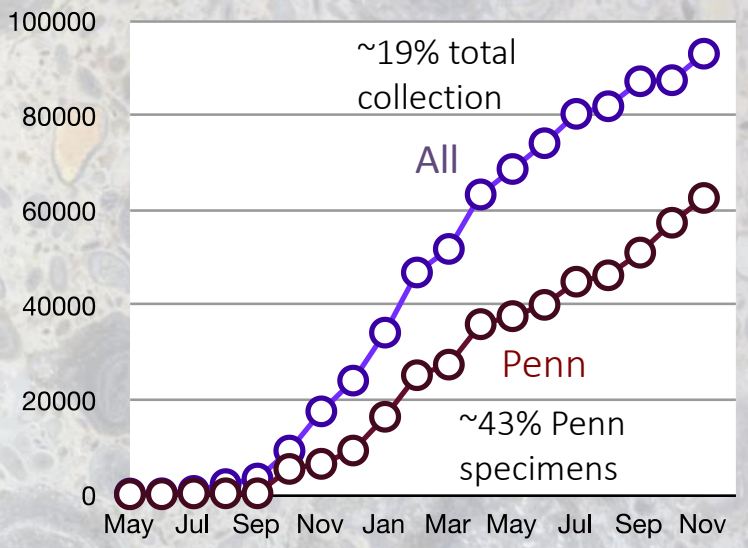
Primary collections made 1930s – 1960s

Prior to this project: ~7.5% of total collection databased

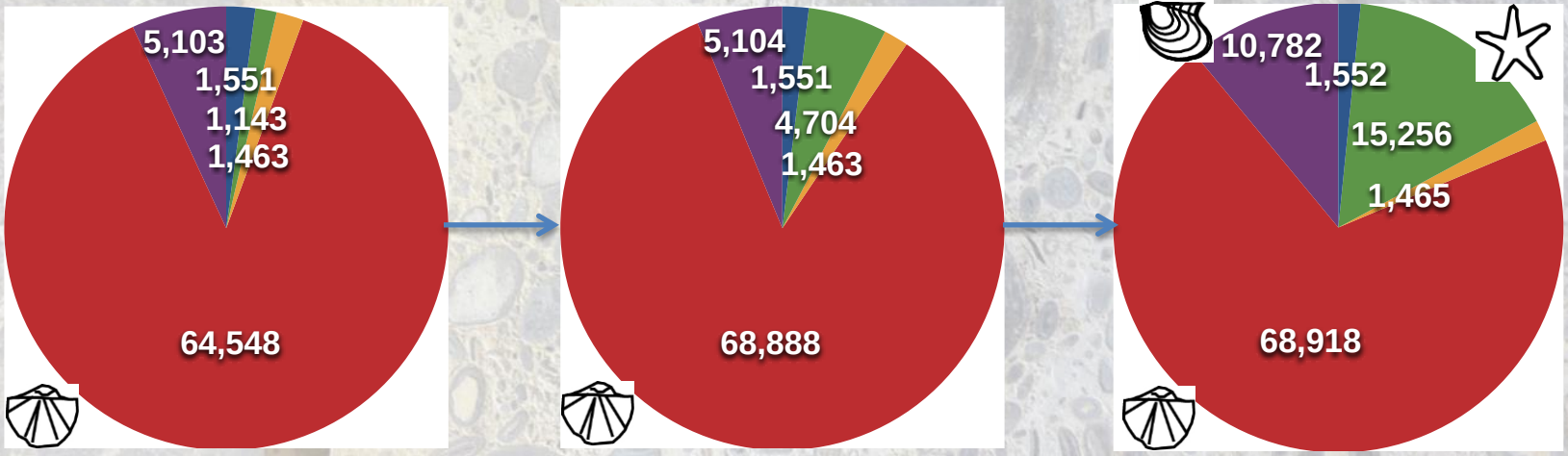
Specimens per month



Total Specimens



Taxonomic breakdown



SPNHC
June 2013

Paleodigitization Workshop
Sept 2013

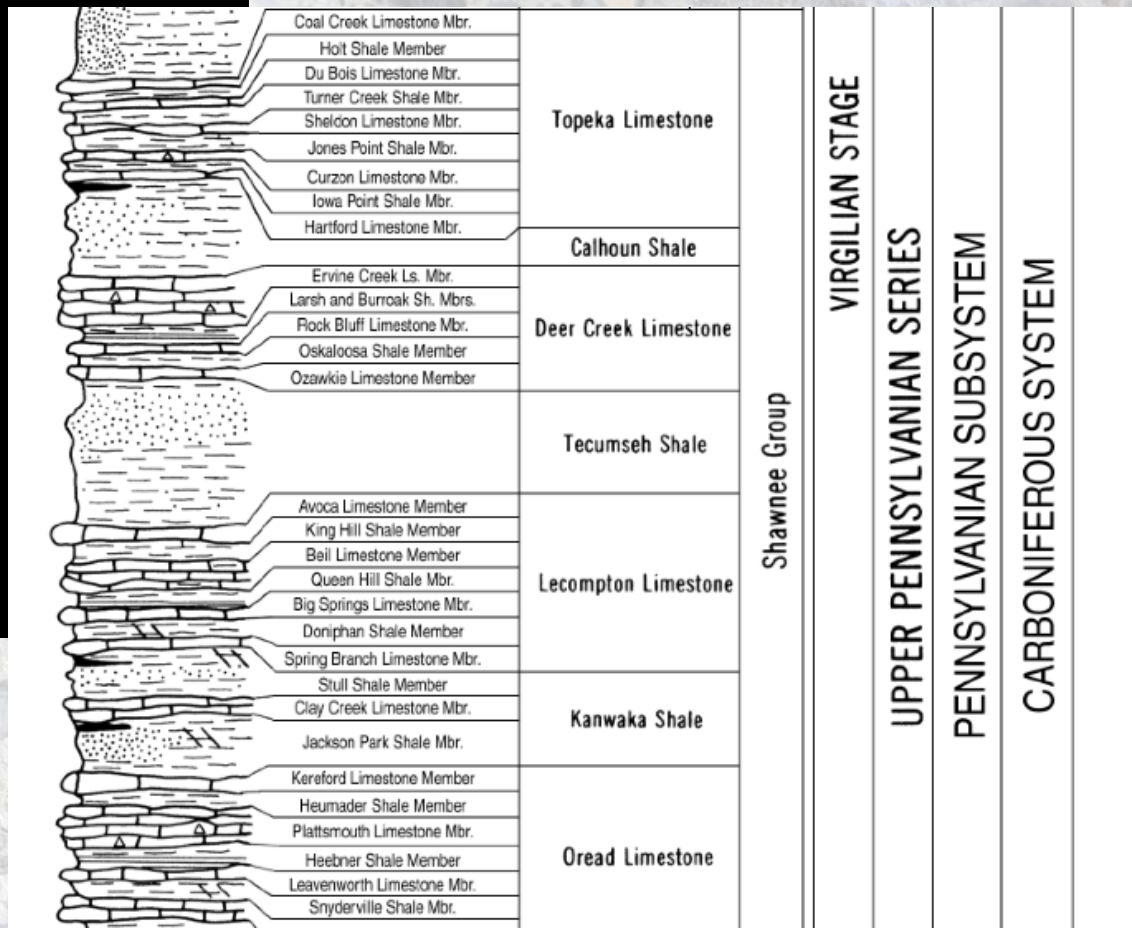
Nov 14th 2013

Arthropoda
Cnidaria
Other
Echinodermata
Brachiopoda

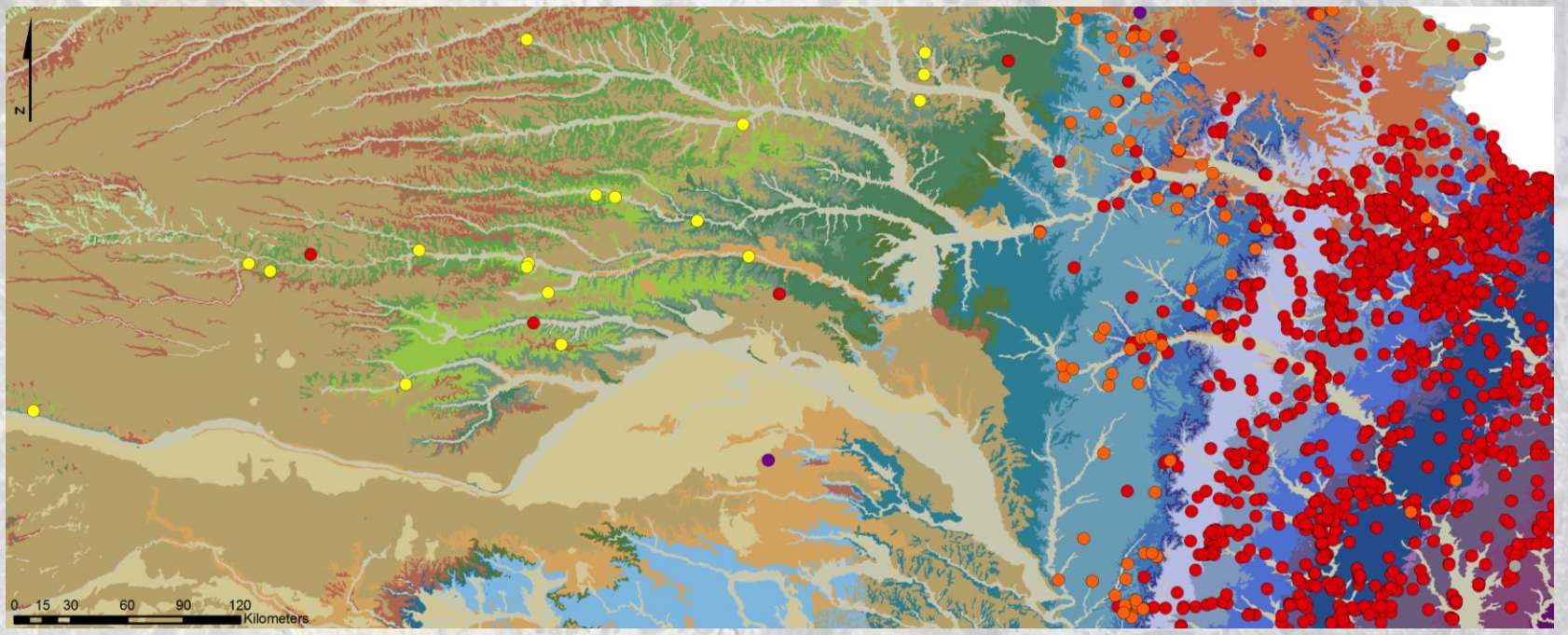
Composita sublitida

Imaging for digital atlases

Using stratigraphy to refine age



Georeferencing

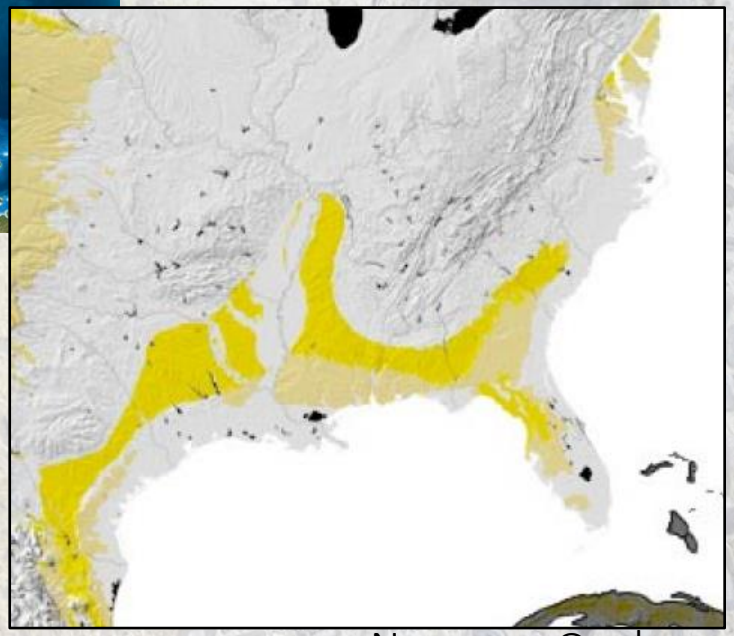


Neogene – Gulf/Atlantic Coastal Plain

23 - 2.6 Ma

Neogene paleogeography

Florida Museum of Natural History
Yale Peabody Museum
Texas Natural Science Center



Neogene Geology

Neogene – Gulf/Atlantic Coastal Plain

Florida Museum of Natural History

>3000 localities
176,615 specimens
~500 species

Jon Hendricks SJSU

Roger Portell FLMNH

The Digital Atlas of Neogene Life: Southeastern U.S.

Gastropoda

Classification

Phylum: Mollusca
Class: Gastropoda

Overview

Gastropods include the snails and slugs. Owing to their strong shells, they have an excellent fossil record that goes back to the Cambrian period. In terms of total numbers of species, gastropods are the most diverse group of mollusks. Gastropods are also diverse in terms of their lifestyles. For example, some like the conchs (*Strombus*) are herbivorous, while others like the cone shells (*Conus*) are venomous predators.

Some of the major groups (or, families) of gastropods known from the Neogene fossil record of the southeastern United States are listed below.

Gastropod Families present in the Neogene of the Southeastern United States

Bursidae

Conidae

Fasciolariidae

Muricidae

Personidae

Ranellidae

Strombidae

Tonnidae

Genera of Muricidae from the Neogene of the Southeastern USA

Acantholabia

Calotrophon

Chicoreus

Dermomurex

Ecphora

Eupleura

The Digital Atlas of Neogene Life: Southeastern U.S.

Ecphora quadricostata

Classification

Phylum: Mollusca
Class: Gastropoda
Family: Muricidae
Genus: *Ecphora*
Species: *Ecphora quadricostata* (Say. 1824)

Geological Range

Early Miocene to Early Pleistocene; Extinct

Stratigraphic Occurrences

Early Pleistocene:

- Chowan River Fm. (VA)

Late Pliocene:

- Duplin Fm. (SC, NC)
- Duplin / Raysor formations (GA)
- Jackson Bluff Fm. (N. FL)
- Raysor Fm. (SC)
- Tamiami Fm. (S. FL)
- Tamiami Fm. (Bayshore Clay Member) (S. FL)
- Tamiami Fm. (Buckingham Limestone) (S. FL)
- Tamiami Fm. (Murdock Station Member) (S. FL)
- Yorktown Fm. (NC, VA)
- Yorktown Fm. (Mogarts Beach Clay) (VA)

Early Pliocene:

- Goose Creek Limestone (SC)

Miocene:

- St. Mary's Fm. (MD, VA)

Middle Miocene:

- Pungo River Fm. (NC)

Early Miocene:

- Calvert Fm. (Plum Point Member) (MD)

Paleogeographic Distribution

Southern Florida to Maryland.

Early Pleistocene Map

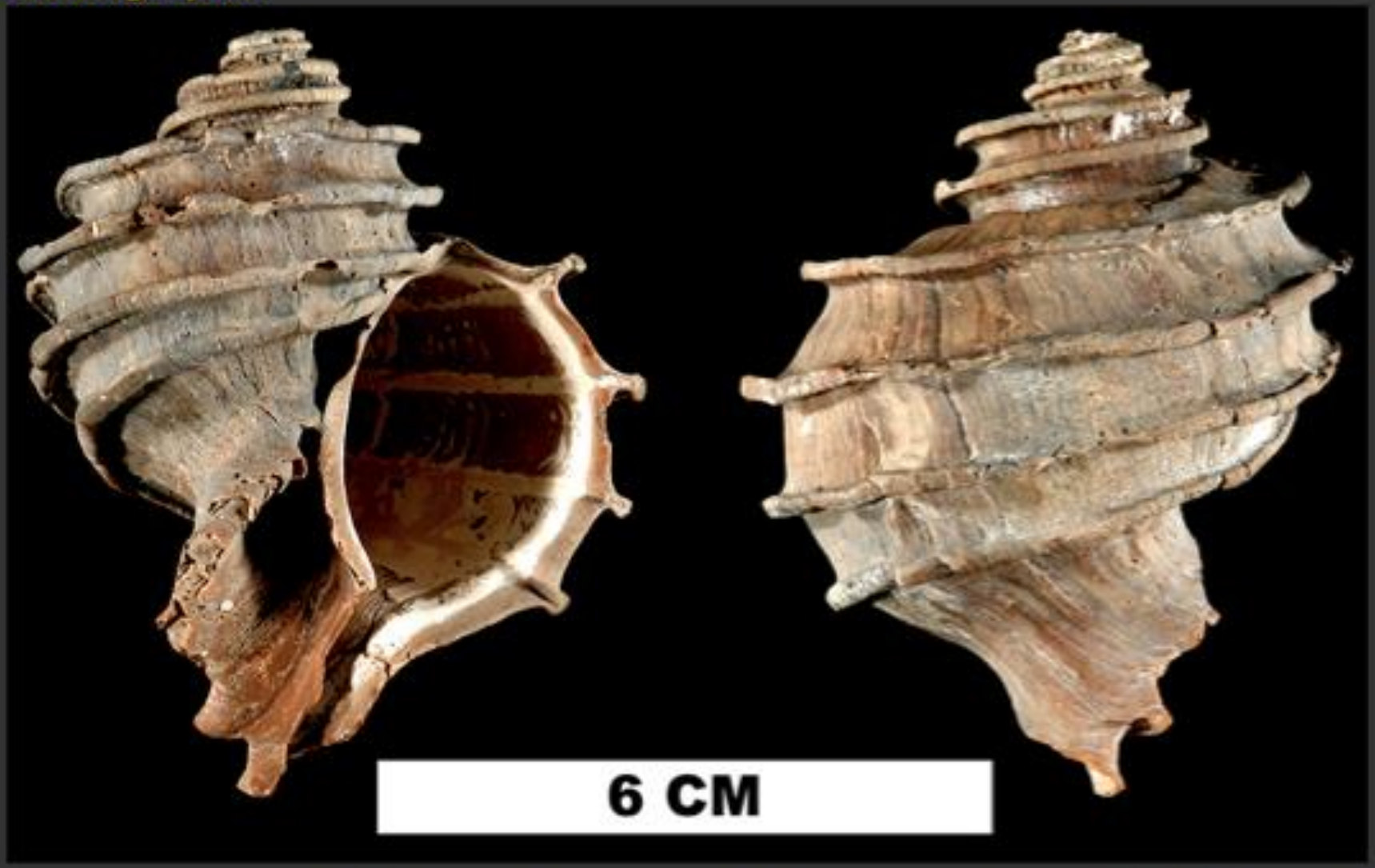
Late Pliocene Map

Early Pliocene Map

Middle Miocene Map

Early Miocene Map

Photographs



Ecphora quadricostata from the Late Pliocene Tamiami Fm. of Sarasota County, Florida (UF 137299).

Summary

Aim: Database and georeference and photograph paleontological collections from three major time periods

Provide detailed taxonomic, stratigraphic (age, environment) and geographic data

- Through iDigBio, GBIF and databases (Specify/KeEmu) - to enable paleobiogeographic, paleoecologic, and macroevolutionary analyses

- As digital atlases - resource for students, teachers, the public

Acknowledgements

PIs: Bruce Lieberman (KU), Jon Hendricks (SJSU), Alycia Stigall (OU), Ann Molineux (UT), Derek Briggs (YPM)

Jim Beach (KU), Michelle Casey (KU), Kendall Hauer (MUGM), Roger Portell (FLMNH), Brenda Hunda (CMC), Susan Butts (YPM), Liath Appleton (UT)

Hannah Braeme (OU), Jen Bauer (OU), Neha Gupta (OU), Rich Malizia (OU), Diane Estes (OU), Cody Contner (OU), Erin Saupe (KU), Curtis Congreve (KU), Sally Chang (KU), Melissa Brooks (KU), Melissa Sadir (KU), Elaheh Momtahan (KU), Wes Gapp (KU), Nina Abdollahian (SJSU), Anthony Lenci (SJSU)……and many others.

iDigBio Georef Working Group, iDigBio Paleodigitization group

Theresa Miller, Andy Bentley and Specify 6 staff