

## Protein and chitin preservation in polymeric sheets in Miocene *Ecphora* gardnerae shells from Maryland, USA

Timothy P. Cleland, G. Asher Newsome, Erin R. Birdsall, Thomas Lam, John R. Nance, and Robert M. Hazen

Acta Palaeontologica Polonica 70 (3), 2025: 507-516 doi:10.4202/app.01201.2024

The shells of muricoid gastropod *Ecphora gardnerae* from the Miocene St. Marys Formation of Maryland, USA, have been shown to contain polymeric sheets within the calcareous matrix. These membranes were found to have amino acids and complex sugar compounds. To explore these biomolecular features further, four new *E. gardnerae* shells were collected and analyzed for proteins and sugar compounds. Using direct analysis in real time (DART) mass spectrometry, we were able to show that the membranes contain chitin. With mass spectrometry-based paleoproteomic techniques utilizing a hydroxylamine extraction or sample preparation by easy extraction and digestion (SPEED), we found preserved peptides from all four shells including peptides that are specific to Gastropoda or Mollusca. The membranes derive from the calcitic layer of the shell and are likely analogous to chitin membranes used by other extant mollusks to control nucleation, growth, and physical properties in the calcareous layers, but future research in gastropod biology will help to address the function of these membranes.

Key words: Gastropoda, Muricidae, Ecphora, paleoproteomics, DART-MS, chitin, Miocene, USA.

Timothy P. Cleland [clelandtp@si.edu; ORCID: https://orcid.org/0000-0001-9198-2828], G.

Asher Newsome [newsomeg@ si.edu; ORCID: https://orcid.org/0000-0003-1683-2197], and

Thomas F. Lam [lamt@si.edu; ORCID: https://orcid.org/0000-0002-0908-0938],

Museum Conservation Institute, Smithsonian Institution, Suitland, MD 20746 USA.

Erin R. Birdsall [birdsalle@si.edu; ORCID: https://orcid.org/0000-0002-1972-7475

], Museum Conservation Institute, Smithsonian Institution, Suitland,

MD 20746 USA. Smithsonian National Museum of the American

Indian, Suitland, MD 20746, USA. John R. Nance [John.Nance@calvertcountymd.gov]

; ORCID: https://orcid.org/0000-0003-1246-1237], Department of

Paleontology, Calvert Marine Museum, PO Box 97, Solomons, MD, 20688,

USA. Robert M. Hazen [rhazen@carnegiescience.edu; ORCID: https://orcid.org/0000-0003-4163-8644],

Earth and Planets Laboratory, Carnegie Science, Washington, DC 20015 USA.

This is an open-access article distributed under the terms of the Creative Commons Attribution License (for details please see <u>creativecommons.org</u>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Full text (493.3 kB) |
Supplementary file (5,358.0 kB)