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BORING THROUGH MUSEUM COLLECTIONS: DOCUMENTING PALEOGENE *OICHNUS* PREDATION TRACES

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Introduction: A wide spectrum of damage on mollusk shells includes mechanical (abrasion, dissolution, impact, etc.) and biogenic (peeling, cracking, puncturing, etc.) mechanisms, with wide-ranging implications to paleo-ichnology and paleoecology [1]. Round openings (drillholes/boreholes) produced by some predatory gastropods (Fig. 1A) occur on a variety of prey, such as brachiopods, echinoderms, and mollusks (Fig. 1B). Named an *Oichnus* Bromley, 1981 ichnogenus [2], these traces have been described in the geologic record from early Paleozoic to recent [3–20]. Different metrics of trace size and morphology have been used [9,13,14], although some challenges remain due to time-consuming measurements or the lack of original samples [20].

The aim of this paper is to describe an effective approach to documenting predation traces on Paleogene shell specimens (mainly Eocene of the U.S. Gulf Coast sites), which are housed in the Invertebrate Paleontology Collection at The Academy of Natural Sciences of Drexel University, Philadelphia, USA. The photogrammetric data are then used for a rapid and effective image-intensity analysis of a selected micrograph.

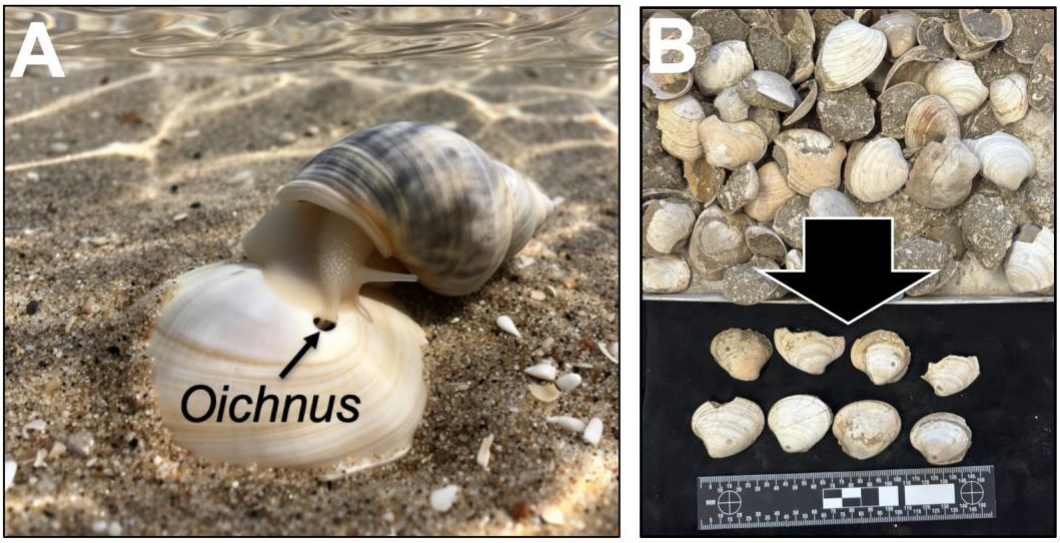

Figure 1. *Oichnus* isp.: A) borehole produced by a predatory gastropod on a bivalve (image: Craiyon); B) Eocene bivalve shells with *Oichnus* extracted from a larger sample.

Methodology: The museum collection provided an opportunity to subsample specimens with *Oichnus isp.* traces (Fig. 1). Individual shells were photographed by an iPhone-15 (maximum zoom setting), with a mm-scale in the background. A microphotograph was made using an inexpensive LED-lit micro-lens attachment with a 200X magnification (Fig. 2A). The microphoto was sufficient to identify key components (Fig. 2B) and an ImageJ software was used to produce a color-scale ("heat map") rendition (dark/light = blue/red; Fig. 2C) and a grayscale intensity profile (black = 0; white = 255; Fig. 2D)[20].

Results and Summary: More than 40 specimens of *Oichnus* isp. (*O. simplex*; *O. paraboloides*, and *O. ovalis*) were identified on various Eocene shells from the U.S. Gulf Coast (Figs. 1B, 2B). An example below shows a beveled opening of *O. paraboloides* on a cardiid shell (Fig. 2B), which is not filled with sediment. The black background allows an easy definition of the grayscale pattern, which is also reflected in profile (Fig. 2D).

In addition, the original image (Fig. 2B) and the color version (Fig. 2C) clearly show the exterior valve sculpturing, with radial ribs (light = red) and interspaces (dark = blue) expressed in profile (Fig. 2D). The relative amplitude of grayscale values can be potentially used to evaluate the degree of abrasion of sculptural elements [20].

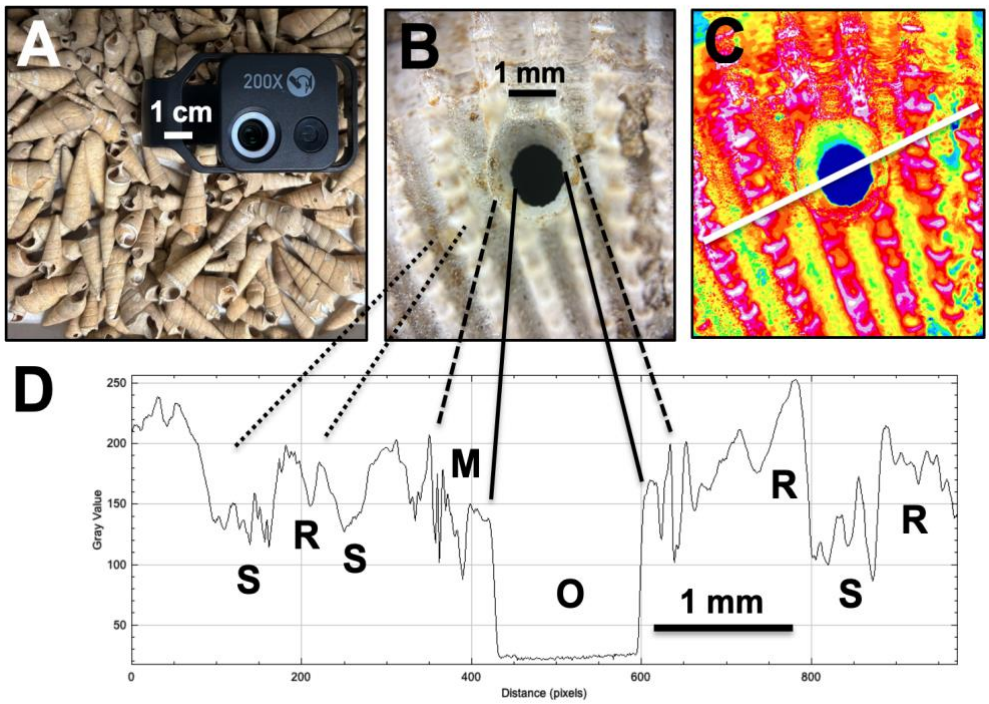

Figure 2. Mollusk samples: A) 200X microscope smartphone attachment with LED light; B) *Oichnus paraboloides* micrograph in a cardiid shell; C) red/blue image with white line representing grayscale profile; D) Grayscale profile showing the exterior shell sculpture – light radial ribs (R) and dark interspaces or swales (S), as well as the beveled margin (M) and opening of *O. paraboloides* (O).

This study demonstrates a rapid, effective, and low-cost approach for documenting and measuring a variety of morphological aspects and bioerosion traces on shell surfaces in museum collections. It can be applied in field conditions, including *in situ* characterization of fragile specimens, as well as to the analysis of archival images (e.g., black and white photographs) of fossil specimens.

REFERENCES

1. Zuschin, M., Stachowitsch, M., and Stanton, R.J.Jr., 2003. Patterns and processes of shell fragmentation in modern and ancient marine environments. Earth-Science Reviews, 63(1–2), 33–82.

2. Bromley, R.G., 1981. Concepts in ichnotaxonomy illustrated by small round holes in shells. Acta Geologica Hispanica, 16(1–2), 55–64.

3. Carriker, M.R. and Yochelson, E.L. 1968. Recent gastropod boreholes and Ordovician cylindrical

borings. Geological Survey Professional Paper 593-B, 1–26.

4. Bromley, R.G., 1993. Predation habits of octopus past and present and a new ichnospecies, *Oichnus ovalis*. Bulletin of the Geological Society of Denmark, 40, 167–173.

5. Kowalewski, M., 1993. Morphometric analysis of predatory drill holes. Palaeogeography, Palaeoclimatology, Palaeoecology, 102(1–2), 69–88.

6. Nielsen, K. S. S. and Nielsen, J. K., 2001. Bioerosion in Pliocene to late Holocene tests of benthic and planktonic foraminiferans, with a revision of the ichnogenera *Oichnus* and *Tremichnus.* Ichnos, 8(2), 99–116.

7. Blissett, D. J. and Pickerill, R. K., 2003. *Oichnus excavatus* Donovan and Jagt, 2002 from the Moneague Formation, White Limestone Group, Jamaica. Caribbean Journal of Science, 39, 221–223.

8. Donovan, S.K. and Jagt, J.W.M., 2005. An additional record of *Oichnus excavatus* Donovan and Jagt from the Maastrichtian (Upper Cretaceous of southern Limburg, The Netherlands). Scripta Geologica, 129, 147–150.

9. Dietl, G.P and Kelley, P.H., 2006. Can naticid gastropod predators be identified by the holes they drill? Ichnos, 13(3), 103–108.

10. Klompmaker, A.A., 2009. Taphonomic bias on drillhole predation intensities and paleoecology of Pliocene mollusks from Langenboom (Mill), The Netherlands. PALAIOS, 24(11), 772–779.

11. Sawyer, J.A. and Zuschin, M., 2010. Intensities of drilling predation of molluscan assemblages along a transect through the northern Gulf of Trieste (Adriatic Sea). Palaeogeography, Palaeoclimatology, Palaeoecology, 285(3–4), 152–173.

12. Ruggiero, E. and Raia, P., 2014. *Oichnus taddeii*, a new fossil trace produced by capulids on brachiopod shells. Spanish Journal of Palaeontology, 29(1), 15–24.

13. Zonneveld, J.-P. and Gingras, M. K., 2014. *Sedilichnus, Oichnus, Fossichnus* and *Tremichnus*: "small round holes in shells' revisited. Journal of Paleontology, 88(5), 895–905.

14. Wisshak, M., Kroh, A., Bertling, M., Knaust, D., Nielsen, J. K., Jagt, J. W. M., Neumann, C. and Nielsen, K.S.S., 2015. In defence of an iconic ichnogenus – *Oichnus* Bromley, 1981. Annales Societatis Geologorum Poloniae, 85(3), 445–451.

15. Leyton-Nolan, G.P. and Buynevich, I.V., 2015. Morphometry of *Oichnus* traces on moon snail shells along a tide-dominated shoreline, Nahant Beach, Massachusetts. GSA Abstracts with Programs, Baltimore, MD, v. 47, p. 341.

16. Leyton-Nolan, G.P. and Buynevich, I.V., 2015. Unsuccessful predation (cannibalism) dominates *Oichnus* traces on extant naticids along the U.S. Northeast coast. GSA Northeastern Section Abstracts with Programs, Bretton Woods, NH, v. 47, p. 138.

17. Bayer, S., Muñoz, D.F., and Aitken., A., 2023. *Oichnus* Bromley

as evidence of predator presence in the Canadian High Arctic. Lethaia, 56(2), 1–10.

18. Karapunar, B., Werner, W., Simonsen, S., Bade, M., Lücke, M., Rebbe, T., Schubert, S., and Rojas, A., 2023. Drilling predation on Early Jurassic bivalves and behavioral patterns of the presumed gastropod predator - evidence from Pliensbachian soft-bottom deposits of northern Germany. Paleobiology, 49(4), 642–664.

19. Klompmaker, A.A. and Dietl, G.P., 2024. Reverse drill holes: remarkable mistakes made by gastropod predators attacking Neogene bivalve prey. Journal of Paleontology, 98(5), 788–794.

20. Buynevich, I.V. and Dernov, V.S., 2026. *Oichnus* predation trace metrics: applications of rapid grayscale analysis. Modern Science: Trends, Challenges, Solutions, Proceedings of the 11th International Scientific and Practical Conference. Cognum Publishing House, Liverpool, UK, 362-368.