

Preserving the Past: Evaluating Conservation and Accuracy in Paleontological Microwear Analysis

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FRAMING

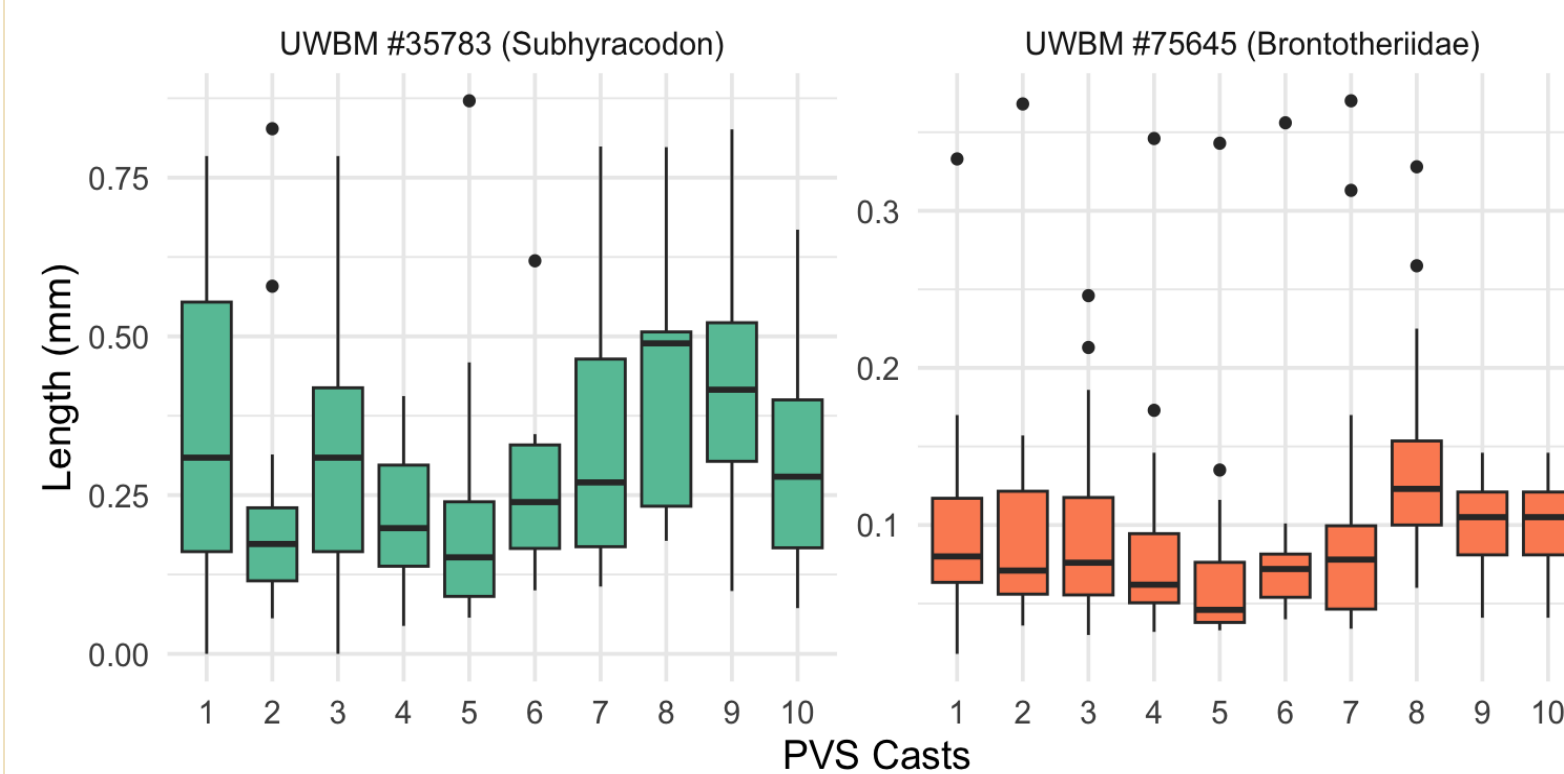
Accurately replicating microscopic wear patterns (pits and scratches) on fossil teeth is essential for dietary and behavioral studies in paleontology. Museums use molding and casting to reduce handling and produce research-quality duplicates, but the fidelity of these replicas, especially after repeated molding, has not been systematically evaluated. This project examines how repeated replication affects microwear preservation, addressing concerns around data accuracy and specimen care.

PROCESS

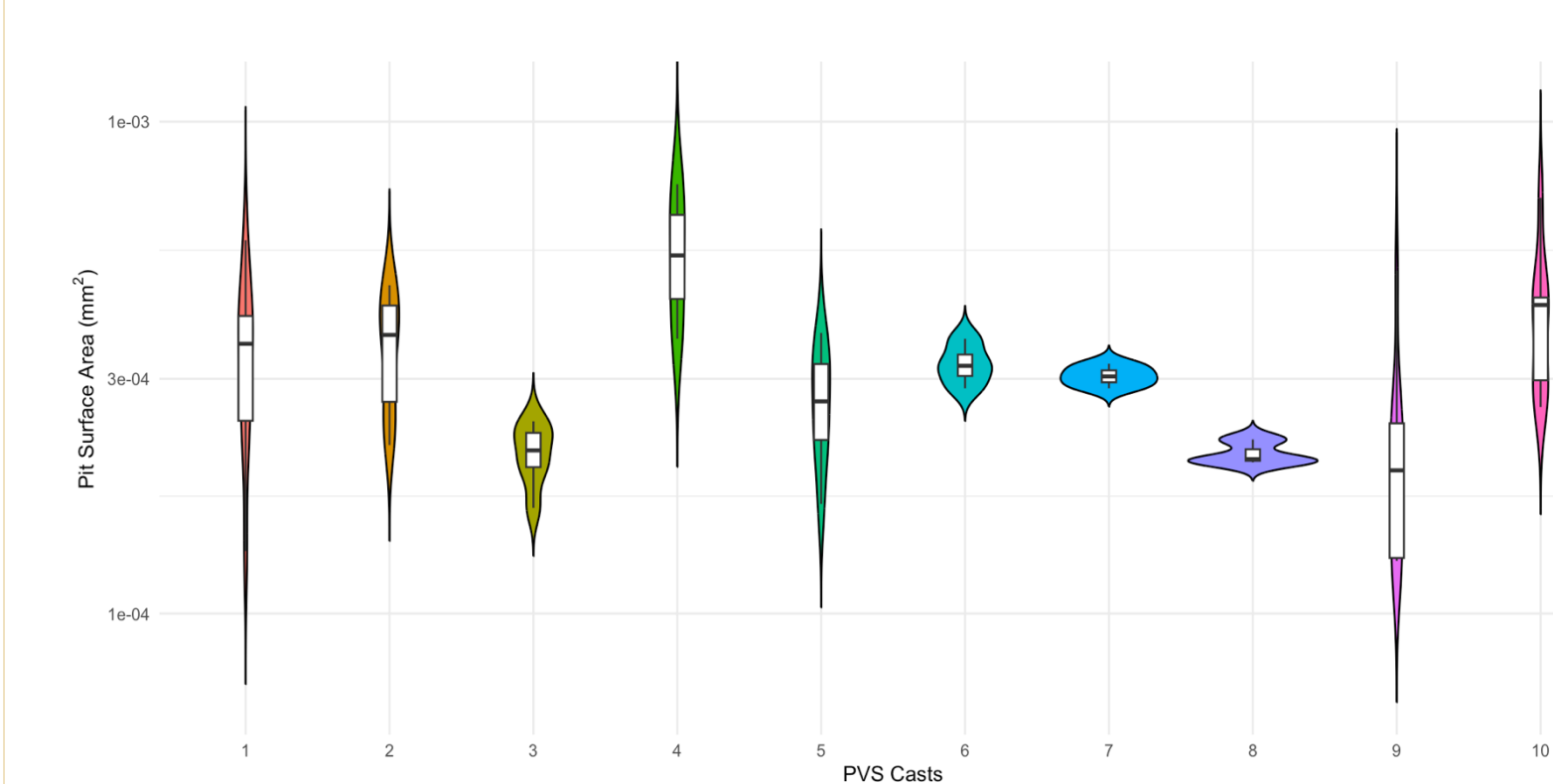
- Selecting fossil teeth from Eocene–Oligocene perissodactyls in the Burke Museum of Natural History
- Creating multiple generations of molds and casts
- Assessed microwear patterns using low-magnification methods (Semprebon et al. 2004)
- Documenting any visible wear or damage over successive casting

RESULTS

Distribution of Microwear Features (Scratches)



Distribution of Microwear Features (Pits)



No pits were observed on casts of the Brontotheriidae.

Significant differences in scratch measurements were found across Brontotheriid casts, especially between Generations 2 and 8). Non-parametric tests showed distributional differences between Generation 1 and several later generations, indicating non-linear variation over casting cycles.

In contrast, Subhyracodon casts showed no significant differences in scratches or pits.

These results suggest molding and can alter microwear features after multiple replications, potentially affecting dietary interpretations. Surface fidelity remains stable for several casts before changes emerge.

PRODUCTS

A how-to guide for molding and casting for microwear analysis and a research paper summarizing findings and data were produced.

Molding and Casting Guide for Microwear Analysis	
Burke Museum of Natural History and Culture	
June 2025	
1.1 CHOOSING A SPECIMEN	<ul style="list-style-type: none"> • Before beginning the molding process, carefully examine the fossil specimen to ensure it's stable enough to withstand silicone application. Identify any fragile areas that may require reinforcement to prevent damage during molding. • Inspect the specimen for existing adhesives or consolidants, especially on tooth surfaces intended for microwear analysis. Any residues in these areas can impact your data quality. Specimens previously treated with shellac or other older consolidants (such as glyptal or concentrated PVA) should be avoided if possible, as these substances are difficult to remove without damaging the fossil, and their glossy finish can obscure critical surface details. If you are molding a specimen that belongs to another institution, make sure that you have written permission to mold the specimen.
1.2 GAP FILLING	<ul style="list-style-type: none"> • Once you have found the appropriate specimen, avoid silicone seeping into the cracks and holes and hardening, as this may cause damage to the fossil. You want to fill these with materials like Carbowax (polyethylene glycol S350), which proves useful in temporary filling as well. All options are soluble in water and provide a temporary stabilization method.
1.3 CLEANING	<ul style="list-style-type: none"> • When cleaning specimens prior to molding, it is important to avoid aggressive solvents such as shellac cleaner, which can cause damage or modification to delicate microwear features. Standard protocols emphasize gentle, non-invasive cleaning methods to preserve microwear integrity (Solounias & Semprebon, 2002). If cleaning is necessary, use USP lab-grade cotton swabs, as non-USP or non-sterile swabs may contain silica particles or other additives that could damage valuable microwear surfaces or introduce new features. Lightly moisten the swabs with ethanol or deionized water, selecting the appropriate solution based on the fossils stability and the type of residue being removed. Avoid applying abrasive pressure to protect the integrity of the tooth surface.
1.4 HOLDING	<ul style="list-style-type: none"> a. Silicone molds are made using a two-part mixture, typically labeled Part A and Part B. Always follow the manufacturer's instructions, which specify the proper mixing ratio. You can measure the components using a digital scale. Be sure to tare the weight of the mixing cup, or use a disposable measuring cup if ratios are given by volume. Select a mixing cup that allows the mixture to expand up to. b. Scrape the sides and bottom of the cup frequently to ensure that all material is fully incorporated. Incomplete mixing can result in improper curing.

Sample page from the molding and casting guide.

NEXT STEPS

Through continued refinement of molding and casting techniques and the establishment of standardized protocols, the paleontological community can balance the need for research access with preservation. This study represents an important step toward more reliable paleodiet reconstructions and, ultimately, a more accurate understanding of ancient ecosystems and evolutionary patterns. Future research should include comparative studies of different molding materials (e.g., platinum- vs. tin-cure silicones) to determine which best preserve microwear features. Additionally, investigations should track changes in microwear patterns resulting from variations in cleaning, molding, and casting protocols.

REFERENCES

- Abrams, K. D. (2016). *Dental microwear variation in Teleoceras fossiger (Rhinocerotidae) from the Miocene (Hemphillian) of Kansas, with consideration of masticatory processes and enamel microstructure* (Master's thesis, Fort Hays State University). Fort Hays State University Scholars Repository. <https://scholars.fhsu.edu/theses/21>
- Semprebon, G. M., Rivals, F., & Solounias, N. (2004). Can low-magnification stereomicroscopy reveal diet? *Journal of Human Evolution*, 47(3), 115–144. <https://doi.org/10.1016/j.jhevol.2004.06.003>

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