Tenacious turds from the Upper Cretaceous Smoky Hill Member, Niobrara Chalk, Kansas

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The Smoky Hill Member of the Niobrara Chalk (Late Coniacian to Early Santonian), Kansas is renowned for its diverse assemblage of bromalites including coprolites, enterospirae, and even rare regurgitates. Producers of these fecal products are attributed to sharks, teleost fish and marine reptiles based on their variously spiraled and non-spiraled morphologies, containing a range of invertebrate and vertebrate inclusions. Traditionally, examination of these fossils has necessitated sub-sampling via consumptive techniques like disaggregation or dissolution on either portions or the entirety of the specimen. Three-dimensional imaging techniques such as X-ray tomographic microscopy (µCT) offer a non-destructive alternative to reveal both macroscopic and microscopic inclusions. Due to the minimal diagenetic alteration of specimens from this locality, µCT imaging and segmentation facilitates the extraction of structural and taphonomic information potentially obscured by physical extraction methods. This study employes non-destructive methods to explore the diversity of gross morphotypes represented by coprolites and a possible regurgitate from this member alongside their internal structure and inclusions. Preliminary results from segmented specimens offer insights into the taphonomic attributes of the coprolites and their ability to preserve exceptionally delicate structures, with remains of vertebral columns still partially articulated. Lightly to non-mineralized inclusions, possibly crustaceans and scale remains, represent a hidden component of the assemblage rarely preserved otherwise. Virtual renders also enable quantitative analysis of the inclusions with respect to the degrees of fragmentation, the orientation and alignment of boney inclusions relative to the longitudinal axis of the specimen, and the relative proportions of bone, pore space, and phosphatic matrix. This work offers a rare glimpse into the feeding, digestive, and excretory behaviors of producers whilst simultaneously capturing unique paleoecological and paleoenvironmental information.