Three-Dimensional Ichnofossil Analyses Using Multistripe Laser Triangulation (Mlt) Technology: Quantifying Trace-Fossil Morphology, Bioturbation Patterns, and Ichnopedologic Fabrics in Sedimentary Rocks

Platt, Brian F.[1;] Hasiotis, Stephen T.[1]; Hirmas, Daniel R.[2] (1) Department of Geology, University of Kansas, Lawrence, KS. (2) Department of Geography, University of Kansas, Lawrence, KS.

A new, low-cost multistripe laser triangulation (MLT) scanner and three-dimensional (3D) editing software were used to semiquantitatively and quantitatively analyze a variety of modern traces and continental and marine ichnofossils. The purpose of this study is to enhance existing ichnological techniques and apply newly developed analytical methods to better understand and interpret trace-fossil morphology, bioturbation patterns, and ichnopedologic fabrics. Use of this technology and supporting software will improve the ability of geoscientists to analyze the original morphology, volume, surface area, and other metrics of macrochannels and macropores in continental and marine deposits created by bioturbation. These features after diagenesis eventually determine the porosity and permeability of sedimentary deposits that become reservoirs, seals, migration pathways, and baffles to the flow of hydrocarbons. Modern and fossil tracks, cocoons, burrows, and coprolites were scanned to capture 3D landmark data used to create 3D digital models. Digital models of burrow casts were also made of traces produced by arthropods and vertebrates in soil-filled aquaria in the laboratory. Stereo pairs and anaglyph images were created from screen captures of digital models rotated precisely about vertical axes. Digital models were also rotated and captured to create animations showing 360° views of traces. Software was used to produce cross-sectional views of ichnofossils from the digital models without actually cutting specimens. Multiple cross-sections at regular intervals were used to create contour maps of traces that allow for easier 3D visualization that otherwise would be difficult to determine from photographs. Quantitative methods included measuring distances and angles and calculating tortuosity indices from the architectural morphology. Two useful properties were surface area (SA) and volume. Area exploited and surface roughness were calculated and determined from SA. Volumes of scanned traces were measured and a new metric termed Volume Exploited was calculated. Data from digital models of ichnofossils can be used to improve morphological and statistical analyses for ichnotaxonomic, paleobiologic, paleopedologic, paleoenvironmental, and paleohydrologic interpretations.