Streamlining data collection and interpretation of quantitative process ichnology datasets

E Timmer[a]

[a] *Earth and Atmospheric Sciences, University of Alberta, AB, Canada*

Process ichnology uses trace fossil data including bioturbation intensity, ichnofossil size-diversity trends, and trace fossil genus abundance as proxies for physical and chemical paleoenvironmental parameters. Using these data, the process ichnology method can provide valuable insight pertaining to sedimentation patterns, salinity, and oxygenation for paleodepositional reconstructions.

Three problems exist with collecting and analyzing process ichnology datasets: (1) size diversity index, bioturbation index and genera abundances are extremely time consuming data to collect accurately at the bed scale; (2) collecting consistent data so that datasets are reproducible even if collected by various individuals is difficult; and (3) visual analysis of potentially large process ichnology datasets for cyclicity and spatial variability is challenging.

To solve the first and second problems, we've coded specialized open source software (PyCHNO) that significantly reduces the time required for users to collect bed-scale process ichnology data. The entire data collection workflow is based on core photographs. With this software, the user segments lithologies in fine grained and coarser grained lithologies, measures causative burrow diameters, labels trace fossil names, and labels bioturbation index at a bed scale. This software generates graphical logs of the process ichnology dataset and exports the raw data into a tab-delimited text file.

To address the third problem, we demonstrate the use of unsupervised clustering, dynamic time-warping and continuous wavelet transforms to interpret the spatial and temporal variation and cyclicity of process ichnology data. As a demonstration, we collected and analyzed process ichnology data in 4 wells penetrating the lower Cretaceous McMurray Formation, Canada. These process ichnology processing techniques significantly improve the raw process ichnology dataset for constraining the genetic and paleoenvironmental variability of the study area.

The methods discussed herein enhance process ichnology data collection and interpretation workflows, and provide valuable paleogeographical insight.

Corresponding author: ric@ualberta.ca