AN "EMBRYONIC IDENTITY CRISIS" OR A CASE OF MISTAKEN IDENTITY? ULTRASTRUCTURAL AND STATISTICAL CHARACTERIZATION OF THE DOUSHANTUO METAZOAN EMBRYOS

SCHIFFBAUER, James D., Dept. of Geosciences, Virginia Tech, Blacksburg, VA 24061

In a recent issue of *Nature*, Bailey *et al*. (2007) proposed that the Doushantuo microfossils *Megasphaera* and *Parapandorina*, previously interpreted as metazoan resting eggs and blastula-stage embryos (Xiao *et al*. 1998), may be interpreted as the world's largest known bacteria, giant vacuolate sulfur bacteria similar to *Thiomargarita namibiensis* (Schulz *et al*. 1999). With this reinterpretation, Bailey *et al*. (2007) claim to resolve the taphonomic conundrum of these fossils, because modern *Thiomargarita*-associated pore water phosphate enrichment and corresponding phosphorite accumulation may have aided not only in the phosphatization of these microfossils, but also in the phosphatization of other fossils within the Doushantuo phosphorites – including large, ornate acanthomorphic acritarchs, algal thalli, and rare tubular forms. With the body of research on these microfossils growing, including the use of many novel investigatory techniques, it seems that Bailey *et al*.'s (2007) description of *Megasphaera* and *Parapandorina* is misleadingly incomplete. Although this comparison to *Thiomargarita*-like bacteria draws a number of intriguing – although likely coincidental – parallels, the authors' deficient characterization of these microfossils suggests that any morphological similarities to these giant bacteria may be entirely superficial. Therefore, this interpretation must be critically investigated, not only in a biological context, but also with regard to taphonomic and sedimentological processes The analyses proposed for further characterization of the Doushantuo microfossils will constitute two separate projects – one conducting serial ion milling for internal ultrastructure image analysis using a dual beam FIB (focused ion beam) preparation technique, and the other extracting complete assemblages from varying rock sample sizes and numerically differentiating the populations of individual cell classes (1-cell forms, 2-cell forms, 4-cell forms, 8-cell forms, etc.) and taphonomic grade for statistical analyses. The first methodology will contribute to the understanding of internal subcellular structures interpreted as possible organelles observed in X-ray tomographic analyses, while additionally providing ultrastructural characteristics that can be morphologically compared to resting eggs, blastula-stage embryos, and *Thiomargarita*-like bacteria. The second methodology will provide useful data in reconstructing the assemblage structure at time of death as well as the preservation potential/extent of decay for each given cell class. Using Monte Carlo simulations to model varying distributions will elucidate the assemblage structure observed from the extracted microfossils. In modern *Thiomargarita* collected from the Gulf of Mexico, nutrient stress caused nearly 100% of the bacterial population to undergo reductive cell division within a span of 2 years, resulting in mostly 2-cell to 8-cell forms with some triplets (3-cell forms) present (Kalanetra *et al*. 2005). The resulting assemblage of cell forms should be easily identifiable, as little to no 1-cell forms should be preserved (assuming ample time under stress). The embryonic and resting egg interpretation proves to be slightly more complicated, as time of death, time averaging, and taphonomic biases must be considered.

References Cited:

Bailey, J.V., Joye, S.B., Kalanetra, K.M., Flood, B.E., and Corsetti, F.A. (2007) Evidence of giant sulfur bacteria in Neoproterozoic phosphorites. *Nature*, 445, 198-201.

Kalanetra, K.M., Joye, S.B., Sunseri, N.R., and Nelson, D.C. (2005) Novel vacuolate sulfur bacteria from the Gulf of Mexico reproduce by reductive division in three dimensions. *Environmental Microbiology*, 7, 1451-1460.

Schulz, H.N., Brinkhoff, T., Ferdelman, T.G., Hernández Mariné, M., Teske, A., and Jørgensen, B.B. (1999) Dense populations of a giant sulfur bacterium in Namibian shelf sediments. *Science*, 284, 493-495.

Xiao, S., Zhang, Y., and Knoll, A.H. (1998) Three-dimensional preservation of algae and animal embryos in a Neoproterozoic phosphorite. *Nature*, 391, 553-558.

Advisor: Dr. S. Xiao