COMMENT TO LIU (2016) "FRAMBOIDAL PYRITE SHROUD CONFIRMS THE 'DEATH MASK' MODEL FOR MOLDIC PRESERVATION OF EDIACARAN SOFT-BODIED ORGANISMS"

Author(s): GREGORY J. RETALLACK
Source: PALAIOS, 32(3):195-196.
Published By: Society for Sedimentary Geology
URL: http://www.bioone.org/doi/full/10.2110/palo.2016.093

PALAIOS
Emphasizing the impact of life on Earth's history

PALAIOS, 2017, v. 32, 195–196
Comment Article
DOI: http://dx.doi.org/10.2110/palo.2016.093

1926 SEPM Society for Sedimentary Geology

COMMENT TO LIU (2016) "FRAMBOIDAL PYRITE SHROUD CONFIRMS THE 'DEATH MASK' MODEL FOR MOLDIC PRESERVATION OF EDIACARAN SOFT-BODIED ORGANISMS"

GREGORY J. RETALLACK
Department of Earth Sciences, University of Oregon, Eugene, Oregon 97403 USA

Liu (2016) provides elegant evidence for pyritization of bedding planes at Ediacaran fossil localities of Newfoundland, but fails to demonstrate the 'death mask' model of moldic preservation for two reasons. First, his petrographic thin sections do not include unpyritized fossils beneath the pyrite, so that his field observations of pyritized fossils are ambiguous (Retallack 2016a). Second, at less than 1.5 mm thick, the pyritic films are insufficient to enable three-dimensional (moldic) preservation (Tarhan et al. 2016). A death mask is a thick (2–3 cm) layer of plaster applied to the face of the deceased to make a three dimensional replica: it does not penetrate the face or its cavities, and oil is used to prevent hair entanglement (Kaufman and McNeil 1989). In proposing the pyritic 'death mask' model, Gehling (1999) envisaged pyrite encrustation without permineralization to explain the high relief of deeply buried Ediacaran fossils from South Australia. No previous work on the topic (Gehling 1999; Dzik and Ivantsov 2002; Mapstone and McIlroy 2006; Liu 2016) has demonstrated a thick pyritic film of sufficient strength to withstand burial compaction above an unpyritized Ediacaran fossil. Petrographic thin sections of Ediacaran fossils from Newfoundland also fail to demonstrate 'death masks' (Retallack 2016a, 2016b), showing instead complete pyritic permineralization of some fossils (*Charniodiscus*, *Ivesheadia*), unpyritized organic preservation of other fossils (*Charnia*), or mixed pyritized-organic preservation (*Aspidella*). Regardless of degree of pyritization, all these fossils are compaction-resistant and up to 6 mm thick, indicating that biopolymers rather than pyrite gave them strength to resist burial compaction (Retallack 1994). Early diagenetic silicification may also have given them compaction resistance (Tarhan et al. 2016), as for many fossil plants (Retallack 1994). Only when the fossil is completely pyritized internally are additional pyritic layers added to the outside (Matten 1973; Marynowski et al. 2007). Pyritization on top, but not within, organic remains is precluded because sulfate reducing bacteria are organotrophic (Birnbaum and Wireman 1984), even pyritizing the sparse organic matrix within calcareous shells (Clark and Lutz 1980).

Liu (2016) also argues "that in the Phanerozoic, pyritization is usually spatially restricted to only the area immediately surrounding organisms, and is typically documented in fine-grained clastic successions, whereas in the Ediacaran, pyritization often extends across entire bedding surfaces, in a range of different lithologies." This observation neglects documented extensive pyritic layers and nodules in intertidal paleosols and soils on mud, sand, and limestone, under salt marsh, mangroves, and other intertidal vegetation of Ediacaran to Holocene age (Clark and Lutz 1980; Altschuler et al. 1983; Retallack and Kirby 2007; Retallack and Dilcher 2012; Retallack 2013, 2015, 2016c). This intertidal to supratidal setting, with a supply of marine sulfate above chemically reducing stagnant groundwater, is the paleoenvironment now envisaged for vendobionts of the Mistaken Point and Drook Formations of Newfoundland (Retallack 2014, 2016b), and explains mixed pyritic and organic preservation of Ediacaran fossils there (Retallack 2016a). Former interpretation of their paleoenvironment as abyssal turbidites is no longer sustainable because of matrix-supported lapilli tuffs and gas escape structures in tuffs overlying the fossil beds, among other reasons (Retallack 2014, 2016b, 2016c). Genuine Ediacaran turbidites were unfossiliferous, like most Phanerozoic turbidites (Retallack 2012). Because Ediacaran intertidal pyritic preservation is not discernably different from Phanerozoic intertidal pyritization, there is no evidence for a taphonomic window of uniquely Ediacaran pyritic preservation closed by the advent of Cambrian marine bioturbation.

REFERENCES

Altschuler, Z.S., Schnepfe, M.M., Silber, C.C., and Simon, E.O., 1983, Sulfur diagenesis in Everglades peat and the origin of pyrite in coal: Science, v. 221, p. 221–227, doi:10.1126/science.221.4607.221.

Birnbaum, S.J. and Wireman, J.W., 1984, Bacterial sulfate reduction and pH: implications for early diagenesis: Chemical Geology, v. 43, p. 143–149, doi:10.1016/0009-2541(84)90144-X.

Clark, G.R. and Lutz, R.A., 1980, Pyritization in the shells of living bivalves: Geology, v. 8, p. 268–271, doi:10.1130/0091-7613(1980).

Dzik, J. and Ivantsov, A., 2002, Internal anatomy of a new Precambrian dickinsoniid dipleurozoan from northern Russia: Neues Jahrbuch für Geologie und Paläontology Monatshefte, v. 7, p. 385–396, http://www.biol.uw.edu.pl/ewolucja/ludzie/81.pdf.

Gehling, J.G., 1999, Microbial mats in terminal Proterozoic siliciclastics: Ediacaran death masks: PALAIOS, v. 14, p. 40–57, doi: 10.2307/3515360.

Kaufman, M.H. and McNeil, R., 1989, Death masks and life masks at Edinburgh University: British Medical Journal, v. 298, p. 506–507.

Liu, A.G., 2016, Framboidal pyrite shroud confirms the 'death mask' model for moldic preservation of Ediacaran soft-bodied organisms: PALAIOS, v. 31, p. 259–274, doi: 10.2110/palo.2015.095.

Mapstone, N.B. and McIlroy, D., 2006, Ediacaran fossil preservation: taphonomy and diagenesis of a discoid biota from the Amadeus Basin, central Australia: Precambrian Research, v. 149, p. 126–148, doi:10.1016/j.precamres.2006.05.007.

Marynowski, L., Rakociński, M., and Zatoń, M., 2007, Middle Famennian (Late Devonian) interval with pyritized fauna from the Holy Cross Mountains (Poland): organic geochemistry and pyrite framboid diameter study: Geochemical Journal, v. 41, p. 187–200.

Matten, L.C., 1973, Preparation of pyritized plant petrifactions: "a plea for pyrite": Review of Palaeobotany and Palynology, v. 16, p. 165–173, doi:10.1016/0034-6667(73)90044-4.

Retallack, G.J., 1994, Were the Ediacaran fossils lichens?: Paleobiology, v. 20, p. 523–544.

Retallack, G.J., 2012, Were Ediacaran siliciclastics of South Australia coastal or deep marine?: Sedimentology, v. 59, p. 1208–1236, doi: 10.1111/j.1365-3091.2011.01302.x.

Retallack, G.J., 2013, Early Cambrian humid, tropical paleosols from Montana, *in* S.G. Driese (ed.), New Frontiers in Paleopedology and Terrestrial Paleoclimatology: Society of Economic Paleontologists and Mineralogists Special Paper, v. 44, p. 257–272.

Retallack, G.J., 2014, Volcanosedimentary paleoenvironments of Ediacaran fossils in Newfoundland: Geological Society of America Bulletin, v. 126, p. 619–638, doi: 10.1130/B30892.1.

Retallack, G.J., 2015, Reassessment of the Silurian problematicum Rutgersella as another post-Ediacaran vendobiont: Alcheringa, v. 39, p. 573–588.

Retallack, G.J., 2016a, Ediacaran fossils in petrographic thin sections: Alcheringa, v. 40, p. 583–600, doi: 10.1080/03115518.2016.1159412.

Published Online: March 2017

Retallack, G.J., 2016b, Ediacaran sedimentology and paleoecology of Newfoundland reconsidered: Sedimentary Geology, v. 333, p. 15–31.

Retallack, G.J., 2016c, Field and laboratory tests for recognition of Ediacaran paleosols: Gondwana Research, v. 36, p. 94–110.

Retallack G.J. and Dilcher, D.L., 2012, Core and geophysical logs versus outcrop for interpretation of Cretaceous paleosols in the Dakota Formation of Kansas: Palaeogeography, Palaeclimatology, Paleoecology, v. 329-330, p. 47–63, doi:10.1016/j.palaeo.2012.02.017.

Retallack, G.J. and Kirby, M.X., 2007, Middle Miocene global change and paleogeography of Panama: PALAIOS, v. 22, p. 667–679, doi: 10.2110/palo.2006.p06-130r.

Tarhan, L.G., Hood, A.S., Droser, M.L., Gehling, J.G., and Briggs, D.E.G., 2016, Exceptional preservation of soft-bodied Ediacara biota promoted by silica-rich oceans: Geology, v. 44, p. 951–954, doi:10.1130/G38542.1.

Received 3 November 2016; accepted 13 December 2016.