Forum Comment

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Exceptional preservation of soft-bodied Ediacara Biota promoted by silica-rich oceans

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Tarhan et al. (2016) propose early silicification of Ediacaran fossils from South Australia by marine silica cement, but their Ge/Si values are evidence for a very different origin as pedogenic cement, and this undermines their biological and taphonomic conclusions. Tarhan et al. analyzed fill of hollow holdfasts with cement between grains showing no evidence of grain suturing and pressure solution, and thus cemented before deep burial. Their median Ge/Si values of 0.91 µmol/mol (but up to 4 µmol/mol) for clastic grains and 2.51 µmol/mol (but up to 10 µmol/mol) for early diagenetic cements within Ediacaran holdfasts are comparable with 1.5 µmol/mol for parent material of modern soils and 3.75 µmol/mol for both soil clays and soil solutions (Kurtz et al., 2002). Values ranging even higher for soil clays (24.3 µmol/mol) and soil solution (14 µmol/mol) are reported by Street-Perrott and Barker (2008). Paleosols are similar as far back as the Archean, with Ge/Si values of 1.06–3.22 µmol/mol (Delvigne et al., 2016). In striking contrast are Ge/Si ratios of <1 µmol/mol in marine and fresh waters and in biogenic and other silica of lacustrine and marine diatomites and cherts (Murray et al., 1991; Filippelli et al., 2000). Ge/Si ratios <1 µmol/mol are also characteristic of Archean (Delvigne et al., 2012) and Ediacaran marine cherts (Dong et al., 2015; Wen et al., 2016), although some Ediacaran siliceous nodules have Ge/Si values as high as 2.54 µmol/mol (Shen et al., 2011) due to pedogenic saponite of disputed detrital or local origin (Bristow et al., 2009). High Ge/Si ratios of 8–20 µmol/mol also are common in hydrothermal solutions, sinters, cherts, and iron-rich parts of banded iron formations (Mortlock et al., 1993; Delvigne et al., 2012), but there are no independent indications of hydrothermal alteration or banded iron formation with Ediacaran fossils in South Australia (Retallack, 2012; Tarhan et al., 2016). The Ge/Si data of Tarhan et al. may be representative of Ediacaran paleosol material within holdfasts, because it is compatible with mobilization of 0.5 mole fraction Si in moderately developed Ediacaran alluvial paleosols of South Australia (Retallack, 2012), and of 0.9 mole fraction Si mobilization in thick Archean paleosols (Delvigne et al., 2016). To 12 independent lines of evidence for a terrestrial habitat and preservational environment of Ediacaran vendobionts from South Australia (Retallack, 2016a), can now be added a 13th: Ge/Si ratios of early diagenetic cements within holdfasts.

The main conclusion of Tarhan et al. is that Ediacaran-style high-relief silicification of fossils was an extinct taphonomic window closed after the Paleozoic by declining marine silica concentrations with the evolution of marine radiolaria and diatoms. Their analysis assumes that Ediacaran vendobionts were marine, although there is mounting evidence that they were terrestrial (Retallack, 2016b). There is a continuous Phanerozoic fossil record of Ediacara-style raised impressions of fossil plants and arthropods in quartz sandstones, due to compaction resistance of lignin and chitin, as well as early cementation (Retallack, 1994). Early silicification and preservation of fossil stigmarian root traces in Carboniferous ganisters, or eluvial paleosol horizons (Percival, 1983; Retallack, 1997), are a comparable phenomenon to the early cementation of Ediacaran holdfasts.

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