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Affirming life aquatic for the Ediacara biota in China and Australia: COMMENT

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Forum Comment

Affirming life aquatic for the Ediacara biota in China and Australia

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Xiao et al. (2013) argue that Ediacaran fossils were not in paleosols because some Australian beds contain the problematic fossil *Eoandromeda* also known from Chinese beds they consider marine. They offer no alternative explanations. My preferred alternative is that *Eoandromeda* was a terrestrial fossil in life position in South Australia, but washed out to sea in China. This hypothesis is supported by the high relief of Australian examples, set deeply within "old-elephant skin texture" (*Rivularites repertus*; Retallack, 2012a), whereas Chinese *Eoandromeda* are thin and effaced in shale (Zhu et al., 2008). *Eoandromeda* was not the only Ediacaran fossil washed out to sea: *Pteridinium carolinense* from green marine siltstones near Albemarle, North Carolina (USA), is also effaced, on smooth bedding planes, and without relief or attachment (Gibson and Teeter, 2001; my personal observations of specimens and sites in November 2012). Land plant fragments are common in post-Silurian marine rocks, such as the Eocene Eugene Formation of Oregon (Retallack et al., 2004). My hypothesis is that *Eoandromeda* was not a marine ctenophore (Wang et al., 2008), but perhaps a colony of bacteria with chiral flagellae (Ben-Jacob, 1997).

Another hypothesis is that *Eoandromeda,* like *Aspidella*, lived within intertidal paleosols (Retallack, 2014). Paleosols of salt marsh and mangal are black, gray, or mottled, with relict bedding and subsurface (Bg) horizons of pyrite nodules (Retallack and Kirby, 2007; Retallack and Dilcher, 2012). Comparable paleosols are known from the Cambrian (Retallack, 2013) and Ediacaran (Retallack, 2014). If oxidized in outcrop, they are brownish red with goethite, and if rich in pyrite, yellowish red with jarosite, as in photographs of the Liantian Formation by Xiao et al. (2013, their figure DR4). Paleokarst, soil-clay minerals, and non-euxinic pyritization are well documented in the Doushantou Formation (Yuan et al., 2005; Bristow et al., 2009). My June 2013 examination of road cuts near Jiulongwan (western Hubei) confirmed gray intertidal paleosols (Sulfaquents) with *Rivularites* surfaces and pyrite nodules (oxidized in outcrop to brown, 7.5YR5/3) within the lower Doushantou Formation. Other paleosols near Jiulongwan included Aquents with red (5R4/4) mottled surfaces in the Shibantan Member of the Denying Formation, and red (10R4/3 and 10R5/3) Calcids in the lower Nantuo Tillite and underlying Liantou Formation. Intertidal paleosols were neither considered nor falsified by Xiao et al.

Xiao et al. also apply their hypothesis to frond fossils from black shales of China interpreted as algae also found in South Australian red sandstone. Like *Eoandromeda*, the Chinese fronds are deflated, uprooted, have less relief, and are more complete than Australian ones. The Australian fragments are not shown with clear *Rivularites* (Retallack, 2012a) and their context is unspecified, so they may have been from lagoon or intertidal facies there (Retallack, 2012b). The Australian fragments have flaring laminae but lack narrow and flexible stalks of known aquatic algae, which require little support but must bend with water flow (Koehl and Wainwright, 1977).

Xiao (2013) and Xiao et al. (2013) are mistaken in considering interference-oscillation ripples as evidence of marine conditions. Oscillation and interference ripples with wavelengths of 6 cm and amplitude of 1.1 cm, like examples from South Australia (Xiao, 2013; Xiao et al., 2013, their figure DR2), form in water depths of only 11 cm in tidal flats, lagoons, lakes, and floodplains (Immenhauser, 2009). The illustration of Xiao (2013) of oscillation ripples from Nilpena obscured by *Rivularites* and a small *Dickinsonia* is an excellent example of a Wadni paleosol (of Retallack, 2012b).

The idea that some Ediacaran fossils lived in soils may be uncomfortably novel, but is not falsified by observation of fossils likely washed out to sea or in different habitats from classical Ediacaran assemblages. A refined recognition of marine, intertidal, and non-marine Ediacaran paleoenvironments and biotas is now emerging from an array of Ediacaran paleosols and facies (Retallack, 2012b, 2014) similar to Phanerozoic coastal paleosols and facies (Retallack and Kirby, 2007; Retallack and Dilcher, 2012).

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