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Notes

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Liu et al. (2010) claim to have found the first evidence for locomotion in the form of putative locomotion traces from the Ediacaran (565 Ma) Mistaken Point Formation of Newfoundland. If by first, they mean the geologically most ancient evidence of animal locomotion, they should have discussed prior claims for animal traces dating back some 2500 m.y. ago (Kauffman and Steidtmann, 1981; Seilacher et al., 1998; Bengtson et al., 2007; Kauffman et al., 2009). All these prior records are problematic in some way (Seilacher, 2007), but the newly described “locomotion traces” from Newfoundland are identical to a kind of tool mark called a tilting trace (Wetzel, 1999). The first documented tilting traces were created by dead shells of mussels (*Mytilus*), with both valves attached and agape, dragged by shallow waves on a foreshore. Crescentic ridges marking successive positions within those tilting marks confirm what was observed in the field, that dead mussel shells can be moved by waves in opposite and crossing directions, a key argument used by Liu et al. to deny that the Newfoundland structures were tool marks. Another telling detail of tilting marks is that crescentic ridges and lateral ridges are very marked where mussels were dragged up ripples, but not so marked where they slid down the other side of ripples. Comparable smooth and ribbed segments can be seen in specimens illustrated by Liu et al., in which ripple-lows are suggested by ribbons of remnant, mantling, reddish-brown volcanic ash. Other comparable tilting marks have been recorded from wrinkled *Eucalyptus* leaves dragged over sand by shallow, wind-generated waves (Jones, 2006), and by rocks attached to the holdfasts of wind-blown kelp in shallow water (Sainsbury, 1956). These tools may be more germane to the Newfoundland structures of Liu et al., because kelp-like and leaf-like fossils are common components of the Mistaken Point fossil biota (Bamforth and Narbonne, 2009).

Tilting traces have only been observed in very shallow marine beaches, estuaries, and deltas, whereas the Mistaken Point Formation has been interpreted as abyssal marine turbidites (Wood et al., 2003; Ichaso et al., 2007). Tilting traces thus support earlier interpretations of shallow marine to supratidal environments for the Mistaken Point Formation (Seilacher 1992; Retallack 1994), based on ungraded airfall ash (Misra 1971; now well illustrated by Ichaso et al., 2007), maroon-red oxidized color (Misra, 1971), calcareous nodules (Benus, 1988), oscillation ripples (Benus, 1988), paucity of pyrite (< 0.095%; Canfield et al., 2007), and freshwater C/S ratios (2.8 ± 0.8 ; Canfield et al., 2007). The structures illustrated by Liu et al. are thus not convincing evidence of deep-marine animal locomotion.

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