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Taphonomic controls on Ediacaran diversity: Uncovering the holdfast origin of morphologically variable enigmatic structures

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ABSTRACT

Earth's earliest known metazoan ecosystems are represented by a handful of globally distributed fossil assemblages, collectively referred to as the Ediacara Biota. Although a number of these deposits have been extensively studied, a large proportion of Ediacaran diversity remains uncharacterized. As a result, our understanding of community structure during this important stage of early metazoan evolution is largely incomplete. Moreover, it is only by examining these deposits from a taphonomic perspective that we can hope to decipher these enigmatic forms and fully reconstruct the Ediacaran community. Using this approach, we describe the anomalous preservation of a distinct, prolific, and previously undescribed Ediacaran biogenic sedimentary structure, informally known as "mop," from the Ediacara Member of the Rawnsley Quartzite in South Australia. Morphological resemblance, spatial association, size distribution, and examination of intermediary forms indicate a shared origin with the holdfast form genus *Aspidella* and convergence with *Pseudorhizostomites*. We interpret mop to have been formed by the dragging or uprooting of a *Charniodiscus*-like frond through a microbially bound substrate by unidirectional currents. Like a freeze frame, mop captures the momentary interaction of organisms and their physical and biotic environment. Detailed characterization of morphological and sedimentological features suggests that variability of mop and associated forms is due largely to taphonomically controlled factors. A better understanding of problematic structures like mop may elucidate the still-enigmatic Ediacaran substrate and the non-actualistic taphonomic processes at work in the preservation of Ediacaran deposits.