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The palaeobiology of Ediacaran rangeomorphs: reproduction, environmental sensitivity and ecological succession

Kenchington,C. G.[1, 2], Wilby, P.R.[2]

[1]Univeristy of Cambridge, Cambridge, CB2 3EQ, Cambridge, email: cgk27@cam.ac.uk

[2]British Geological Survey, Keyworth, NG12 5GG

The Earth has supported life for most of its 4.5 billion year history, but the first macroscopic organisms only appeared some 600 million years ago, in the Ediacaran. Their world was fundamentally different from the Phanerozoic, and many aspects of their biology and ecology remain a mystery. The late Ediacaran fossil assemblages of Avalonia (Charnwood Forest, UK and Newfoundland, Canada) represent some of the oldest evidence for complex macroscopic life, and are dominated by rangeomorphs, a group characterised by their self-similar branching architecture.

Even without knowing the phylogenetic relationships of rangeomorphs, it is possible to resolve key aspects of rangeomorph palaeoecology. The response(s) of communities in Charnwood Forest and Newfoundland to both ambient disturbance and to more substantial events is investigated by combining detailed petrographic analysis of the host sediments with multivariate statistical techniques. We demonstrate that higher taxonomic diversity is correlated with low–intermediate physical disturbance; that upright taxa (e.g. *Charnia*) dominate surfaces which experienced small-scale, sub-lethal sedimentation events and comparably high background sediment input; and that flat-lying forms (e.g. *Fractofusus*) preferentially occur on surfaces with low sediment input. The population demographics of several taxa also show evidence of multimodality: in some (including *Charnia* and *Primocandelabrum*), bimodality was induced by culling of part of an incumbent population by a substantial disturbance event, followed by re-colonisation; in others (e.g. *Fractofusus*), overlapping cohorts reflect non-continuous or pulsed reproduction. Disturbance (ambient and discrete events) demonstrably influenced community succession, with early-colonising taxa dominating horizons with low overall levels of disturbance, and those able to survive disturbance events dominating recovery populations and horizons with higher levels of disturbance. Based on the life history traits and environmental preferences identified for different rangeomorphs, we propose a model of ecological succession for Avalonian rangeomorph communities.