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New Precambrian trace fossils, the end of the Ediacara biota, and first mass extinction of complex life

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The Precambrian-Cambrian transition marks perhaps the most dramatic geobiological change in the last billion years of Earth history, and yet remains poorly understood. This interval marks the extinction of the enigmatic Ediacara biota (a collection of multicellular eukaryotes whose affinities with modern metazoans are unknown), the Cambrian 'explosion' of modern animal groups, and a shift from stratified, microbially-dominated 'matgrounds', to more recognizable Phanerozoic 'mixgrounds' colonized by a wide variety of infaunal metazoans. Key to understanding this transition is unraveling the causes behind the extinction of the Ediacara biota, as these made way for the proliferation of modern animal groups. Here, we present new data from latest Ediacaran sections in southern Namibia that preserve both Ediacaran soft-body fossils, and trace fossils that represent the activity of Cambrian-type animals. We show that: 1) latest Ediacaran communities had low evenness and species richness, consistent with interpretation as 'stressed' ecosystems; and, 2) these Ediacaran communities co-existed with metazoan trace-makers that may represent some of the earliest evidence for passive predation. Together, these findings provide support for a 'biotic replacement' model of the extinction of the Ediacara biota, in which extinction was protracted, and ultimately caused by the evolution of Cambrian-style predators and 'ecosystem engineers'. These findings also suggest that the first mass extinction may ultimately have been biologically caused and mediated, in stark contrast to the subsequent Phanerozoic 'Big Five' events.

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Figure 1: Swartpuntia germsi – a typical member of a depauperate latest Ediacaran benthic community, from Farm Swartpunt, southern Namibia.