LIPID BIOMARKERS REVEAL A BACTERIAL DOMINATED ECOSYSTEM AFTER THE STURTIAN GLACIATION

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Recently, several efforts to characterize the preserved lipid hydrocarbons in Neoproterozoic sediments have resulted in the observation of a systematic change in biomarker distribution between sedimentary rocks from the early and late Neoproterozoic (1.0–0.54 Ga). Steranes preserved in Tonian (1.0–0.72 Ga) organic matter nearly exclusively comprise cholestane, whereas stigmastane is the prominent steroid remnant in most Ediacaran sedimentary rocks (Brocks et al., 2017; Hoshino et al., 2017). This observation suggests a distinct restructuring of the community composition around the two Snowball Earth events (i.e. Sturtian and Marinoan), which covered most of the Cryogenian period (717–635 Ma). Combined with an increased nutrient influx in the melting stages (Reinhard et al., 2017), it has been hypothesized that these glaciations provided the ecological trigger for increased predatory pressure (van Maldegem et al., 2019) and the rise of stigmasteroid-producing green algae (Brocks et al., 2017), establishing a more intricate food network which eventually allowed large animals to emerge during the late Ediacaran (Bobrovskiy et al., 2018). The timing of the proliferation of algae and emergence of eumetazoan animals indicate that the Snowball Earth events were pivotal for the evolution of complex life on Earth. Yet, due to the poor preservation of post-Snowball organic matter, information about the post-Snowball Earth ecosystem is limited. Thus far only lipid hydrocarbons in post-Marinoan deposits (~635 Ma) have been systematically investigated to understand how life recovered in the direct aftermath (Elie et al., 2007; van Maldegem et al., 2019).

We here present a comprehensive data set of indigenous lipid biomarkers preserved in sedimentary rocks deposited directly after the Sturtian glaciation (~662 Ma). In combination with strongly coupled nitrogen and carbon isotopic excursions that reveal fast changing biogeochemical cycles after the melting of the Snowball, we observe a dynamic ecological and environmental shift from an ice-covered basin with limited biological activity, via a bacterial dominate ecosystem in the first meters, to an environment which supports both bacterial and eukaryotic organisms. These signatures combined allow us to reconstruct ecology in the hothouse climate after Earth's most severe glacial period and potentially how the Neoproterozoic global glaciations impacted life on Earth.

References

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