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# a biological trigger for snowball earth?

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The Neoproterozoic era features glaciogenic rocks with equatorial remnant magnetism, a pattern of progressive increases interspersed with dramatic periodic reversals in Sr87/86 dC13 and S34, evidence from paleosols and banded iron formations for a rise in atmospheric O2, and the first fossil evidence for multicellular eukaryotes, including fungi, sponges and lichens. These data have been synthesised in a 'Snowball Earth' hypothesis whereby the planet oscillates between icehouse and extreme greenhouse conditions, but the trigger for this process and its cessation remains elusive. We use an earth system box model to investigate the hypothesis that selective PO4 weathering by Neoproterozoic lichens acted as the trigger for increased O2 by causing a series of bursts of PO4 export to the ocean, resulting in bursts in marine production, hence marine organic carbon burial, the temperature from which may have been sufficient for the ice-albedo feedback to take the system to near global glaciation. Reactive surface area available for weathering is parameterised in the model. We show that this mechanism could have caused the glaciations at 710 and 635MYA. Cessation of the oscillations may have resulted from the origin of a stable global soil interface triggered by lichen increasing reactive surface area by ice nucleation and hyphal pentration. This may have triggered a positive feedback process involving escalating recruitment of soil bacteria. The nutrient stoichiometry of the soil interface is proposed as being critical for this process.