Geophysical Research Abstracts
Vol. 19, EGU2017-16933, 2017
EGU General Assembly 2017
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What can experimental geobiology tell us about mass extinctions, past, present and future?

David Bond

School of Environmental Sciences, University of Hull, Hull, United Kingdom (d.bond@hull.ac.uk)

We know more than ever about the causes and consequences of Earth's greatest mass extinctions thanks to much improved resolution in the fossil record, dating, and proxies for palaeoenvironmental change. Despite much progress, there is no consensus on what drives ecosystems to collapse. The realisation that Earth is again facing stresses implicated in its past crises (e.g. proximal kill mechanisms such as global warming, ocean acidification and anoxia) has intensified research on the ultimate cause(s) of extinctions (e.g. large igneous provinces and bolide impacts). However, the links between proximal kill mechanisms and their drivers remains poorly understood. Here I evaluate environmental factors implicated in major episodes of species extinctions and explores the mechanistic links by which they did their damage. Experimental geobiology is beginning to unlock the secrets of past crises by examining responses of species to change. Reduced pH, for instance alters the efficacy of fishes' chemical receptors, leaving them less equipped to detect prey, predators and mates – invoking "death-by-celibacy" scenarios. Elevated atmospheric CO_2 induces hypercapnic stress (as well as being the root cause of ocean acidification). Prolonged exposure to anoxia causes death without selectivity. Global warming induces a multitude of stresses, primarily linked to increased metabolic rate according to the Q10 law. Experimental geobiologists and Earth scientists could together unravel the causes of past extinctions, better inform understanding of the modern crisis and our approach to the future.