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Selective environmental stress from sulphur emitted by continental flood basalt eruptions

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Several biotic crises during the past 300 million years have been linked to episodes of continental flood basalt volcanism, and in particular to the release of massive quantities of magmatic sulphur gas species. Flood basalt provinces were typically formed by numerous individual eruptions, each lasting years to decades. However, the environmental impact of these eruptions may have been limited by the occurrence of quiescent periods that lasted hundreds to thousands of years. Here we use a global aerosol model to quantify the sulphur-induced environmental effects of individual, decade-long flood basalt eruptions representative of the Columbia River Basalt Group, 16.5–14.5 million years ago, and the Deccan Traps, 65 million years ago. For a decade-long eruption of Deccan scale, we calculate a decadal-mean reduction in global surface temperature of 4.5 K, which would recover within 50 years after an eruption ceased unless climate feedbacks were very different in deep-time climates. Acid mists and fogs could have caused immediate damage to vegetation in some regions, but acid-sensitive land and marine ecosystems were well-buffered against volcanic sulphur deposition effects even during century-long eruptions. We conclude that magmatic sulphur from flood basalt eruptions would have caused a biotic crisis only if eruption frequencies and lava discharge rates had been high and sustained for several centuries at a time.