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Recurrence Rates of Explosive Volcanism in Paleo-equatorial Pangaea and the Effects of Volcanic Ash Loading on Biogeochemical Cycling Near the Peak of the Late Paleozoic Icehouse

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Abstract Text:
The peak of explosive volcanism in the late Paleozoic occurred ca. 300 Ma in eastern equatorial Pangaea where widespread calc-alkaline magmatism accompanied syn-orogenic collapse of the Variscan Mountains. The continental Brousse-Broquiès basin (Massif Central, south-central France) preserves a well-exposed section of upper Carboniferous pyroclastic-volcaniclastic lacustrine strata that captures one example of this widespread magmatism. We present high-precision geochronology and sedimentology that together define a Kasimovian (305.65-306.28 Ma) volcanic recurrence interval of <10 kyr. This is the first quantification of upper Carboniferous volcanic recurrence, and a unique opportunity to gain insight into the nature of frequent and highly explosive silicic volcanism that was occurring across many analogous volcanic centers of eastern equatorial Pangaea during the peak of the late Paleozoic icehouse. The collective impact of this volcanism on the climate system may have been substantial. For example, the fertilization and/or weathering of Fe-bearing volcanic ash could have enhanced organic carbon burial, perhaps contributing to atmospheric carbon dioxide (pCO_2) lows and large-magnitude (>>100ppm) fluctuations in glacial-interglacial pCO_2, but nutrient feedbacks on (marine) organic carbon burial are not well constrained. Using quantitative data from the Upper Paleozoic geological record (ie., recurrence) and observed data from modern analogues (gas flux, nutrient load), preliminary results of sensitivity tests using an Earth system model (cGENIE) suggest that Fe-bearing ash

provided only a minimal stimulus to biological productivity. The Permo-Carboniferous world serves as a deep-time analog for understanding the novel mechanistic links among explosive volcanism, acidic atmospheric chemistry, nutrient availability in mineral aerosols, and organic carbon burial. Future carbon cycle modeling of this interval will consider the fertilization effect caused by highly reactive *non-volcanic* mineral dust, which – together with the elevated iron solubility of atmospheric aerosols (in a volcanically-influenced acidic atmosphere) – may have impacted biogeochemical cycling on scales sufficient to initiate or sustain cold climate modes during the lead-up to peak LPIA conditions.

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