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A gradual increase in pCO_2 punctuated by cold tropical temperatures points to volcanic winters as the trigger for the abrupt End-Triassic extinction

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The End Triassic Extinction (ETE) is one of the "Big-5" Phanerozoic mass extinctions and has arguably the best terrestrial stratigraphic record based on the cyclic lacustrine sediments of the Newark Supergroup. In the Newark Basin, the ETE horizon is positioned stratigraphically above a short reverse magnetic polarity chron E23r and below the lowest flow of the Central Atlantic Magmatic Province (CAMP), a massive Large Igneous Province spread across four continents. We report new magnetic stratigraphy and paleosol-based estimates of atmospheric pCO_2 and temperature from cores encompassing the lowest CAMP lava flows and underlying strata. We systematically identify chron E23r in the upper Passaic Formation, tying our pCO_2 and temperature estimates to the established Newark geomagnetic polarity timescale. We find a gradual, coherent increase in pCO_2 over a timespan of ~60 kyrs[1] beginning significantly before, and extending through, the ETE horizon. This gradual rise culminates in a sharp peak in pCO_2 above the ETE just ~2 meters below the first CAMP basalts. Juxtaposed on this gradual increase in pCO_2 is a sharp transient ~8°C decrease in D47 temperature at the ETE, followed by a warming trend. In previous work we identified a pulse in atmospheric pCO_2 immediately following emplacement of each CAMP flow-unit from soils in stratigraphic superposition with basalts in the Newark and Hartford basins[2,3]. We attribute this protracted pCO_2 increase below the first Newark basalts to the initial phase of igneous activity before the earliest CAMP lavas observed in Morocco. Given the abrupt nature of the terrestrial faunal turnover, a gradual rise in pCO_2 through the ETE strata precludes CO_2 as a primary trigger for the mass extinction. However, the brief cold interval at the ETE level coincident with the <centennial-scale eruption of the initial CAMP lavas in Morocco[1] points to sulfur emissions[4] and multiple subsequent short-lived volcanic winters as the likely kill mechanism, consistent with the extinction of primarily uninsulated Triassic vertebrate taxa in the tropics.

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