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Rapid pyrolysis of paleo-oil pools recorded by fluid inclusions in an Ediacaran carbonate reservoir, southern China: Implications for the end-Guadalupian mass extinction

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Thermogenic greenhouse gas emission associated with large igneous province emplacement has previously been hypothesized as a possible contributor to global warming that triggered mass extinctions in Earth's history, yet this issue remains inadequately understood due to a lack of robust evidence. Here, we present a well-preserved mineralogical, fluid inclusion and geochemical record indicating a rapid pyrolysis of vast paleo-oil pools in an Ediacaran carbonate reservoir in the central Sichuan Basin, southern China relating to the eruption of the Emeishan Large Igneous Province that has potentially contributed to the end-Guadalupian extinction. We conclude that the pyrolysis of the paleo-oil pools occurred around 258.4±7.3 Ma associated with the emplacement of the Emeishan Large Igneous Province, causing a rapid increase of temperature and pressure with an estimated transient reservoir pressure of nearly twice of the lithostatic pressure. A subsequent drop in the formation pressure was observed as the temperature continued to rise, indicating that massive over-pressured CH_4 in the reservoir had been rapidly emitted into the atmosphere along faults or magmatic pipes, ultimately contributing to the end-Guadalupian extinction. This work highlights the significance of massive emission of thermogenic CH_4 related to large igneous provinces for climate change, carbon cycling and biological evolution in Earth's history.