



The role of igneous and metamorphic processes in triggering mass extinctions and Earth crises

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Mass extinctions and transient climate events commonly coincide in time with the formation of Large igneous provinces (LIPs). The end-Permian event coincides with the Siberian Traps, the end-Triassic with the Central Atlantic Magmatic Event (CAMP), the Toarcian with the Karoo LIP, and the Paleocene-Eocene Thermal Maximum (PETM) with the North Atlantic Igneous Province. Although the temporal relationship between volcanism and the environmental crises has been known for decades, the geological processes linking LIPs to these environmental events are strongly debated: Explosive LIP volcanism should lead to short term cooling (not long term warming), mantle CO₂ is too ¹³C-enriched to explain negative ¹³C carbon isotope excursions from sedimentary sequences, the LIP volcanism is poorly dated and apparently lasts much longer than the associated environmental events, large portions of the LIPs remain poorly explored, especially the sub-volcanic parts where sills and dikes are emplaced in sedimentary host rocks, and thus gas flux estimates from contact aureoles around sill intrusions are often poorly constrained. In this presentation, we discuss the status of LIP research with an emphasis on the sub-volcanic processes. We show that potential for degassing of greenhouse gases, aerosols, and ozone destructive gases is substantial and can likely explain the triggering of both climatic events and mass extinctions.