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Synchrotron light X-ray microtomography reveals a crystalline mush within the deep plumbing system of Large Igneous Provinces

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Phanerozoic mass extinction events mostly coincide in time with the emplacement of Large Igneous Provinces (LIPs). Among the *Big 5*, the most catastrophic biotic crises in Earth's history, the mass extinction at the Cretaceous-Paleogene boundary occurred during the emplacement of Deccan Traps [1] and the end-Triassic mass extinction is synchronous with the activity of Central Atlantic Magmatic Province (CAMP) [2]. Magmatic volatiles, and especially CO_2, from LIPs play a key role in triggering global-scale climatic and environmental changes [3], as well as in driving magma ascent through the transcrustal plumbing system and in governing eruptive dynamics [4]. CO_2-rich melt inclusions within glomerocrystic aggregates of clinopyroxene in basaltic samples from the Deccan Traps and the CAMP indicate both early CO_2 exsolution during magma ascent and its abundance in the magmatic plumbing system [5]. Bubble-bearing melt inclusions and glomerocrystic aggregates in basaltic rocks from both these LIPs were imaged by synchrotron light X-ray microtomography at Diamond Light Source (UK). Based on their different density, several mineral phases, glass and voids, occupied by volatile phase in the case of bubbles, can be discerned. 3D reconstructions of analysed volumes allow investigation of the distribution of melt inclusions within crystal clots and estimation of the glass/bubble ratio within the melt inclusions, constraining the original concentration of volatile species in the melt prior to gas exsolution and glass shrinkage. The X-ray microtomography data acquired for these LIPs unveil the microstructural features of bubble-bearing melt inclusions and their host glomerocrystic aggregates, revealing a multi-phase mush in the deep plumbing system, where CO_2 exsolved from the interstitial melt within a crystalline framework worked as a propellant for magma ascent and eruption.

[1] Renne *et al.* (2015), *Science* **350** (6256), 76-78. [2] Marzoli *et al.* (2018), *Topics in Geobiology* **46**, 91-125. [3] Black & Gibson (2019), *Elements* **15**, 319-324. [4] Caricchi *et al.* (2018), *Earth and Planetary Science Letters* **491**, 160-171. [5] Capriolo *et al.* (2020), *Nature Communications* **11**, 1670.