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The link between volcanism and travertine-tufa formation at Barranco de Azuaje in Gran Canaria

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Freshwater carbonate deposits such as travertine and tufa serve as valuable archives of past hydrogeological and volcanic processes. On oceanic volcanic islands, their formation is frequently associated with magmatic CO degassing, although this relationship remains insufficiently constrained. The Barranco de Azuaje in northern Gran Canaria contains the most significant Holocene travertine–tufa deposits in the Canary Islands, located near the lava flows of the Montaña Doramas eruption. Past inconsistencies in dating these carbonates compared to the underlying lava questioned a genetic link, leading to hypotheses that deposition was climate-driven. Resolving this controversy is essential for understanding volcanic effects on groundwater systems and for evaluating geosites of high scientific and conservation value.

To address this, we carried out detailed field mapping, anthracological analysis, and geochronological studies using nine radiocarbon-dated charcoal samples and sixteen U–Th dated carbonate samples. Bayesian modelling integrating stratigraphic constraints allowed us to establish a robust chronological framework. Results show that the Montaña Doramas eruption took place at 3107 [3164, 3068] cal BP, and carbonate deposition started immediately afterwards, lasting around 865 years. The absence of a temporal gap, combined with the stratigraphic evidence of carbonates directly resting on fresh scoriaceous lava surfaces, supports a cause–and–effect relationship between volcanic activity and carbonate precipitation. Hydrothermal alteration of groundwater, increased temperature, and magmatic CO input likely triggered rapid carbonate deposition in perched springs and fluvial backwaters, in both cases showing high abundance of both imprints of plant macrofossils (land plants and liverworts), and plant microfossils (pollen, spores, diatoms).

This research shows that volcanic eruptions can trigger localised freshwater carbonate formation on rejuvenated volcanic islands, providing insights into past volcanic degassing and

palaeoenvironmental conditions. Besides its scientific importance, the study highlights the fragility and rarity of these deposits—now less than 10% of their original volume—emphasising the urgent need for conservation and dissemination efforts. Understanding these processes benefits hazard assessment, groundwater management, and geoconservation strategies in volcanic areas.

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