

# Cause–effect relationship between volcanism and travertine–tufa deposition: Barranco de Azuaje (Gran Canaria, Canary Islands)

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## 1. Background / Introduction

- Travertine and tufa commonly form where CO<sub>2</sub>-rich waters interact with volcanic systems, promoting carbonate precipitation
- In Gran Canaria, freshwater carbonate deposits are rare, but notable examples occur in Barranco de Azuaje, spatially associated with the Mt. Doramas eruption
- Previous geochronological data were inconsistent, this relationship remained controversial
- Aim: test whether travertine–tufa deposition was triggered by the Montaña Doramas eruption
- No temporal gap had been previously demonstrated between volcanism and carbonate deposition

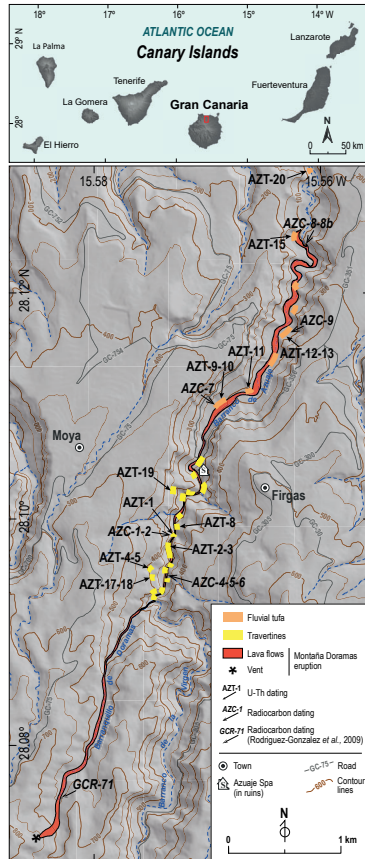
## 2. Study area

- Ravine located in the N–NE sector of the island
- Lava flows from Montaña Doramas Holocene eruption
- Travertine deposits occur mainly on ravine walls, while fluvial tufas occur along the valley bottom (Fig. 1)
- Carbonate deposits occur exclusively downstream of the lava flows

## 3. Methods

Integrated geochronological approach:

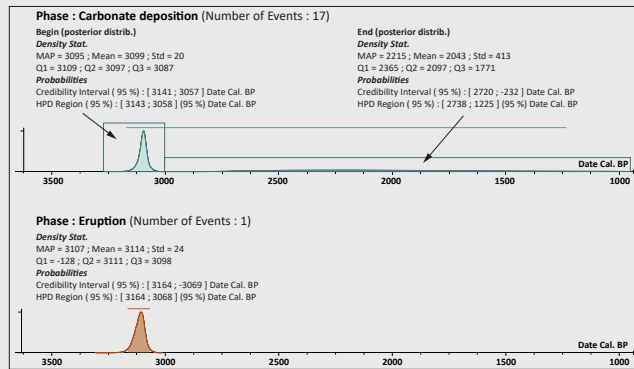
- **Fieldwork**
  - Mapping of carbonate deposits
  - Reconstruction of the 3D fluvial tufa geobody
  - GIS-based volume estimation
- **Geochronology**
  - 9 charcoal samples → Radiocarbon dating
  - 16 travertine/tufa samples → U-Th dating
- **Bayesian modeling (ChronoModel)**
  - Integration of:
    - stratigraphic relationships
    - radiocarbon ages
    - U-Th ages
- **Tests the temporal relationship between eruption and carbonate deposition**



▲ Figure 1. Geological map of Barranco de Azuaje showing the Montaña Doramas vent and lava flow, together with the distribution of travertine and fluvial tufa deposits and location of samples used for the geochronological study (U-Th and <sup>14</sup>C dating). Their spatial coincidence supports a direct relationship between volcanism and freshwater carbonate deposition

## 4. Results

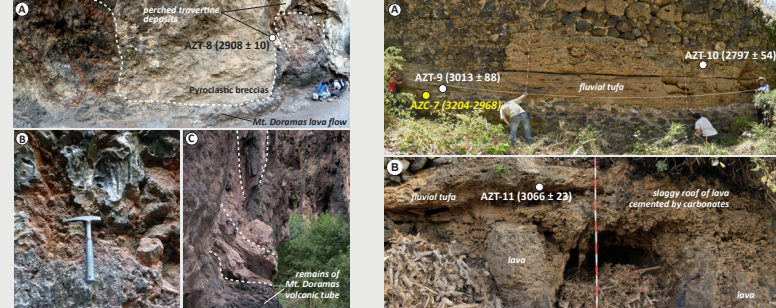
- Eruption age: 3107 cal BP (95% HPD: 3164–3068 cal BP)
- Carbonate deposition: immediate onset; duration ~865 years (358–1885 years)
- Depositional interval: 3095–2215 cal BP
- No temporal gap between eruption and carbonate deposition



◀ Figure 2. Posterior probability distributions from the Bayesian model showing that the Montaña Doramas eruption occurred at ~3107 cal BP and that carbonate deposition started immediately afterwards, with no temporal gap, lasting several centuries

## 5. Field evidence

- Travertine over lava roof
- Fluvial tufa over lava with minimal/no detrital



▲ Figure 3. Travertines directly deposited on the roof of a Mt. Doramas lava tube. Panels A–C show how perched travertines adapt to the volcanic substrate, changing from columnar to laminar morphologies

▲ Figure 4. Fluvial tufa deposits directly overlying the Mt. Doramas lava flow. Panels A–B show carbonate layers with abundant plant imprints resting on a well-preserved slaggy lava roof, with minimal to no detrital sediment, indicating immediate carbonate deposition

## 6. Geological interpretation

Evidence supporting a volcanism–carbonate genetic link:

- Travertine and tufa directly overlie lava flows
- Minimal detrital sediment between lava and carbonate deposits
- Spatial coincidence between eruption and deposits
- Age compatibility from Bayesian model
- No temporal gap between eruption and carbonate deposition

Mechanism proposed:

- Volcanic eruption releases CO<sub>2</sub>-rich fluids
- CO<sub>2</sub> dissolves in groundwater
- Carbonate precipitation occurs in springs and streams
- Formation of travertine upstream and tufa downstream
- Magmatic CO<sub>2</sub> input and thermal anomalies enhance carbonate precipitation

These observations support a direct cause–effect relationship between volcanism and carbonate formation

## 7. Conclusions

- The Montaña Doramas eruption occurred ~3100 years BP
- Travertine–tufa deposition began immediately after the eruption
- Carbonate deposition lasted several centuries
- Cause–effect relationship between volcanism and carbonate deposition in Gran Canaria

## 8. Acknowledgements

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**Key Message:**  
Holocene volcanism triggered freshwater carbonate deposition in Barranco de Azuaje through volcanic CO<sub>2</sub> degassing

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