

# **Pre-eruptive dynamics and timescales estimates at the Campi Flegrei Caldera**

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We review pre-eruptive dynamics and evidence of open-system behavior in the volcanic plumbing system beneath Campi Flegrei Caldera, together with estimates of magma residence time, magma ascent, and mixing-to-eruption timescales (Petrelli et al., 2023). We first summarize geochemical and textural evidence (e.g., magma mixing, crystal disequilibria, vertical zonings, and isotopic records) of open-system behavior for the pyroclasts erupted in the last 40 ky at Campi Flegrei Caldera. We show that the fingerprint of open-system dynamics is ubiquitous in the deposits associated with the volcanic activity at the Campi Flegrei Caldera in the last 40 ky. Then, we describe the results of geophysical and petrological investigations that allow us to hypothesize the structure of the magma feeding system. We point to a trans-crustal magmatic feeding system characterized by a main storage reservoir hosted at ~ 9 km that feeds and interacts with shallow reservoirs, mainly placed at 2–4 km. Finally, we define a scenario depicting pre-eruptive dynamics of a possible future eruption and provide constraints on timescales of magma ascent. Results show that considerably fast ascent velocities (i.e., of the order of m/s) can be easily achieved for eruptions fed by both shallow (i.e., 3–4 km) and deep (i.e., ~ 9 km) reservoirs. Comparing the results from experimental and numerical methods, it emerges that mixing-to-eruption timescales occurring at shallow reservoirs could be on the order of minutes to hours. Finally, we highlight the volcanological implications of our timescale estimates for magma ascent and mixing to eruption. In particular, explosive eruptions could begin with little physical ‘warning’, of the order of days to months. In this case, the onset of volatile saturation might provide pre-eruptive indicators.

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