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The deep and magmatic degassing source of unrest episodes at Campi Flegrei caldera (southern Italy)

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Volcanic calderas are affected by unrest episodes usually dominated by hybrid magmatic-hydrothermal system dynamics. Unrest episodes can evolve to eruptions of variable intensity, up to Plinian. Campi Flegrei caldera (CFc) is a type-location for this kind of activity escalation. CFc provides unique opportunity to build-up a volcanological model in which geochemical, geological and geophysical data are interpreted together to understand how degassing following magma emplacement drives the caldera resurgence. Uneruptive unrest episodes reflect i) a sudden increase of the CO2 magmatic fraction following the shallow emplacement of one single volatile-rich magma batch, ii) voluminous gas separation in a nearly single-step process, and iii), on longer times scales of 10-20 years, degassing driven by crystallization and deep gas fluxing. Our volcanological model matches three decades of geochemical constraints from fumarole discharges, as well as data from melt inclusions of past CFc eruptions. Besides, magma physical properties demanded for modeled degassing conditions are in good agreement with existing geophysical data. Our results open new perspectives to the definition of unrest scenarios at highly-populated CFc.