

Rapid ascent and accumulation of mafic and alkaline magma precedes caldera forming eruptions

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Mafic and alkaline magma is usually associated with effusive eruptions, and while there are several instances of mafic explosive eruptions explosive behaviour from mafic-alkaline magma is extremely rare. Here we discuss the mafic-alkaline caldera complex Colli Albani which has seven large volume ignimbrites (up to 69 km³; Giordano et al., 2010). Often the explosive behaviour of Colli Albani is explained by CO₂ added via shallow carbonate assimilation. Through a combination of field observations, mineral chemistry and textures, and Sr and Nd isotopes in clinopyroxene, we show that the high potassic, silica undersaturated and CO₂-rich magmas typical of Colli Albani is produced by partial melting of a metasomatized mantle. These gas rich, low viscosity magmas are transferred rapidly through the crust, which in turn favours the rapid accumulation of 30 km³ of eruptible magma in the upper crust in tens to hundreds of years. Our results suggest that the caldera forming eruptions at Colli Albani result from the rapid accumulation of magma in the in the shallow crust which is finally destabilized by a CO₂-rich magma sourced directly from the mantle. Thus, a large caldera forming eruption at Colli Albani would be preceded by the accumulation of magma in the shallow crust in tens to hundreds of years, which would be detectable with geophysical methods. Importantly, such short timescales suggest that magma was present in the deepest portion of the magmatic system also during the pauses in volcanic activity, and thus long dormancy does not imply extinction (Giordano and Caricchi, 2022).

[1]G. Giordano, T. C. Team, The colli albani volcano, Special Publications of IAVCEI 3 (2010) 43–97.

[2]G. Giordano, L. Caricchi, Determining the state of activity of transcrustal magmatic systems and their volcanoes, Annual Review of Earth and Planetary Sciences 50 (5 2022).