

Long-term magmatic evolution at the Campi Flegrei caldera (southern Italy)

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Understanding the mechanisms involved in the formation of large silicic magma bodies is fundamental to better constrain volcanic hazard of caldera-forming eruptions, particularly in densely populated areas. Most silicic caldera systems are characterized by evolutionary patterns, including pre-caldera volcanism, climactic eruption and post-collapse magmatism, which are accompanied by significant petrological changes. A key challenge for volcanologists is to better constrain those cycles, in order to provide information about the state of magma reservoirs at a given time.

The Campi Flegrei caldera (southern Italy) is an excellent example of active and restless volcano, which represents a significant threat for more than 1.5 million people currently living within the caldera and its surroundings. During the last 60 ky, Campi Flegrei was the site of two cataclysmic caldera-forming eruptions involving trachy-phonolitic magmas (Campanian Ignimbrite, ~39 ka and Neapolitan Yellow Tuff, ~15 ka) and a number of smaller magnitude volcanic events, the last of which occurred in historical times (Monte Nuovo, A.D. 1538). We investigate the long-term magmatic evolution at Campi Flegrei by combining bulk-rock geochemistry with detailed analyses of crystals and coexisting glasses from a number of eruptions, including the two caldera-forming events and the pre- and post-collapse magmatic activity. Our data reveal that during the two major eruptions most of the eruptible crystal-poor magma and part of the cumulate crystal mush were efficiently evacuated from the upper crustal reservoir, leading to a caldera collapse. Subsequently, the magmatic system was replenished by mafic magmas of deeper origin (shoshonite and latite), which evolved through time towards more silicic, colder and more volatile-rich compositions (trachy-phonolites), building up a new upper crustal mush system. The most recent eruption at Monte Nuovo, characterized by highly evolved, low temperature and wet magmas akin to those that fed the pre-caldera magmatic activity, suggests that a potentially explosive magma reservoir might be currently active at Campi Flegrei.