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Reconstructing the magmatic evolution prior to the 3–5 December 2015 paroxysm at Voragine Crater, Etna

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After almost fourteen years of dormancy, eruptive activity resumed at Etna's Voragine summit crater in February 2013, and again in January 2015, in the form of intra-crater Strombolian eruptions. Sporadic ash emissions began again in August 2015 and progressively intensified to Strombolian activity, ultimately culminating in a sequence of four paroxysmal lava fountains between 3 and 5 December 2015. The cause of the reactivation of Voragine, and the origin of the paroxysms, remain uncertain. To address these questions, we characterise the petrological characteristics of tephra fall samples spanning the reawakening of Voragine from the Strombolian activity in January to the first two paroxysmal lava fountains. We find that increasing eruption intensity was accompanied by increasingly primitive melt compositions. Curiously, however, melt inclusions hosted within the resorbed cores of plagioclase phenocrysts erupted during the paroxysms are more evolved melt than the surrounding matrix glass, and similar to those erupted during the preceding Strombolian activity. The phenocryst assemblage in all samples includes plagioclase, clinopyroxene, olivine and Fe-Ti oxides, in order of decreasing abundance. Plagioclase, in particular, exhibits complex compositional zoning and disequilibrium textures. Most plagioclase crystals erupted during the December lava fountains exhibit strongly resorbed anorthitic cores surrounded by sodic rims with a sharp boundary and uniform compositional range. The sodic rim thickness increases from a <10 μm (3 Dec) to 10–100 μm (4 Dec) and displays a skeletal growth morphology. Microlites are rare, but those present are identical in composition to the final sodic rim on larger phenocrysts. In contrast, the January and September samples exhibit a range in groundmass crystallinity. Phenocryst cores are similar to those erupted in December, but have a much less distinctive sodic rim. Together, these data record mixing and crystal transfer between a mafic recharge magma and a more evolved resident magma.