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Volcanic eruptions from near-solidus magma chambers and their relevance for the volcanic hazard at densely inhabited areas

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The rejuvenation of magmatic system by hot fluids from deep reservoirs is an important assumption in volcanology. Recent studies have proposed that magma reservoirs crystallized to a rigid (but not completely solid) mush show signs of remelting, and a number of eruptions have been interpreted as induced by this mechanism . Recent theoretical models suggest also that the percolation of magmatic gases through reservoirs cooled at near-solidus temperatures could be a potential re-melting mechanism. The magmatic system beneath Campi Flegrei caldera, an active volcanic district near Naples (Italy), is a good analog to study the physics of reactivation of near-solidus magmatic reservoirs. In fact, recent tomography analyses infer the presence of a magma sill at depth as high as 7.5 km, whereas very high velocities, compatible both with saturated limestone and solidified lavas, are inferred below 4 km. Given the small size of the caldera (3 km across, it seems realistic that residual magma from caldera-forming eruptions could be present in the shallow layers, solidified by degassing and hence hardly distinguishable from limestone. Here, we show that for the studied magma composition (i.e., a k-trachyte from the Campanian Ignimbrite Eruption, Campi Flegrei) re-melting can occur without a general increase of the magma temperature, but simply by diffusion of H2O as the principal component of the magmatic gases feeding the system. Laboratory experiments performed at 100 and 200 MPa and modelling results for water saturated melts, indicate that the kinetics of this process is (a) compatible with the rest periods of a re-juvenating magma chamber and (b) fast enough to overcome the irreversible cooling of large reservoirs. These results, strongly suggesting that closed, near-solidus magmatic systems can be locally

remelted without the input of new magma, give a new perspective for the assessment of volcanic hazard in densely inhabited regions.