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Caldera resurgence driven by magma viscosity contrasts

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Calderas are impressive volcanic depressions commonly produced by major eruptions. Equally impressive is the uplift of the caldera floor that may follow, dubbed caldera resurgence, resulting from magma accumulation and accompanied by minor eruptions. Why magma accumulates, driving resurgence instead of feeding large eruptions, is one of the least understood processes in volcanology. Here we use thermal and experimental models to define the conditions promoting resurgence. Thermal modelling suggests that a magma reservoir develops a growing transition zone with relatively low viscosity contrast with respect to any newly injected magma. Experiments show that this viscosity contrast provides a rheological barrier, impeding the propagation through dikes of the new injected magma, which stagnates and promotes resurgence. In explaining resurgence and its related features, we provide the theoretical background to account for the transition from magma eruption to accumulation, which is essential not only to develop resurgence, but also large magma reservoirs.