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Time-dependent vent conditions during explosive caldera-forming eruptions

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Different situations accounting for adequate conditions to develop ring faults in collapse calderas have been proposed after several decades of investigations on such a major volcanic process and hazard. The classical collapse scenario is that of a chamber underpressurized below a critical value due to the removal of magma during the course of an eruptive event. Analogue experiments based on this evacuation scenario reproduce most structural features like fractures, faults, or regions with different stress regimes, and provide a clear link between the reservoir aspect ratio and the caldera morphology. Moreover, a number of theoretical models try to assess the fraction of mass removed or, equivalently, the chamber pressure drop, during the pre-collapse eruptive phase depending on chamber geometry and magma properties. Other scenarios not conforming this classical view include collapse by opening of ring-faults due to regional doming beneath a sill-like-shaped overpressurized shallow magma chamber or faulting by chamber overpressure and tensional regional stresses.

Regardless of the triggering mechanism, it is clear that the initiation of a caldera collapse changes dramatically the ambient conditions within the magma chamber and, simultaneously, provides new paths for magma to reach the surface through peripheral conduits or fissures. Such physical and geometrical changes have a large impact on the eruptive dynamics and, in consequence, alter substantially the conditions at the vent (s). Due to the huge destructive potential of caldera-forming eruptions, the comprehension and quantification of these changes becomes a subject of special relevance to predict, trough modelling, the effects of such tremendous events. Surprisingly, only a few studies, most based on field data, exist on the temporal evolution of the physical conditions at the vent during caldera-forming eruptions. Models for chamber and

conduit flow dynamics during caldera-forming eruptions constrain to the pre-collapse eruptive phase. In this presentation we extend previous theoretical studies to the syn-caldera subsidence eruptive phase in order to quantify chamber and vent(s) conditions during the whole eruptive sequence. Thus, we obtain a more reliable time-dependent boundary conditions to be used by models on pyroclastic flows and fallout dispersal. However, it is important to note that caldera-forming eruptions are complex phenomena and may have very different behaviours due to a number of reasons. A detailed analysis of any particular case is out of the scope of the present study. Our aim is just to obtain, through simple modelling, general trends shared by most of these eruptions.