Geophysical Research Abstracts, Vol. 7, 09873, 2005
SRef-ID: 1607-7962/gra/EGU05-A-09873

A physical framework to account for both caldera-forming and non-caldera forming volcanic eruptions

S. Tait (1,3), J. Gardner (2)

(1) Institut de Physique du Globe de Paris, and Université de Paris 7, (2) Dept. Of Geological Sciences, Univ. of Texas, Austin, (3) Dept. Earth Sciences and Engineering, Imperial College, London (tait@ipgp.jussieu.fr / Fax: +33 1-44272481 / Phone: +33 1-44277996)

The most extreme explosive volcanic eruptions involve caldera collapse by mechanical failure of crustal rocks forming the roof of a magma reservoir. These major natural hazards inject massive amounts of gases, aerosols and ash into the stratosphere and generate huge, devastating, hot pyroclastic flows. However, many events, despite erupting similar magma types, do not involve caldera collapse, exposing a dichotomy for which existing eruption models cannot account. Here we outline a new physical framework to address directly the question of why calderas form in some cases but not in others. Vesiculation of volatile-saturated magma in the reservoir, driven by the eruption, generates a buoyancy force which, by pushing up on the roof, acts to hold open the eruption conduit even though pressure in the reservoir drops below the lithostatic value. In some cases under-pressure is eventually able to combat buoyancy and shut down the eruption, but in others it is not able to do so, and these eruptions evolve beyond a point of no return to reach caldera collapse. Key control parameters are size and burial depth of the reservoir, holding out hope for improved prediction and hazard assessment based on measurable initial conditions.