Geophysical Research Abstracts
Vol. 18, EGU2016-18290-1, 2016
EGU General Assembly 2016

Environmentally-mediated ash aggregate formation: example from Tungurahua volcano, Ecuador

Ulrich Kueppers (1), Paul M. Ayris (1), Benjamin Bernard (2), Pierre Delmelle (3), Guilhem A. Douillet (1), Yan Lavallée (4), Sebastian B. Mueller (1), Donald B. Dingwell (1), and Kate J. Dobson (1)

(1) Earth & Environmental Sciences, Ludwig-Maximilians-Universität (LMU), Munich, Germany, (2) Instituto Geofísico, Escuela Politécnica Nacional, Quito, Ecuador, (3) Environmental Sciences, Université catholique de Louvain, Belgium, (4) Earth, Ocean and Ecological Sciences, University of Liverpool, UK

Volcanic ash is generated during explosive eruptions through an array of different processes; it can be produced in large quantities and can, in some circumstances, have the potential for far-reaching impacts beyond the flanks of the volcano. Aggregation of ash particles can significantly impact the dispersal within the atmosphere, and its subsequent deposition into terrestrial or aquatic environments. However, our understanding of the complex interplay of the boundary conditions which permit aggregation to occur remain incomplete.

Tungurahua volcano, Ecuador, has been intermittently active since 1999. In August 2006, a series of pyroclastic density currents (PDC) were generated during a series of dry, Vulcanian explosions and travelled down the western and northern flanks of the volcano. In some locations, the related PDC deposits temporarily dammed the Chambo river, and the residual heat within those deposits produced vigorous steam plumes. During several field campaigns (2009-2015), we mapped, sampled, and analysed the related deposits. At the base of the Rea ravine, a large delta fan of PDC deposits had dammed the river over a length of several hundred metres. In several outcrops adjacent to the river and in small erosional gullies we found a peculiar stratigraphic layer (up to ten centimetres thick) at the top of the PDC deposits. As this layer is capped by a thin fall unit of coarse ash that we also find elsewhere at the top of the August 2006 deposits, the primary nature is without doubt. In this unit, we observed abundant ash aggregates up to eight millimetres in diameter within a poorly sorted, ash-depleted lapilli tuff, primarily comprised of rounded pumiceous and scoriaceous clasts of similar size.

Leaching experiments have shown that these aggregates contain several hundred ppm of soluble sulphate and chloride salts. Recent laboratory experiments (Mueller et al. 2015) have suggested that in order for accretionary lapilli to be preserved within ash deposits likely requires a combination of sufficient humidity and a pre-existing soluble salt load on aggregating ash particles. We suggest that steam pluming from the dammed Chambo river, coupled with soluble salts emplaced by gas-ash interactions between ejection and deposition, provided a unique opportunity for the formation of accretionary lapilli with sufficient mechanical strength to survive deposition, accounting for their presence in a deposit otherwise absent of such aggregates. This possibility provides an important reminder of the role played by external environmental triggers in shaping the properties volcanic ash deposits.