Geophysical Research Abstracts
Vol. 16, EGU2014-10505, 2014
EGU General Assembly 2014

Segregation of particles in a tapered fluidized bed with implications for pyroclastic volcanism

Thomas Gernon (1) and Mark Gilbertson (2)

(1) Ocean and Earth Science, University of Southampton, SO14 3ZH, United Kingdom (thomas.gernon@noc.soton.ac.uk), (2) Department of Mechanical Engineering, University of Bristol, BS8 1TR, United Kingdom

Volcanic vents (or diatremes) such as those formed in the eruption of kimberlites, lamproites and alkali basalts are thought to effectively behave as tapered fluidized systems. Tapered fluidized beds are extensively used in industrial operations to induce thorough mixing of particles of differing sizes. In the volcanic system, fluidization occurs as a consequence of the trapping of crystals and pyroclasts during waning eruption phases, when the increased cross-sectional area of the vent prevents most particles from escaping. This phase, known as the pressure-adjusted regime, is accompanied by extensive gas release from ascending melts and hot pyroclastic deposits confined to the vent. The ascending gas is capable of fluidizing the vent-filling deposits and as such will inevitably lead to particle segregation, similar to that observed in gas escape pipes in ignimbrites. It has been shown that gas flow through the dense-phase of tapered beds is heterogeneous, generating a central fluidized core and unfluidized peripheral regions. The structure becomes much more complex when the particles reach the minimum fluidization velocity (U_{mf}), leading to segregation. The aim of this study is to investigate how the two different types of structure – that is the flow structure resulting from the tapered shape of the bed (i.e. akin to the diverging geometry of a vent) and the segregation structures – interact and affect each other. Experiments were performed in a tapered planar bed (θ=15°) using bidisperse mixtures of ballotini. The growth and extent of flow and segregation structures were measured, as well as the fabrics observed under different conditions. The most significant impact of a tapered geometry is seen at flow-rates just in excess of U_{mf} when vertical columns of particles form, completely displacing larger-scale flow structures. Our results have important implications for understanding the gas flow regimes that occur deep inside volcanic vents, as well as those operating in pyroclastic density current deposits.