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# Dynamics of experimental hot particle-laden jets

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Explosive volcanic eruptions eject dense, hot, multi-phase jets which can exhibit several behaviors. The evolution of these flows in the atmosphere crucially depends on the rate of entrainment of surrounding air into the jet, on the dynamics of the particles within the jet and on the thermal exchanges between the particles and gas. If the entrainment and the heating of atmospheric air within the jet is important, the density of the volcanic mixture can become smaller than the one of the atmosphere and the jet forms a buoyant eruption column. Otherwise, the jet naturally collapses producing pyroclastic density currents. To explain these two extreme evolutions, physical models use a powerful « top-hat » formalism which predicts a sharp limit between both regimes. Observations of historical eruptions revealed nevertheless that a third regime exists in which the volcanic jet separates into a buoyant rising part and a denser collapsing part. In this specific regime, the « top-hat » formalism cannot be used because of the unsteady behavior of the flow. A method to investigate this regime consists in performing laboratory experiments. We present here an experimental study in which a turbulent jet of hot gas and hot particles is ejected into a large chamber of cold air. According to the range of source conditions, the jet forms a buoyant column, a collapsing fountain or a buoyant column partially collapsed. We quantify the fraction of the jet collapsed by collecting the particles and we show that the dynamical regime strongly depends on the amount of particles at the source. Moreover the results show that the transition between the buoyant and the total collapse regimes predicted using a « top-hat » formalism corresponds to the extreme conditions to form a buoyant column but not the extreme conditions to generate a fountain. The partial collapse behavior occurs

therefore at source conditions for which a total collapse is expected.