A model for volcanic ash formation under low excess gas pressure

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To explain the ash formation mechanism under gentle eruption, I have constructed a new model for bubble wall fragmentation in magma, applicable even when the excess internal gas pressure is low, using the theory of melt fracture by viscous flow. Consider a bubble with thin wall. When it grows the bubble wall expands and shear flow occurs inside it. Applying the evaluated shear strain rate in the wall to the melt fracture theory, we can see that the bubble radius, wall thickness, and excess internal gas pressure give the criterion for bubble wall fragmentation. For example, when the excess pressure is 30 to 3 atm, (bubble radius)/(bubble wall thickness) is expected to be in the range 100 to 1000 for the occurrence of bubble wall fragmentation, i.e., volcanic ash formation.