Intermittent and efficient outgassing by upward propagation of film ruptures

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We simulate the ascent of bubbly magma in a volcanic conduit by slow decompression experiments of syrup foam as a magma analogue. During the decompression, some large voids appear in the foam. The expansion of a specific void at a depth leads to another void expansion, and the void expansions then propagate upward. The void expansion finally reaches the surface of the foam, which rises and falls locally by outgassing. The velocity of the upward propagation of void expansions agrees with the rupture velocity of a bubble film, suggesting that the rupture of films separating each void propagates upward to create a pathway for outgassing. This mechanism may cause gas emission, such as Strombolian eruption, in which the upward traveling of decompression triggers the explosive gas emission originated at a depth. The calculated apparent permeability of decompressed foam can become higher than that measured for natural pumices/scoriae. The upward propagation of film ruptures can cause efficient outgassing.