Explosive expansion of a slowly-decompressed magma analog: evidence of delayed bubble nucleation

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Slow decompression of magma generally results in an effusive or mildly explosive expansion of the magma, but counterexamples of sudden switches from effusive to explosive eruptive behaviour have been documented at various volcanoes worldwide. The mechanisms involved in this behavior are currently debated, in particular regarding basaltic magmas. Here, we explore the interplay between decompression rate and vesiculation vigour by decompressing a magma analog obtained by dissolving pine resin into acetone in varying proportions. Our mixtures contain solid particles and upon decompression experience the nucleation of acetone bubbles. We find mixtures high in acetone, containing smaller and fewer solid particles, experience strong supersaturation and fragment for very slow decompressions, despite having low viscosity, while mixtures low in acetone, with more and larger solid particles degas efficiently. We interpret our results in terms of delayed bubble nucleation due to a lack of efficient nucleation sites. We discuss how a similar mechanism might induce violent, explosive expansion in volatile-rich and poorly crystalline low-silica magmas, by analogy to previous inferences for rhyolitic magmas