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Interpretations of phenocryst embayments

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Phenocryst embayments in volcanic samples tend to be filled with glass, regardless of the crystallinity and vesicularly of the groundmass surrounding the phenocryst. Embayments are important in volcanology and magma petrology because: 1) they often provide the only areas of matrix glass sufficient for compositional analysis in microlite-rich samples; 2) volatile gradients in embayments are used to constrain rates of magma ascent; 3) with further crystal growth, embayments may develop into melt inclusions, an essential source of data on melt composition evolution. Robust interpretations of data from embayments requires an understanding of why they form and why vesiculation and crystallisation are locally suppressed in these melt channels during ascent. We review instabilities in crystal growth and resorption, considering latent heat, local accumulation of elements, and interaction of the crystal growth front with pre-existing bubbles and other crystals. A survey of textures in volcanic samples from several volcanoes suggests that embayment formation by growth is more common than by resorption. Crystal nucleation suppression in the embayment of a growing phenocryst can be explained by buildup of excluded elements and continued growth (rather than nucleation) of the phenocryst phase. However, the suppression of bubble formation despite the accumulation of excluded volatiles is more difficult to explain but could be related to latent heat and difficulties in bubble formation in a restricted space. Finally, we flag complications in interpretations of embayment composition data due to element accumulation and bubble nucleation suppression.