Generation of water-rich lenses in the roof and walls of a shrinking magma chamber

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We performed numerical simulations of the water release and transport within a solidifying magma body. At a pressure of 2 kbar, the bubbles formed by water exsolution within a crystal-poor liquid magma are small and their Stokes velocity is low. However, the exsolved water can rapidly rise where crystals form a solid network that deforms and channels the bubbles (Parmigiani et al, 2017. Geochem. Geophys. Geosyst. 18, 2887–2905. doi.org/10.1002/2017GC006912). As a result, water is preferentially transported in the mush that surrounds the magma chamber. If the water is not transported further through capillary fracturing, water-rich lenses form atop the mush and get trapped in the solidifying walls and roof of the chamber as it cools and shrinks. The periodical release of the trapped water could explain bradyseismic crisis and cycles of volcano deformation. If present, water-rich lenses could be mistaken for melt on seismic or electrical tomography of magmatic systems and lead to an overestimation of the chamber size. High proportions of water result in the fragmentation and fluidization of the rock even at low melt fraction. We speculate that it could help the formation of schlierens observed in granites. If the chamber fails and erupt, the entrainment by the magma of the water-rich, melt-poor material could explain why many erupted products are crystal-rich and why antecrysts are so common.

Mots-Clés : magma chamber, mush, water, bubbles.

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