Chlorine mapping as a new tool to investigate the degassing processes of silicic magma

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Vesiculation, outgassing and foam collapse are considered to be the primary control of eruption styles. However, the detailed mechanism of these processes is poorly understood. One possible way to explore this is to use the chlorine content mapping of the groundmass glass: Because of its low diffusivity, chlorine may maintain the disequilibrium distribution produced during the degassing processes. Therefore, the chlorine distribution potentially provides information about the degassing history during ascent. To examine this possibility, we carried out vesiculation and bubble resorption experiments of rhyolitic melt, and analysed the chlorine content around bubbles using an FE-EPMA. Experiments were carried out by heating hydrous rhyolitic obsidian in an open-system capsule at 1000 degC and 10-30 bar for 3-24 h. The run products showed a structure of two distinct regions: One is the bubble-rich core and the other is the bubble-free margin. The bubble-free margin is the product of bubble resorption caused by diffusive dehydration (Yoshimura and Nakamura, 2008). In the bubble-rich core, chlorine diffused towards bubbles, showing that these bubbles are absorbing chlorine during growth. The outermost bubbles are those dissolving in the undersaturated melt. These bubbles had high-Cl corona, indicating that these bubbles discharge chlorine during resorption. In the bubble-free margin, circular spots with high chlorine contents were observed. These spots represent the remnant of dissolved bubbles. These results suggest that chlorine mapping may be a powerful tool to decipher the history of degassing processes in ascending magma.

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