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A Feedback mechanism between crystals and bubbles in a RuO₂-bearing melt

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Crystals are known to affect bubble behavior in natural and industrial oxide glass melts.[1] In volcanology, high crystal contents ($\phi_c > 30$ vol.%) may drastically increase the suspension viscosity, altering bubble dynamics severely enough to modify the eruptive style.[2] During industrial glass production, crystals may affect the process and the final product, if formed in an uncontrolled way. In this work, we investigate in laboratory-scale how a small crystallinity of nano-sized RuO₂ ($\phi_c \sim 2$ vol.%) modifies bubble behavior in a melt, generating a cyclic gas-release phenomenon (Fig. 1).

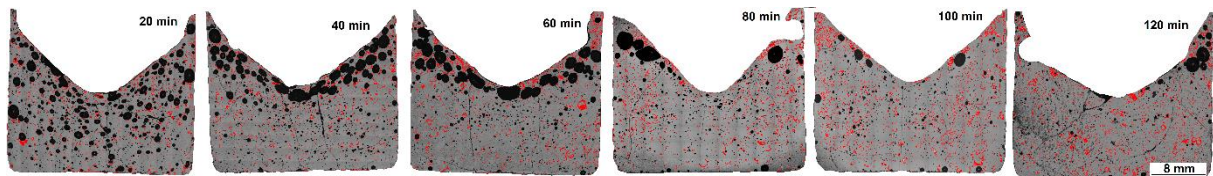


Figure 1: Optical microscope images of samples containing a borosilicate melt (grey), RuO₂ crystals (red), and bubbles (black) prepared at 1000 °C different dwell times.

We conduct a series of experiments on a three-phase system composed of a borosilicate melt, bubbles, and RuO₂ crystals. Optical microscopic investigation is performed on the products of thermal treatment at 1000 °C for different durations. Based on viscosity measurements, contact angle measurements, and numerical simulations, we propose a mechanism of entrainment of bubbles carrying crystals to the upper surface accompanied by crystal aggregation, and followed by an increase in viscosity to explain the observed phenomenon.

References

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- [2] H.M. Gonnermann, M. Manga. *Modeling Volcanic Processes: The Physics and Mathematics of Volcanism (chapter 4)*, **2013**, 55-84