Geophysical Research Abstracts
Vol. 21, EGU2019-15300, 2019
EGU General Assembly 2019

In situ observation of nanolite formation in volcanic melt: implications for magma explosive volcanism

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Iron-bearing nanocrystals (i.e. nanolites) are enigmatic particles recently found[1] in volcanic glasses produced during explosive eruptions of magmas. The formation of these small crystals during magma transport towards Earth's surface changes the melt structure, increases viscosity[2] and the likelihood of hazardous explosive eruptions. Despite decades of research, few direct measurements have been made of the structure of magmas *in situ* under volcanic conditions.

We have performed *in situ* high temperature synchrotron X-ray diffraction measurements of volcanic melts during cooling to monitor nanolite precipitation from magmas at eruptive temperature. This allowed the characterization, over a timescale in the order of seconds, of the transient evolution of the melt structure during cooling under controlled conditions of oxygen fugacity. The results reveal the formation of nanolites during controlled cooling. The XRD data presented here is the first *in situ* high-temperature observation of the formation of nanolites in volcanic melts. This finding allows us to explore the mechanisms acting during nanolite formation and explosive eruption of magmas.

1. Mujin, M., Nakamura, M. & Miyake, A. Eruption style and crystal size distributions: Crystallization of groundmass nanolites in the 2011 Shinmoedake eruption. Am. Mineral. 102, 2367–2380 (2017).

2. Di Genova, D. et al. A chemical tipping point governing mobilization and eruption style of rhyolitic magma. Nature 552, 235–238 (2017).