Redox state and nanolite crystallization of erupting magma during ash forming eruption at Bromo Volcano, Indonesia

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We discusses a vent-conduit process during ash forming eruption at Bromo volcano, Indonesia, based on the observation of microstructure and redox variation of volcanic glass. The volcanic ash particles were collected in 24th March 2011 by real-time sampling from ongoing activity. The activity was characterized by strombolian eruption and emission of gray-brown ash plume with shock wave, showing magma head ascended to near the ground surface. The volcanic glass of the ash forming eruption comprises brown and black glasses under the stereoscopic microscope. Although both of volcanic glasses exhibits glassy appearance and identical chemical composition, observation of microstructure by Field-Emission Electron Micro Probe Analyzer (FE-EPMA) showed that the black glass contains nanolites (Mujin and Nakamura, 2014) in its matrix glass. The Fe-K edge μ-XANES (micro X-ray Absorption Near Edge Structure) spectra demonstrate that brown glass ($Fe^{3+}/\Sigma Fe$ = 0.20-0.26) is more reduced than black glass ($Fe^{3+}/\Sigma Fe$ = 0.32-0.60). From combination of the glass composition, the measured $Fe^{3+}/\Sigma Fe$ ratio and 1060 degree C of temperature, the oxygen fugacities are estimated to be NNO which is similar with that of magmatic gas from Bromo (Aiuppa et al. 2015) for brown glass and NNO+4 for black glass. Moreover we found that the oxygen fugacity becomes higher in nanolite-developed region around the edge or vesicle wall in a single black glass. These suggest close relationship between oxidation and nanolite crystallization. Vigorous recycling of eruptive material from repetitive eruptions can cause oxidation of volcanic glass and nanolite crystallization.

Keywords: Volcanic ash, Redox state, Nanolite

