TEXTURAL STUDY AND ERUPTION DYNAMICS OF THE MALALAK TEPHRA (TANDIKAT VOLCANO), WEST SUMATRA, INDONESIA

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Abstract

The Malalak Tephra (sourced from Tandikat volcano) is considered one of the youngest and most voluminous tephra deposits (VEI-5) in West Sumatra, Indonesia. However, several constraints such as deposit characteristics and eruption dynamics, remain poorly understood. Therefore, this study focuses on the linkage between temporal variation (stratigraphy) with componentry, bulk density, and juvenile textures such as vesicles and phenocrysts of the Malalak Tephra deposit. This deposit mainly consists of five pumice fall layers (F-1, F-2, F-3, F-4, and F-5) with gradational contact between each layer (repetitions of normal and reverse grading). White and grey pumices occur as the main juvenile phase. White pumice has a higher crystallinity (avg. of 44 %) and more evolved chemical composition of glass (73–78 wt. % SiO2) compared to grey pumice (average crystallinity 37 % with 71–77 wt. % SiO2), suggesting that both pumices originated from different magma chambers and mingled just before and during the eruption. Grey pumice is typically denser than white pumice, with varying bulk density of 0.65–1.78 g/cm3 and 0.48–1.09 g/cm3 for grey pumice and white pumice, respectively. Bulk density was observed to increase (for white and grey pumices) from the main stage (F-1 and F-2) to the closing stage (F-3, F-4, and F-5). Because bulk density is strongly dependent on bulk vesicularity, and bulk vesicularity is controlled by vesicle number density (which is a function of decompression rate), it can be inferred that the main stage was relatively more explosive compared to the closing stage.

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ABSTRACT

The Malalak Tephra (sourced from Tandikat volcano) is considered one of the youngest and most voluminous tephra deposits (VEI-5) in West Sumatra, Indonesia. However, several constraints such as deposit characteristics and eruption dynamics, remain poorly understood. Therefore, this study focuses on the linkage between temporal variation (stratigraphy) with componentry, bulk density, and juvenile textures such as vesicles and phenocrysts of the Malalak Tephra deposit. This deposit mainly consists of five pumice fall layers (F-1, F-2, F-3, F-4, and F-5) with gradational contact between each layer (repetitions of normal and reverse grading). White and grey pumices occur as the main juvenile phase. White pumice has a higher crystallinity (avg. of 44 %) and more evolved chemical composition of glass (73–78 wt. % SiO_2) compared to grey pumice (average crystallinity 37 % with 71–77 wt. % SiO_2), suggesting that both pumices originated from different magma chambers and mingled just before and during the eruption. Grey pumice is typically denser than white pumice, with varying bulk density of 0.65–1.78 g/cm^3 and 0.48–1.09 g/cm^3 for grey pumice and white pumice, respectively. Bulk density was observed to increase (for white and grey pumices) from the main stage (F-1 and F-2) to the closing stage (F-3, F-4, and F-5). Because bulk density is strongly dependent on bulk vesicularity, and bulk vesicularity is controlled by vesicle number density (which is a function of decompression rate), it can be inferred that the main stage was relatively more explosive compared to the closing stage.

Keywords: Tandikat volcano, explosive eruption, stratigraphy, textural study, bulk density, vesicle number density