ERUPTION DYNAMICS AND CONDUIT PROCESS OF THE 52-ka MANINJAU CALDERA FORMING ERUPTION, WEST SUMATRA, INDONESIA

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The eruptive products from caldera forming eruption usually includes non-welded and welded ignimbrite. The formation of welded ignimbrite modifies the whole structure of the deposit, hence limits the understanding of caldera forming eruption. Interestingly, the 52-ka caldera forming eruption of Maninjau in West Sumatra, Indonesia, only produce the non-welded ignimbrite that distributed to the whole direction from the main volcanic edifice. The absence of welded ignimbrite has allowed us to conduct detail comparison for each erupted ignimbrite from different directions and advance the understanding of caldera forming eruption. We attempted to correlate the stratigraphy and reconstruct the eruption stages based on componentry combined with petrography, chemical analyses of plagioclase, and melt compositions by FE-EPMA and clarify the conduit process by textural analyses bulk-density and bubble number density (BND).

Ignimbrite from the 52-ka eruption consists of two distinctive types of white pumice (transparent and non-transparent). Transparent white pumice (T-WP) are rich in pheno-bubble (pre-existing bubble in magma chamber with diameter >0.1 mm), poor in matrix-bubble (syn-eruptive bubble with diameter <0.1 mm), and relatively fragile. In contrast, non-transparent white pumice (NT-WP) are phenobubble-poor, matrix bubble-rich, and relatively strong. The 52-ka eruption also produces non-transparent type of grey and banded pumice. Based from colour difference, grey pumice can be classified as follows: light grey pumice (NT-LGP), pale grey pumice (NT-PGP), dark grey pumice (NT-DGP). Lithic component is relatively homogeneous with the domination of pre-caldera lava with minor quartzite and metasedimentary rocks. The most complete stratigraphic section (from lower to upper part) only can be found in the ±100m-deep Sianok valley and corresponds to eastern ignimbrite deposit. From this location, we found the increment of lithic content towards the stratigraphic height thus become our backbone to justify the eruption stages and make correlation with other ignimbrites. Particularly, we divided the eruption stages to three level: early (0-10 lithic wt.%), middle (10-20 lithic wt.%), final (>20 lithic wt%). As a result, most of the eastern ignimbrites correspond to early stage, while northern and some of western side correspond to middle stage, and southern, most of western, and some eastern side correspond to final stage. The increment of lithic towards the eruption time is consistent with the increment of NT-WP, grey pumice, banded pumice, and decrement of T-WP. There is no difference in mineralogy, crystallinity, melt, and plagioclase compositions between T-WP and NT-WP (pl>qz>bt>px>ox, average 0.8 %, 76-81 wt.% SiO_2, An_{20-30}, respectively), hence we assume that both pumices originated from same magma chamber. Before the eruption, the white-magma chamber mingled with crystal rich (average 25 %, pl>px>bt>ox), quartz-free grey-magma (70-79 wt.% SiO2, modal anorthite: An_{50-60}). We suggest that the upper part of the giant pre-eruptive white-magma body was supersaturated with pheno-bubble, producing T-WP during the early-middle stage. While the lower part of white-magma body was relatively poor in pheno-bubble, influenced by injection of grey magma, and evacuated during the caldera collapse, producing NT-WP, grey pumice, banded pumice, and lithic during the final stage.

The modal density of white pumice decreases from the early to final stage. We interpret this as the effect of more intense matrix-bubble nucleation resulted by decrement of pheno-bubble. Namely, the number density of pheno-bubble is responsible for limiting the secondary nucleation of matrix-bubble. The decrement of pheno-bubble will give rise to matrix-bubble nucleation and reduce the area of glass thus reduce the bulk density. This is consistent with our result that white pumice from the early and middle stages are composed by lower BND compared to the final stage.

Keywords: caldera forming eruption, Maninjau, componentry, chemical analyses, textural analyses, bubble number density