

Spatial variation of magmatic temperatures and water contents in western Java Island, Indonesia: estimation from mineral

TAKAYAMA, Kohei^{1*} ; OHBA, Tsukasa¹ ; ABDURRACHMAN, Mirzam² ; IWAN, Setiawan¹ ; FIRMANSYAH, Reza²

¹Akita University, ²Institut Teknologi Bandung

Across-arc variations of magmatic temperatures and water contents in West Java were investigated from whole-rock chemistry, petrography, and phenocryst mineral compositions. Volcanic rocks were collected from eight volcanoes in the region. To determine these properties, the pyroxene thermometer by Brey and Kohler (1990) and the plagioclase-melt hygrometer by Putirka (2008) were applied. Rocks in this region range from basalt to andesite with some exceptions: dacite from Guntur and latite from Dago. Silica contents range from 53-58 wt% in Papandayan, 51-63 wt% in Guntur, 50-57 wt% in Galunggung, 57-61 wt% in Cikuray, c. 57 wt% in Tangkuban Parahu, 56-57 wt% in Dago, 49-57 wt% in Tampomas, and 55-61 wt% in Ciremai, respectively. Although a majority of rocks belong to medium-K series, potassium content varies by location, increasing with the distance from the trench. Basalt and basaltic andesite from Galunggung, one of the frontal volcanoes, are classified as low-K series, and part of rocks from rear-arc volcanoes, Tampomas, Tangkuban Parahu, and Dago, are assigned to high-K series. To equalize effects of differentiation, samples with similar silica contents (c. 57 wt%) are selected to apply the geothermometer and the hydrometer. Pyroxene rims indicate a temperature range from 900-1050 °C (970-1000 °C in Papandayan; 900-1020 °C in Guntur, 970-1020 °C in Galunggung, 970-1020 °C in Cikuray, 940-1050 °C in Tangkuban Parahu, 970-980 °C in Tampomas, and 950-1020 °C in Ciremai). The temperature estimates of cores range from 900-1030 °C (970-1000 °C in Papandayan, 930-950 °C in Guntur, 950-1030 °C in Galunggung, 960-1010 °C in Cikuray, 990-1030 °C in Tangkuban Parahu, 950-1030 °C in Tampomas, and 900-940 °C in Ciremai). Water content of plagioclase rims ranges from 0.5-1.6 wt % and each volcano exhibit narrow range (1.0-1.2 wt% in Papandayan, 1.6 wt% in Guntur, 0.9-1.2 wt% in Galunggung, 1.6-1.8 wt% in Cikuray, 0.5-0.7 wt% in Tangkuban Parahu, 0.7 wt% in Dago, 1.1-1.3 wt% in Tampomas, and 1.2 wt% in Ciremai). The water contents estimated from core composition show no distinct difference from those of rims, ranging from 0.6-1.4 wt% (1.3-1.5 wt% in Papandayan, 1.1-1.4 wt% in Guntur, 0.6-1.0 wt% in Galunggung, 1.1-1.4 wt% in Cikuray, 0.8-1.1 wt% in Tangkuban Parahu, 0.6-0.8 wt% in Dago, 0.9-1.2 wt% in Tampomas, and 1.0 wt% in Ciremai). Neither temperature nor water content is correlated with the distance from the trench; lateral variations are not distinct in terms of these properties. In many samples, pyroxene crystals exhibit reverse-zoning with increasing Mg-number, and the estimated temperatures at rims are higher than those of cores, implying recharge of hot magmas into colder magma reservoirs.

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