

SARI

Kompleks Gunung Api Telomoyo merupakan rangkaian gunung api di Jawa Tengah yang termasuk ke dalam Wilayah Kerja Panas Bumi dan dikaitkan sebagai sumber panas bagi sistem panas bumi. Berdasarkan penelitian sebelumnya, daerah ini menunjukkan adanya perubahan komposisi mineralogi yang progresif dari basaltik dengan kandungan olivin menjadi andesit yang mengandung augit, hipersten, dan hornblenda. Untuk itu, diperlukan informasi mengenai diferensiasi secara kimia, fisik, dan aspek tempoalnya. Penelitian ini akan berfokus proses diferensiasi yang menghasilkan lava pada daerah penelitian berdasarkan identifikasi dari masing-masing analisis. Penelitian membagi menjadi sembilan pusat erupsi: Gilipetung, Kelir, Weru, Candi Dukuh, Andong, Kendil, Gajah, Telomoyo, dan Telomoyo Baru. Analisis dilakukan pada 31 sampel untuk geokimia *major oxide*, petrografi, dan *crystal size distribution* (CSD). Daerah penelitian dibagi menjadi magma Tipe 1 (Unit Gilipetung, Kelir, Candi Dukuh, dan beberapa sampel Weru (WR13 & WR22)), Tipe 2 (Unit Andong), dan Tipe 3 (Unit Weru, Kendil, Gajah, Telomoyo, dan Telomoyo Baru) dengan indeks diferensiasi K_2O , MnO , dan P_2O_5 menurun dan TiO_2 yang meningkat seiring bertambahnya SiO_2 . Magma Tipe 1 memiliki proses fraksional kristalisasi dengan SiO_2 50,7 – 54,7 wt%, litologi *trachy-basalt* dan *basaltic trachy-andesite*, seri magma *Higher High-K*, memiliki waktu singgah 3 – 266 tahun. Magma Tipe 2 memiliki proses fraksional kristalisasi dengan SiO_2 57,4 – 58,5 wt%, litologi *trachy-andesite*, seri magma *Medium-K Calc-Alkaline*, memiliki waktu singgah 12 – 161 tahun. Magma Tipe 3 memiliki kombinasi fraksional kristalisasi, *magma mixing*, dan asimilasi dengan SiO_2 56,1 – 61,2 wt%, litologi *basaltic trachy-andesite* hingga *tracy-andesite*, waktu singgah 5 – 138 tahun. Evolusi magma dan karakteristik magma memiliki hubungan yang tercermin dari kelimpahan mineral seiring dengan peningkatan SiO_2 . Kristalinitas akan meningkat seiring dengan peningkatan SiO_2 . Waktu singgah magma akan mempengaruhi kristalinitas dan evolusi magma yang hubungannya bergantung pada *supply rate* magma. Sementara, waktu singgah magma tidak berhubungan dan karakteristik magma.

Kata kunci: Kompleks Gunung Api Telomoyo, diferensiasi magma, geokimia lava, *crystal size distribution*, waktu singgah magma

ABSTRACT

The Telomoyo Volcanic Complex is a chain of volcanic centers located in Central Java, classified within a Geothermal Working Area and considered a potential heat source for the surrounding geothermal system. Previous studies have indicated a progressive change in mineralogical composition, from olivine-bearing basaltic rocks to andesitic compositions containing augite, hypersthene, and hornblende. Considering this, further investigation is required to understand the chemical, physical, and temporal aspects of magmatic differentiation. This research focuses on the processes of differentiation that produced the lava flows in the study area, based on insights from various analytical approaches. The study identifies nine eruptive centers within the complex: Gilipetung, Kelir, Weru, Candi Dukuh, Andong, Kendil, Gajah, Telomoyo, and New Telomoyo. A total of 31 samples were analyzed for major oxide geochemistry, petrography, and crystal size distribution (CSD). Based on the geochemical and petrographic characteristics, the magmas in the study area are classified into three types. Type 1 magma includes units from Gilipetung, Kelir, Candi Dukuh, and several samples from Weru (WR13 and WR22). Type 2 magma corresponds to the Andong unit, while Type 3 magma comprises the remaining units of Weru, Kendil, Gajah, Telomoyo, and New Telomoyo. These magma types are distinguished by trends in geochemical indices, where K_2O , MnO , and P_2O_5 concentrations decrease and TiO_2 increases with rising SiO_2 content. Type 1 magma is characterized by processes of fractional crystallization, with SiO_2 contents ranging from 50.7 to 54.7 wt%. The lithologies are identified as trachy-basalt and basaltic trachy-andesite, belonging to the Higher High-K magma series, with magma residence times ranging from 3 to 266 years. Type 2 magma is the result of fractional crystallization, with SiO_2 contents between 57.4 and 58.5 wt%, trachy-andesite lithology, and is part of the medium-K calc-alkaline series, with residence times of 12 to 161 years. Type 3 magma, on the other hand, formed through a combination of fractional crystallization, magma mixing, and assimilation processes. It has SiO_2 contents ranging from 56.1 to 61.2 wt%, lithologies of basaltic trachy-andesite to trachy-andesite, and residence times of 5 to 138 years. The evolution and characteristics of magma are interrelated, as reflected by the abundance of mineral phases that increase alongside rising SiO_2 content. Crystallinity tends to increase with higher silica concentrations, indicating progressive differentiation. Magma residence time influences both crystallinity and magmatic evolution, with the nature of this relationship depending on the magma supply rate. However, magma residence time appears to have no direct correlation with the intrinsic chemical characteristics of the magma itself.

Keywords: *Telomoyo Volcanic Complex, magma differentiation, lava geochemistry, crystal size distribution, magma residence time*