

K-Ar ages of Kelut-Welirang volcano cluster, East Java, Sunda arc: comparison with clusters that hosts large calderas

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Sunda arc, Indonesia, has many active caldera volcanoes and is well suited for studying the evolution of large caldera systems. Volcano groups are distributed in clusters at Sunda arc. Two adjacent volcano clusters in East Java, Semeru-Tengger and Kelut-Welirang, are compared. Semeru-Tengger volcano cluster consist of Semeru and Tengger-Bromo volcano systems. Tengger-Bromo system has formed Ngadisari and Sand Sea calderas. Kelut-Welirang volcano cluster consists of multiple active volcano groups and has comparable footprint and cumulative volume as Tengger-Bromo. However, large-scale eruptions in the order of 10km³ or greater have not taken place at Kelut-Welirang volcano cluster.

Kelut-Welirang volcano cluster consists of five volcano groups. They are Penanggungan, Arjuno-Welirang, Argowayan, Butak-Kawi-Panderman, and Kelut from northeast to southwest. They are classified as active volcanoes except for Argowayan, and Kelut is currently active. However, their formation ages are not understood.

K-Ar dating is performed in order to determine and compare the long-term activity of the two clusters. Mass fractionation correction method is used for argon measurement, for many of the samples are very young. Samples with crystalline groundmass are selected for dating to obtain precise and reliable age. Groundmass is separated from phenocryst and used for dating.

The active periods and the ages of the volcano groups are identified by K-Ar dating as follows. (a) Argowayan, which consists about half of the volume of Kelut-Welirang cluster, has formed between 1.0-0.8Ma. (b) There was long dormancy in the area of this cluster, and the four volcano groups have formed within the past 0.2 m.y. (c) Kelut has started to form by 0.2Ma, and has repeatedly produced lava domes to present. (d) Much of Butak-Kawi-Panderman has formed around 0.2Ma. The group is considered active, but the long-term eruption rate of the group has decreased substantially since the early stage of edifice building activity at 0.2Ma. (e) Arjuno-Welirang is younger and likely started to form by 0.1Ma. (f) Penanggungan is the youngest volcano group and likely to have formed within the past 0.05 m.y.

The obtained ages allow us to compare Kelut-Welirang and Tengger-Semeru volcano clusters. Although Kelut-Welirang cluster has comparable volume to Tengger-Semeru, it consists of separate volcano groups formed at different ages. The long-term eruption rate for the past 0.2Ma is relatively large, but much of the erupted volume is contributed from new volcano group. In contrast, the volcano edifices of Semeru-Tengger have almost entirely formed from 0.5Ma to present. The eruptive centers are concentrated at Tengger and Semeru, and have repeated active periods.

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