Long-term volcanism around active calderas in Bali and Tengger-Bromo region, East Java, Sunda arc

Kiyoshi Toshida[1], Shingo Takeuchi[1], Ryuta Furukawa[2], Akira Takada[2], Supriyati Andreastuti[3], Nugraha Kartadinata[3], Anjar Heriwaseso[3], Rosgandika Mulyana[3], Asep Nursalim[3], Oktory Prambada[3], Yudi Wahyudi[3]

[1]CRIEPI, Japan, [2]AIST, GSJ, Japan, [3]CVGHM, Indonesia

E-mail: toshida@criepi.denken.or.jp

We study the long-term volcanism around the active calderas in Bali and Tengger-Bromo region, East Java. Mass fractionation correction method is utilised for the mass spectrometry of K-Ar dating, which accounts for the fractionation of initial argon ratios. Lava samples having pilotaxitic or intergranular groundmass texture are selected for dating in order to obtain accurate and precise ages. Some of the samples dated are estimated to contain initial argon ratios that are fractionated from atmospheric values.

We have identified three active periods of volcanism in Bali. They are 1.6-1.5 m.y. BP, 0.7-0.5 m.y. BP, and 0.2 m.y. BP to present. Volcanic rocks to the west of Bratan caldera were formed by the 1.6-1.5Ma activity. Volcanoes consisting the northern aprons of caldera sommas were formed by the 0.7-0.5 Ma activity. Between 0.2-0.1 Ma, volcanism occured extensively around present Batur and Bratan calderas. The shield volcanoes consisting the somma of Batur and Bratan have started to form by covering the 0.5 Ma volcanoes. Batukau, EL 706m volcano near Pasek, and Cemara volcanoes were also formed in this period. From 0.1Ma to present, the activity continued at Batur somma and formed Abang peak. Agung volcano started to form by 0.05 m.y. BP. Both Batur and Bratan systems have produced caldera-forming eruptions multiple times in the past 0.03 m.y., and their intra-caldera activity has continued along with the activity of Agung.

Caldera-forming eruptions of Tengger-Bromo system are older than Bali calderas, yet the volcano is still very much active. The two calderas are Ngadisari and Sand Sea. The activity of Tengger volcano started with the formation of northern somma (Pananjakan) in 0.5-0.45 Ma, after the 1.2 m.y. hiatus following the formation of 1.7 Ma Kukusan volcano. The aprons were formed in the subsequent active periods. More than half of the edifice volume erupted between 0.35-0.2 Ma and have formed much of the aprons, with average eruption rate greater than 2km3/ky. The northeastern to southern somma, and the northern apron, were formed in 0.35-0.3 Ma. The eastern apron and the southwestern apron were formed in 0.25-0.2 Ma. Lavas and cones in the northwestern apron, and Ngadas basalt and andesite lavas (which fill the Ngadisari caldera), have formed in 0.08-0.06 Ma. The age of Sand Sea eruption is determined to be about 0.05 Ma from stratigraphy relations. Therefore, the central cones are found to be younger than 0.05 Ma, which is consistent to 14C ages of tephra at the caldera rim from previous study. The average eruption rate of the central cone activity is calculated to be about 0.1 km3/ky. Petrography and whole-rock chemistry of ejecta from the central cones, including the active vent (Bromo), are similar to those of Ngadas lavas and Sand Sea eruption PDC deposits. These observations imply that the present magma supply and accumulation system is similar to the one prior to the Sand Sea eruption.