

## Long-term volcanic history preceding caldera-formation in Bali, Sunda arc

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Large-scale, caldera-forming eruptions cause significant effects on both regional and global scale. Large amount of magma need to accumulate over long period of time before large-scale eruption takes place. In order to find the characteristics on the long-term variation of volcanic activity prior to caldera-forming eruptions, we observe stratigraphy and topography, and conduct comprehensive sample collection of volcanic rocks in Bali, Sunda arc. Batur and Bratan (Buyan Bratan) calderas have formed in Bali. Multiple caldera-forming eruptions have taken place from the both systems, and the volcanoes remain active. The active stratovolcano (Agung) is located to the east of Batur. Modal abundance analysis, whole-rock chemistry and K-Ar dating are performed at CRIEPI. Mass fractionation correction method is used for the mass spectrometry of K-Ar dating, which accounts for the fractionation of initial argon ratios. In order to obtain accurate and precise ages, lava samples having pilotaxitic or intergranular groundmass texture are selected for dating through sample collection and thin section observation. These measures help decrease and the amount of non-radiogenic argon and improve accuracy. Some of the samples dated are estimated to contain initial argon ratios that are fractionated from atmospheric values, confirming the significance of utilizing mass fractionation method and careful sample selection.

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 distributed 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 activities. Tapis, the small volcano covered by Agung, as well as Seroja (Seraya) volcano in the eastern part of Bali, were also formed in this period.

The most recent active period can be divided into two parts based on K-Ar ages. Between 0.2-0.1 Ma, volcanism occurred extensively in Batur and Bratan region. Batukau volcano (located SW of Bratan), EL 706m volcano near Pasek (located between Batur and Bratan), and Cemara (located south of Agung) volcano were formed. The shield volcanoes consisting the somma of Batur and Bratan have started to form in the same period, covering the 0.5 Ma volcanoes.

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, and constructed the edifice that partly covers older Tapis and Cemara volcanoes. Both Batur and Bratan systems have produced caldera-forming eruptions multiple times in the past 0.03 m.y. The calderas have formed between the aprons of volcanoes from different ages (0.5 Ma and 0.2 Ma or younger). Their intra-caldera activity has continued along with the activity of Agung.

Cemara volcano has smooth peak area and, contrastingly, peculiar steep cliff of the east apron. The small hills distributed in the SE of Cemara may have formed by sector collapse of Cemara volcano, and requires further study.

Clinopyroxene phenocrysts of volcanic rocks in Bali are generally light-colored under the microscope in thin sections, indicating their high Mg# and relatively high temperature of magma. The aphyric andesite lavas have relatively higher K<sub>2</sub>O, TiO<sub>2</sub> content and FeO\*/MgO ratio compared to older andesite. The large shield volcanoes of 0.2 Ma consist of aphyric andesite lava layers. We find it significant that the magmatic system possessed the ability to generate and store large amount of aphyric andesite magma prior to the caldera-forming stage.

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