K-Ar age determination of rejuvenated stage lavas on the island of Oahu, Hawaii

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Many hotspot volcanoes undergo rejuvenated volcanism after a long period of erosion of the shield. The cause of this volcanism have long been one of the most puzzling questions concerning hotspots. Although there are several models about the cause of rejuvenated volcanism, evaluation of these models were difficult because detailed temporal and spatial distribution of rejuvenated volcanism was not known. K-Ar ages were determined on Honolulu Volcanics (HV) from the island of Oahu in order to clarify the duration of volcanic quiescence after formation of the shield volcano and the temporal and spatial distribution of HV. In previous studies, HV was regarded as younger than 1 Ma, although some of the age data are much older than the Koolau Volcanics (1.8-2.6 Ma; Doell & Dalrymple, 1973). Lanphere and Dalrymple (1980) suggested that these anomalously old ages are due to excess argon contained in mantle xenoliths. The number of reliable ages is not sufficient to construct the HV eruptive history. In this study, we used only groundmass for dating. Argon content was determined by unspiked sensitivity method (Matsumoto et al., 1989) and potassium content was determined by flame photometry. We applied mass fractionation correction procedure (Matsumoto and Kobayashi, 1995) in order to obtain accurate radiogenic argon content because all of the samples had atmospheric contamination as high as 80%. Our new K-Ar ages for HV lavas range 0.03-0.80 Ma. Based on the ages for the Koolau Volcanics, the length of the volcanic hiatus is about 1 m.y. It appears that there are two peaks in the Honolulu volcanism at 0.80-0.35 and 0.12 Ma. It is suggested that volcanism was waned during 0.35-0.12 Ma, during which only one age was obtained in this study. Ages distributes nearly continuous during 0.35-0.80 Ma (with no significant age gaps) and the frequency of eruption seems to have increased with time. The ages around 0.12 Ma are indistinguishable from each other within 1 sigma errors. The younger group can be further divided into two groups based on spatial distribution (Tantalus and Koko rifts), and show distinct chemical compositions (nephelinitic vs. weakly alkalic). Our new ages are consistent with the model that rejuvenated volcanism is caused by a secondary melting zone of the plume (Ribe & Christensen, 1999). The timing of the younger pulse and the directions of the rifts are consistent with the hypothesis that the pulse was caused by a flexural arch.