K-Ar AGES OF ALKALI BASALTS FROM THE OKI-DŌGO ISLAND

ICHIRO KANEOKA*, EIICHI TAKAHASHI** and SHIGEO ZASHU*

(Received August 2, 1976)

K-Ar ages were determined for basalts from the Oki-Dōgo Island. The sample KRB was collected from a lava flow of more than 15 meters thick which composes Kuroshima, located to the north of Ōku village, Oki-Dōgo Island. TOMITA (1935) assigned this lava flow as "the third trachy-basalt" in his classification and regarded it to be Pleistocene or Holocene. The sample OKD was collected from a volcanic neck which lies about 1 km to the southwest of the lava flow KRB. This volcanic neck has intruded the T₂ sediment defined by TOMITA (1935) which corresponds to the Ochi Formation of Miocene defined by UCHIMIZU (1966). This was firstly described by TAKAHASHI (1975). These samples are fresh alkali-olivine basalts and contain many ultramafic xenoliths of deep origin.

K was analysed by a flame photometer with Li internal standard method. Radiogenic ⁴⁰Ar was determined by using a

Reynolds-type mass spectrometer with ³⁸Ar as tracer. Since the present samples contain relatively high atmospheric Ar of about 70—90%, the resultant analytical error in the age becomes about 5—8% for each analysis. Both samples were analysed as whole rocks. In the present study, we use such decay constants for ⁴⁰K as were recommended to be most reliable by the Subcommittee on Geochronology, ICS, held in Sydney in 1976. If the conventional ones (i. e. $\lambda = 5.304 \times 10^{-10}$ year⁻¹, $\lambda_e = 0.584 \times 10^{-10}$ year⁻¹) are used, the resultant K-Ar ages lower by 0.08—0.09 million years in the present case. To examine the state of secondary alteration more objectively, H₂O content was also measured by ignition loss method.

The results are shown in Table 1. Their H₂O contents are relatively low, which suggests their freshness and supports the assessment by microscopic observations. It has been found that no Ar loss occurred for vol-

Table 1. K-Ar ages of basalt from the Oki-Dōgo Island.

Sample	Rock type	K (%)	⁴⁰ Ar* ($\times 10^{-7}$ ccSTP/g)	$\frac{^{40}\text{Ar}_{\text{atm.}}}{^{40}\text{Ar}_{\text{total}}} \times 100$ (%)	Age 1) ($\times 10^6$ years)	H ₂ O(+) (%)	H ₂ O(-) (%)
OKD	Alkali-olivine basalt	1.49 ± 0.01	2.09	82.4	3.61	0.59	0.11
KRB	Alkali-olivine basalt	1.83 ± 0.01	2.44 } 2.35 2.27 } ± 0.09	88.1 70.5	3.30 ± 0.12	0.41	0.27

N.B.

1) $\lambda = 5.544 \times 10^{-10}$ year⁻¹, $\lambda_e = 0.581 \times 10^{-10}$ year⁻¹.

± means the reproducibility of the measurement.

* Geophysical Institute, Faculty of Science, University of Tokyo, Bunkyo-ku, Tokyo.

** Geological Institute, Faculty of Science, University of Tokyo, Bunkyo-ku, Tokyo.

Table 2. Summary of radiometric ages of volcanic rocks from the Oki-Dōgo Island.

Sample and sampling locality	Rock type	Classification and estimated age from stratigraphy (Uchimizu, 1966)	Radiometric age ($\times 10^6$ years)	Method	Reference
OKD (see text)	Basalt	n. d.	3.6	K-Ar	This study
KRB (Kuroshima)	Basalt	Ōmine Basalt Group (Pleistocene)	3.3	K-Ar	This study
Kumi	Obsidian	Oki-Trachyte-Rhyolite Group (Pliocene)	3.9	Fission Track	Suzuki (1970)
Kurotaki	Obsidian	Oki-Trachyte-Rhyolite Group (Pliocene)	*6.3<	K-Ar	Kaneoka (1970)
Nijiyama	Basalt	Saigō-Basalt Group (Early Pliocene)	*0.84	K-Ar	Hirooka and Kawai (1967)

* These K-Ar ages were recalculated by using decay constants for ^{40}K recommended by the Subcommittee on Geochronology, ICS, held in Sydney in 1976. No significant difference is observed from the reported values.

canic rocks with low $\text{H}_2\text{O}(+)$ content and the obtained K-Ar age is reliable (KANEOKA, 1972). Hence the present samples are suitable for K-Ar dating.

The obtained K-Ar ages are about 3.6 and 3.3 million years for the samples OKD and KRB respectively. Although the former sample seems to be a little older than the latter, the difference in the apparent age cannot be regarded to be significant considering the uncertainty of the measured age of about 0.15–0.25 million years.

In the Oki-Dōgo Island, only few radiometric ages of volcanic rocks have been reported so far. These results including present ones are summarized in Table 2, where samples are arranged from younger to older one estimated stratigraphically by UCHIMIZU (1966). TOMITA (1935) estimated similar stratigraphy in this area. Although Ōmine-Basalt Group has been regarded to be of Pleistocene by UCHIMIZU (1966), present result indicates that they extruded in Pliocene. Furthermore, large difference is observed between the estimated age and the radiometric age for the sample from Nijiyama. This sample is a fresh basalt collected from Nijiyama quarry about 2 km to the northwest of Saigō-Machi (town) (H. ITOH, 1976, personal communication). Although UCHIMIZU (1966) regarded it as pre-rhyolite activity (Saigō-Basalt Group), its K-Ar age is less than one million years (HIROOKA & KAWAI, 1976) and significantly younger than those of intermediate-acidic volcanic rocks (Oki-Trachyte-Rhyolite Group) which exceed several million

years. Reinvestigation of the stratigraphical relationship between “Saigō-Basalt Group” and “Oki-Trachyte-Rhyolite Group” has revealed that the former covers the latter at several outcrops around Saigō-Machi (TAKAHASHI, 1976). Furthermore, the secondary hydration affects both fission track and K-Ar ages of obsidians, resulting generally in reducing the apparent age (KANEOKA, 1972; LAKATOS & MILLER, 1972). The obsidian from Kurotaki shows large $\text{H}_2\text{O}(+)$ content of 2.92%, indicating the possibility of Ar loss (KANEOKA, 1970). Hence the obtained age should be regarded as the younger limit of the eruption. No details are known for the sample from Kumi.

A series of alkali rocks has been observed in succession in the Oki-Dōgo Island and UCHIMIZU (1966) regarded them to have been formed through magmatic differentiation in the magma reservoir. Radiometric age data suggest, however, that the period of volcanic activities of intermediate-acidic rocks of alkali rock series might be different from those of alkali-olivine basalts: large amount of intermediate-acidic rocks of alkali rock series extruded in late Miocene and/or Pliocene, whereas sporadic eruptions of alkali-olivine basalts occurred from middle Pliocene through Pleistocene in the northeastern part of the island. This may also reflect the difference of their origin. These basaltic activities might be comparable with those observed in San'in-San'yō districts during Cenozoic time (TAKAHASHI, 1973).

This study was financially supported in

part by the ITOH Science Foundation.

References

- HIROOKA, K. and KAWAI, N. 1967: Results of age determination of some late Cenozoic rocks in Southwestern Japan. *Ann. Progress Rep. Paleogeophys. Res. Japan*, 69—73.
- KANEOKA, I. 1970: K-Ar age determination of young volcanic rocks and the age of the ocean floor. *Ph. D. Thesis, Univ. Tokyo*, 195 p.
- KANEOKA, I. 1972: The effect of hydration on the K/Ar ages of volcanic rocks. *Earth Planet. Sci. Lett.*, **14**, 216—220.
- LAKATOS, S. and MILLER, D. S. 1972: Evidence for the effect of water content on fissiontrack annealing in volcanic glass. *ibid.*, **14**, 128—130.
- SUZUKI, M. 1970: Fission track ages and uranium contents of obsidian. *J. Anthropol. Soc. Nippon*, **78**, 50—58.
- TAKAHASHI, E. 1975: Finding of spinel-ilherzolite inclusions in Oki-Dōgo Island, Japan. *Jour. Geol. Soc. Japan*, **81**, 81—83 (in Japanese).
- TAKAHASHI, E. 1976: Ultramafic xenolith of alkali basalt, Oki-Dōgo Island in the Japan Sea. *Master Sci. Thesis, Univ. Tokyo*, 219 p.
- TAKAMURA, H. 1973: Petrographical and petrochemical studies of the Cenozoic basaltic rocks in Chugoku Province. *Geol. Rep. Hiroshima Univ.*, **18**, 1—167 (in Japanese).
- TOMITA, T. 1935: Geology of Dōgo, Oki Islands, in the Japan Sea. *Jour. Shanghai Sci. Inst.*, [2], **2**, 39—146.
- UCHIMIZU, M. 1966: Geology and petrology of alkali rocks from Dōgo, Oki Islands. *Jour. Fac. Sci., Univ. Tokyo*, [II], **16**, 85—159.