NOTE

**Discrepant results of C-14 and fission track
datings for some volcanic products
in southern Kyushu**

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Abstract—Seven charcoals from the Ito pyroclastic flow deposits in southern Kyushu show discordant C-14 ages, ranging from 2,460 to 38,900y. To obtain the upper limit of age for the Ito pyroclastic flow, three obsidians from the Arasaki pumice fall deposits underlying the Ito were dated by fission track method. The ages of the obsidians range from 31,000 to 41,000y. Possible sources of error in the C-14 dating are discussed.

INTRODUCTION

Some C-14 ages have been reported for the volcanic products in southern Kyushu. The volcanic deposits dated are the Ito pyroclastic flow (ARAMAKI, 1965; ISSHIKI *et al.*, 1965; YOKOYAMA, 1971; SATO *et al.*, 1971; KOBAYASHI *et al.*, 1971), the Osumi pumice fall (GOHARA, 1965) and the Ata pyroclastic flow (ARAMAKI and UI, 1965; UI, 1971). Recently preliminary fission track dates have been obtained on obsidians from the Arasaki pumice fall deposits which constitute one of the substrata of the Ito pyroclastic flow. On the basis of some stratigraphic evidences, a comparison is made on the available dates of the volcanic products in southern Kyushu.

STRATIGRAPHIC RELATIONS AND OCCURRENCES OF THE SAMPLES*

All the charcoal samples discussed in this report were collected from the unconsolidated, loose pyroclastic deposits occurring around the Kagoshima Bay, southern Kyushu. The detailed pyroclastic stratigraphy of the area indicates that these deposits were formed mainly by the eruption of voluminous pyroclastic fall and flows of dacitic and rhyolitic compositions (ARAMAKI, 1969a, b). The relevant part of the stratigraphic column is given in Table 2. The upper four stratigraphic units in Table 2, *i.e.*, Ito

* The details of sampling localities will be described elsewhere.

pyroclastic flow, Kamewarizaka breccia, Tsumaya pyroclastic flow and Osumi pumice fall, are all the products of a single but composite cycle of eruption (ARAMAKI, 1969 a,b). The whole sequence of eruptive events which produced these four stratigraphic units was apparently a matter of very short duration so that the dating methods discussed in this report may not be able to distinguish one unit from another. All carbon samples, except GaK-211 which is a black soil, are charred wood materials derived from carbonization of tree branches and trunks which were incorporated in high-temperature pyroclastic flow (or ash flow) deposits during large-scale eruptive episodes. Therefore, there is in the field no indication of carbonization for these samples at lower temperatures such as atmospheric except for GaK-211. All the samples from the pyroclastic flow deposits were taken from the "fresh" outcrops as far as ordinary petrological criteria go. The field occurrences are just the same as such well-established pyroclastic flow units as the pumice flows of Crater Lake (WILLIAMS, 1942) and the Taupo pumice flow (HEALY, 1965), for both of which a group of conformable C-14 dates has been reported.

The obsidian samples were collected from the outcrop of the Arasaki pumice fall deposits at Kaigata, Tarumizu City, Kagoshima Prefecture. The Arasaki pumice fall deposits conformably underly the Osumi pumice with a soil layer about 20 cm thick. The time gap between the Arasaki and the Osumi may not have been large, judged from the thickness of the soil layer.

Thus, there is no evidence that the difference between the ages of the Ito and the Arasaki is large enough to be figured out by the dating methods.

C-14 DATES OF THE ITO PYROCLASTIC FLOW AND FISSION TRACK DATES OF THE ARASAKI PUMICE FALL

The experimental procedures of C-14 dating are described by SATO *et al.*, (1968), KIGOSHI (1966) and HAMADA and FUJIYAMA (1964). The procedure of fission track dating is similar to that used by SUZUKI (1970). The experimental details in the present work are given in Table 1.

Table 1. Experimental details of fission track dating for obsidians from Arasaki pumice fall

Sample No.	Etching period ¹⁾ , sec.	Spontaneous fission track density, cm ⁻²	Dose of thermal neutrons ^{2),3)} ×10 ⁻¹⁴	Induced fission track density, cm ⁻² ×10 ⁻⁴	Uranium content ³⁾ , ppm
KG-a	15	19.2	1.42	0.528	2.2
KG-b	15	21.1	3.00	1.03	2.0
KG-c	15	25.6	3.00	1.13	2.2

1) 48% HF, room temperature.

2) Neutron source: TRIGA-II, Institute for Atomic Energy, Rikkyo University.

3) Estimation based on the induced fission track density of a standard glass. The use of the standard glass will be described in detail elsewhere.

The C-14 and the fission track dates for the volcanic products in southern Kyushu are summarized in Table 2. Among the C-14 dates for the Ito pyroclastic flow, TK-77, GaK-558 and N-638 show comparable ages. TK-75 gives the highest value. Of the remaining three samples, the ages of TK-59 and TK-60 are anomalously young. The fission track ages measured on three separate obsidians from the Arasaki pumice fall deposits range from 31,000 to 41,000y.

DISCUSSION

The sample TK-60 having the anomalously young age was collected from the freshly bulldozed face of the Ito pyroclastic flow deposits. The sample clearly retained an outline of a tree trunk about 30cm in diameter, buried nearly 10m below the surface and isolated from any living plant such as rootlets. The tree-ring texture still remained. However, the charcoal sample turned out to be loose, mudlike material when it was taken out from the outcrop, and its original texture was lost into soft, amorphous aggregate. The sample TK-59 was collected from a fairly old face of a road cut about 2m high. The macroscopic feature of the sample was about the same as TK-60, except that TK-59 represented tree branches about 5 cm in diameter. Another

Table 2. C-14 and fission track ages of volcanic products in southern Kyushu

Stratigraphic unit	C-14 age (years B.P.)			Fission Track age (years B.P.)**		
	No.*	Material	age	No.	material	age
Ito pyroclastic flow	TK-59	charcoal	8,760 $\pm$ 250 ¹⁾			
	TK-60	charcoal	2,460 $\pm$ 350 ²⁾			
	TK-75	charcoal	38,900 $\pm$ 2,100 ³⁾			
	TK-77	charcoal	26,800 $\pm$ 500 ⁴⁾			
	GaK-473	charcoal	16,350 $\pm$ 450 ³⁾			
	GaK-558	charcoal	23,400 $\pm$ 800 ⁴⁾			
	N-638	charcoal	26,000 $\pm$ 695 ⁵⁾			
Kamewarizaka breccia						
Tsumaya pyroclastic flow						
Osumi pumice fall		black soil (containing organic material)	22,000 $\pm$ 850 ⁶⁾			
Arasaki pumice fall				KG-a	obsidian	31,000 $\pm$ 9,000
				KG-b	obsidian	38,000 $\pm$ 6,700
				KG-c	obsidian	41,000 $\pm$ 10,400
Ata pyroclastic flow	GaK-472	charcoal	24,500 $\pm$ 900 ⁷⁾			
	GaK-3366	charcoal	23,800 $\pm$ 1,200 ⁸⁾			

* TK-, GaK- and N- indicate University of Tokyo Carbon Dating Laboratory, Gakushuin University C-14 Dating Laboratory and Institute of Physical and Chemical Research, respectively.

1) SATO *et al.*, 1971, 2) KOBAYASHI *et al.*, 1971, 3) ARAMAKI, 1965, 4) ISSHIKI *et al.*, 1965, 5) YOKOYAMA, 1971, 6) GOHARA, 1965, 7) ARAMAKI and UI, 1965, 8) UI, 1971.

** Estimated error is the statistical standard deviation on the fission track count.

unusual property of these two samples appeared in the process of alkali treatment which is one of the standard chemical procedures for all charcoal samples. The most part of these samples was easily suspended in a KOH solution. After this treatment was repeated several times, the amount of residue became very small. Namely, insoluble charcoal obtained was insufficient for ordinary combustion process. On account of this difficulty, combustion was made on the first residue for these samples. To obtain further information about the property of the sample, a fraction of the first residue of TK-60 was subjected to an elementary analysis and the carbon content was found to be 23.7%. This value is considerably lower than those of native charcoals usually used as C-14 dating samples in our laboratory, the latter being 56 to 58%. This may indicate that TK-60, and probably TK-59, are not ordinary charcoals but have some amount of secondary material, notwithstanding that they are considered to have been living trees at the time of eruption and directly carbonized by heat of the pyroclastic flow.

In contrast with TK-59 and 60, TK-75 having the highest C-14 age value well retained the original tree-ring texture, and charcoal fragments, when handled in the laboratory, were hard enough not to crumble into powder. TK-75 had every property of native charcoal in the processes of chemical treatment.

Even though TK-59 and 60 are excluded, there still exists a considerable scatter among the remaining five dates for the Ito pyroclastic flow. They range from 16,350 to 38,900y. The ages of three samples (TK-77, GaK-558 and N-638) are comparable giving an average of 25,000y. The highest value of the ages obtained, about 39,000y, however, is near the limit of the C-14 dating method. If a small amount of modern carbon contaminates such an old sample, a large error will be introduced into the measured age. It is considered that the scattered C-14 dates of the Ito pyroclastic flow possibly reflect various amounts of contamination of some younger carbon. This implies that the age of the Ito pyroclastic flow may be greater than 25,000y.

As described in the preceding section, the age of the Ito should be less than, but not so different from, the age of the Arasaki pumice fall deposits. The fission track ages of the obsidians from the Arasaki deposits range from 31,000 to 41,000y. There are, however, three C-14 dates which are not consistent with the above age relationship (GaK-211, GaK-3366 and GaK-472 in Table 2.). A carbonaceous material collected from a soil just under the Osumi pumice fall deposits was dated to be 22,000y (GOHARA, 1965) and, for two charcoals from the Ata pyroclastic flow (ARAMAKI and UI, 1965; UI, 1971), C-14 dates of 24,500 and 23,800y were reported. Both the Osumi and the Ata are stratigraphically lower than the Ito. On the other hand, FUKUOKA and KIGOSHI (1970) performed an ionium dating on a zircon-glass pair from the Ito pyroclastic flow. It gave $53,000 \pm 22,000$ y. The date of the soil carbon may be excluded because it is possible that the sample contained a considerable amount of extraneous carbon. As for date of the Ata pyroclastic flow, the information from

available C-14 dates should not be considered to be sufficient to allow any solid conclusion, as the occurrence of the charred wood is just the same as those in the Ito pyroclastic flow deposits, and the possibility of a large scatter of age due to contamination can not be eliminated.

To summarize, all the available dates concerning the eruption of Ito pyroclastic flow (and related pyroclastics) point to an age between 25,000 and 40,000y.

Finally, it must be pointed out that a single analysis of charcoal sample will not always provide a correct information about an age of a pyroclastic flow, and that a quality of charcoal sample should be carefully checked.

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