

## LETTERS TO THE EDITOR

### GEOPHYSICS

#### Potassium-Argon Ages of Some Rocks from Viti Levu, Fiji

SEVERAL potassium-argon age determinations have been made on rocks from western Viti Levu, Fiji. The results are given in Table 1. The age measurements are thought to be accurate to better than  $\pm 3$  per cent.

An intrusion of hornblende granodiorite about 7 miles long by  $2\frac{1}{2}$  miles wide crops out 8 miles east of Nandi. Bartholomew<sup>1</sup> mapped this intrusion as a member of the Tholo Plutonics, which are regarded as Middle Miocene. The measured potassium-argon age (Table 1, GA 456) is 33 m.y., corresponding to Lower to Middle Oligocene<sup>2,3</sup>. Bartholomew suggested that the andesite flows cropping out adjacent to the granodiorite are younger than the intrusion; however, later work<sup>4</sup> has shown that the granodiorite intrudes the lava flows. Owing to marked alteration none of the andesites was suitable for age determination. Isolated outcrops of limestone, dated as Upper Eocene and Lower Oligocene on fossil evidence<sup>1,5</sup>, occur associated with these andesites, which are therefore regarded as Upper Eocene or younger. Unconformably overlying the andesites are Mio-Pliocene sediments. Hence, the measured potassium-argon age of the granodiorite is in accord with the stratigraphy.

Table 1. POTASSIUM-ARGON RESULTS FROM FIJIAN ROCKS

Specimen No.	Mineral	Potassium (wt. %)	Average potassium (wt. %)	<sup>40</sup> Ar*/ <sup>40</sup> K	Air correction (%)	Age (m.y.)
GA 456	Hornblende	0.294, 0.298	0.296	0.00196	61	33
GA 459	Biotite	7.63, 7.68	7.65	0.000309	58	5.3
GA 460	Biotite	7.32, 7.33	7.325	0.000317	63	5.4
GA 457	Biotite	7.73, 7.75	7.74	0.000297	66	5.0
GA 458	Biotite	7.48, 7.49	7.485	0.000282	61	4.8

$\lambda_e = 0.584 \times 10^{-10} \text{ yr}^{-1}$ ,  $\lambda_\beta = 4.72 \times 10^{-10} \text{ yr}^{-1}$ . \*<sup>40</sup>Ar\*, radiogenic component.

GA 456: Hornblende granodiorite,  $\frac{1}{2}$  mile south of Yavuna Village, 117° 32.5' E., 17° 50' S.

GA 459: Augite-biotite-andesite, Lomoloma quarry, 7 miles north of Nandi, 177° 27.1' E., 17° 42.6' S.

GA 460: Augite-biotite-andesite, north side of Sambeto Range,  $\frac{1}{2}$  mile east of Lomoloma, 7 $\frac{1}{2}$  miles north of Nandi, 177° 26.9' E., 17° 42.2' S.

GA 457: Augite-biotite-monzonite, Nggalimbua Creek, 1 $\frac{1}{2}$  miles north-east of Nandele, 177° 35.2' E., 17° 42.7' S.

GA 458: Augite-biotite-monzonite, Nggalimbua Creek, 2 miles north-east of Nandele, 177° 35.4' E., 17° 42.6' S.

The Sambeto Volcanics, a formation within the Suva Series, form the rugged Sambeto Range, north-east of Nandi. They consist mainly of augite-biotite-andesite lava flows and agglomerates<sup>1,6</sup>. Biotite separated from two specimens of the andesite (Table 1, GA 459, GA 460) yield an age of  $5.35 \pm 0.1$  m.y.; this is Upper Pliocene<sup>2,3</sup>. Numerous foraminifera, corals and molluscs, which occur in tuffaceous sediments of the Suva Series underlying and overlying the Sambeto Volcanics, indicate that the sediments are not older than Upper Miocene and that they are probably Pliocene<sup>1,6</sup>. The foraminifer *Pulleniatina obliquiloculata*, found in a tuff overlying the Sambeto Volcanics, almost certainly indicates a Lower Pliocene age, according to Eames, Banner and Blow in Bartholomew<sup>6</sup>. However, the potassium-argon data strongly suggest that these beds are Upper Pliocene. The apparent discrepancy may be the result of very substantial loss of radiogenic argon from the biotites, or the age derived from the fossil evidence may be incorrect. Loss of argon from the biotites is considered to be unlikely because the biotites are quite unaltered and, although the rocks are folded, there is no evidence of metamorphism. *Pulleniatina obliquiloculata* has a range from Upper Miocene to Recent<sup>7,8</sup>, or Pliocene to Recent<sup>9</sup>; hence, the presence of

this fossil in the Suva Series is not inconsistent with the Upper Pliocene age indicated by the determinations of potassium-argon. It is suggested therefore, on the basis of the potassium-argon results, that the Suva Series is at least in part of Upper Pliocene age.

Two miles north-east of Nandele a plug of augite-biotite-monzonite, about  $1\frac{1}{2}$  miles in diameter, crops out. This plug is intrusive into the Suva Series, and the biotites GA 457 and GA 458 give an age of  $4.9 \pm 0.1$  m.y. for the intrusion. The monzonite and the Sambeto Volcanics have been correlated because of their petrographic similarities<sup>1</sup>, and, although the monzonite is slightly younger than the Sambeto Volcanics, the potassium-argon ages are consistent with the view that they are genetically related. This monzonite plug is one of the youngest plutonic rocks found in the Earth's crust<sup>10</sup>.

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<sup>1</sup> Bartholomew, R. W., *Geol. Survey Fiji, Bull.* 7 (1960).

<sup>2</sup> Kulp, J. L., *Science*, **133**, 1105 (1961).

<sup>3</sup> Evernden, J. F., and Curtis, G. H., *Proc. INQUA Cong. Warsaw*, 1961 (in the press).

<sup>4</sup> Houtz, R. E. (personal communication).

<sup>5</sup> Coles, W. S., *U.S. Geol. Soc. Prof. Paper*, 374-A (1961).

<sup>6</sup> Bartholomew, R. W., *Geol. Surv. Fiji, Bull.* 2 (1959).

<sup>7</sup> Banner, F. T., and Blow, W. H., *Paleontology*, **2**, 1 (1959).

<sup>8</sup> Lloyd, A. R. (personal communication).

<sup>9</sup> Banner, F. T., and Blow, W. H., *Contrib. Cushman Found.*, **2**, 1 (1960).

<sup>10</sup> Knopf, A., *Geol. Soc. Amer. Spec. Paper* 62, 685 (1955).

#### Photometric Observations of the Aurora of October 28, 1961, at Sacramento Peak, New Mexico

In a previous communication<sup>1</sup> the unusual fluctuations of the airglow green line, 5577 Å [OI], at Sacramento Peak, New Mexico, during the night of October 28-29, 1961 (0200-1100 October 29, U.T.), were reported\*. Lewis<sup>2</sup> has now reported some observations of the green line at Lauder, New Zealand (latitude 45° S. geographic, 50° S. geomagnetic), for the previous night when a bright aurora was observed in both the northern and southern hemispheres. Here the Sacramento Peak photometric observations for this night are reported. Lewis's report covers the time period up to about 1235 U.T. on October 28, while the Sacramento Peak observations extend to 1155 U.T., and it is therefore possible to make a comparison between the northern and southern hemisphere behaviour during a concurrent time period. In the present communication all times are U.T.

Very little information has been published on the simultaneous optical behaviour of aurora in the northern and southern hemispheres. De Witt<sup>3</sup> has published an investigation of the occurrence of aurora in geomagnetically conjugate areas using several nights of International Geophysical Year all-sky camera data. So far as I am aware, however, the only published comparison of photometric data taken simultaneously in the northern and southern hemispheres is that of Roach, Barbier and Duncan<sup>4</sup>, who discussed the position of the red auroral arc of July 8, 1958, at three non-conjugate stations. A comparison of the overlapping (in time) data taken at Lauder, New Zealand, and Sacramento Peak, New Mexico,