28. 40Ar-39Ar GEochronological Studies on Rocks Drilled at Holes 462 and 462A, Deep Sea Drilling Project Leg 61

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ABSTRACT

40Ar-39Ar step-heating dating was applied to a basalt from Hole 462 and to basalt and dolerite samples from Hole 462A. Only a basalt sample at Hole 462A yielded a reasonable isochron age, 110 ± 3 million years. The radiometric age is consistent with the fossil record (Cenomanian) in the sediments, into which the basalt sill intruded. However, the age is much less than that of the oceanic basement as deduced from the magnetic anomaly (M-26).

SAMPLES

Sample 462-60-1, 65-69 cm is a clinopyroxene-plagioclase phryic basalt containing some clays which are altered products of glasses. The sample is from a sill, next to glassy margins, which intruded into Cretaceous sediment (Cenomanian). Sample 462A-32-1, 46-49 cm is a clinopyroxene-plagioclase phryic basalt, and is lithologically quite similar to Sample 426-60-1, 65-69 cm; it is also from a sill, next to a glassy margin, which intruded into Cretaceous (Cenomanian) sediment. Glasses are partly altered to clays. Sample 462A-50-3, 130-134 cm is from a dolerite sill which intruded into sediments (Hauterivian). The degree of alteration here is the slightest among the three samples. The microscopic observations were made by Dr. H. Tokuyama, Ocean Research Institute, University of Tokyo.

EXPERIMENTAL METHODS

Chunks of three samples (about 1 g each) were vacuum-sealed in a quartz tube (9 mm dia. × 7 cm) with K2SO4 and two standard samples (JG1 granodiorite prepared by Geological Survey of Japan, t = 90.8 m.y., K2O = 7.64%). The quartz tube was then subjected to a neutron flux of about 5 × 1020 n cm−2 s−1 in a Japan Material Testing Reactor (JMTR).

The correction factors for interfering neutron-induced Ar isotopes were determined on K2SO4 and CaF2; the latter was irradiated in another quartz tube in the same irradiation run. The correction factors thus determined are (40Ar/39Ar)K2S = 0.117, (40Ar/37Ar)K2S = 3.6 × 10−4, and (39Ar/37Ar)CaF2 = 7 × 10−4. These corrections were not significant, however, for the final age calculation. The heterogeneity in the neutron flux was estimated from the results on the two standard samples to be about 0.6%/cm along the length of the quartz tube. The irradiated samples were heated at seven temperature programs (500°C, 600°C, 700°C, 800°C, 900°C, 1000°C, and fusion) for 45 minutes. The temperature was controlled by adjusting the output power of the induction heater with the aid of an optical pyrometer.

RESULTS

The experimental data are represented in both an age spectrum and an isochron plot (Figs. 1 and 2). The analytical data are given in Table 1, in which a total fusion age and an apparent K-Ar age for each temperature fraction are also shown. The age results are given in Table 2.

Sample 462-60-1, 65-69 cm

This gives a very ragged age spectrum, roughly of a staircase type, and no plateau age can be defined (Fig. 1). Except for the lowest-temperature fraction (500°C), however, other data points lie roughly on a line which is close to a reference isochron of 120 m.y. Although the considerable deviation of each data point from a line, and the ragged age spectrum, indicate that the sample suffered geological disturbances such as Ar-loss, the rough linear correlation in the isochron plot may be related to the age of the sample, as deduced from studies (Ozima et al., 1979) on 40Ar-39Ar systematics of artificially disturbed samples. That the total fusion age is much less than the reference isochron age may indicate radiogenic 40Ar loss from the sample. We suggest 120 m.y. as a rough approximation of the age of the sample.

Sample 462A-32-1, 46-49 cm

Except for the 600°C fraction, which constitutes only 1.6% of the total 39Ar released, all other data points lie fairly well on a line (Fig. 2). The y-intercept of the line is 300, which is not significantly different from the atmospheric 40Ar/36Ar ratio. The regression line was determined with the use of York's correlated error program (1969), and the statistical parameter MSUM (Brooks et al., 1972) was calculated to be 2.82. In the age spectrum, more than 80% of the total 39Ar released, though only for a single temperature fraction, gives an apparent K-Ar age of 110 m.y., which agrees well with the isochron age. The total fusion age (103.7 m.y.) is slightly less than the isochron age, suggesting a slight loss of the radiogenic 40Ar from the sample. From the linearity in the isochron plot and from the concordance between the isochron age and the major part of the apparent K-Ar age, we conclude that the sample is 110 m.y. old.
aminations did not give any positive evidence of such contents less than 0.1%. This suggests that the high 462A-50-3, 130-134 cm; most of the cores have K are 0.67% for Sample 462-60-1, 65-69 cm, 0.78% for According to the onboard XRF analyses, K
2 O contents K-bearing alteration products (Tokuyama, written K-bearing alteration products, although microscopic ex-
mination products, since formation of K-rich alteration products almost simultaneous with the emplacement of submarine volcanic rocks seems to be rather general (Hart and Staudigel, 1978). Whichever the case is, the radiometric age represents the time of the sill intrusion. It is also possible, however, that the radiometric age represents the formation age of some K-bearing alteration products, since formation of K-rich alteration products almost simultaneous with the emplacement of submarine volcanic rocks seems to be rather general (Hart and Staudigel, 1978). Whichever the case is, the radiometric age should give a good indication of the time of basalt intrusion. Hence, the radiometric age for Sample 462A-32-1, 46-49 cm clearly indicates the ex-

Sample 462A-50-3, 130-134 cm

This sample gave very scattered data points in the isochron plot and a very ragged age spectrum, neither of which provided any useful age information. The total fusion age is 131 m.y., the significance of which, however, is difficult to judge.

**DISCUSSION**

The three samples we chose for the dating have the highest K-content among the rocks drilled at Site 462. According to the onboard XRF analyses, K2O contents are 0.67% for Sample 462-60-1, 65-69 cm, 0.78% for Sample 462A-32-1, 46-49 cm, and 0.44% for Sample 462A-50-3, 130-134 cm; most of the cores have K2O contents less than 0.1%. This suggests that the high K-content in the present samples may be due to some K-bearing alteration products, although microscopic examinations did not give any positive evidence of such K-bearing alteration products (Tokuyama, written communications, 1979). A preliminary EMP analysis showed that K residues essentially along the grain boundaries. At present we cannot conclude whether the observed high K-content in the samples is due to some submicroscopic K-rich alteration products or is a primary characteristic.

According to the Initial Core Descriptions, Sample 462A-32-1, 46-49 cm is from a sill intruded into Cretaceous (Cenomanian) sediment. Hence, the 40Ar39Ar age is in accordance with the fossil record. The concordance between the radiometric age and the fossil record is most easily explained by assuming that the radiometric age represents the time of the sill intrusion. It is also possible, however, that the radiometric age represents the formation age of some K-bearing alteration products, since formation of K-rich alteration products almost simultaneous with the emplacement of submarine volcanic rocks seems to be rather general (Hart and Staudigel, 1978). Whichever the case is, the radiometric age should give a good indication of the time of basalt intrusion. Hence, the radiometric age for Sample 462A-32-1, 46-49 cm clearly indicates the ex-
existence of much younger volcanism than in the oceanic basement, as deduced from the magnetic anomaly M-26 (~155 m.y.).

REFERENCES


