HALF-LIFE OF ^{26}AL; T. L. Norris, A. J. Gancarz, D. J. Rokop, K. W. Thomas, Los Alamos National Laboratory, Los Alamos, New Mexico 87545

The half-life of ^{26}Al is being redetermined because of some inconsistent results obtained when using the reported half-life for calculating cosmic-ray-exposure ages of meteorites. The cosmic-ray-exposure age is conveniently calculated from the ^{21}Ne content and production rate, which is normally assumed to be constant.

Production rates of ^{21}Ne are deduced from a variety of other cosmic-ray-produced radionuclides. The production rates, in units of 10^{-8} cc STP ^{21}Ne/g Myr, are: (1) 0.46 based on ^{26}Al ($t_{1/2}$ = 7.2 x 10^5 yr), (2) 0.30 based on ^{53}Mn ($t_{1/2}$ = 3.8 x 10^6 yr), (3) 0.3 from ^{10}Be ($t_{1/2}$ = 1.6 x 10^6 yr), (1,2,3,4). The two lower values for production rate are consistent with tritium/^{3}He and ^{39}Ar/^{38}Ar ages (5) and ^{81}Kr derived ages(6).

The rate based on ^{26}Al is about 50% higher than that based on other radionuclides and could be explained if the reported half-life is 30 - 40% low or if the cosmic ray flux varies over time (2,3).

It is therefore appropriate to redetermine the half-life of ^{26}Al. The best previous ^{26}Al half-life was measured by Rightmire, Kohman, and Hintenberger (7). Their value was later adjusted based on a more accurate branching ratio between positron emission and electron capture (8). The half-life in current use is (7.16 ± 0.32) x 10^5 years.

The method we used to measure the half-life consists of a mass spectrometric determination of the ^{26}Al concentration in a solution coupled with a measurement of the specific radioactivity of the same solution. The ^{26}Al had been made previously by irradiating pure silicon at LAMPF for a period of 3 years with a total fluence of 10^{23} protons. The aluminum was separated and purified with an HDEHP extraction and an oxalic acid anion exchange column (9). The ^{26}Al was further purified for mass spectrometric analysis by using an HF anion exchange column to separate aluminum from sodium and magnesium.

The specific radioactivity of the solution, based on three gravimetric aliquots, was measured on a Ge(Li) gamma-ray detector and is shown in Table 1. The specific radioactivity is corrected for the 99.764% branching ratio for the 1.808 MeV gamma ray decay. The counting data, though acceptable, will be improved in future work to the ultimate precision of the detector calibration which is 2-3%.

The ^{26}Al concentration was determined mass spectrometrically from two untraced and three traced samples. The tracer was prepared from 99.9995% pure Johnson Mathy aluminum rod. Table 2 shows the ^{26}Al/^{27}Al ratios from the untraced and traced samples are reproducible to <0.2%. The ^{26}Al/^{27}Al ratios have been arbitrarily adjusted by a factor of .98 to account for mass fractionation in the mass spectrometer because it is not possible to determine the correction experimentally. This factor is equal to the square root of the mass ratio 26/27 and represents a maximum correction. The calculated concentrations of ^{26}Al in the source solution agree within ~1% for the three aliquots. The variation among samples is at least 10 times larger than is typical and this may be due to contamination of the mass spectrometry samples. To improve the isotope ratios an oxalic acid anion exchange column clean-up will be substituted for the HF anion column on future samples.

A preliminary value for the half-life of 7.0 x 10^5 years with a uncertainty of at least ± 5% is calculated from the mass spectrometric and specific radioactivity measurements. This value is within the experimental error of the accepted half-life and though the precision of this determination will be improved it is not expected to result in any radical change from the currently used half-life.

Even with this preliminary value it seems clear that an erroneous half-life is not the source of the discrepancies in the observed ^{21}Ne production rates. It is unlikely that all the other half-lives are in error, thus our results suggest a further investigation of the consistancy of the cosmic-ray flux over the past 2 to 3 million years.

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TABLE 1

^{26}Al ACTIVITY DATA

Sample	Specific Radioactivity (dpm/g)
20	4.28×10^{3} (± 2.5%)
21	4.18×10^{3} (± 4.8%)
22	4.18×10^{3} (± 2.06%)
Average	4.21×10^{3} (± 1.3%)

TABLE 2

MASS SPEC DATA

Sample	Atom Ratio* (^{26}Al/^{27}Al)	^{26}Al Concentration (g/g)
Untraced		
UT-1	6.208×10^{-2} (± 0.15%)	
UT-2	6.200×10^{-2} (± 0.16%)	
Average	6.204×10^{-2} (± 0.13%)	
Traced		
5X	1.025×10^{-2} (+ 0.14%)	9.577×10^{-8}
10X	6.136×10^{-3} (± 0.29%)	9.715×10^{-8}
15X	3.697×10^{-3} (± 0.15%)	9.625×10^{-8}
Average		9.639×10^{-8} (± 0.73%)

*Adjusted for mass fractionation, see text.