The Isotopic Composition of Magnesium in Terrestrial Samples

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The variation in the isotopic abundance of the stable isotopes of magnesium, one of the most common elements in the earth's crust and in meteorites, has received little detailed study. It has been reported on by Blewett and Jones (1936),[1] and by White and Cameron (1948),[2] using a commercial magnesium reagent. In dolomite samples, Daughtry, Perry and Williams (1962)[3] found a different magnesium 24-magnesium 26 ratio. However, on the whole it has been little studied.

Since some experimental difficulties were experienced in measuring the magnesium isotope ratio, the present study was begun with the hope of resolving these difficulties and with the thought that knowledge of the magnesium isotope ratio in the terrestrial sample might lead to useful geochemical findings.

The magnesium was mainly separated by the classical method of rock analyses. Dilute sulfuric acid and 50% hydrofluoric acid were added to two grams of the sample. After the calcium had been separated by the ordinary ammonium oxalate method, the magnesium was precipitated by oxine. After ignition, it was leached by hydrochloric acid. The ion exchange resin (Dowex 50-X12) was used for the purification of the magnesium of sodium and aluminum, which might disturb mass spectrometric analyses.[4] Magnesium oxide was mounted on the sample filament with phosphoric acid. The isotopic composition was measured in a mass-spectrometer, built by Nuclide Analysis Associates, with a 12-inch radius and a deflection of 60°. The ions, Mg^+, were produced by using a triple filament source made of tungsten ribbons. The beam current was amplified with an electron multiplier. In order to stabilize the ion beam, an advantage was gained by the use of phosphoric acid for mounting the magnesium oxide samples. The peak shape thus obtained is shown in Fig. 1.

There are several possible sources of error in the determination of magnesium isotope composition (Masses 24, 25 and 26): isotopic fractionation in the sample preparation, mass discrimination in the ion production, instrument drift, and instability. The isotopic fractionation in the sample preparation and also the contamination were avoided by the use of

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[1] J. P. Blewett and E. J. Jones, *Phys. Rev.*, **50**, 464 (1936).

[2] J. R. White and A. E. Cameron, ibid., **74**, 991 (1948).

[3] A. C. Daughtry, D. Perry and M. Williams, *Geochim. et Cosmochim. Acta*, **26**, 857 (1962).

[4] J. Yoshimura and H. Waki, *Anal. Chem. Japan*, **6**, 362 (1957).

Table I. The results of magnesium isotope ratio

Sample	25/24×100	26/24×100	Note
G-1	12.748±0.05	13.984±0.03	Standard rock sample
W-1	12.749±0.05	13.965±0.04	Standard rock sample
Sea water[*]	12.750±0.03	13.965±0.02	Pacific ocean
	12.762±0.03	13.966±0.02	Pacific ocean
Reagent	12.708±0.02	13.987±0.02	Magnesium chloride
	12.704±0.05	13.966±0.04	Magnesium chloride
Table[**]	12.880	14.141	

[*] Supplied by Dr. D. Schink.

[**] F. A. White, T. L. Collins and F. M. Rourke, *Phys. Rev.*, **101**, 1786 (1956).

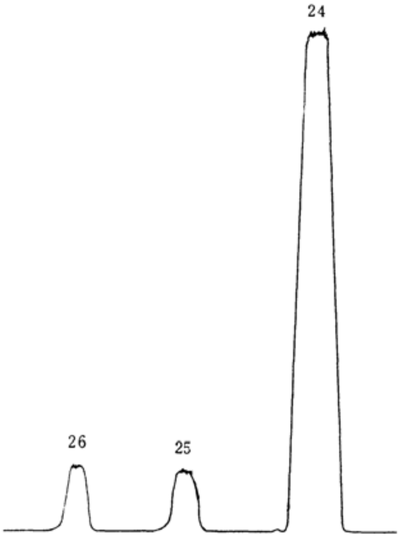

Fig. 1. The obtained peak shape of magnesium isotope.

the same chemical procedure and the same reagents as far as possible. The mass discrimination in the production of ions is not believed to be serious because the mass analyses were always repeated under the same conditions. Moreover, no variation in the isotopic ratio with time was observed during the course of the individual runs. The statistical uncertainty of each run—due principally to the instrumental effect—was usually within 2%. The difference in the average ratio on repeated runs was not significant.

The results of the measurement are shown in Table I. No mass correction factor is necessary for the relative ratio to be compared, because this study was designed to check the terrestrial magnesium samples with existed in the different formulae. On the basis of these preliminary results, no difference in the magnesium isotope composition of standard rocks, of sea water and of chemical reagents could be found. In other words, within the limits of the samples and of analytical error, no difference in the isotopic ratio among the terrestrial magnesium samples has been established. However, nothing decisive can be stated about the secondary dolomite which was reported by Daughtry et al. (1962).[3]

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