

DETERMINATION OF SAMARIUM AND NEODYMIUM IN GEOLOGICAL SAMPLES

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In the middle of seventies Lugmair published paper dealing with a new possibility of a determination of an age of rocks based on the concentration of isotopes of samarium and neodymium^{1/}. The age can be calculated from the slope $(e^{\lambda \Delta t} - 1)$ of the line defined by the relation

$$\frac{{}^{143}\text{Nd}}{{}^{144}\text{Nd}}_t = \frac{{}^{143}\text{Nd}}{{}^{144}\text{Nd}}_{t_0} + \frac{e^{\lambda \Delta t} - 1}{\lambda} \cdot \frac{{}^{147}\text{Sm}}{{}^{144}\text{Nd}}_t \quad (1)$$

where

$\frac{{}^{143}\text{Nd}}{{}^{144}\text{Nd}}_t, \frac{{}^{143}\text{Nd}}{{}^{144}\text{Nd}}_{t_0}$ are atomic isotope ratios in time t and t_0 , respectively,
 $\frac{{}^{147}\text{Sm}}{{}^{144}\text{Nd}}_t$ is the ratio of number of atoms of the isotopes in time t
 λ is the decay constant of ${}^{147}\text{Sm}$
 $\Delta t = t - t_0$ means the age of a sample

For the application of dating by this method we have developed techniques of an isolation of samarium and neodymium from the sample, and a determination of an isotopic composition, and a concentration of isotopes^{2/}.

To isolate samarium and neodymium from the sample a special separation procedure has been developed. The procedure consists of three steps-coprecipitation of rare earth elements (REE) with calcium oxalate, an isolation of REE on a column filled with anion exchange resin Dowex 1x8 in the mixture of acetic and nitric acids and a separation of Sm and Nd from the REE group by means of a chromatographic column with cation exchange resin Dowex 50 Wx8. Alpha-hydroxyisobutyric acid neutralized by NH_4OH to the pH value 4.62 has been used as an elution agent.

The optimum eluate volumes of Sm /Nd/ fractions have been estimated by means of the elution of radioactive isotopes ${}^{154}\text{Eu}$,

^{243}Am and ^{244}Cm added to the sample. The separation procedure makes possible to isolate Sm with less than 0.01% of Nd and vice versa.

Samarium /neodymium/ isotope composition has been measured with a mass spectrometer Varian TH-5 a so called two filaments technique. The optimum amount of the element determined on the filament is about 0.1 μg .

A reference material ECR-1 has been used for a normalization of isotope composition results^{3/}.

Isotopic dilution mass spectrometry has been applied to the determination of the concentration of the isotopes ^{147}Sm and ^{144}Nd in the sample. ^{143}Nd and ^{149}Sm have been used for spiking.

The method described makes possible to determine the isotopic ratio $^{143}\text{Nd}/^{144}\text{Nd}$ with a precision of 0.01 relative % /26/ or better and the concentrations of ^{144}Nd and ^{147}Sm isotopes with a precision of 0.1 relative % /26/ or better on a level of several tens of ppm of the element. The method has been validated by an analysis of granite samples.

References

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