FISSION TRACK EVIDENCE OF OCEAN BOTTOM SPREADING

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ABSTRACT

Fission track dating of oceanic basalts from Mid-Atlantic Ridge gives an evidence in support of hypothesis of ocean bottom spreading. The spreading rate is estimated to be 1 cm/year.

INTRODUCTION

IN recent years the hypothesis of ocean floor spreading[1-2] has been supported by chronological tests based on fission track dating of oceanic basalts[3-6]. Prior to this the strongest evidence for this hypothesis was based on linear bands of magnetisation stored in the rocks of the ocean floor.

In most of the investigations todate the oceanic basalts used belong to the Mid-Atlantic Ridge as it is the most thoroughly surveyed and sampled location on any mid-oceanic ridge system. The dredging operations were started in the area around Mid-Atlantic Ridge first by the Geological Survey of Canada in 1966 and then by the joint French-American collaboration known as FAMOUS (French American Mid-Oceanic Undersea Survey).

Basaltic samples from closeby the ridge commonly possess a glassy veneer which is suitable for fission track dating. Because of the inherited argon, these basalts are unsuitable for K-Ar dating. Radiometric methods fail to date these specimens because of their young ages.

COLLECTION OF SAMPLES

The basaltic glass samples were collected from FAMOUS area of Mid-Atlantic Ridge and the sample used in the present investigation came from dredging operation CH31-DR11. The samples were obtained through the courtesy of Professor Subbarao and their location is nearly 1 km from the axis of Mid-Atlantic Ridge (Lat. 36° 49′ 3″N, Long. 33° 15′ 0″ W). The basaltic samples are dark brown, dull and opaque in the form of a chunk but lustrous in the fractured form. They represent the pillow lavas which accumulated at the Mid-Atlantic Ridge due to intense magmatic activity in the recent past.

EXPERIMENTAL PROCEDURE

The basaltic samples were fractured, mounted in epoxy resin, ground and polished with cerium oxide powder until they became transparent in transmitted light. The polished samples were etched in 40% HF at room temperature for 40 seconds while the etchant is kept constantly stirred. The etched samples were scanned under Carl Zeiss microscope using a magnification of 300 ×. There was hardly any track identified on first scanning of the samples.

The sample surface was repeatedly ground, polished and etched to remove a few microns of exposed surface. The fossil fission tracks were very carefully distinguished from surface features which are etched along with the tracks. Only five tracks were found after scanning an area of 2 cm^2 of sample surface.

Oceanic basalt was fractured into small bits, washed with acetone, packed into aluminium capsule and irradiated with thermal neutron dose of 5×10^{16} (nvt) at CIRUS Reactor of B.A.R.C., Trombay. The irradiated samples were polished and etched as before to reveal induced fission tracks. The diameter of the induced fission tracks was measured and their surface density determined by scanning a few mm^2 area. The mean diameter of etched tracks is 7·5 μm and the induced track density 70400 cm^{-2}.

RESULTS AND DISCUSSION

The f.t. age of oceanic basalt is calculated by using the simplified version of f.t. age eqn.[7]

$$T = 6 \cdot 01 \times 10^{-8} \times \rho_s/\rho_i \phi. \qquad (1)$$

Substituting the values ρ_s/ρ_i, i.e., ratio of fossil to thermal neutron induced track density and the thermal neutron dose ϕ which is estimated by using a calibrated glass dosimeter[8], the f.t. age T is found to be $1 \cdot 07 \times 10^5$ year.

The uranium concentration in the oceanic basalt can be estimated by using formula[9]

$$C_u = k \times \rho_s/\rho_i \quad \text{atom/atom} \qquad (2)$$

where k is a constant which depends upon the nature of sample material, diameter of tracks, fission cross-section and etching parameters. Assuming the oceanic basalt as glassy material the value of C_u is estimated to be 0·03 ppm.

Due to the low uranium contents and the young ages of the FAMOUS basalts the fission track method is close to its limits of application. Nevertheless, even

in such extreme cases, this is the only method which gives us reliable ages provided large surface areas are scanned for fossil tracks. There is a large statistical error in our result due to paucity of fossil tracks and the f.t. age obtained is an order of magnitude higher than the value found by French group[6].

The rate of ocean bottom spreading is estimated from the f.t. age of oceanic basalt and its distance of location from the axis of Mid-Atlatic Ridge which is nearly 1 km in our case. Assuming, the last magmatic activity around the median valley of the Ridge occurred around 3000 years ago[6], the spreading rate is found to be 1 cm/year. It has been observed[6] that the spreading rate depends upon the distance of location from the axis of Mid-Atlantic Ridge and with increase of distance the spreading rate decreases rapidly. It has also been verified that spreading rate is asymmetric about the median axis of the Ridge. Our result is comparable with the values inferred from the magnetic data[10] (0.7–1.5 cm/year) but it is not in agreement with the values obtained by French group[5] on the basis of fission track analysis.

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PROPERICIAZINE AS A SELECTIVE AND SENSITIVE REAGENT FOR THE SPECTROPHOTOMETRIC DETERMINATION OF VANADIUM AND ITS APPLICATION TO VANADIUM STEELS

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ABSTRACT

Propericiazine is shown to be a selective and sensitive spectrophotometric reagent for vanadium. It forms an orange red species with vanadium(V) in phosphoric acid medium. The orange red species exhibits maximum absorption at 496 nm with a molar absorptivity of 9.0×10^3 1 mole^{-1} cm^{-1}. Beer's law is valid over the concentration range of 0.1–6.6 ppm. The proposed method has been used successfully for the determination of vanadium in vanadium steels.

INTRODUCTION

MOST of the reagents proposed for the spectrophotometric determination of vanadium are unsatisfactory for one reason or the other. The authors have now developed propericiazine (PP), Cyano-3 [(hydroxy-4-piperidino)-3-propyl]-10-phenothiazine as a sensitive and selective reagent for the spectrophotometric determination of vanadium(V). The proposed method offers the advantage of simplicity, rapidity, stability, sensitivity and selectivity without the need for extraction or heating.

EXPERIMENTAL

Stock solution (0.01 N) of vanadium(V), prepared from AnalaR sodium metavanadate in distilled water, was standardised against a standard Fe(II) solution and further diluted as needed. Solution of PP [0.1% (m/V)] was prepared in distilled water containing a few drops of hydrochloric acid and stored in an amber bottle in a refrigerator. Beckman Model DB spectrophotometer with matched 1 cm silica cells was used for absorbance measurements.