COMBINED NEUTRON ACTIVATION AND PARTICLE TRACK ANALYSIS OF ELEMENT DISTRIBUTIONS IN A ROCK SLICE OF MINERALIZED GRANITE

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The radioactivity induced in rock slices during fission track analysis for uranium can usefully be employed in instrumental neutron activation analysis for determination of major and trace element distributions in the sample using a collimated gamma spectrometer. A description is given of the application of particle track techniques in conjunction with activation analysis to a geochemical study of element migration in a sample of mineralized granite from Nigeria. The study indicates that U is enriched during the earlier period of rock-fluid interaction (microclinization) and that Th is enriched during greisenization.

Introduction

The use of plastics for detection of fission and alpha particles is a well established technique which has been comprehensively reviewed by FLEISCHER et al. The method is routinely applied to the determination of concentrations and distributions of fissile or alpha-emitting radionuclides in a range of materials of geochemical and environmental interest, some examples being marine particulate and biological materials, air, recent sediments and thin (0.03 mm) rock sections. During the irradiation process for production of fission tracks, radioactivity is induced in the sample as a result of neutron capture by its component nuclei. In the case of thick (0.5 cm) rock slices, the induced activity is sufficient to allow the study of element distributions in the sample by instrumental neutron activation analysis.

In this paper we describe an analytical procedure combining particle track and neutron activation analysis techniques in a study of 0.5 cm thick slices of Nigerian granite in which visual changes in the colour and proportion of the minerals, produced by the effects of mineralising fluids, can be seen in hand specimen. The object of the study was to correlate the observed mineralogical changes with track distributions in alpha and fission track plates produced from the samples and with element
distributions derived from instrumental neutron activation analysis. Combination of these standard techniques provides useful information on the behaviour of stable and radioactive elements in the samples, where element mobility can be correlated with mineralogical changes. A description of the method is given below with results and brief geological interpretation for a typical sample. A more detailed geological discussion will be published elsewhere.

**Experimental**

**Particle track analysis**

A typical sample, R1/40, of weight 126 g and thickness 0.5 cm is displayed in Fig. 1. One face of the sample was prepared as a smooth surface suitable for particle track analysis with a set of asymmetrical reference axes A–B (length 20 cm) and C–D (length 4.5 cm) marked clearly as shown. The sample shows distinctive groupings of crystals which are described and divided into three zones in Fig. 2.

![Figure 1](image1.png)

*Fig. 1. Photograph of rock slice R1/40. Reference axes AB (20 cm) and CD (4.5 cm) aid correct alignment of the particle track plates. Axis AB provides the control direction for recording element migration.*

![Figure 2](image2.png)

*Fig. 2. Sketch diagram of sample R1/40 with superimposed 20 cm scale relating to the 1 cm sections used to estimate element concentrations. Mineralogical detail of the marked zones can be correlated with Fig. 1.*