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Extended Abstracts

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Combined $^{87}Rb/^{84}Sr$ Spike: Calibration and application to datation of Loma Pelada Granite, Tucuman, Argentine

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An adequate spiking technique involving 2 steps using a combined $^{87}Rb/^{84}Sr$ was developed for Rb and Sr content determinations in all types of rocks or minerals.

The mean error of 0,4% in Rb/Sr determinations on 6 Loma Pelada granites was obtained using one of 10 options established according to Rb and Sr contents. In an isochron diagram, including these analyses, an age of ca.470 Ma with an initial ratio of 0,7063 ± 0,0005 (1 σ) has been calculated.

Introduction

With the advent of modern mass spectrometers linked to computers $^{87}Sr/^{86}Sr$ ratios with a precision better than 0,01% have been obtained.Nevertheless, the errors of $^{87}Rb/^{86}Sr$ ratios are usually much higher (in the range 0,2-0, 3%), depending on analytical procedure adopted by each laboratory. The best procedure is to use an adequate combined Rb/Sr spike solution. However, 3 or more different combined Rb/Sr spike solutions are usually required in order to conform to the different Rb and Sr contents, previously estimated for example by X-ray fluorescence method.Another alternative for combined Rb/Sr spike is to use a two steps spiking technique wich is described here, and applied for the first time to the Loma Pelada Granite, an isolated orographic unit within tectonic valley of Tafí, in the Sierras Pampeanas orogenic domain, Tucumán Province, NW Argentine. The age determinations were carried out on rocks from a two-mica-bearing facies, wich is the most abundant in this elongated plutonic body with 2,6 km² in area [(1)].

Experimental Procedures and Results

The combined $^{87}Rb/^{84}Sr$ spike was prepared from concentrated solutions of ^{84}Sr and ^{87}Rb. The concentrations of both elements were determinated by adding precise amounts of Rb and Sr solutions prepared from normal and known isotopic composition salts, of NBS-984 RbCl and Spex $SrCO_3$ respectively. The procedure for calibrating spike solutions and the principles of isotope dilution mass spectrometry (IDMS) are known since 1954 (2-4).

In the present work, the errors in concentration for both elements based in mass spectrometric date from 4 mixed solutions were ca. 0,1%. The concentration ratios found was 2,0 µg(^{87}Rb/g)/0,46(g (^{84}Sr/g). This ratio, suitable for ultramafic rocks, can be used for other types with a Rb content from 6 to ca 1250 ppm and Sr content from a few to 4000 ppm, provided that an adequate aliquot of solution is spiked.In other situations, where the concentrations are outside the above range, the correct spiking for Rb and Sr can be obtained by adding an extra combined Rb/Sr spike solution. The total numbers of options are 10, and must be selected according to Rb and Sr contents determined in a semi-quantitative basis.

Rb and Sr contents by IDMS using the combined Rb/Sr spike solution were determined on 6 selected from the 12 samples of the Loma Pelada Granite. The analytical work was done at Centro de Pesquisas Geocronológicas (CPGeo-USP), and techniques are described with some detail by Kawashita[5]. The minor modifications are the use of savilex vials instead of 50 ml teflon vessels for acid digestions, and of a pipette with discardable tips for aliquoting anf spiking technique.

The 6 Rb/Sr determinations reveal an age of 470 +/- 10 Ma. with an intial ratios of 0,7063 +/- 0,0005 and a MSWD of 0,191. This MSWD is adequate considering the cut level suggested by Snelling[6]. The calculated age of 470 Ma for the granite intrusion could be related with the regional heating in base to the determinations of Bachman[7](1987), that gives similar ages for the banded schists that constitutes the granite field rock. On the other hand, the initial relations determinated indicate that the melt could not derive exclusively by parcial melt of the field rock . These have a courage of $^{87}Sr/^{86}Sr$= 0,7150 (8,9) while the obtained value is 0,7063. Mixing of mantle and crust components could explain the observed isotopic relationship. Geological setting supports this hypotesis.

Conclusions

The combined $^{87}Rb/^{84}Sr$ spike solution with a ratio of 2.0 microg/ 0. 46microg, ideal for ultramafic rocks, is also useful for any type rocks or minerals, since a two steps techniques is used. It is recommended to be used in laboratories where is available only the chemical and Rb/Sr separation facilities, and the mass spectrometry is perfomed elsewher.

References

1. Saavedra Alonso, J. et al.,*RAGA, XXXIX* (1-2): 12-27 (1984).
2. Inghran, M.G., *Ann.Rev.Nucl.Sci.***4**, 81-92 (1954)
3. Hintenberger,H.*Enriched Isotopes and Mass Spectrometry* (1956)
4. Russel, R.D.,*Chem.Geol.* **20**, 307-314 (1977)
5. Kawashita, k., *Thesis*, Instituto de Geociencias/USP (1972)
6. Snelling, N.S., *Inst.Geol.Sci.Rep.* **76**.18 (1976)
7. Bachman,G.et al.,*X Cong.Geol.Arg.,Tuc.;Acta* **3**: 17-20.(1987)
8. Bachman,G.et al.,*Zbl.Geol.Paläont.* Nº **9/10**:1257-1268. (1986)
9. Rapela,C. et al.,*Geol.Soc.Amer.SP.*Paper **241**:77-90(1990).