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Rb-Sr GEOCHRONOLOGY OF THE AMBALAVAYAL GRANITE, KERALA

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Abstract

Rubidium and strontium determinations are reported for seven whole-rock samples of the Ambalavayal granite of northern Kerala. The data yield a well defined Rb/Sr isochron, corresponding to an age of 595 ± 20 Ma and initial $^{87}Sr/^{86}Sr$ ratio of 0.7171 ± 0.0022. The age marks a regime of Late Precambrian-Early Palaeozoic granite magmatism in the southwestern Indian shield. The agreement of the Rb/Sr age with the previously measured K/Ar age of 560 ± 30 Ma indicates no significant secondary thermal event in the region. The evolved initial Sr ratio suggests either an exclusive origin or significant crustal contamination of magma derived from a deeper source.

Introduction

A number of intrusive granite and syenite plutons showing spatial relationship with regional fault-lineaments have been reported from the Kerala region. The basement rocks of this region, which form the southwestern segment of the Indian shield, are dominantly charnockites, khondalites and migmatites, belonging to a granulite facies regime. Apart from a few mineral ages, no systematic geochronologic data are available for the intrusive phase. This paper reports the Rb-Sr isochron age of the Ambalavayal granite, an important member of the group of granite plutons in the region.

The Ambalavayal granite

The pink granite of Ambalavayal in Wynad district of northern Kerala is emplaced within Precambrian biotite gneisses (Fig. 1). It is spatially related to the Moyar fault-lineament and occurs near its intersection with the Calicut lineament. The granite outcrops as an E-W elongated body, covering about 25 sq km (Nair *et al* 1982). The mineral assemblage comprises of perthitic K-feldspar and interlocking quartz with sodic plagioclase in subordinate amount. Pleochroic greenish hornblende, riebeckite and biotite are the principal mafic constituents. Sphene, epidote, monazite, apatite, calcite and Fe-Ti oxides constitute the accessories. The granite, related pegmatites and quartz veins show disseminated molybdenite mineralization, correlated with an event of taphrogenic metallogeny (Santosh and Nair, 1983).

Seven whole-rock samples of the granite were collected from active quarries that expose fresh, unaltered rock. The sample preparation techniques and analytical procedures are the same as reported by Gopalan *et al* (1979).

Results

The Rb/Sr ratios and the isotope composition of strontium for the Ambalavayal granite samples are presented in Table I. Plots of $^{87}Sr/^{86}Sr$ versus $^{87}Rb/^{86}Rb$

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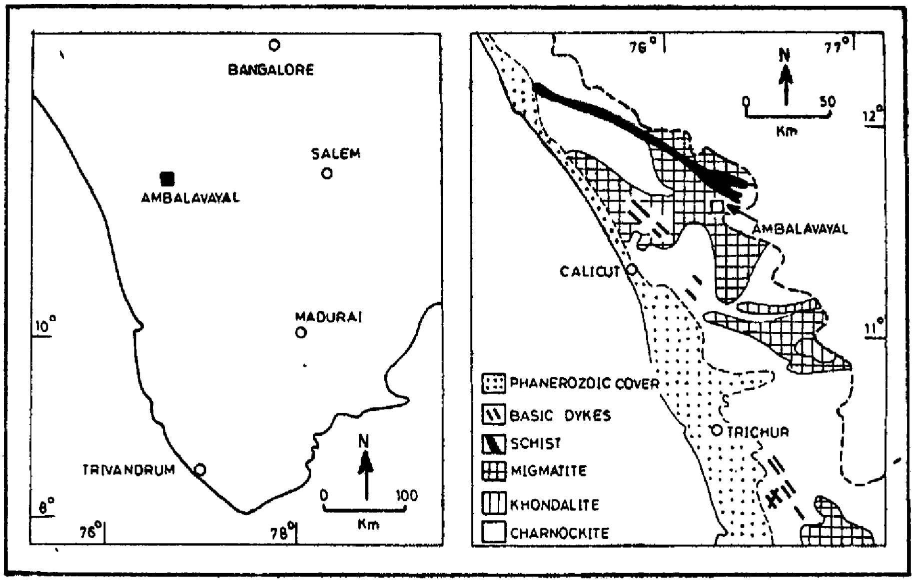

Figure 1. Location of the Ambalavayal granite and generalised geology of Northern Kerala.

TABLE I.
Rb-Sr analytical data for the Ambalavayal granite.

Sample No.	^{87}Rb (ppm)	^{86}Sr (ppm)	^{87}Rb/^{86}Sr atomic	^{87}Sr/^{86}Sr atomic
ALD 1/1	17.82	3.89	4.53	0.7402±0.0016
ALD 1/2	11.83	4.23	2.80	0.7420±0.0020
ALD 2/1	22.22	0.97	22.55	0.9076±0.0029
ALD 2/3	11.26	0.71	15.68	0.8510±0.0016
ALD 3/1	15.20	0.57	26.55	0.9414±0.0016
ALD 5/1	10.62	4.02	2.61	0.7403±0.0013
ALD 6/1	11.05	3.36	3.25	0.7427±0.0013

are shown in Fig. 2. The vertical component of the error lines is the standard deviation for contiguous sets of ten to fifteen ^{87}Sr/^{86}Sr ratios, while the horizontal bar represents the ± 2 per cent uncertainty in the measured ^{87}Rb/^{86}Sr ratio. Except for the slight departure of one sample, all the other six conform closely to a single straight line within experimental error, the straight line shown being the least square fit of the data based on the two-error weighted regression method of York (1966). The slope of the line corresponds to an age of 595 ± 20 Ma, the error being the standard deviation of the least square fit. The decay constant used in calculating the age is the latest value adopted, 1.42×10^{-11}Yr^{-1} (Steiger and Jager, 1977). The Y-intercept of the isochron indicates an initial ^{87}Sr/^{86}Sr ratio of 0.7171 ± 0.0022.

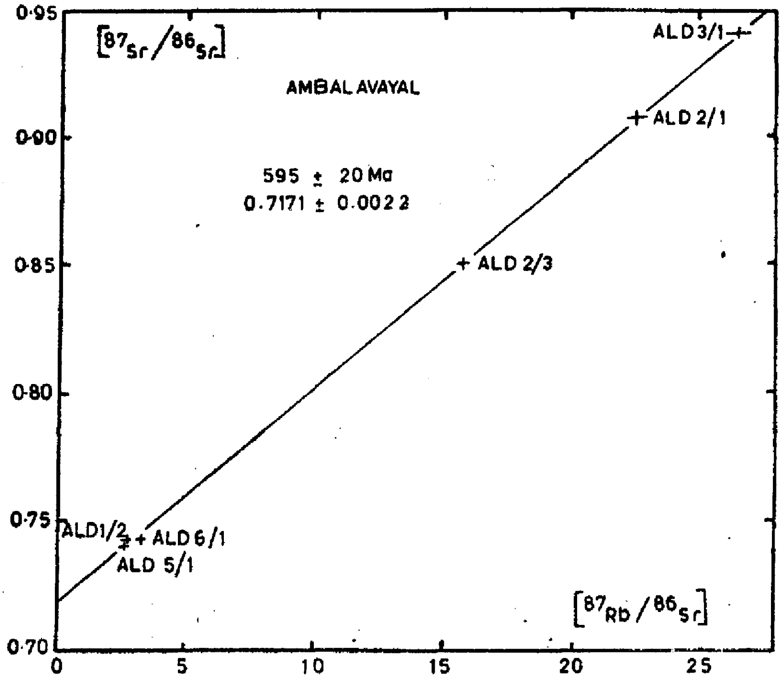

Figure 2. Rubidium-Strontium isochron for the Ambalavayal granite.

Discussion

The Rb/Sr whole-rock age agrees within experimental error with the K/Ar age of 560 ± 30 Ma measured previously on biotite separates from the Ambalavayal granite (Nair *et al* 1985). Since the blocking temperature of biotite is about 300°C (Hanson and Gast, 1967), the region around the Ambalavayal granite has not experienced any significant thermal event since the emplacement of the granite about 600 Ma ago. The Rb/Sr age of the Ambalavayal granite thus marks a Late Precambrian-Early Palaeozoic granite magmatism in this part of the southwestern Indian shield. This confirms the earlier assumption and available ages pertaining to this episode (Nair and Vidyadharan, 1982; Nair *et al* 1985). This age is also in accord with the ~500 Ma tectonothermal event recognised in south India (Aswathanarayana, 1964; Crawford, 1969).

Plutons of similar ages and petrochemical characters occur in other shield areas also where they have been convincingly related to anorogenic magmatism (eg: Harris, 1982). In the present case, the intrusives are spatially related to regional fault-lineaments. It is probable that the generation and emplacement of the granite and syenite plutons of the region are related to the pre-rift tectonics of the Indian continent and signify an event of taphrogenic magmatism (Santosh and Nair, 1983).

Though the initial Sr isotopic composition of the Ambalavayal granite is not precise by modern standards, it is very different from inferred upper mantle composition about 600 Ma ago. The evolved value indicates a crustal origin for the granite. The geochemical signature of the granite, however, is markedly different from that of the associated basement gneisses. The pluton shows alkali enrichment and unique trace element composition including low Rb levels and extremely high LREE contents, suggesting derivation from a partial melt generated at lower crustal levels or upper mantle. If the granite magma had indeed a lower crustal or upper mantle origin, the high Sr ratio indicates a significant crustal contamination of the parental magma.

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