

## A NOTE ON THE AGE OF THE PARAMAKA METAVOLCANICS IN NORTHEASTERN SURINAME<sup>1</sup>

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### ABSTRACT

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Suites of meta-quartz andesites and metabasalts from the Paramaka Formation of the Marowijne Group record a Rb-Sr whole-rock age of  $1.95 \pm 0.15$  Ga ( $\lambda = 1.42 \times 10^{-11} \text{ a}^{-1}$ ). This age is taken as closely approaching the time of the volcanism, which is at variance with the much higher age postulated for these rocks in French Guiana.

### INTRODUCTION

The low-grade metamorphic volcanic-sedimentary sequences of the pre-granitic Marowijne Group occur near the Marowijne River in NE Suriname and in NW Suriname (BOSMA & GROENEWEG, 1973; BOSMA & DE ROEVER, 1975). They continue to the east in northern French Guiana and to the west in northern Guyana and Venezuela, extending for some 1000 km along the northern margin of the Guiana Shield. It has been suggested that the lower sequences of this Group represent one of the few Proterozoic greenstone belts (VEENSTRA, 1978).

In NE Suriname the Marowijne Group is divided into three formations, in order from old to young as follows (see also Geological Map of Suriname, 1978):

- (1) The Paramaka Formation, metabasalts with apparently intrusive metagabbros-metanorites and intercalated metacherts in the lower part, giving way to meta-(quartz) andesites with intercalated metacherts and phyllites upwards. The volcanism marks the beginning of the deposition of the Marowijne Group in Suriname.
- (2) The Armina Formation, rhythmically alternating meta-graywackes and phyllites.
- (3) The Rosebel Formation, meta-arenites with intercalated phyllites and metaconglomerates.

The metabasalts of the Paramaka Formation have the chemical characteristics of modern ocean-floor basalts (major and trace elements, including REE, VEENSTRA, 1978, BOSMA ET AL., in prep.). Along with the intercalation of metacherts and locally of manganiferous and ferri-ferrous quartzites (gondites and itabirites), this indicates deposition in a marine, probably oceanic environment. The chemistry of the meta-(quartz) andesites corresponds to that of island-arc type volcanics.

The Armina association of rhythmically alternating graywackes and phyllites suggests a flysch-type sedimentation, whereas a molasse-type sedimentation is invoked for the deposition of the Rosebel Formation. Most detrital components have been derived from the Paramaka volcanics, for the Armina Formation largely from the intermediate volcanics and for the Rosebel Formation both from the intermediate and the mafic volcanics.

The volcanic-sedimentary sequences underwent regional metamorphism in the greenschist facies, mostly in the lower subfacies, but reaching the lower amphibolite facies in the contact zones along granitoid intrusions. The regional metamorphism was synkinematic with the main phase of (isoclinal) folding. The sequences of the Marowijne Group have been intruded by the Trans-Amazonian granitoid magmas  $1875 \pm 40$  Ma ago (PRIEM ET AL., 1971).

This paper reports the results of Rb-Sr investigations on suites of samples from the metabasalts and meta-quartz andesites of the Paramaka Formation north of Lake van Blommestein (Fig. 1). Metamorphic recrystallization has largely transformed both suites of rocks into greenschist facies assemblages, but they still display relict porphyritic textures.

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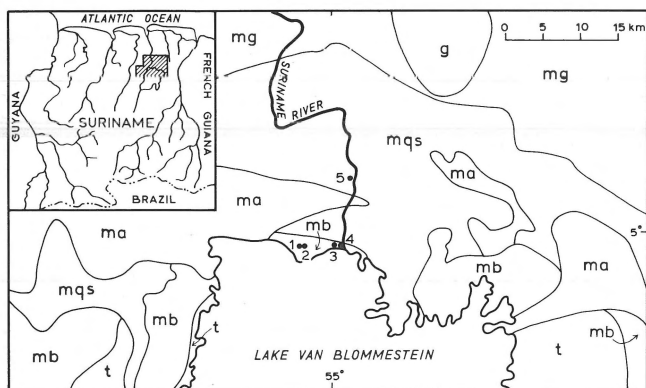


Fig. 1  
Geological sketch map of the area north of Lake van Blommestein, showing the locations of the investigated samples. Legend: t, intrusive tonalite; g, intrusive granite; ma, meta-arenite; mb, metabasalt and locally metagabbriorite; mg, metagraywacke; mqs, meta-quartz andesite. Narrow dolerite dikes are not shown. Sampling sites: 1, SUR 294, 348; 2, SUR 349; 3, SUR 346; 4, SUR 280; 5, SUR 352 through 355.

## ANALYTICAL PROCEDURES

Crushed and pulverized samples were analysed for their Rb and Sr contents and Rb/Sr ratios by X-ray fluorescence spectrometry, using a Philips PW 1450/AHP automatic spectrometer. The samples were measured as pressed-powder pellets; the mass-absorption corrections for both sample and external standard are based upon the Compton scattering of the Mo-K $\alpha$  primary beam (VERDURMEN, 1977). The isotope measurements were made on a computer-controlled Varian CH5 mass-spectrometer with Faraday cage collector and digital output. The estimated overall limits of relative errors are 1% for Rb/Sr and 0.05% for  $^{87}\text{Sr}/^{86}\text{Sr}$ .

The Rb-Sr best-fit lines through the data-points were

computed according to YORK (1966, 1967). Errors in the ages and initial  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios are quoted at the 95% confidence level as computed from the analytical data. The Mean Squares Weighted Deviation (MSWD) was calculated according to MCINTYRE ET AL. (1966).

The IUGS recommended value of  $1.42 \times 10^{-11} \text{ a}^{-1}$  was used for the  $^{87}\text{Rb}$  decay constant.

## RESULTS AND DISCUSSION

The Rb-Sr data are listed in table I and plotted in the diagram of figure 2. The four meta-quartz andesites define an isochron of  $1.98 \pm 0.20 \text{ Ga}$  with initial  $^{87}\text{Sr}/^{86}\text{Sr} = 0.703 \pm 0.002$  (MSWD = 0.1). No isochron arrangement is displayed by the five metabasalts, but four of them have a good linear correlation approximately parallel to the isochron of the meta-quartz andesites. A best-fit line through these four points corresponds to an age of  $1.93 \pm 0.20 \text{ Ga}$  and initial  $^{87}\text{Sr}/^{86}\text{Sr} = 0.702 \pm 0.001$  (MSWD = 0.9). The fifth metabasalt (SUR 294) plots below the best-fit line through the other four samples; this rock is interpreted as reflecting an open-system behaviour to Rb-Sr during the Trans-Amazonian regional metamorphism and is therefore omitted from the age calculation.

An age between about 2.2 and 2.5 Ga is postulated for the Série de Paramaca in French Guiana, the continuation of the Paramaka Formation in Suriname (CHUBERT, 1974). The ages of about 1.9-2.0 Ga measured in this study could thus reflect a resetting during Trans-Amazonian metamorphism. However, the low initial  $^{87}\text{Sr}/^{86}\text{Sr}$  ratio of the metabasalts does not signal a pre-metamorphic history of some 0.3 to 0.5 Ga: the value of  $0.702 \pm 0.001$  corresponds to the lower limit of the range of possible Sr isotopic compositions in the sub-oceanic upper mantle about 2.0 to 2.5 Ga ago (FAURE & POWELL, 1972), so it is highly improbable that mantle-derived

Table I  
Rb-Sr data of the metabasalts and meta-quartz andesites of the Paramaka Formation.

Sample Nr.	Rb (ppm)	Sr (ppm)	Rb/Sr (Wt/Wt)	$^{87}\text{Sr}/^{86}\text{Sr}$	$^{87}\text{Rb}/^{86}\text{Sr}$
<b>Metabasites</b>					
SUR 280	22.3	92.2	0.242	0.72153	0.702
SUR 294	20.9	105	0.199	0.71660	0.577
SUR 346	3.0	121	0.0251	0.70436	0.0726
SUR 348	11.3	136	0.0836	0.70851	0.242
SUR 349	3.5	118	0.0297	0.70414	0.0858
<b>Meta-quartz andesites</b>					
SUR 352	38.9	175	0.222	0.72094	0.643
SUR 353	33.6	196	0.172	0.71696	0.498
SUR 354	41.1	165	0.249	0.72331	0.722
SUR 355	33.9	138	0.246	0.72314	0.712

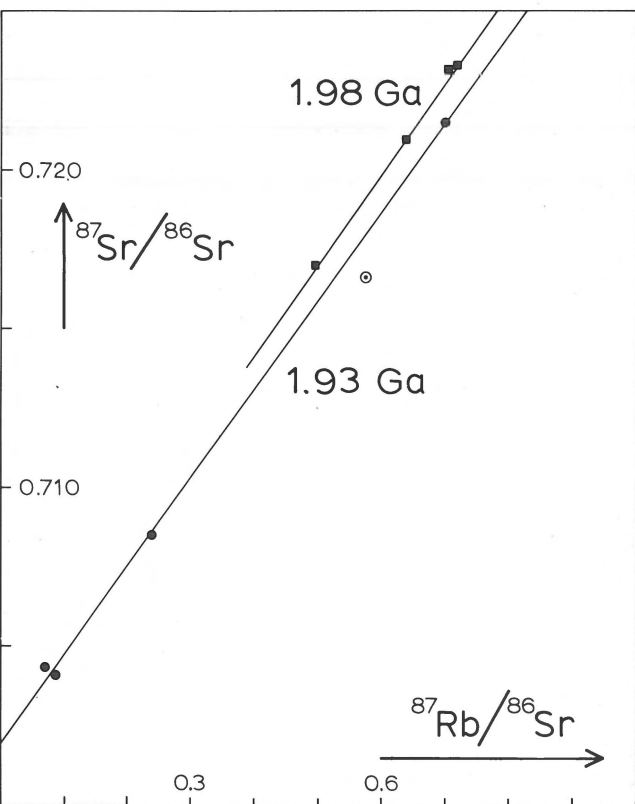


Fig. 2  
Best-fit lines through the Rb-Sr data-points of the Paramaka volcanics. Squares, meta-quartz andesites; circles, metabasalts. The open circle (SUR 294) has been excluded from the regression analysis.

basaltic magma should have been lower in  $^{87}\text{Sr}/^{86}\text{Sr}$ . Moreover, the position of sample SUR 294 below the best-fit line through the other four metabasalts is interpreted as reflecting an open-system behaviour to Rb-Sr during the Trans-Amazonian regional metamorphism, implying that the older samples were not, or to a much smaller degree, disturbed.

The quartz-andesites occur only slightly higher in the stratigraphic column than the basalts, indicating that there cannot have been a large time-interval between both types of volcanism. The mean of both ages,  $1.95 \pm 0.15$  Ga, may therefore be taken as closely approaching the time of the extrusion of the Paramaka volcanics.

The much higher age of the Série de Paramaca in French Guiana is based on the alleged age of about 2.2 Ga of some granitic intrusions, the so-called 'Granites Guyanais' (CHOUBERT, 1974). However, this alleged event of granitic magmatism rests on a few isolated determinations ( $^{207}\text{Pb}/^{206}\text{Pb}$  analyses of one zircon and two columbite-tantalites, and lead model age of one galena), whereas the dating work in Suriname has shown that the whole granitoid-acidic volcanic basement is of Trans-Amazonian age,  $1875 \pm 40$  Ma (PRIEM ET AL., 1971). The Rb-Sr age of  $1.95 \pm 0.15$  Ga reported in this paper for the Paramaka volcanics in Suriname is at variance with the age between 2.2 and 2.5 Ga postulated in

French Guiana, but it confirms the interpretation of the volcanics as an early stage of eugeosynclinal deposition in relation to the Trans-Amazonian orogeny (BOSMA & DE ROEVER, 1975).

The metavolcanics of the Paramaka Formation in north-eastern Suriname and northern French Guiana are correlated with the amphibolites and metasediments of the Barama Group in northern Guyana and the Serie de Carichapo in Venezuela (CHOUBERT, 1974). On a pre-continental drift reconstruction this belt fits to the Eburnian belt in West Africa, dated at  $2.0 \pm 0.1$  Ga (BERTRAND & CABY, 1978).

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