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## POTASSIUM-ARGON AGES ON PYROCLASTIC ROCKS FROM THE PLEISTOCENE SABATINI VOLCANIC DISTRICT, NORTH OF ROME

**ABSTRACT.** — Potassium-argon age determinations have been carried out on two volcanic formations in the Pleistocene Sabatini Volcanic District north of Rome. Mudflows near the base of the « Tufi Stratificati Varicolori de' La Storta » (a stratified tuff sequence) gave several ages clustered at about 0.49 m.y., indicating that deposition of this unit began very shortly after emplacement of the « Tufo Rosso a Scorie Nere », a widespread ignimbrite that has previously been dated at about 0.5 m.y. The « Tufo Giallo di Sacrofano », a yellow ignimbrite that filled valleys eroded through the two units mentioned above, gave an age of  $0.37 \pm 0.07$  m.y. These two new dates are in excellent agreement with observations on the volcanic stratigraphy in this area.

**RIASSUNTO.** — Sono stati datati col metodo K-Ar due prodotti del vulcanesimo sabatino nella zona della Valle del Treia. I valori ottenuti sono di 0,49 m.a. per alcune colate di fango alla base dei « Tufi Stratificati Varicolori de' La Storta », e di  $0,37 \pm 0,07$  m.a. per il « Tufo Giallo di Sacrofano », un'ignimbrite che ha riempito un sistema di valli erose dopo la deposizione dei « Tufi Stratificati Varicolori de' La Storta ».

Questi valori sono in ottimo accordo con osservazioni dettagliate sulla stratigrafia vulcanica in questa zona.

### Introduction

We report here the results of a geochronological study of two volcanic units in the area Districts of interfingering between the Vico and Sabatini Districts — the central two of the four districts that make up the Pleistocene Roman Volcanic Province. As a general rule K/Ar dating of rocks as young as Pleistocene has proven very difficult because of the low levels of radiogenic argon, but in the case of the Roman Volcanic Province this difficulty is at least partially offset by the high potash content of the rocks. Previous K/Ar age determinations on rocks of the Vico and Sabatini Districts have been published by EVERNDEN et al. (1964), EVERNDEN and CURTIS (1965), NICOLETTI (1969), BONADONNA and BIGAZZI (1969), AMBROSETTI et al. (1969), BONADONNA and BIGAZZI et al. (1970), fission track ages have been reported by BIGAZZI et al. (1973).

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The stratigraphy is punctuated by three ignimbrite units, each about 30 m thick. The middle ignimbrite unit is the « Tufo Rosso a Scorie Nere » (MATTIAS most important of the Vico ash flow tuffs. As mentioned above, this unit has been and VENTRIGLIA, 1970 = « Ignimbrite C », LOCARDI, 1965; BERTINI et al., 1971), the dated at about 0.5 m.y. (0.43 m.y., EVERNDEN and CURTIS, 1965;  $0.52 \pm 0.12$  m.y., NICOLETTI, 1969).

### Geological setting

The Vico District comprises a single composite volcano located about 50 km north-northwest of Rome. Rim elevations reach 965 m (M. Fogliano) and the summit is marked by a caldera containing the Lago di Vico and a small, late cone (M. Venere). The principal output of the Vico Volcano has been a series of four ignimbrite units (LOCARDI, 1965; MATTIAS and VENTRIGLIA, 1970; BERTINI et al., 1971) which in most directions extend out to about 20 km from the crater. The most important of these ignimbrite units is the « Tufo Rosso a Scorie Nere » (MATTIAS and VENTRIGLIA, 1970) or « Ignimbrite C » (LOCARDI, 1965), for which several K/Ar dates of around 0.43 m.y. (EVERNDEN and CURTIS, 1965) and one of  $0.52 \pm 0.12$  m.y. (NICOLETTI, 1969) have been obtained. ALVAREZ et al. (1975) have shown that the « Tufo Rosso a Scorie Nere » can be traced 50 km south and southeast from the Vico Crater, nearly to the outskirts of Rome. In addition to the four ignimbrite units, the Vico Volcano erupted a large amount of pyroclastic material in the form of mudflows and air-fall tuffs. Lava flows are a relatively minor component, occurring mostly near the crater; they have been studied by AMENDOLAGINE and al. (1963), MATTIAS (1966), and CUNDARI and MATTIAS (1974).

The Sabatini District is marked by an east-west line of maars 25 km northwest of Rome that link the large collapse caldera of Lago di Bracciano to the west with the Sacrofano Crater to the east. The Sacrofano Crater was formed by collapse of a volcano that was probably the source of several units, including one or more ignimbrites. General studies of the Sabatini District have been published by SCHERILLO (1947), MATTIAS and VENTRIGLIA (1970) and BERTINI et al. (1971); a census of the craters is given by MATTIAS (1970) and the maars and their base surge deposits have been studied by MATTSON and ALVAREZ (1973).

In the area between the Vico Volcano and the Sabatini craters products of the two districts interfinger (MATTIAS and VENTRIGLIA, 1970). The stratigraphy in this area is very complicated because of competition between stream erosion and volcanic deposition, which has resulted in extensive channelling on all scales (ALVAREZ, 1972, 1973). The samples dated in the present study were collected in the area of interfingering between the two districts because available stratigraphic control in this area establishes the chronological order of the various units and provides a tie between the volcanic sequences of the two districts.

*Stratigraphy of the sampling area (Fig. 1)*

Our samples were collected in the area of the 1:25,000 map sheet «Nepi» (143-I-SE). In this area the Treia River and its tributaries have cut canyons up to 100 m deep that expose the entire volcanic sequence together with the underlying Pliocene clay and sand. In the central part of the Nepi sheet (ALVAREZ, 1972) the volcanic sequence rests on Lower Pleistocene gravels marking the bed of the Paleotiber River.

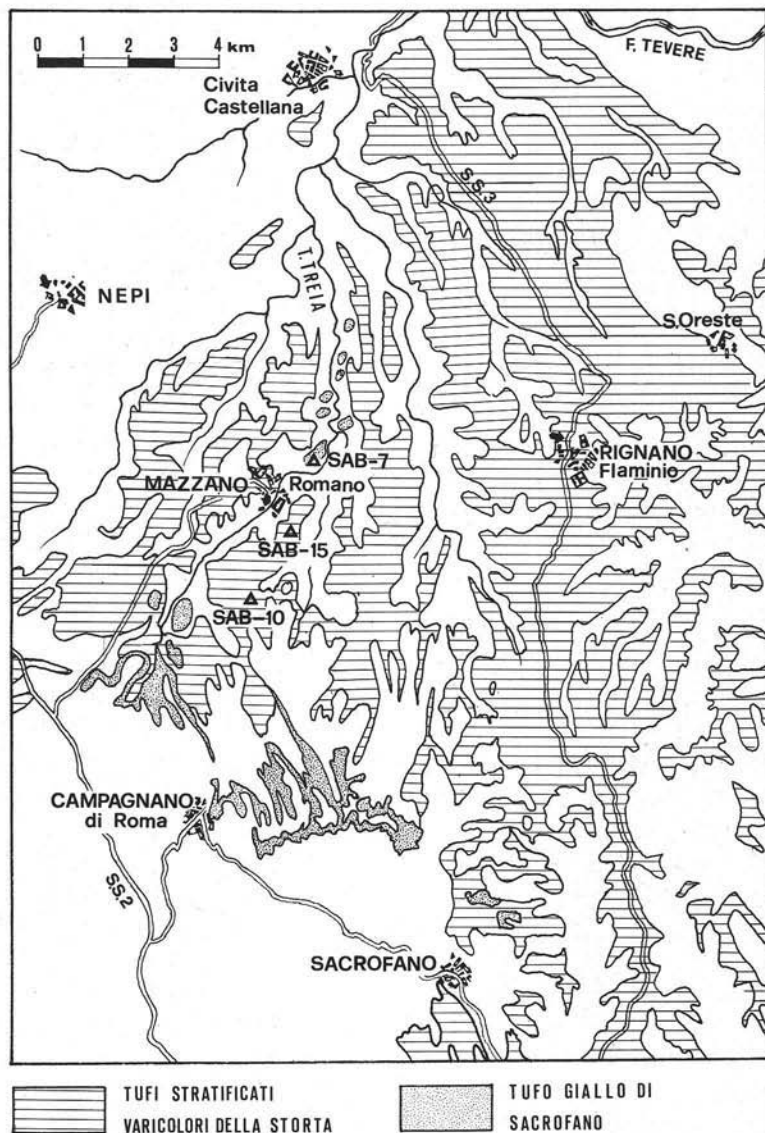


Fig. 1. — Geological map of Mazzano Romano area from Mattias e Ventriglia (1970), revised by Alvarez.

The lower ignimbrite («Tufo Giallo della Via Tiberina») and the upper ignimbrite («Tufo Giallo di Sacrofano») are both products of the Sabatini District and probably of the Sacrofano Volcano (MATTIAS and VENTRIGLIA, 1970; ALVAREZ, 1972).

In this study we have dated samples from two stratigraphic units. Samples SAB-10 and SAB-15 are from the Tufi Stratificati Varicolori de' La Storta. In the Treia Valley area this unit is composed of orange or golden-colored mud flows («lahars») which rest on the «Tufo Rosso a Scorie Nere» above a level contact that shows no sign of erosion (<sup>1</sup>). This stratigraphic evidence suggests that in the Treia Valley area, at least, the mud flows of the «Tufi Stratificati Varicolori de' La Storta», are only slightly younger than the «Tufo Rosso a Scorie Nere», and that it may not be possible to distinguish their ages radiometrically.

Sample SAB-7 is from the «Tufo Giallo di Sacrofano», the youngest of the three ignimbrites in the Treia Valley area. As described by ALVAREZ (1972), this unit fills paleovalleys that cut down through both the «Tufi Stratificati Varicolori de' La Storta» and the «Tufo Rosso a Scorie Nere». In addition, the emplacement of the «Tufo Giallo di Sacrofano» was followed by renewed erosion that has continued to the present, producing the modern canyons of the Treia Valley which are deeper and wider than the paleovalleys that were filled by the «Tufo Giallo di Sacrofano». The magnitude of the two sets of valleys suggests, therefore, that the «Tufo Giallo di Sacrofano» should have an age slightly more than half that of the «Tufo Rosso a Scorie Nere».

### Analytical technique

Potassium-argon radiometric determinations were carried out on crystals of leucite, sanidine, and biotite, separated with standard enrichment methods (heavy liquids, magnetic separator). Potassium was determined by Flame Spectrophotometry; controls have been carried out using as reference International Standards.

Argon was determined by the methodology used in previous studies (NICOLETTI and PETRUCCIANI, 1974); using as reference standards Muscovite P207, Muscovite Berna 4M, and Phonolite MZ. These standards have given the following values (standards in parentheses):  $80.5 \pm 1$  ( $81 \pm 1$ );  $18.3 \pm 0.8$  ( $18.7 \pm 0.5$ );  $7.5 \pm 0.3$  ( $7.4 \pm 0.2$ ) m.y.

The results obtained are summarized in Table 1.

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(<sup>1</sup>) In other areas these units have a level contact which shows sign of erosion (SCHE-  
RILLO, 1940).

TABLE I  
Experimental results

Sample no.	Formation	Locality *	Mineral	$^{40}\text{Ar}$ C, C, S, T, P, RAD g	$^{40}\text{Ar}$ RAD%	K%	$\pm \epsilon$	M. Y.**
SAB-7	Tufo Giallo di Sacrofano	42°12'35" N; 0°02' 22" W; elev. 175 m (Quarry abg ve Mazzano-Calciata road)	Sanidine	$0.1529 \cdot 10^{-6}$	10.12	10.34	$0.37 \pm 0.07$	
SAB-10	Tufi Stratificati vari colori de' La Storta	42°10'34" N; 0°03'28" W; elev. 220 m (100 m E of Casale del Bottegone)	Leucite	$0.3789 \cdot 10^{-6}$	13.09	15.75	$0.61 \pm 0.1$	
			Biotite	$0.0952 \cdot 10^{-6}$	3.88	6.09	$0.40 \pm 0.2$	
SAB-15	Tufi stratificati vari colori de' La Storta	42°11'45" N; 0°02'40" W; elev. 225 m (350 m NE of Capo Magliano)	Biotite	$0.1593 \cdot 10^{-6}$	7.82	8.06	$0.50 \pm 0.1$	$\bar{m} \pm \epsilon$ $0.49 \pm 0.1$
			Biotite	$0.1556 \cdot 10^{-6}$	1.86	8.06	$0.49 \pm 0.2$	
			Leucite	$0.3025 \cdot 10^{-6}$	23.64	16.17	$0.47 \pm 0.05$	

\* Longitude west of Rome (Monte Mario).

\*\* M.Y. = Million Years.

## Discussion

These new dates are in excellent agreement with detailed geological observations on the volcanic stratigraphy in the Treia Valley area (ALVAREZ, 1972). As discussed above, the uneroded contact between the lowest mud flow beds of the «Tufi Stratificati Varicolori de' La Storta» and the underlying «Tufo a Scorie Nere» ignimbrites suggests that there should be little difference in age between these two units. Thus the five new dates clustering around 0.49 m.y. for the basal mud flows (SAB-10 and 15) are in good agreement with the previous dating of the «Tufo Rosso a Scorie Nere» at about 0.5 m.y.

A comparison of the dimensions of the modern canyons of the Treia Valley system with those of the paleovalleys that were filled by the «Tufo Giallo di Sacrofano» led us to anticipate an age for this unit of somewhat more than half that of the «Tufo Rosso a Scorie Nere». The age obtained,  $0.37 \pm 0.07$  m.y., is thus reasonable on the basis of stratigraphic observations.

Considerably younger dates have been reported for the «Tufi Stratificati Varicolori de' La Storta» in the Riano area, about 15 km southeast of the Treia Valley area (BONADONNA and BIGAZZI, 1969).

This difference in age between the Riano area and the Treia Valley area is not necessarily contradictory, since a stratified tuff sequence like the «Tufi Stratificati Varicolori de' La Storta» may represent deposition during a long interval of time. We conclude that in the Treia Valley area deposition of beds assigned to this formation began immediately after emplacement of the «Tufo Rosso a Scorie Nere», and terminated well before emplacement of the «Tufo Giallo di Sacrofano» ignimbrite at  $0.37 \pm 0.07$  m.y. In the Riano area, where the «Tufo Giallo di Sacrofano» is not recognized, deposition of beds assigned to the «Tufi Stratificati Varicolori de' La Storta» continued until about 0.225 m.y.

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