

**DATING OF MIOCENE ACID AND INTERMEDIATE
VOLCANIC ACTIVITY IN HUNGARY**

by

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Since 1974 a systematic *K/Ar* research has been carried out on Miocene volcanic rocks in Hungary as a joint project of the Hungarian Geological Institute and the Institute of Nuclear Research of the Hungarian Academy of Sciences.

The great number of dated rocks (from over 400 localities) and the critical evaluation of radiometric ages enabled us, in spite of the frequent disagreement of *K/Ar* and geologic ages, to establish the temporal evolution of Miocene volcanism in Hungary.

The first results of *K/Ar* dating were presented in 1977 at the XIth Congress of the CBGA, Kiev (KADOSA BALOGH et al., 1980). At the VIIth Congress of the RCMNS, Athens, the chronologic conclusions of *K/Ar* datings on rhyolitic pyroclastics have been summarized (G. HÁMOR et al., 1979). The first review of radiometric studies on Miocene volcanic rocks in Hungary was presented at the XIIth Congress of the CBGA, Bucharest (1981) by E. ÁRVA-SÓS et al. (1983) and an other paper dealt with the *K/Ar* results on Miocene volcanites from NE Hungary (K. BALOGH et al., 1983).

From among the radiometric ages presented here those of first order chronostratigraphic importance are used for the establishment of a revised radiometric time scale for the Central Paratethys Neogene by D. VASS et al. (this volume). The present work has a twofold aim.

1 In view of the new age data an updated picture of the evolution of Miocene acidic and intermediate volcanic activity in Hungary is presented.

2 The average ages of Miocene stage boundaries in the Central Paratethys deduced from radiometric ages and palaeomagnetic data on this territory (D. VASS et al., this volume) may slightly differ from those established for Hungary. As a step towards the assessment of regional variation of the ages assigned to stage boundaries, the differences will be emphasized which exist between the boundary ages defined for the Central Paratethys as a whole on one hand and for Hungary on the other. The sites of rocks referred to in the text are shown in Fig. 1.

In Hungary, the oldest Miocene volcanites occur in SE Transdanubia. In the Mecsek Mts the andesite at Komló overlies Eggenburgian sediments (according to palynology by M. SÜTŐ-SZENTAI, 1983). Rhyolite tuffs are intercalated in Eggenburgian strata and rhyolite tuffs and flood tuffs occur over the andesite too. According to palynological data (E. NAGY, 1969) the rhyolitic sequence is of Ottnangian—Eggenburgian age. Recent dating of the andesite resulted in 19.5 ± 0.9 Ma (borehole Komló 170, K. BALOGH et al., unpublished). The two oldest reliable ages on the rhyolite tuff are 19.6 ± 1.9 Ma (Szászvár, Szekernye valley) and 19.5 ± 1.4 Ma (Váralja-quarry) (G. HÁMOR et al., 1979). These dates are regarded as within the Eggenburgian, near the Eggenburgian—Ottnangian boundary.

Rhyodacitic tuffs belonging to the Middle Rhyolitic Tuffs are also present in the Mecsek Mts. Their mean age (16.4 Ma) is in a full accordance with the average age of the Middle Rhyolite Tuffs (16.4 ± 0.8 Ma) calculated for the whole territory of Hungary (G. HÁMOR et al., 1979).

North of the Mecsek Mts borehole Tengelic 2 penetrated rhyodacitic volcanites covered by sediments belonging to zone NN5 (A. NAGYMAROSY, pers. comm.). The average age on 11 biotites from different depths is 15.6 ± 0.7 Ma, but the mean age of 15.7 ± 0.55 Ma measured for 9 biotites from lava rocks is more reliable (K. BALOGH, 1984). According to stratigraphy and K/Ar age this sequence is a younger member of the Middle Rhyolite Tuffs.

Dacite was reached by borehole Nagydorog 1, N of the Mecsek Mts. Biotites from 4 cores from different depths gave resulted an average age of 19.29 ± 0.37 Ma (K. BALOGH, 1984).

A mean age of 18.5 ± 1.7 Ma has been determined of 6 biotites from dacitic tuffs intersected by borehole Paks 2. (E. ÁRVA-SÓS et al., 1983).

Alkali rhyolite is exposed at the surface at Sárszentmiklós. According to its radiometric age of 17.0 ± 0.7 Ma it is associated with the Middle Rhyolite Tuffs. This age is, however, somewhat doubtful since due to the absence of biotite the measurements were made on magnetically split fractions of the altered rocks and the presence of older contaminating material might be suspected. Similar alkali rhyolite from borehole Albertirsa 1 provided a younger age of 14.3 ± 0.5 Ma (E. ÁRVA-SÓS et al., 1983).

At Bántapuszta the rhyolite tuff is situated in the lower part of the Upper Badenian (J. KÓKAY, GY. RAINCSÁK, 1983), which yielded an average biotite age of 15.0 ± 0.4 Ma (K. BALOGH, 1984).

In the Zsámbék basin (W of Budapest) boreholes Budajenő 3 and Perbál 6 intersected a rhyolite tuff layer in the lower third part of the Sarmatian (Á. JÁMBOR, 1976; Cs. RAVASZ, 1978). Its average K/Ar age, measured on biotites, turned out to be 13.7 ± 0.5 Ma (G. HÁMOR et al., 1979; K. BALOGH, 1984).

In the Börzsöny—Dunazug Mts Miocene volcanic activity started with the ejection of andesite pyroclastics in the Early Badenian (T. BÁLDI, J. KÓKAY, 1970; G. HÁMOR, Á. JÁMBOR, 1971). According to radiometric dating (G. HÁMOR et al., 1979), the oldest volcanites are contemporaneous with the main eruption phase (16.4 ± 0.8 Ma) of the Middle Rhyolitic Tuffs. On the basis of K/Ar dating on biotites and amphiboles (K. BALOGH et al., unpublished) the production of volcanic material terminated about 15.0 Ma B.P., while according to stratigraphy it was restricted to the Early Badenian (T. BÁLDI, J. KÓKAY, 1970).

In N Hungary Miocene volcanism started with the eruption of the Lower Rhyolite Tuffs in Early Oligocene time (G. HÁMOR, Á. JÁMBOR, 1971). Due to the strong alteration the radiometric dating of this level is difficult. This is illustrated by the $^{39}Ar/^{40}Ar$ release spectrum (Fig. 2), recorded by Y. TAKIGAMI (Tokyo University) on a biotite, from Ipolytarnóc which indicates strong recrystallization of the biotite. The total fusion age is 19.0 ± 1.4 Ma, this deviates from the K/Ar ages of 16.3 ± 1.6 Ma and 16.0 ± 2.0 Ma measured in Debrecen (K. BALOGH, 1984). The deviation may be attributed to the great analytical errors and the extreme sensitivity needed for $^{39}Ar/^{40}Ar$ measurement on young minerals. On the basis of the latest datings the most likely age of Lower Rhyolite Tuffs in N Hungary is about 19.0 Ma or somewhat younger.

In the Mátra Mts the Lower Rhyolite Tuffs were followed by Karpatian andesites (GY. VARGA et al., 1975). Due to their altered character these are still undated. The Karpatian andesites were followed by rhyodacite tuffs in the uppermost Karpatian (M. HAJÓS, 1968) dated at Tar as 16.4 ± 1.1 Ma (G. HÁMOR et al., 1979). K/Ar age of

16.2±0.6 Ma has been measured (G. HÁMOR et al., 1979) on the rhyodacite tuff at Fót (NE of Budapest) which is in the same stratigraphic position (J. HALMAI, 1981). The rhyodacite tuffs were followed by andesites in the Early Badenian and these andesites are covered with rhyolite at Gyöngyössolymos (GY. VARGA et al., 1975). A highly reliable age of 15.9±0.5 Ma was measured on the rhyolite (K. BALOGH, 1984). Due to the frequent loss of radiogenic argon, it is difficult to date the end of the volcanism. The most reliable ages on the youngest andesite dikes fall in the range of 14.0–15.0 Ma (K. BALOGH et al., unpublished). This makes it likely that the volcanism continued in the Late Badenian, too. In the Zagyva trench (between the Cserhát and Mátra Mts) *K/Ar* ages as young as about 10 Ma have been measured (G. HÁMOR et al., 1978; K. BALOGH, 1984). This may be explained by postvolcanic tectonism or hydrothermal activity.

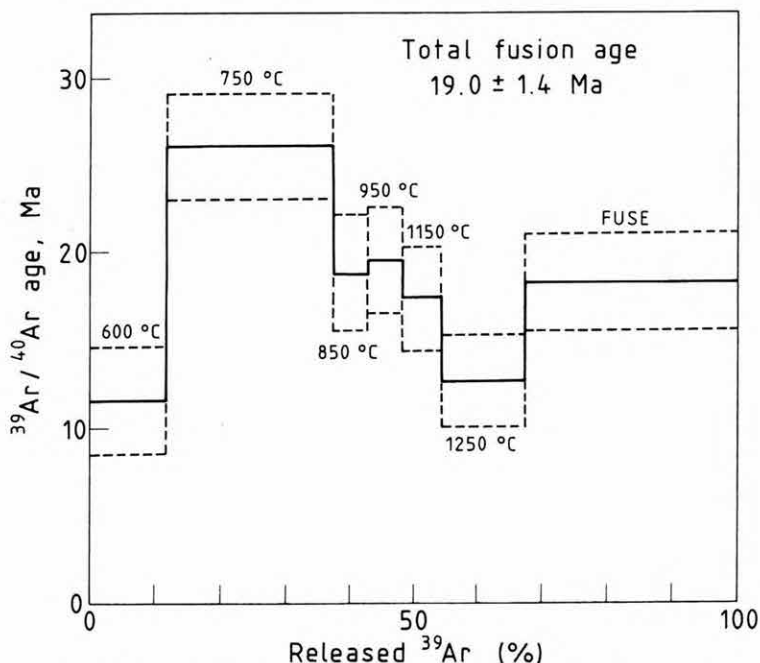


Fig. 2. $^{39}\text{Ar}/^{40}\text{Ar}$ spectrum of the Lower Rhyolite Tuff at Ipolytarnóc. Measured by Y. TAKIGAMI, Tokyo Univ 1984.

Andesitic and basaltic-andesitic volcanic activity is detected N of the Bükk Mts (Sajómercse, Dubicsány, Kelemér) in the Sarmatian and Pannonian. Radiometric ages (9.5–12.7 Ma, E. ÁRVA-SÓS et al., 1983; K. BALOGH, 1984) are in agreement with the stratigraphy.

In borehole Alsóvadász 1 (Cserhát) the rhyolite tuff is situated directly above the Karpatian–Badenian boundary. The biotite based average age (15.6 ± 0.7 Ma) is in accordance with the stratigraphic position within the limits of experimental precision (E. ÁRVA-SÓS et al., 1983).

The chronology of Miocene volcanism in the Tokaj Mts and Trans-Tisza region has been treated in detail by K. BALOGH et al. (1983) and Z. PÉCSKAY (1983).

In the Tokaj Mts Miocene volcanic activity started with rhyolite tuffs in the Badenian and it is characterized by parallel rhyolitic, dacitic and andesitic material

production till the end of Sarmatian. Alunite crystals from veins in the uppermost Sarmatian (T. ZELENKA, 1964; GY. RADÓCZ, 1969; Á. JÁMBOR, 1971) yielded K/Ar ages of 10.7–11.0 Ma (K. BALOGH et al., 1983; Z. PÉCSKAY, 1983) proving that the Sarmatian–Pannonian boundary can not be younger than 11.0 Ma in this area. In the Tokaj Mts volcanic activity continued with dacite and andesite production in the Pannonian and terminated with the basalt eruption at Sárospatak 9.4 ± 0.5 Ma B.P. (V. SZÉKY-FUX et al., 1980).

In the Trans-Tisza region the oldest Miocene volcanites are rhyolites reached by borehole Kisújszállás-ÉK 1. The radiometric age of 18.25 ± 0.3 Ma (E. ÁRVA-SÓS et al., 1983) may be accepted as the start of Miocene volcanism in this area. In the central part of the Trans-Tisza region Miocene volcanism was introduced by andesites in the Karpatian, it continued with alternating rhyolitic and andesitic products and terminated with rhyolite tuffs in the Sarmatian (K. BALOGH et al., 1983; Z. PÉCSKAY, 1983; V. SZÉKY-FUX, 1985). Along the boundary of Hungary and the USSR rhyolite tuff and rhyolite production finished near the end of Sarmatian (L. KULCSÁR, 1968). K/Ar ages measured on biotite and lava rock fall in the range of 11.0–11.3 Ma (K. BALOGH et al., 1983). Though a very small rejuvenation can not be excluded the radiometric dates support that the Sarmatian–Pannonian boundary is not older than 11.5 Ma. On the other hand Lower Pannonian dacite tuff from borehole Nagykozár 2 (S Hungary) yielded an older age (11.6 ± 0.5 Ma; K. BALOGH, 1984). Accordingly, the Sarmatian–Pannonian boundary may be older in the southern part of Hungary.

In the Pannonian the acidic and intermediate volcanism terminated and alkaline basaltic volcanic activity started, which lasted till the end of Pliocene (K. BALOGH, et al., 1985).

Chronostratigraphic conclusions

The age of Eggenburgian–Ottנגian boundary is 19.0–19.5 Ma. In S Hungary the older, in N Hungary the younger datum is more likely.

The age of Ottנגian–Karpatian boundary can not be directly established from the datings performed in Hungary.

The age of 16.4 Ma averaged for the Middle Rhyolitic Tuffs (G. HÁMOR et al., 1979) is a good approximation for the Karpatian–Badenian boundary. It is coherent with the age adopted by D. VASS et al. (1987), but it is slightly younger than suggested by F. RÖGL and F. STEININGER (1983). The Middle–Late Badenian boundary can not be younger than 15.0 Ma. The probable age of Badenian–Sarmatian boundary is about 14.0 Ma, somewhat older than suggested by D. VASS et al. (1987) and F. RÖGL and F. STEININGER (1983). 11.5 ± 0.5 Ma is accepted for the Sarmatian–Pannonian boundary. This agrees well with the age given by F. RÖGL and F. F. STEININGER (1983). In S Hungary the older, in NE Hungary the younger datum is more likely.

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