

1. MINERALOGIE—PETROLOGIE

PETROLOGIA ROCILOR MAGMATICE

**BASE SURGE DEPOSITS IN THE CIOMADUL MASSIF
(SOUTH HARGHITA MOUNTAINS) ¹**

by

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Pyroclastics. Base surge. Lapilli. Neogene. Dacitic composition. Eruptions. Bedding. East Carpathians — Neogene eruptive-Quaternary — Harghita Mountains.

Abstract

Base surge deposits with accretionary lapilli occurring in the Ciomadul massif in the south Harghita Mts are first described in Romania. These deposits are the result of phreatomagmatic eruptions in the first phase of the dacitic volcanic activity in the study zone.

Résumé

Dépôts pyroclastiques de type „base surge” dans le massif de Ciomadul (monts de Harghita de sud). On décrit, pour la première fois dans la Roumanie, les dépôts pyroclastiques de type „base surge” à lapillis accrétonnaires situés dans le massif de Ciomadul, au sud des monts de Harghita. Ces dépôts sont engendrés par des certaines éruptions phréatomagmatiques de la première phase de développement du volcanisme dacitique de la zone.

Introduction

Significant results obtained in volcanology during the last years made possible a better understanding of the complex phenomena related to the explosive volcanic activity. It opened the way to the reconstitution of the explosive volcanism on the basis of the characteristics of its products as well as the way to a more accurate genetic systematization

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of the pyroclastic deposits. An excellent synthesis of these results is given in Fisher and Schmincke's "Pyroclastic Rocks" (1984).

At present, the following genetic classification of the pyroclastic deposits is admitted: (1) pyroclastic fall deposits; (2) pyroclastic flow deposits and (3) pyroclastic surge deposits.

The recognition of the base surge deposits (a category of the pyroclastic surge deposits), of the volcanic phenomenon that has generated them, respectively, is relatively recent, brought about by the 1965 eruption of the Taal volcano (Philippines) (Moore et al., 1966 in Fisher, Schmincke, 1984). In volcanic eruptions base surge represents the blast carrying ash particles as diluted suspension skimming the ground around the eruption centre, usually occurring during the phreatomagmatic eruptions. The sedimentation of the solid charge generates pyroclastic deposits displaying some characteristics of eolian deposits. Such types of deposits were identified in numerous zones with recent or older volcanism. Their occurrence in the Ciomadul massif was evidenced on the occasion of the Second Geological Symposium held at Gheorghieni (Szakács et al., 1984, unpublished paper).

Geological Setting

The dacitic explosive-extrusive volcanism in the Ciomadul massif developed on a basement represented by the Cretaceous flysch and by older Pliocene pyroxene andesites. During the first phase the pyroclastic cone was built as a result of the explosive activity of two known eruptive centres — Sfânta Ana and Mogoş. The pumice-rich deposits constituting the cone belong to all genetic types, the surge-type ones being among the last ones. The loose tephrae were redistributed towards the base of the cone and outside it, through lahars and by erosional reworking. During the second stage domes and short lava flows occurred on the flanks of the pyroclastic cone and outside it, under tectonic control.

Volcanics consist of hornblende and biotite dacites and hornblende biotite, pyroxene and quartz dacites, displaying a high-K character (Szakács, Seghedi, 1986).

Base Surge Deposits

The base surge deposits crop out in an artificial exposure, nearby the road leading to the Sfânta Ana Lake, in the vicinity of the north-eastern border of the eruption centre in the Mogoş swamp zone. They are fine-grained unconsolidated tephrae, consisting of lithic fragments of dacites, pumice, volcanic glass and crystals (mainly plagioclase, hornblende and biotite).

This deposit is characterized by a dune-type bedding (Pl. I, Fig. 1). The stoss side displays fine laminae dipping 5–10° towards the source. The lee side laminae are thicker, generally plan-parallel, locally oblique, with dips of 18–20° (Fig. 1). The visible height of the dune-type structure is of about 1.5 m.

The outcrop displays, in fact, a longitudinal section through the "dune" so that one can observe the shifting of the crest concurrently with the deposition of newer beds, giving rise to a dip axial plane of about 40° . According to Fisher and Schmincke the mentioned characteristics point out a low flow regime unlike the deposits emplaced in high flow regime, characterized by antidune-type sedimentary structures.

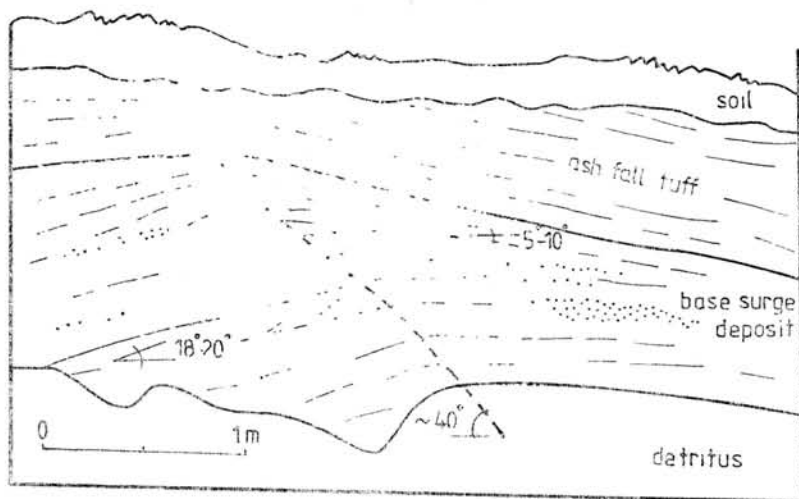


Fig. 1 — Sketch of the outcrop with base surge deposits (after the photo in Plate I, Fig. 1).

The deposit presents a certain grading of the pyroclastic material. The coarser material, rich in lithic fragments, forms thin levels or elongated lenticular "trains" (Fig. 1). The granulometric features of the deposit are shown in Figure 2 as a cumulative curve. The average diameter (in ϕ units) is $+0.4$ and the sorting coefficient ($\sigma - \phi$) is 1.7. These parameters are in agreement with the closeness to the source (less than 200 m); similar deposits of the Taal volcano (Philippines) point out a more reduced granulation and a better grading at gradually increasing distances from the source (Waters, Fisher, 1971, mentioned by Fisher, Schmincke, 1984).

The presence of accretionary lapilli³ represents another feature of the base surge deposits in the Ciomadul massif. A large number of accretionary lapilli is found within a well-developed level of ca 15–20 cm thick as well as in some thinner levels (1–3 cm). Although they occur also in the stoss side their abundance is characteristic of the lee side of the dune structure. Their size varies from some millimetres to about 1 cm. They display a strong spherical shape (Pl. II, Fig. 1). They often show concentric internal structure (Pl. II, Fig. 2). Accretionary lapilli represent small agglomerations of fine moist ash, formed during the explosive volcanic eruptions in conditions of liquid or steam water abundance.

The mere presence of the accretionary lapilli does not have diagnostic value for phreatomagmatic eruptions; however, their association with base surge deposits is quite relevant for this type of volcanic activity.

The hypothesis of a phreatomagmatic eruptive process for the formation of base surge deposits with accretionary lapilli in the Ciomadul massif represents the most plausible explanation of the field evidence, indicating the water abundance in the eruption column and a massive production of fine tephra, deposited in the source vicinity.

In the examined outcrops the base surge deposit is overlain by air-fall tuffs some decimetres thick (Fig. 1).

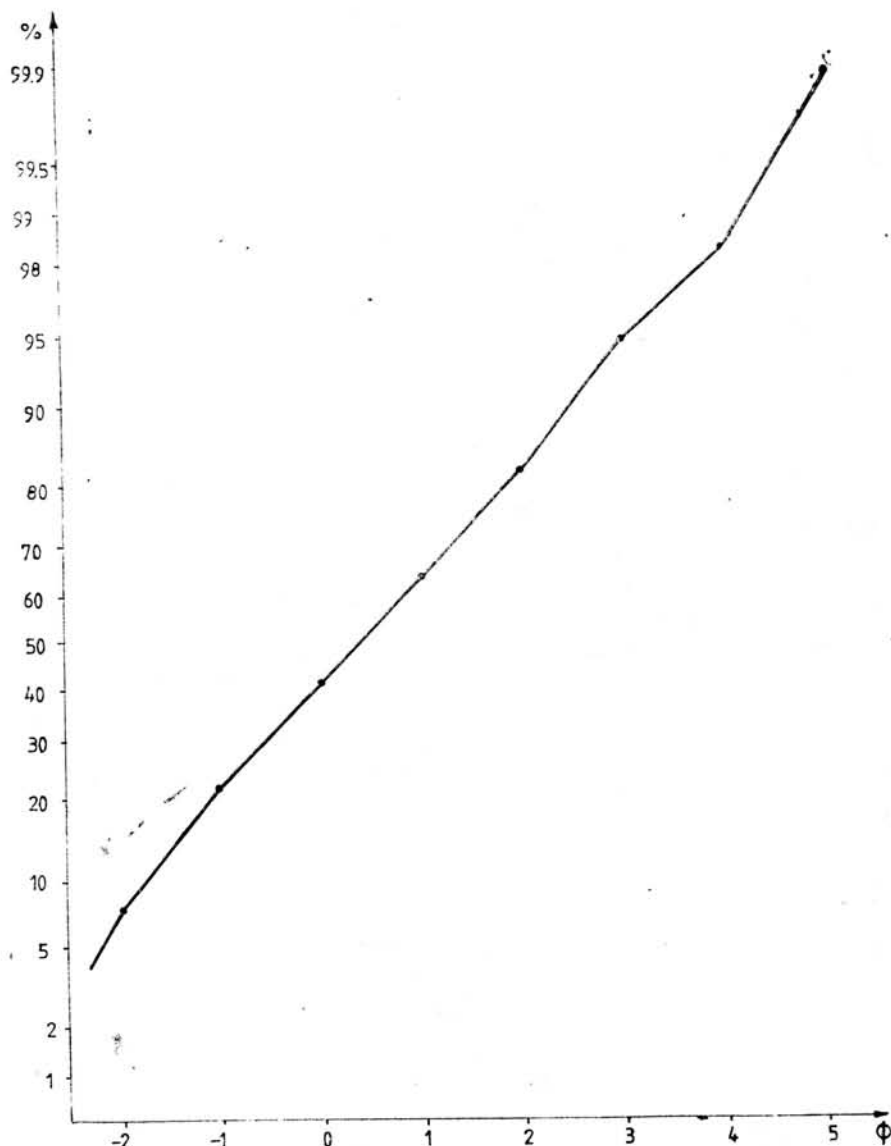


Fig. 2 — Granulometric cumulative curve of the base surge deposits; $Md\theta=0.4$; $\sim\theta=1.7$.

Our observations indicate a possible wider development of the base surge deposits in the Ciomadul massif, showing more and more attenuated characters (wave height and length of the dune-type structures, grain-size, etc.) as we move away from the source. Likewise, the presence of base surge deposits in other areas of the Călimani-Gurghiu-Harghita eruptive chain, especially in connection with the first stage of volcanism, is also likely.

³ The presence of accretionary lapilli was mentioned in Romania only in the Carboniferous (?) acid volcanics in the Carapelit Formation of North Dobrogea (Seghedi, Szakács in Seghedi et al., 1987).

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DEPOZITE PIROCLASTICE DE TIP „BASE SURGE” ÎN MASIVUL CIOMADUL (MUNȚII HARGHITA DE SUD)

(Rezumat)

Într-o deschidere din imediata apropiere a centrului de erupție **Mohoș** aflorează depozite piroclastice dacitice de tip „base surge” cu caractere tipice: granulație redusă ($Md \phi = +0,4$), sortare moderată ($\sigma \phi = 1,7$), structuri de tip dună cu lamine paralele și oblice la unghi mic ($5-10^\circ$ pe partea „în curent”, $18-20^\circ$ pe partea „sub curent”). Este caracteristică prezența abundentă a lapililor acreționari, mai ales pe partea „sub curent” a structurii de dună. Aceste caractere tipice denotă proveniența depozitelor de „base surge” cu lapili acreționari în urma unor procese hidroclastice (erupții freatomagmatice).

Depozite de val piroclastic (pyroclastic surge deposits) sînt descrise pentru prima dată, cu această ocazie, pe teritoriul României.

EXPLANATION OF PLATES

Plate I

Fig. 1 — Outcrop in base surge deposits near Mohoš swamp.

Fig. 2 — Accretionary lapilli tuff in base surge deposit (lee side).

Plate II

Fig. 1 — Accretionary lapilli detached from base surge deposit.

Fig. 2 — Concentric structure in accretionary lapillus.



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