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ACCRETIONARY LAPILLI TUFFS IN THE HARGHITA MTS.

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In the Neogene volcanic area of the Harghita Mts. two accretionary lapilli tuff occurrences are described: one in an unconsolidated pleistocene dacitic base surge deposit near Mohoş swamp in Ciomadul Massif and another, until present unknown in Var brook valley near Siculeni village in the eastern part of the North Harghita, part of a Pontian diagenised andesitic fallout sequence. Frequency, size, shape and internal structure of the found accretionary lapilli are presented. For the first time in Romania armored lapilli are semnaled within the Var brook outcrop. Accretionary lapilli occurrence within a base surge deposit near Mohoş and their association with armored lapilli in the Var brook, undoubtly point to the hydroclastic (phreatomagmatic) origin for both enclosing pyroclastics. Further identification of accretionary lapilli bearing tuff levels in future might represent good time markers in volcaniclastic sequences.

Key words: Explosive volcanism, Neogene volcanism, Accretionary lapilli, Armored lapilli, Base surge dposit, Fallout tuff, Harghita Mts.

1. Introduction.

Accretionary lapilli are small lapilli sized (2—64 mm), quasisphaerical formations which occur in some fine pyroclastic deposits. They consist of agglutinated fine ash particles, frequently with concentrical and gradual internal structure: a coarser central core enveloped by a finer external coating.

Accretionary lapilli form in wet ash clouds by agglutination of the fine moistened ash particles, mainly during hydroclastic (phreatic or phreatomagmatic) eruptions. They occur either in ash — fall or base surge deposits.

Accretionary lapilli were worldwide found in tephra deposits of several famous historic eruptions, like those of Vesuvius (79, 1822, 1906), Kilauea (1790), Krakatau (1883), Mont Pelée (1902), Paricutin (1943), Capelinhos (1957—58), Taal (1965) and St. Helens (1980 (T. O. Reimer, 1983 a) and in many old pyroclastics of various age, from Precambrian (i.e. T. O. Reimer, 1983 b) to Cenozoic (i.e. A. V. Harkovska, 1984). Their presence is recently mentioned in Romania within the Paleozoic rhyolitic volcanics of North Dobrogea (A. Seghedi et al., 1988) and in Late Cenozoic dacitic pyroclastic products of South Harghita Mts. (A. Szakács, I. Seghedi, in press).

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2. Occurrences

We actually know only two occurrences of accretionary lapilli bearing pyroclastic deposits within the wide area of the Călimani—Gurghiu—Harghita Neogene volcanic chain, both in Harghita Mts. — in Ciomadul Massif (southern end of the chain) and in the eastern part of the North Harghita Mts., in the vicinity of the village of Siculeni (fig. 1). The former is localised in an outcrop of dacitic base surge deposit near Mohoș swamp and is described elsewhere (A. Szakács, I. Seghedi, in press). The pyroclastic sequence is made by one of the most later explosiv events which built up the twinned pyroclastic cones of Sf. Ana and Mohoș Subsequently dacitic domes were extruded on the flanks of these Pleistocene edifices.

The latter occurrence, unknown until now, is found in a small quarry of local interest on the north side of the Var brook, at an altitude of aproximatively 900 m. This 2 m high outcrop consists of a succession of decimetric, generally well sorted, layered ash-fall deposits with a single, 15—25 cm thick, accretionary lapilli bearing layer, overlain by fine ash-flow deposits. This white-yellowish bed consists of fine ungraded diagenised ash-fall tuff containing abundant accretionary lapilli. It is overlain by a thinner and coarser ash-fall tuff layer with rare accretionary lapilli and several armored lapilli. This layer grade upward in an even coarser tuff with no lapilli-sized material. This petrographically homogeneous (pyroxene-andesite) pyroclastic fall sequence is Pontian in age, part of the lower volcanic compartment of the Călimani—Gurghiu—Harghita volcanic chain (D. Rădulescu et al., 1964).

3. Description of accretionary lapilli and armored lapilli

Frequency. Accretionary lapilli represent aproximatively 30—35 percent of the host pyroclastic rock in Mohoș outcrop and 15—25 percent in Var brook quarry respectively.

Size. The study accretionary lapilli usually range in size between 4 -12 mm (6—8 mm most frequently) in the Mohoș outcrop and between 2—10 mm (5—6 mm most frequently) in the Var brook occurrence. Larger lapilli are more abundant in Mohoș area, the smaller ones at the Var brook.

Shape. The great majority of accretionary lapilli are quasisphaerical but in both occurrences there are some ellipsoidal forms too, more frequent in the Var brook outcrop. No parallel arrangement of elongated lapilli within the tuff bed is observed (plate II, fig. 2).

Internal structure. The quasitotality of the found accretionary lapilli shows a graded internal structure with a homogeneous core and a simple or multiple finer external coating. In the Mohoș outcrop overall grain-size of accretionary lapilli ash is more finer than the enclosing loose tephra material. Core grain-size in the compacted, diagenised accretionary lapilli tuff from the Var brook is almost identical with respect to those

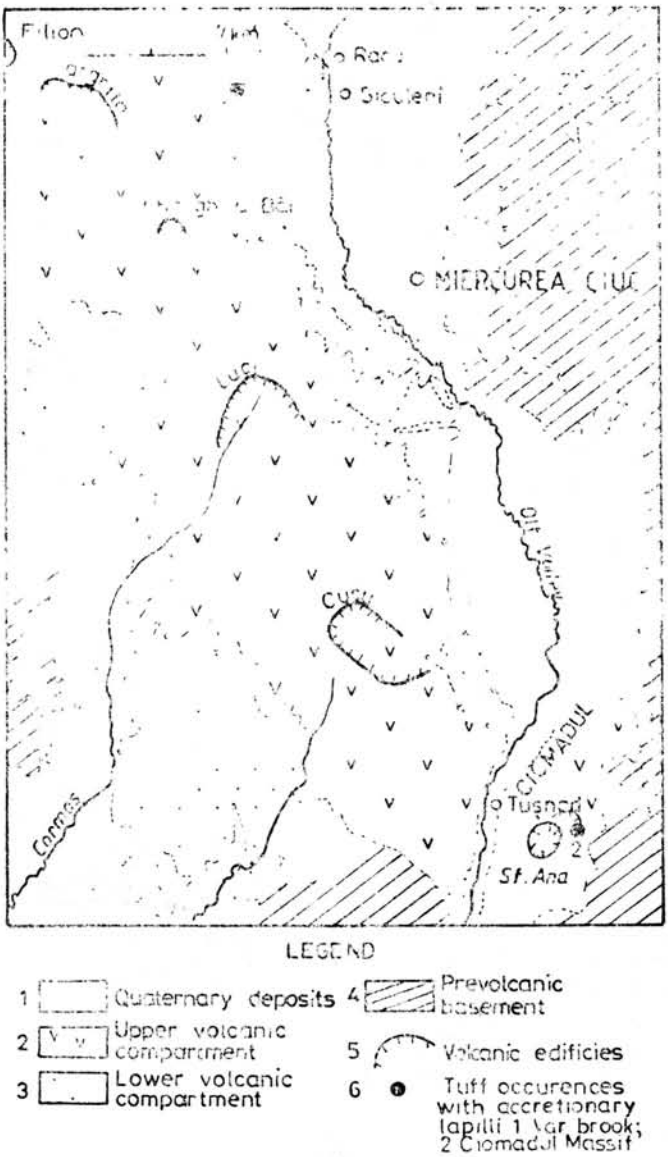

Fig. 1. — Geological sketch of the Harghita Mts. with location of the accretionary lapilli tuff occurrenzes: (1) Var brook, (2) Mohoş.

of the enclosing tuff or at most slightly finer, suggesting their formation and deposition from the same ash-cloud.

External layer thickness versus lapilli size ratio range within 1/3—1/7 in the Mohoş outcrop and 1/1,5—1/7 in the Var brook.

Among accretionary lapilli from Ciomadul Massif two types of grading are found: (1) a continuous grain-size diminishing from the interior to the exterior (plate I, fig. 2) and (2) a two-step gradation with different grain-size external layers (plate I, fig. 3). In both cases tangential arrangement of elongated ash particles within these peripherical zones is observed. In certain instances accretionary lapilli in Mohoş outcrop show recurrent multiple grading with two or rarely three finer layers (table I, fig. 1). This type of grading is slightly more frequent within the Var brook accretionary lapilli: the finer external layer is indurated and highly oxidized, opaque in thin sections (plate II, fig. 4). All accretionary lapilli in the Var brook occurrence display a well expressed, contrasting finer external envelope.

According to their internal structure, accretionary lapilli from both occurrences belong to type B accretionary lapilli, after Reimer's classification (T. O. Reimer, 1983 a), with one possible exception in Mohoş area, where a multiple layered coarse (10 mm in diameter) accretionary lapilli may be formed, at least for his external half, of rolling through freshly deposited fine ash (type C after T. O. Reimer, 1983 a).

Armored lapilli (Waters and Fisher, 1971 fide R. V. Fisher, H. U. Schmincke, 1984) appear only in the Var brook quarry as mentioned above. They unvariably consist of a lapilli sized grey pumiceous lithic fragment with a thin-layered ash envelope (plate II, fig. 3). This coating displays the same features as the described accretionary lapilli, multiple grading inclusively. Their size range between 15—25 cm, with the envelope thickness versus lapilli size ratio of 1/2—1/10. The coating grain-size is clearly distinct (finer) with respect to the mean grain-size of the coarce tuff which encloses the armored lapilli.

4. Discussion

Genetical mechanisms for accretionary lapilli are more recently presented by T. O. Reimer (1983 a) and briefly mentioned by R. V. Fishe and H. U. Schmincke (1984). According to these authors accretionary lapilli formed in wet (R. V. Fisher, H.-U. Schmincke, 1984) or in both wet ant dry (T. O. Reimer, 1983 a) ash-cloud columns during some explosive volcanic events. The essential forming factors and forces include: electrostatic attraction, capillary pressure of pore fluids and crystallisation of dissolved matter, after T. O. Reimer (1983 a) or electrostatic forces, surficial tension of water and mechanical compaction, after R. V. Fisher and H.-U. Schmincke (1984). It seems that the main cohesive force between the electrostatically attracted ash particles initially is the water surficial tension and subsequently the pore mineral crystallisation. This matter is not yet completely elucidated.

Accretionary lapilli obviously do not survive in aqueous media where they disaggregated because of their weak initial cohesion. Thus they are, when abundant, excellent palaeoenvironment indicators for subaerlal depo-

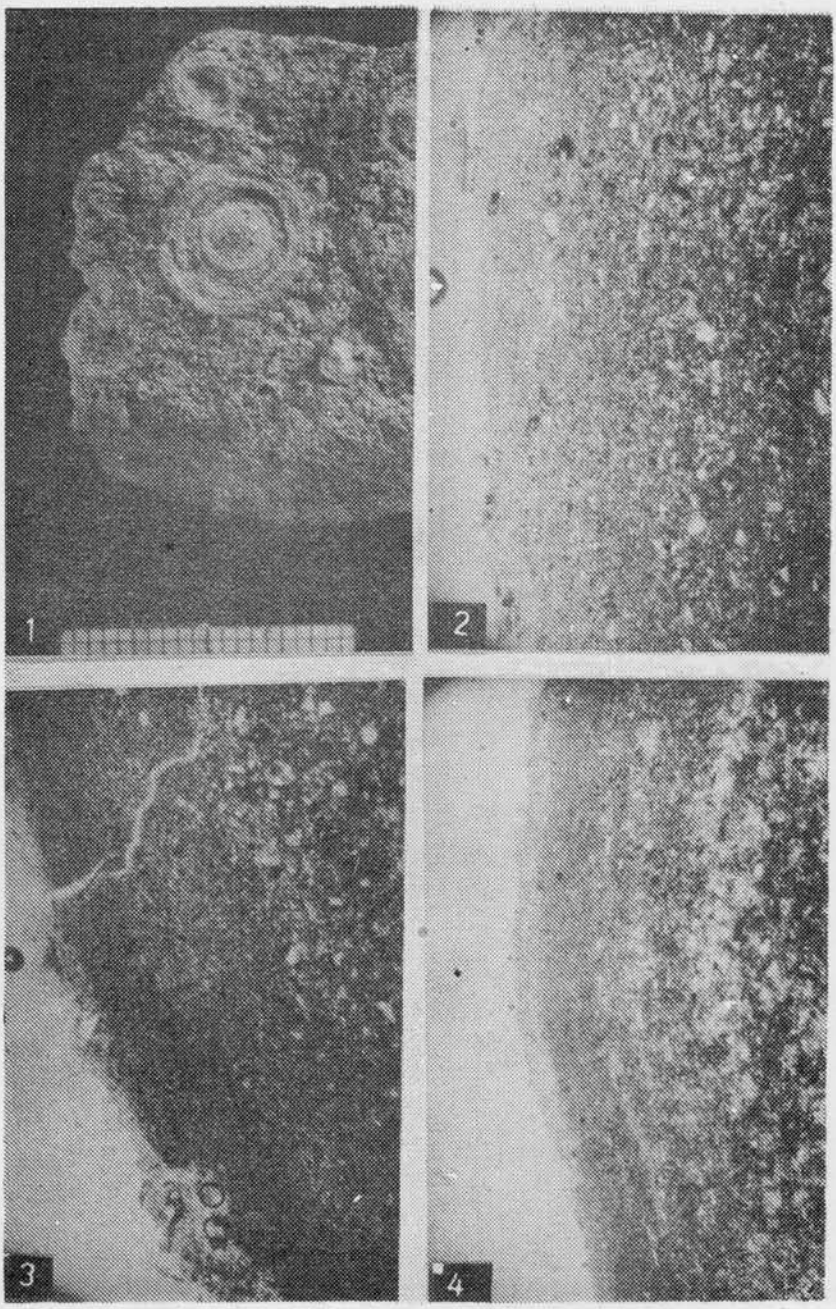

Plate I : Fig. 1. Accretionary lapilli bearing weakly consolidated tuff hand specimen from Mohoş .utcrop. Note the larger, multiple gradend lapillus. Scale in mm. *Fig. 2.* Photomicrograph of the outer part of an accretionary lapillus with continuous grading. Mohcş outcrop. 1 N, 25×. *Fig. 3.* Photomicrograph of the outer part of an accretionary lapillus with two-step grading. Mohoş outcrop. 1 N. 25×. *Fig. 4.* Photomicrograph of the outer part of ou accretionary lapillus from Mohoş outcrop. 1 N, 25×.

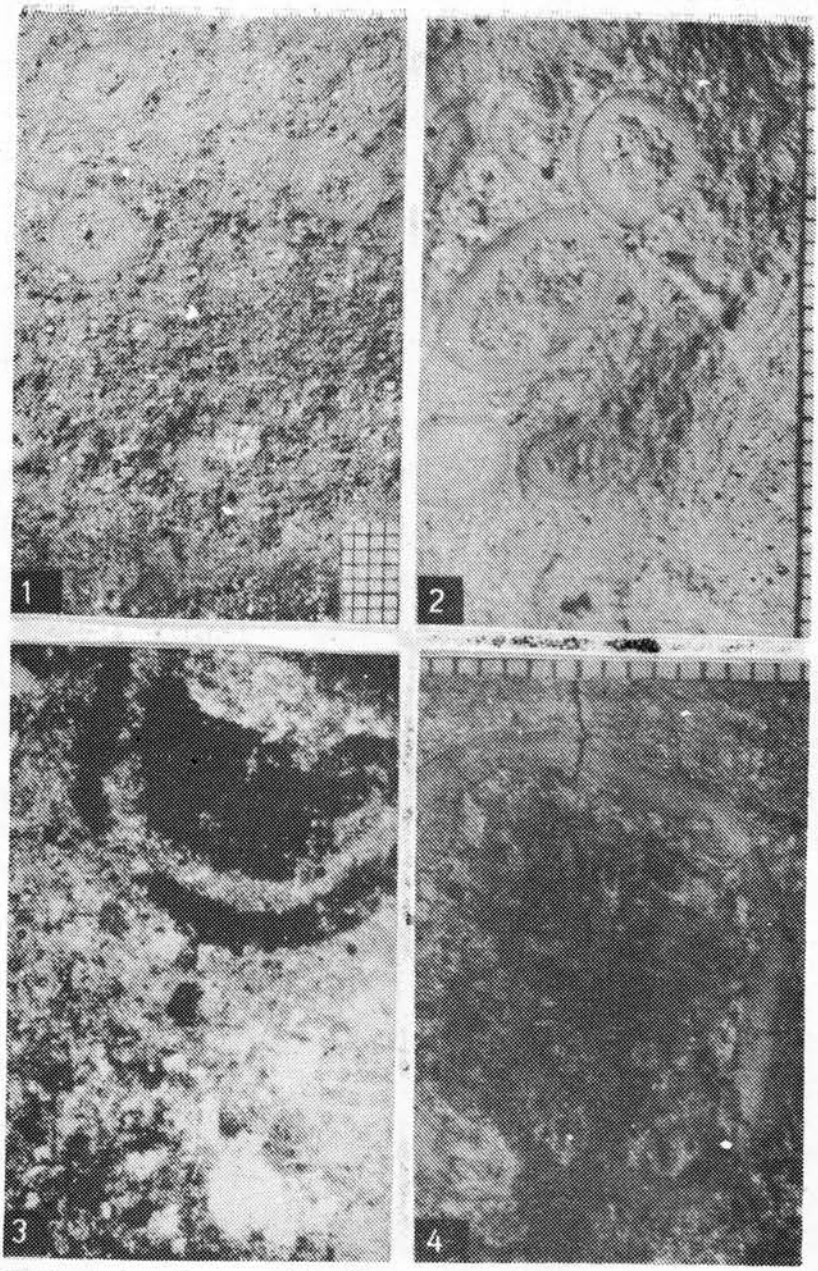

Plate II : Fig. 1. Accretionary lapilli tuff from the Var brook quarry. Scale in mm. ***Fig. 2.*** Quasisphaerical and elliptical accretionary lapilli in tuff from the Var brook quarry, Scale in mm. *Fig. 3.* Photomicrograph of an accretionary lapillus with opaque oxidized margin and internal zone. Var brook quarry. 1 N, 10×. *Fig. 4.* Armored lapillus with pumiceous core. Var brook quarry. Scale in mm.

sition. Further information they bring about the type of the explosive eruptions during which they are formed. Although their simple occurrence in a pyroclastic deposit has not a sure diagnostic value for hydroclastic eruption, they most commonly form during this type of eruptive activity. In our case their association with a base surge deposit in the Ciomadul Massif is a doubtless index for phreatomagmatic genesis, as pointed out earlier (A. Szakács, I. Seghedi, in press). For the fallout tuffs of the Var brook area the presence of armored lapilli have a more accurate indicative value than accretionary lapilli, since such formations were exclusively reported from hydroclastic deposits (R. V. Fisher, H.-U. Schmincke, 1984).

Although accretionary lapilli bearing tuffs are found until now in only two isolated occurrences within the Romanian Neogene volcanic provinces, their possible identification in further more numerous outcrops of the same deposits or in other more widespread old tephras in future might give us an excellent time marker within volcaniclastic deposits.

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TUFURI CU LAPILI ACRETIONARI ÎN MUNŢII HARGHITA

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(Rezumat)

Lapilii acreţionari sînt mici formaţiuni cvasisferice, de dimensiunea lapililor (2—64 mm), care se formează în cursul unora dintre erupţiile vulcanice explozive prin aglutinarea particulelor fine de cenuşă umezită din norul de erupţie. Au fost întîlniţi atît în depozitele unor erupţii istorice ale celor mai cunoscuţi vulcani de pe glob, cît şi în piroclastite vechi, începînd din precambrian şi pînă în Cainozoic. Prezenţa lor în România a fost semnalată anterior în piroclastitele riolitice paleozoice din Dobrogea de Nord şi în depozitele piroclastice pleistocene din munţii Harghita de Sud.

Cele două ocurenţe de tufuri cu lapili acreţionari se găsesc în apropierea mlaştinii Mohoş din masivul Ciomadul (Harghita de Sud) şi pe pîriul Var din versantul estic al Harghitei de Nord în perimetrul comunei Siculeni.

În primul caz lapillii acreţionari apar în cadrul unui nivel decimetric de tuf neconsolidat făcînd parte dintr-un depozit de tip base surge (S z a k á c s, S e g h e d i, sub tipar). Aceştia au formă cvasisferică, diametrul cuprins între 4—12 mm (cel mai frecvent între 6—8 mm) şi prezintă o structură internă concentrică, gradată, cu un miez central omogen şi un înveliş mai fin. Trecerea la învelişul exterior mai fin se face fie continuu, fie discontinuu, „în două trepte". Uneori s-au observat gradări multiple.

Ocurenţa de pe virful Var constă dintr-o suită de strate decimetrice de tufuri de cădere de compoziţie andezitică, diagenizate, unul dintre ele conţinînd lapili acreţionari în proporţie de 15—25%. Aceştia au formă sferică sau eliptică, dimensiuni de 2—10 mm (cel mai frecvent 5—6 mm). Învelişul exterior fin este puternic oxidat, ca şi cîte o zonă interioară în cazul unei gradări multiple. În această deschidere s-au întîlnit, pentru prima oară în România, lapili armoraţi, cu miez de ponce.

Lapilii acreţionari din ambele ocurenţe aparţin tipului B după clasificarea lui R e i m e r (1983 a), cu o singură posibilă excepţie la Mohoş, ce ar putea reprezenta tipul C.

Deşi simpla lor prezenţă nu are valoare diagnostică sigură pentru erupţii hidroclastice, ocurenţa lapililor acreţionari într-un depozit de tip base surge la Mohoş şi asocierea lor cu lapili armoraţi pe pîriul Var, indică în mod sigur generarea lor în cursul unor astfel de erupţii (freatomagmatice) în ambele cezuri. Prezenţa lor indică, de asemenea, un mediu de depunere subaerian. Identificarea şi a altor ocurenţe de tufuri cu lapili acreţionari va putea oferi, în viitor, un mijloc util de corelare areală în cadrul unor stive de depozite vulcanoclastice din regiunile cu vulcanism neogen din România.