TECTONICS OF THE NORTHWESTERN SLOPE OF THE MÁTRA MOUNTAINS

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INTRODUCTION

The investigation area lies in the northwestern part of the Mátra Mountains mass, as shown on the attached map-scheme *(Fig. 1)*. In the west, the morphological patterns and the disposition of the formations reveal that both the Várhegy of Hasznos and the volcanic mass in the vicinity of Tar are in a markedly down-dropped position with regard to the Mátra Mountains mass. The fracture system of the Zagyva Graben is also indicative of tectonic movements. Consisting mainly of andesites and their tuffs and subordinately of dacitic tuffs, the Helvetian to Lower Tortonian volcanic complex is presently about 300 m thick. It rests on the schlier formation overlying the Helvetian lignite formation. These formations are locally covered by a thick talus mantle concealing both the majority of the andesite dykes of the Mátra Mountains sedimentary foreland and the tectonic lines intersecting the formations.

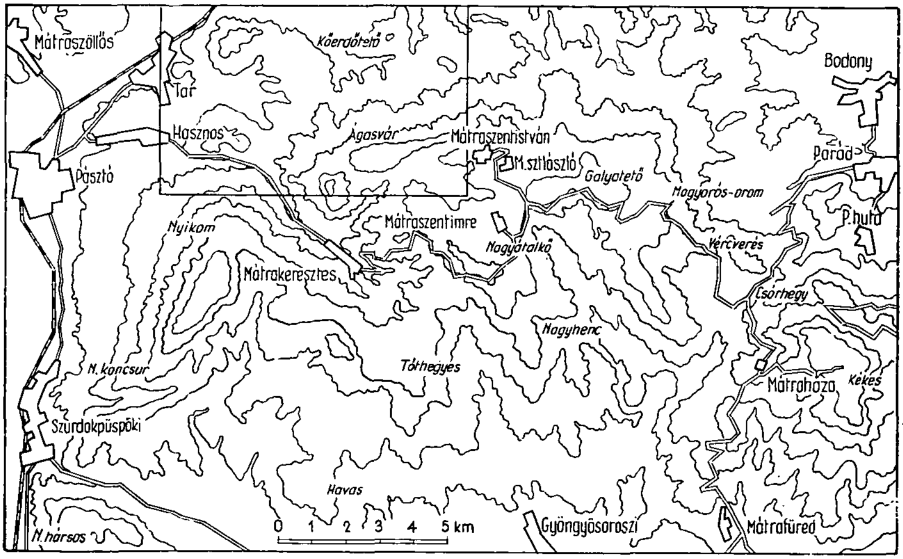

Fig. 1. Geologic map of the area investigated.

GEOHISTORICAL EVOLUTION

As shown by drilling in the broader environs of the Mátra Mountains (Sóshartyán, Szécsény) and by the xenoliths recovered from the deeper portions of the Mátra Mountains andesites, the basement of the northwestern sector of the mountains seems to be constituted by crystalline schists [K. BALOGH, 1966. and BALOGH—KŐRÖSSY, 1968.]. The eroded surface of these schists, has been overlain by Paleogene sediments.

The oldest formation uncovered by drilling near the Mátra Mountains northwestern border is the clay — clay-marl — sandstone sequence of the Rupelian stage which was hit at 401.50 m depth during the drilling of borehole Nagybátony-I, but which was not yet cut through at 1537 m, where drilling was stopped. It is overlain first by an Upper Oligocene sequence, then by 250 m of Burdigalian deposits. The lower part of the last-mentioned formation is represented by marine sediments with larger pectinids, the upper part, in turn, by 16 to 60 m of so-called Lower Dacitic Tuff of peculiar white colour which used to be referred to as "Lower Rhyolite Tuff". Exploratory drilling was stopped at the point where the dacitic tuff underlying the Helvetian lignite formation was reached, so that little is known about their actual thickness and facies.

After the Late Burdigalian continental phase the Helvetian epoch began by a slow ingression of the sea. The slow subsidence of the region is indicated, on the one hand, by the clay mineralization of the upper portion of the dacitic tuffs (a phenomenon suggestive of inundation!), on the other hand, by the deposition of lignite seams.

Whereas in the vicinity of Mátranovák and Homokterenye the lignite formation consists of three seams, at the Mátra Mountains northern foot it includes only two of them. Seam II is of deep-bog origin, including a barren intercalation of 0.7 to 0.8 m thickness. The higher-seated Seam I is of shallow-bog origin. The seams have dip angles of 165° – 185°/6° – 12°.

After the deposition of the lignite formation the rate of subsidence was accelerated, which gave rise to gradual pinching out in southern direction of the lignite. The lignite formation is overlain, after a thin intercalation of Chlamys sands (which may locally lack), by marly, micaceous siltstones (schlier) which usually contain a poor fauna. In Csutaj pit and Szalajka brook the author of the present paper collected the following fossils which were determined by M. BOHN—HAVAS [MEZŐSI, 1966]: gastropods — *Turritella beniosti* COSSMANN et PAYROT, *Turritella subangulata* BR., *Ringicula (Ringiculella) auriculata buccinea* BR., *Rissoa sp.*, *Neritina sp.*, *Turritella sp.*, *Polynices sp.*, *Columbella sp.*, *Cantharus sp.*, *Drillia sp.*, *Natica sp.*, *Clavatula sp.*, bivalves — *Venus (Clausinella) basteroti* DESH., *Solenocurtus candidus* REN., *Pinna sp.*, *Venus sp.*, *Tellina sp.,;* foraminifers — *Robulus sp.*, *Nonion sp.*, *Nodosaria sp.,;* fragments of Ostracoda and Echinus. From another locality of the Szalajka Valley, I. CSEPREGHY—MEZNERICS [1954] quoted the following mollusc species: *Protoma cathedralis paucicincta* SACCO, *Architectonica simplex* BRONN., *Nassa (Usita) restituta hörnesi* MAYER, *Nassa (Caesia) cf. inconstans* HOERNES et AUINGER, *Ancilla (Baryspira) glandiformis* LAMARCK, *Conus (Conospira) dujardini* PHIL., *Ringicula (Ringiculella) auriculata buccinea* BROCCHI, *Leda (Lembulus) fragilis* CHEM., *Angulus (Oudardia) compressa* BROCCHI. In the upper reaches of Szalajka brook SCHRÉTER [1940] found *Brissopsis sp.* specimens, north of Kőerdő Hill he collected *Ringicardium danubianum* MAYER and MACOMA *elliptica* BROCCHI var. *ottnangensis* R. HOERN.

In the geological survey borehole Hasznos-l, in Helvetian schlier, the following forms were found and determined by M. MUCSI: *Stenothyra sp.*, *Potamides sp.*, *Venus sp.*, *Tellina sp.*, *Arca sp.*, *Cardium sp.*, and *Pinna sp.*

Ingression was replaced by regression, coupled this time with andesitic volcanism, as early as the second half of the Helvetian. The first layers of the about 60- to 100-m-thick agglomerated andesite tuffs and andesites are still intermingled with marine sands and clays; these tuff layers are stratified, their material is graded. The best exposure is in the Csevice Valley near Tar and in the vicinity of Tyukod Hill. The tuffs are also represented in the core of the survey borehole Hasznos-l (southern slope of Hegyes Hill). At the time of lava effusion that followed the Helvetian tuff eruptions the area under consideration was an emergent land already.

At the Helvetian—Tortonian boundary appears the so-called pumiceous Middle Dacitic Tuff. Its upper member was redeposited in Early Tortonian time, as evidenced by its being mixed with Lower Tortonian volcanic detritus in a number of places. Its thickness is 70 m or so in the Fehérkő mine of the Csevice Valley and 60 m in borehole Tar-29. In the survey borehole Hasznos-l it is merely 39 m thick, but it should be taken into consideration that drilling was started from within this formation.

Controlled by rejuvenated fracture lines, Early Tortonian volcanism also yielded a considerable amount of lava. It brought about fissure volcanoes (e.g. Stremina crest), parasitic craters (e.g. the valley of Csörgő brook), minor volcanic cones (e.g. Kőerdő Hill) and, in some places, thin lava flows which were dismembered by subsequent erosion (e.g. on the southern side of the Farkaslyuk).

The volcanic cones consisting of andesites of dacitic nature (Óvár and Ágasvár), the subvolcanic, fresh, dark grey pyroxenic andesites and amafitic andesite masses and dykes appear to be of nearly equal age. In many cases a connection can be shown to exist between the subvolcanic products and the dykes. The dykes have not pierced the Upper Tortonian tuffitic limestones of Leithakalk facies anywhere; consequently, they are older than the Leithakalk. On the other hand, they are younger than the Lower Tortonian volcanic complex, because this is intersected by dykes.

The depressions of the resultant volcanic landscape were inundated by Late Tortonian sea, which thus produced the diatomite deposit of Hasznos and the tuffitic limestones of the Szalajka Valley near Tar, respectively. In addition, a faint eruption of pyroclastics should also be reckoned with, as evidenced by the rhyolite tuff bands intercalated within the sediments here. The thickness of the diatomite formation can be estimated at about 120 m in borehole Hasznos-4, that of the tuffitic limestones at about 70 m in borehole Tar-29. To the east of this area, the latter formation is only represented by thin rags which could escape erosion.

According to determinations by M. Bohn—Havas [Mezősi, 1963], the tuffitic limestones contain the following fossils: foraminifers — *Venus (Clausinella) basteroti* Desh., *Cyprina grinodica* Ben., *Pecten aduncus* Eichw. (fragment), *Phacoides (Linga) columbella* Lam., *Pitaria (Paradione) chione* Lam., *Arca sp., Lucina sp., Mactra sp., Meretrix sp., Tapes sp.,* Out of Bryozoans, *Vincularia sp.,* was recognized by Kolosváry.

According to J. Noszky Sr. [1927], at the confluence of Madarász and Csertő brooks there is a small patch of tuffaceous sediments of Leithakalk facies. They contain, beside *Amphistegina vulgaris* and *Heterostegina costata*, ill-preserved specimens of *Conus fuscocingulatus* Bronn., *Panopaea menardi*, *Cardium turonicum* May., *Pecten sp., Lucina sp., Serpula sp.* and *Dentalium sp.* At this locality, however, the tuffitic limestones are already redeposited, the autochtonous deposit being farther east.

After the withdrawal of Late Tortonian sea, this region also witnessed an intensification of erosion. On the norther side of the Mátra Mountains crest, talus fans were accumulated which presently vary between 10 and 30 m in thickness, locally attaining 95 m.

TECTONICS

The northwestern part of the Mátra Mountains is characterized by a faulted structure with chess-board-patterned fault-grabens and minor horsts. The present-day tectonic pattern of the investigation area is the result of repeated tectonic movements.

The earliest detectable tectonic movement of the area corresponds to the time of Late Helvetian volcanism. In fact, in the Ágasvár range, at the Szamárkövek and in Csörgő brook the Middle Dacitic Tuff is flanked by fracture lines of WNW—SES trend. Farther east, the Lower Tortonian volcanic complex lies, as exposed today, immediately on the Helvetian schliers, as the Helvetian volcanic complex and the Middle Dacitic Tuff are absent. Both these formations reappear farther east in the Polinka Valley along a fracture line of similar trend. The fracturing of the Helvetian lignite formation and of the schliers as well as their progressive plunging under the Mátra Mountains mass seems to correspond to the date of this faulting.

The second phase of differential movement coincided with the time of Early Tortonian volcanism when fissure volcanoes and minor parasitic craters were formed. Such a fissure volcano seems to be represented by the narrow crest running from Ágasvár towards Mátraszentiván, a volcanic range controlled by a fracture line of ENE—WSW trend. The similarly trending stretch of the valley of Csörgő brook and the WNW—ESE-trending valley of Narád brook also appear to belong to this category.

Lower Tortonian tectonic trends are also indicated by the dykes which partly coincide with the afore-mentioned directions and partly are of E—W or N—S trend. Both types of dykes represent lava masses of various sizes which have intruded into open fissures. The eventual vertical dislocations along dykes must be either pre- or post-volcanic, because dilatation joints, as a rule, cannot be supposed to be connected with, any major vertical displacement. The slight contact effects observable along the dykes were examined by Bognár and Póka [1964].

Post-Miocene crustal movements, whose manifestations can be distinctly demonstrated, were considerable, too. Whereas the earlier faults are oriented roughly ENE—WSW and WNW—ESE, respectively, the Miocene faults strike either NE—SW or NW—SE.

Most of the 150 deep boreholes drilled in the investigation area have reached the Burdigalian Lower Dacitic Tuff. With reference to this level, the size of displacement can be determined. On the basis of the plotted profiles, tectonic movements of various ages can be readily shown to have occurred. The gradual disintegration of the Helvetian schlier began as early as Late Helvetian volcanism.

Profile A—B of *Fig. 3* (70°—250°) extends from the borehole Nagybátony-109 drilled into the western bank of Kecskés brook, towards Ágasvár. Near Felső-Katalinbánya there is a horst-like hill. The eastern continuation of the andesite dyke exposed on the Csutaj can be encountered partly in underground workings, partly in minor dyke portions exposed to the surface. The volcanic rock hit at about 530 m in borehole Nagybátony-224 may be a portion of an andesite apophysis or of a subvolcanic body. Towards Ágasvár, the Helvetian schlier grows gradually thicker, to attain

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Fig. 2. Geologic structure of the area.
Legend: 1. Slope-detritus, alluvium; 2. Upper Pannonian sand; 3. Upper Tortonian tuffaceous limestone, diatomaceous earth; 4. Lower Tortonian andesite and andesite-tuff; 5. Dacite-tuff; 6. Helvetian andesite and andesite-tuff; 8. Helvetian coal series; 9. Burdigalian dacite-tuff; 10. Upper Oligocene; 11. Fracture-line; 12. Direction of geologic section.

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Tar
Csevice brook
Kőerdő peak
Cserto brook
Szalajka brook
A
Kecskés br.
Terendel brook
Szoros brook
Dobróka brook
Nyíres valley
D
Dobróka
E
F
Nagy-Bec meadow
Gombás peak
Mt. Várhegy
Csörgő brook
Mt. Hegyes
C
B
Polana valley
Hutahelyi brook
Csörgő brook
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LEGEND
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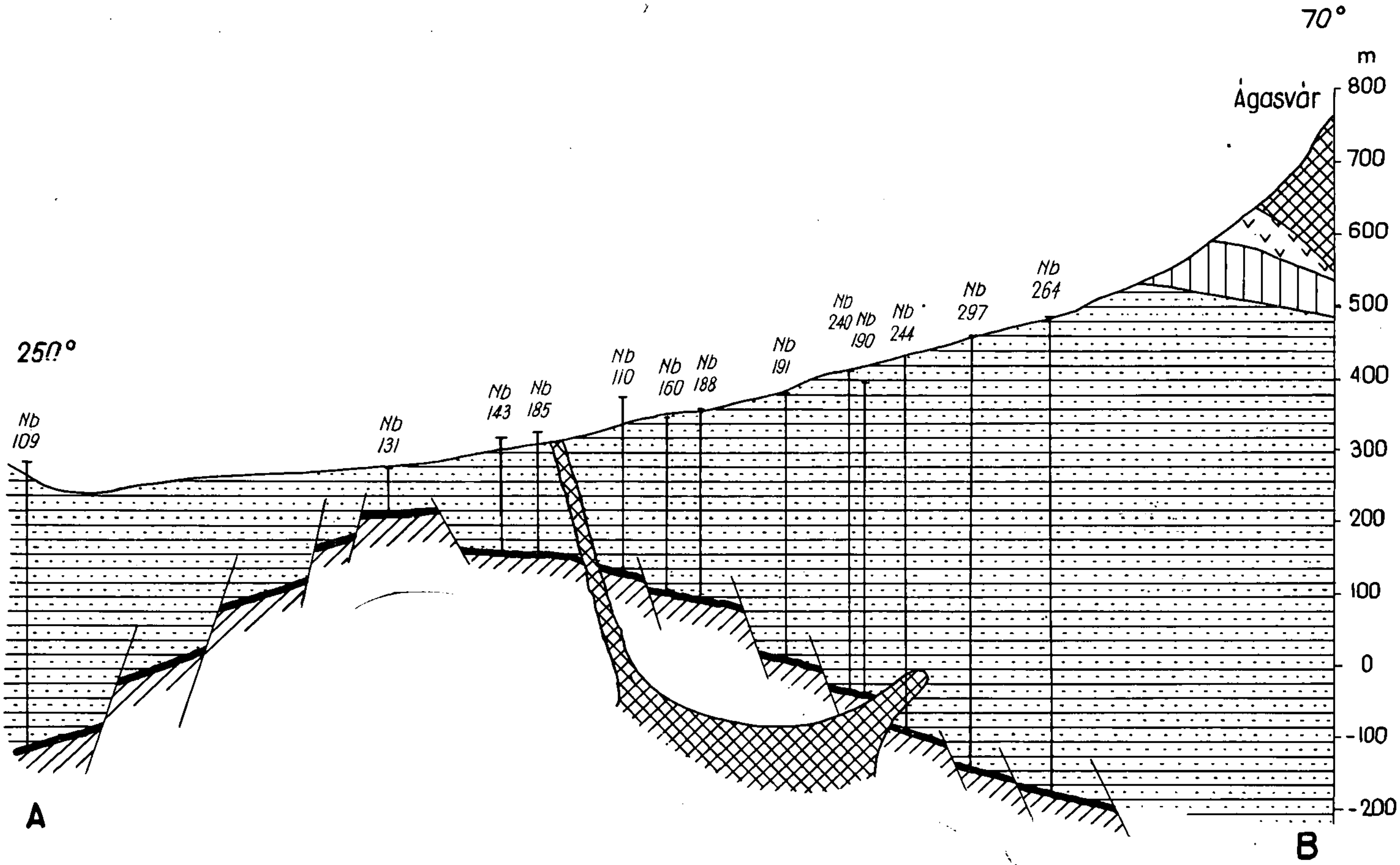

Fig. 3. Geologic section in the direction A—B on Fig. 2.

about 700 m in thickness beneath the Upper Helvetian agglomeratic andesite tuffs. The chess-board-patterned fracturing of the schlier and its southward tilting seem to be due to Latest Helvetian crustal movement. Later movements changed but little the position of the schlier. The faults strike at about 60° to 240° and 130° to 310°, respectively. Stratification planes dip usually southward at 6° to 12°.

Examination of geological structure along a profile (C—D, *Fig. 4*) of NE—SW orientation will also show the southward growth in thickness of the Helvetian schlier. In Tarkő brook — at about 330 m elevation a.s.l. — the Burdigalian Lower Dacitic Tuff is exposed. The borehole Nagybátony—105, drilled into the ridge between Sziget and Bükkös brooks, reached the Lower Dacitic Tuff (absolute elevation: +33 m) as high as at 413.4 m depth. Farther southwest, the tuff lies at nearly 550 m depth (absolute elevation: —80 m) in borehole Nagybátony—186.

The andesite dyke, exposed on the ridge running between Nagy Bec meadow and Tarkő brook in the eastern part of a profile (E—F) of approximately E—W trend *(Fig. 5)*, may be the off-shoot of a large subvolcanic body. This seems to be evidenced, on the one hand, by borehole Nagybátony—268 which, after crossing the lignite formation, was stopped at 443.6 m depth; on the other hand, by borehole Nagybátony—259 drilled into the bed of Sziget brook, which intersected the andesites twice, beneath 95 m of scree. Not far from here is the andesite dyke of the ridge between Sziget and Bükkös brooks. The andesite dyke, exposed in the bed of Bükkös brook, also seems to be connected with the afore-mentioned subvolcanic body. All of these andesite dykes strike NNW—SSE. The minor peaks of the Lower Dacitic Tuff along the profile are, for the most part, members of a southeastward horst range.

In Late Pliocene time a large NE—SW-trending fault graben was formed in the western part of the region. Whereas the Late Helvetian and Early Tortonian movements stroke at 60° to 240° and 130° to 310°, respectively, the strike of this fault graben corresponds to 30°—210°. The faults detected by Noszky Sr. [1927], Schréter [1940], and Szentirmai [1965], faults extending from Kőerdő Hill southwestwards, are only part of this system, as evidenced by the three boreholes, Tar-3, Tar-29, and Hasznos-4, drilled into the graben axis. Of these, the Lower Dacitic Tuff — exposed about one kilometer and a half farther east — was reached, at nearly 596 m depth, by only the borehole Tar-3 in the northeastern part of the fault graben. Drilled in the middle stretch of the graben, borehole Tar-29 cut tuffitic limestones under clayey talus down to 77 m depth. Underneath, 60 m of Lower Tortonian agglomeratic andesite tuffs followed. These were in turn underlain by the Middle Dacitic Tuff, again of 60 m thickness. The Helvetian schlier began at 447.5 m but was not cut through, as drilling was stopped at 675 m depth. However, considering the thickness of this formation in the near-by boreholes, the Burdigalian Lower Dacitic Tuff might be expected to occur here at about 820 m depth. The Upper Tortonian diatomite-bearing sequence, exposed near the Várhegy of Hasznos, was found to occur between 104 and 221 m in borehole Hasznos—4 (at the southwestern tip of the graben). This observation can be used for conclusions as to the height of faulting here. Since in the valley of Kövecses brook, near borehole Hasznos—4, the Middle Dacitic Tuff, marking the Helvetian—Tortonian boundary, is exposed to the surface, the fault plains must be steep. (Would this not be the case, so the Middle Dacitic Tuff would border on the older formation occurring on the eastern side of the fault.) Nota bene, borehole Hasznos—4 was stopped within Lower Tortonian andesite tuffs at 304 m depth.

One of the benches of this comparatively deep graben (about 450 m deep, as shown by drilling) is the fault detected by Noszky Sr. and Schréter. Parallel with it, there runs another, larger fault, indicated by Szentirmai, along which the Middle

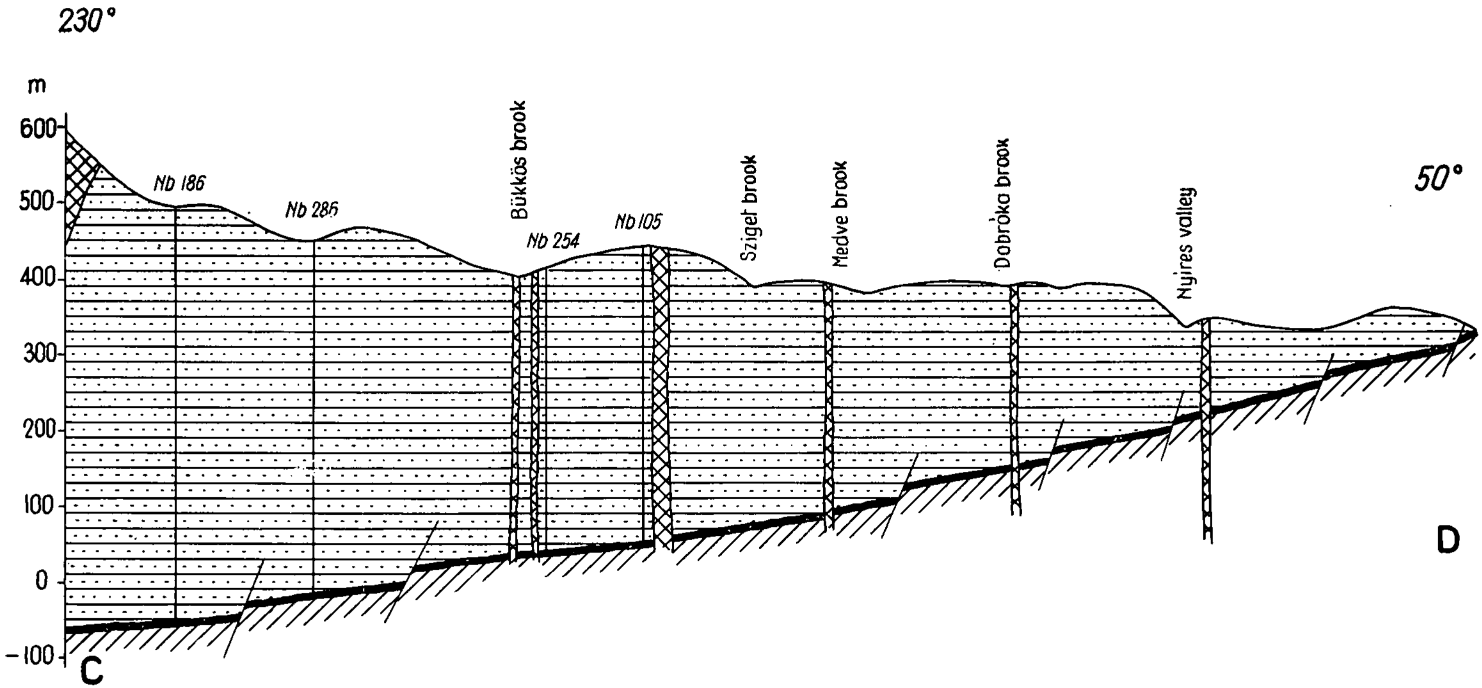

Fig. 4. Geologic section in the direction C—D, on Fig. 2.

Dacitic Tuff appears in the neighbourhood of the Helvetian schlier. It is in this large depression that the so-called „Szakadás gödre" was formed. Here only the Upper Helvetian agglomeratic andesite tuffs were intersected by borehole Tar—4.

In the vicinity of Gombás Hill this graben was filled up in Late Pliocene to Early Pleistocene time. The talus deriving from Mátrakeresztes is constituted partly by clay-mineralized amafitic andesites of onion-shaped (curbicortical) weathering, partly by dark grey, less weathered pyroxenic andesites. In addition to them, debris of jasper, opal, chalcedony, and veined quartzite are common, the last of which sometimes carry parasitic baryte plates. These are likely to represent residues of erosion of the baryte veins occurring in the vicinity of Mátrakeresztes.

Similarly in Late Pliocene time, a fault system of approximately NW—SE strike was formed. As the most eloquent example of it, the environs of Hegyes Hill may be quoted. The geological survey borehole on the southern slope of Hegyes Hill cut first the Middle Dacitic Tuff and then penetrated into Helvetian schlier at 173 m depth. However, at about 100 m south of the bore-head, the schlier is already exposed to the surface. This part of the Kövecses Valley has been controlled by this fault. The valley stretch by the Várhegy is also connected with the same fault. Between boreholes Hasznos—2 and Hasznos—3 there is a difference of 96 m in the hypsometric position of the Burdigalian Lower Dacitic Tuff, a phenomenon which is also due to a fault of NW—SE trend. The outcrop of the Middle Dacitic Tuff on the eastern slope of Gombás Hill is also fault-controlled, since Helvetian schlier lies close to it on the eastern side.

The NE—SW-trending fracture lines in the vicinity of Fehérkő mine near Tar village are known from earlier literature data [Noszky Sr., 1927., Schréter, 1940., Kubovics, 1963].

CONCLUSIONS

The investigation area lies in the northwestern Mátra Mountains. Uncovered by drilling in the northwestern foreland of the Mátra Mountains, the oldest formation of the area is the sedimentary sequence of the Rupelian stage. This is overlain first by Upper Oligocene, then Burdigalian sequences. The footwall of the Helvetian lignite formation is constituted by the Lower Dacitic Tuff. After lignite deposition the rate of subsidence was accelerated. The lignite-bearing sequence is overlain, with intermediary of Chlamys sands or without them, by marly, micaceous siltstones (schliers), whose thickness may locally approach to 700 m. This formation is commonly poor in fauna. In Helvetian time, regression was coupled with andesitic volcanism. The resultant pyroclastics, appearing at the Helvetian—Tortonian boundary, have been termed the Middle Dacitic Tuff. Early Tortonian volcanism in this area produced fissure volcanoes, parasitic craters, minor volcanic cones, and thin lava flows. All of the subvolcanic bodies, inclusive of dykes, are of subequal age. Certain depressions of the resultant volcanic landscape were invaded by Late Totronian transgression which brought about tuffitic limestones in the Szalajka Valley near Tar village and diatomite accumulations by Hasznos. After regression of Late Tortonian sea, erosion processes revived here too.

The earliest detectable tectonic deformation in the area under consideration corresponds to the date of Late Helvetian volcanism. It is characterized by WNW—ESE and ENE—WSW trends. The second tectonic phase coincided with Early Tortonian volcanism, when fissure volcanoes were formed. In addition, valley tracks have partly been controlled by the same movements. Trends aggree with those of the first

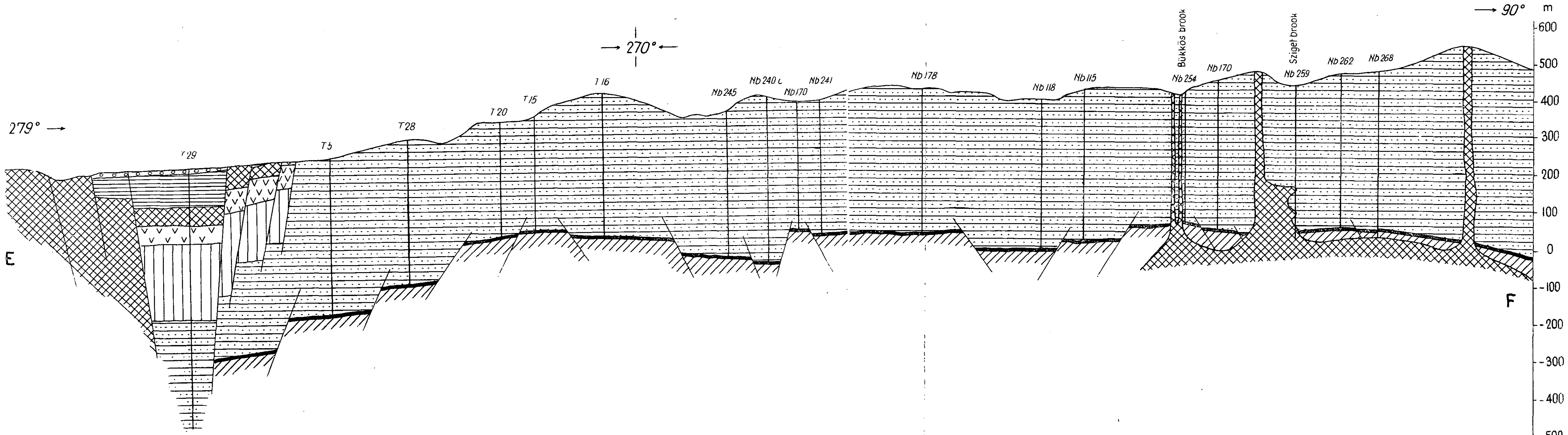

Fig. 5. Geologic section in the direction E—F on Fig. 2.

phase. Early Tortonian tectonic trends are also indicated by the strike directions of dykes intruded into dilatational fissures. Post-Miocene movements, of NE—SW and NW—SE trends, were also remarkable, as evidenced by the formation of a step-faulted, deep graben characterized by level differences of nearly 450 m and by steep fault planes.

REFERENCES

BALOGH, K. [1966]: Magyarázó Magyarország 200 000-es földtani térképsorozatához. M-34-XXXII. Salgótarján.

BALOGH, K., KŐRÖSSY, L. [1968]: Tektonische Karte Ungarns im Maßstabe 1:1000000. — Acta Geol. Acad. Sci. Hung. *12*, 255—262.

BARTKÓ, L. [1961]: Az észak-magyarországi barnakőszéntelepek kora. — Földt. Közl. *91*, 143—146.

BOGNÁR, L., PÓKA, T. [1964]: Nagybátonyi andezittelér slir és homokkő érintkezései. — Földt. Közl. *94*, 82—88.

CSEPREGHINÉ—MEZNERICS, I. [1954]: A keletcserháti helvéti és tortónai fauna.—Földt. Int. Évkönyve *41*, 4.

KÉRI, J. [1964]: A Dél-nógrádi barnakőszén terület újabb kutatási eredményei. — Földt. Közl. *94*, 466—472.

KUBOVICS, I. [1963]: Az ÉNy-i Mátra földtani és vulkanológiai viszonyai. — Földt. Közl. *93*, 466—480.

LÁNG, S. [1955]: A Mátra és a Börzsöny természeti földrajza. — Földrajzi monográfiák 1.

MEZŐSI, J. [1963]: Occurrence of lajta limestone in Western Mátra. — Acta Miner. Petr. Szeged *16*, 11—24.

MEZŐSI, J. [1966]: Magyarázó a Mátra hegység földtani térképéhez. 10 000-es sorozat. Tar (Fenyvespuszta). M. Áll. Földtani Intézet.

MEZŐSI, J. [1967]: Magyarázó a Mátra hegység földtani térképéhez. 10 000-es sorozat. Szorospatak. Manuscript.

NOSZKY, J. SR. [1927]: A Mátra hegység geomorfológiai viszonyai. — Debreceni Tisza István Tud. Társ. Honismertető Biz. Kiadv.

PANTÓ, G. [1961]: Beszámoló a vulkáni hegységek időszerű kérdéseiről tartott vitaülésről. — Földt. Int. Évi Jelent. 1957—58. 525—548.

SCHRÉTER, Z. [1940]: Nagybátony környéke. — Magyar Tájak Földtani Leírása 2. Budapest.

SZÁDECZKY—KARDOSS, E. [1958]: A vulkáni hegységek kutatásának néhány alapkérdéséről.—Földt. Közl. *88*, 385—403.

SZÁDECZKY—KARDOSS, E., VIDACS, A., VARRÓK, K. *et al.* [1959]: A Mátra hegység neogén vulkanizmusa. — A MTA Nemzetközi Geokémiai Konferencia Munkálatai. Budapest. Manuscript.

SZÁDECZKY-KARDOSS, E., PANTÓ, GY., PÓKA, T., PANTÓ, G., SZÉKY-FUX, V., KISS, J., KUBOVICS, I. [1967]: Die Neovulkanite Ungarns. Acta Geol. Acad. Sci. Hung. *11*, 221—252.

SZENTES, F. [1939]: Jelentés 1934—35. években a Mátra É-i oldalán végzett földtani felvételről. — Földt. Int. Évi Jel. 1933—35. 621—652.

SZENTES, F. [1961]: Magyarország tektonikai térképe. — Földt. Int. Évi Jel. 1957—58. 7—24.

SZENTIRMAI, I. [1962]: Földtani és kőszénföldtani vizsgálatok a nagybátonyi Katalin II. lejtősaknában. — Földt. Közl. *92*, 69—80.

SZENTIRMAI, I. [1965]: A nagybátonyi barnakőszén terület bányaföldtani viszonyai. — Földt. Kutatás 8, 17—25.

VARGA, GY. [1967]: Szerkezet és vulkanizmus a Mátrában. — Földt. Int. Évi Jel. 1965. 305—316.

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