METASOMATIC DOLOMITIZATION ON THE WESTERN PART OF THE NAGYSZÁL MOUNTAIN

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Concerning the exploration for binding materials made in the years 1965—1967, the western part of the Nagyszál was explored by several drill-holes. During these exploration works several hydrothermal traces pointing to an ancient thermal spring activity were observed both in the present limestone quarry and the materials of drillings. Significant dolomitization of the limestone series presumably connected with hydrothermal metasomatism could be established. The thermal spring acitivity, almost in the whole area — mostly on the 420 and 450 m levels — is marked partly by numerous calcite veins partly by typical spring-caved spherical chambers and galleries opened with the mining. The calcite veins refer to a former spring activity, the spring-cavern galleries to the last uprush places of the one-time springs. This uprush might be contemporaneous with the end of the spring activity.

In the Upper Liassic limestone series, opened in 200 m thickness in some places, limonite, pyrite and kaoline also of hydrothermal origin were found beside several variously coloured calcite veins. The impregnation of fluidal character and sugar-like appearance of the rock texture were observed in several places of the limestone series. These rocks represent in most cases transitional rock types between the limestone and dolomite, as it is shown by laboratory investigations.

As known from the literature, in the underlying strata of the Noric limestone series of the Nagyszál, reaching more than 200 meters, Karnic dolomite is deposited in a thickness of several hundred meters. Smaller spots of this dolomite crops out in the neighbourhood of the borehole XV-1 *(Fig. 1)*. The Karnic dolomite is considered as chemical sediment of marine origin.

The appearance of dolomitic limestone, limey dolomite and dolomite observed in the boreholes crossing the Noric limestone strata, points to hydrothermal veins. On the basis of the hydrothermal traces observed in the area as well as the vein-like or stocky appearance of dolomitic rocks, they are considered of metasomatic origin. Of the dolomitized strata traversed by boreholes, the average thickness of dolomitic limestone is 3,45 m, that of the limey dolomite 2,77 m and finally the average thickness of the dolomite is 1,0 m.

The one-time hydrothermal activity may be considered as a process connected with the andesite volcanism of Visegrád, Nagybörzsöny and the Miocene volcanism of the Cserhát. The hydrothermae rushed up mainly along transverse fractures of N—S and NW—SE direction. The hydrothermae percolating through the carbonate rocks resulted in their dissolution of different rate and under favourable tectonical conditions, where the percolating water could move more freely, dolomite could formed from the solution. The dolomitization is a fairly complicated process, whose rate depends mostly upon the temperature, CO_2 pressure, the pH and the concentration of ions.

The dolomitization connected with hydrothermal metasomatism and the dolomitic impregnation of the limestone strata, respectively, is represented by manysided investigations carried out on the rock materials of the region.

The primary, Karnic dolomite of marine origin, shown in *Fig. 2*, is of equigranular texture, with grain sizes of 100—200 μ. The typical Noric limestone *(Fig. 3)*, is mainly of fine-crystalline texture. In *Fig. 4* a dolomite veinlet intruded into the limestone is to be seen. The metasomatic limey dolomite shown in *Fig. 5* is of inequigranular texture, with preponderance of the fine-grained fraction (70%). In the fine-grained matrix middle- (20%) and coarse-grained (10%) calcite is to be seen.

To illustrate the surface of the primary, sedimentary and that of the metasomatic dolomite, also electron microscopic investigations were made. *Fig. 6* shows the electron photomicrograph of the surface of the primary, marine and *Fig. 7* that of the secondary, metasomatic dolomite. The electron microscopic investigations were made by carbon replica of fresh fracture-surface of the rock.

Comparing the photomicrographs, the most remarkable is the appearance of parallel edges on the surface of marine dolomite, oriented in one direction within the phase boundaries. The surface is generally of "foamy" character. The lines of metasomatic dolomite are undetermined, the surface is relatively smooth. On both photomicrographs dolomite rombohedrons remained as dust on the fracture-surface are to be seen.

The map of hydrothermally decomposed and dolomitized rock types in the Nagyszál area explored by drillings is shown in *Fig. 1*.

The map shows the greater — 0,8—3,7 m in thickness — calcite veins and thermal spring-caved galleries according to the conditions in the year 1968. The percentage of the hydrothermally decomposed and the dolomitic rock types compared to the thickness of the drilled strata is shown by the circle diagrams drawn in the place of the exploration boreholes. The comparison between the surface and 420 m level (the lowest mining level of the "Danube Cement and Lime Work's" quarry) is illustrated by the inner circle of the diagrams whereas the situation between 420—380 m levels is represented by the outer circles. The explanation of *Fig. 1* is at the same time a summary wherein the data of boring VII-04 traversing the lower strata (between 352,7—272,7 m) denoted by hexagon are not shown.

Evaluating the data of *Fig. 1* from the point of view of metasomatic dolomitiza-

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Fig. 2. Photomicrograph of primary dolomite from the depth of 90,0 m, hole XV-1. Crossed nicols, ×50.

Fig. 3. Photomicrograph of limestone from depth of 50,0 m, hole VIII-3. Crossed nicols, ×*50.*

Fig. 4. Photomicrograph of dolomite veined limestone, from the depth of 50,0 m, hole VIII-3. Crossed nicols, ×50.

Fig. 5. Photomicrograph of secondary limey dolomite from the depth of 130,0 m, hole VIII-3. Crossed nicols, ×50.

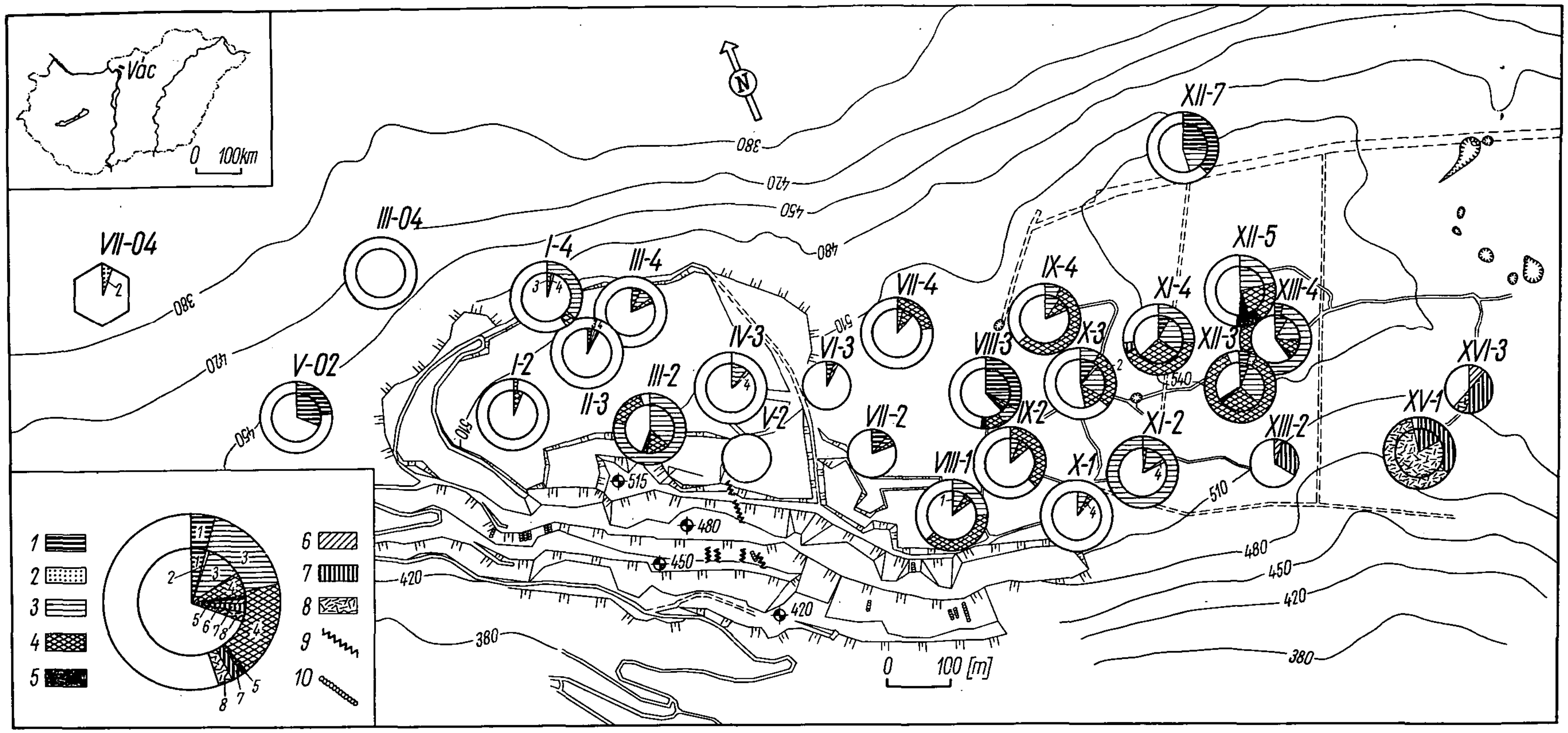
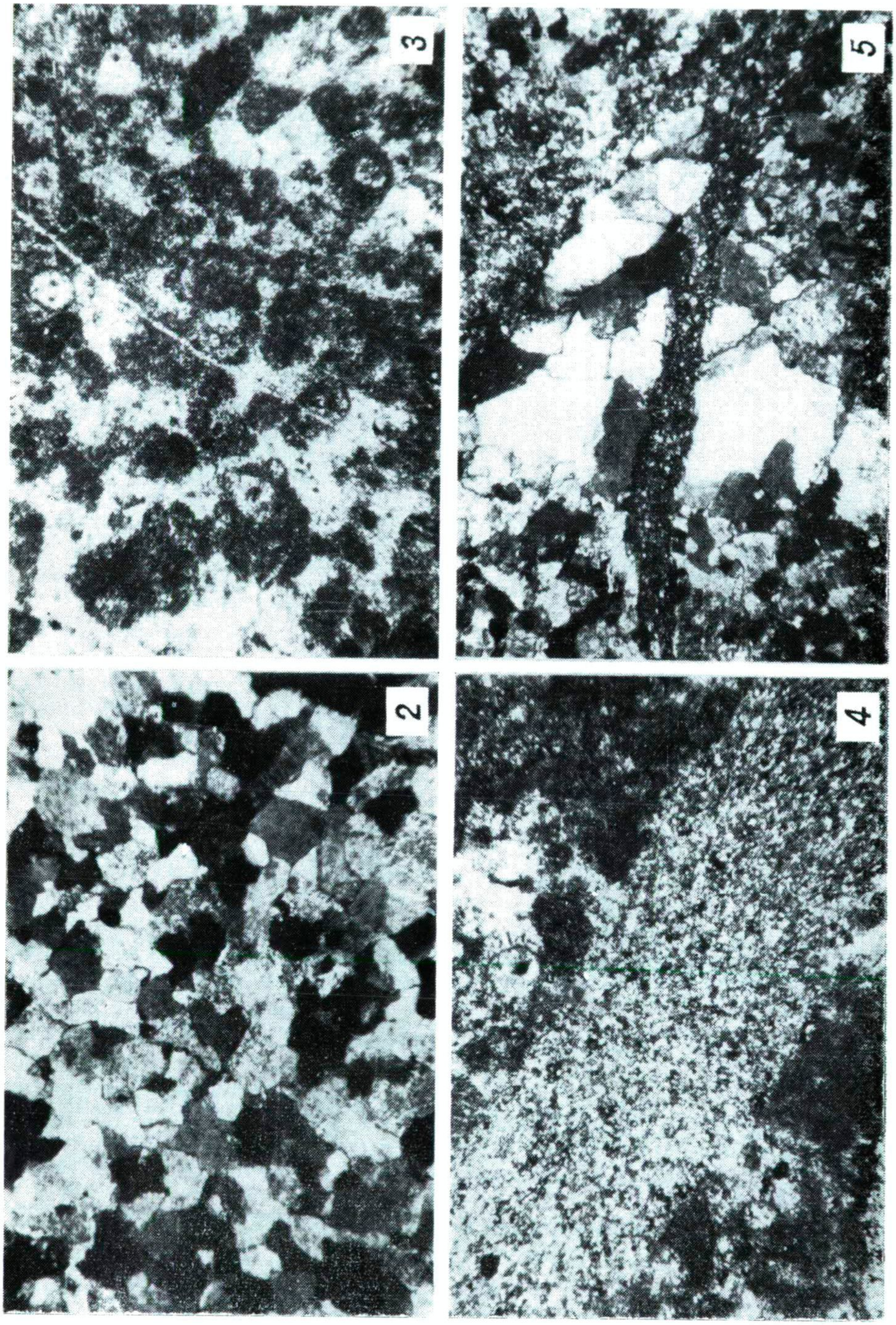


Fig. 1. Map of the hydrothermally decomposed and dolomitized rock type tse hon western part of the Nagyszál at Vác

Explanation and summarizing diagram (in the left lower corner of the figure): The inner circle represents the opened up part from the surface to the level 420 m; the outer circle the levels betwen 420—380 meters; the hexagon indicates the levels betwen 352,7—272,7 meters. 1) Hydrothermally decomposed limestone; 2) Hydrothermally decomposed silty rock flour, silt with rock flour; 3) Dolomitic limestone; 4) Limey dolomite; 5) Dolomite (secondary); 6) Dolomitic limestone; 7) Limey dolomite; 8) Dolomite (primary); 9) Larger calcite vein; 10) Cave system of thermal spring origin.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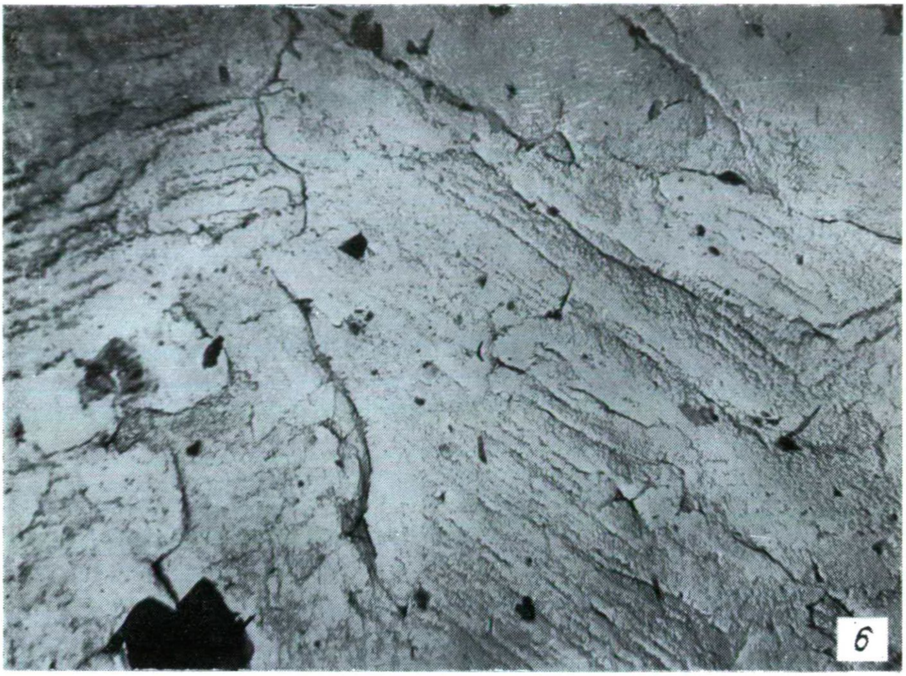

Fig. 6. Electron photomicrograph of the surface of primary dolomite, from the depth of 90,0 m, hole XV-1. ×4800.

tion the followings are emphasized. The percentage of the secondary dolomite types compared to the total thickness of strata crossed by boreholes is as follows:

	Between the surface and 420 m level	Between the levels 420—380 m
Dolomitic limestone	11,17%	17,41%
Limey dolomite	7,24	17,16
Dolomite	0,42	0,65

As it is shown by these values the metasomatic dolomitization resulted in mainly dolomitic limestone from the surface to the depth of 420 m level and dolomitic limestone and limey dolomite in equal parts between levels 420—380 m, respectively.

Summarizing the results is to be seen that the area NW from the line of boreholes VIII-1—VIII-3 is less dolomitized. A more considerable dolomitization is found only in the strata of borehole III-2, consisting of mainly dolomitic limestone. This part of the area belongs namely to the line of "active" fractures which is shown also by the nearness of a great calcite vein opened up in the quarry, referring to later hydrothermal actions.

The rate of dolomitization is more expressed reagionally from W to E and vertically toward the greater depths. The uprush places of hydrothermae resulting in dolomitization may be supposed where the secondary dolomit types are the thickest. These places agree well with the greatest fractures shown on the geologic map of this region.

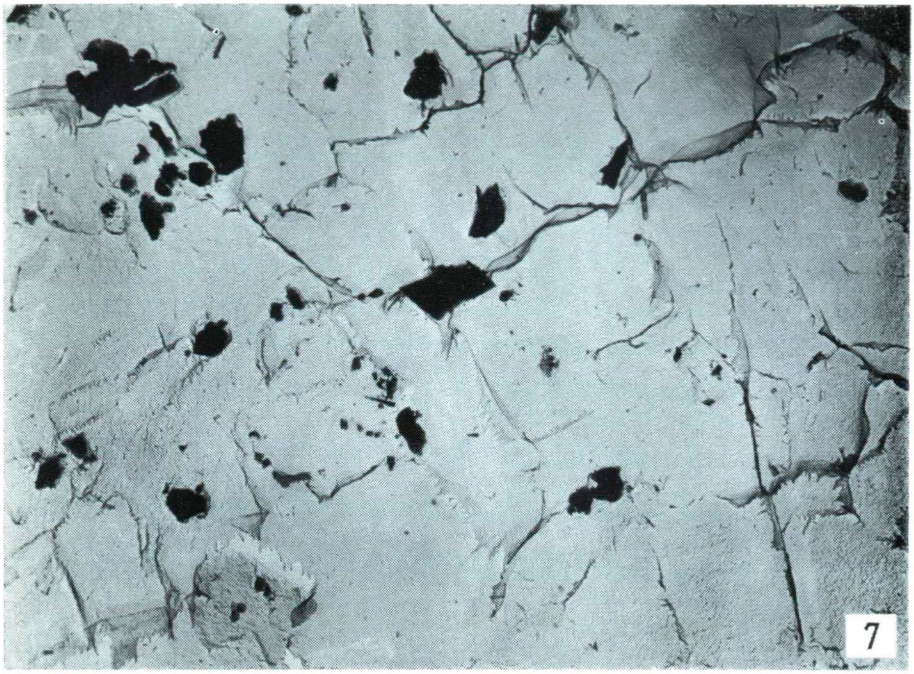

Fig. 7. Electron photomicrograph of the surface of secondary limey dolomite from the depth of 130,0 m, hole VIII-3. ×4800.

The stronger dolomitization of the eastern part may be connected with the transverse fracture between the boreholes VIII-1 and VIII-3 as well as IX-2 and IX-4, further with the fracture SE from the line of boreholes IX-2, IX-3 and XI-4. The most intensive metasomatic dolomitization could be observed in the rock material of the boreholes XII-3, XII-5 and XIII-4 as well as in the lower part of boring XI-2.

The thermal spring activity and the metasomatic dolomitization, respectively, on the Nagyszál — taking into consideration the data found in the literature — extended from the Miocene to the Pleistocene.

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