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PETROGRAPHICAL CHARACTERISTICS OF DITRÓ (OROTVA) GRANITES, EASTERN CARPATHIANS, TRANSYLVANIA, ROMANIA: A PRELIMINARY DESCRIPTION

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ABSTRACT

One of the most important rock groups outcropping in the NE part of the Ditró Massif, north of the Orotva (Nagyág) creek and from the Török creek to the crystalline schists is the group of the granitic rocks. On the basis of their modal composition and textural features, this rock group can be divided into the following rock types: 1. syeno- and monzogranites with equigranular texture; with potassium feldspar megacrystalline texture, alkaline granites. 2. syenites, quartz syenites, alkaline syenites, foidic monzosyenites. 3. monzonites, quartz monzonites. 4. cataclasites.

On the geological maps of 1:10.000 scale the granitoid formations were shown as a homogeneous body. Our studies have revealed that petrography of this area is much more complex than it was interpreted by the former studies. On the basis of the textural studies, it has been concluded that secondary textural patterns of the rock types are similar, and it can be attributed to endomagmatic effect, weathering processes and tectonic deformation.

INTRODUCTION

The Syenite Massif of Ditró is situated in the S-SW part of the Gyergyó Alps belonging to the Eastern Carpathians. Diameter of its surface is 19 km in NW-SE and 14 km in SW-NE directions, respectively; its area is 225 km^2 including the bordering zones as well (PÁL MOLNÁR, 1994a). This intrusion intruded into the central crystalline rock massif of the Eastern Carpathians is petrologically very complicated allochtonous body divided into tectonic units of E-NE dip, and it has a complex form (PÁL MOLNÁR, 1994b). The granitod rocks occur in many points of the Ditró Massif, and they can be found in the largest extent in the northern part of the massif, east of the Török creek and north of the Orotva-Nagyág creek as far as the crystalline rocks (*Fig. 1.*).

Aim of our study is a petrographical classification of this granitoid body, and the collection of the basic knowledge for the further detailed analyses. Structure and origin of the massif have been studied by several authors (STRECKEISEN, 1954; ANASTASIU, CONSTANTINESCU, 1977, 1981; JAKAB et al., 1987), however, a comprehensive classification has not been published, although, any further analysis would be inconsequent without this kind of study.

In this paper, we summarize the results of the petrographic study on rocks of this area described as granite.

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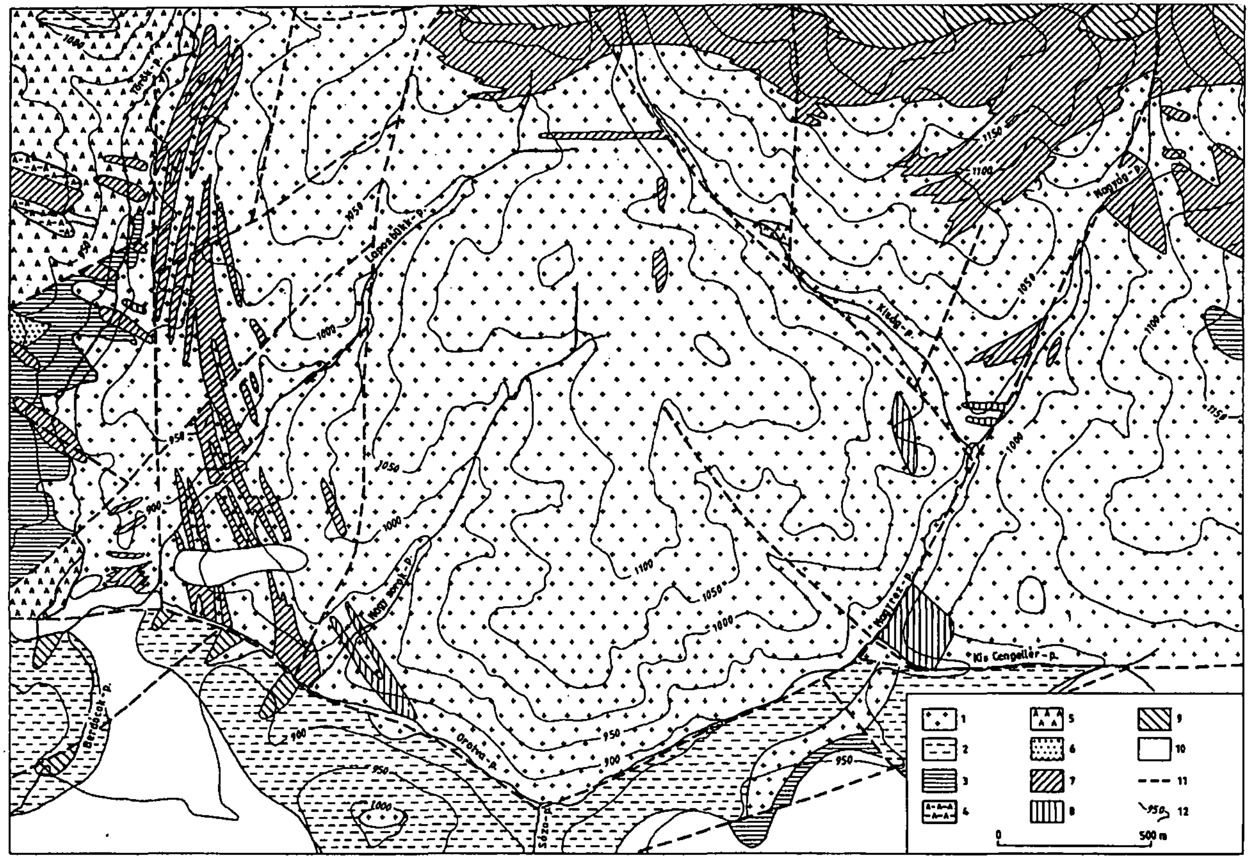

Fig. 1. Geological map of the NE part of the Ditró Syenite Massif (JAKAB et al., 1987)
1. granite; 2. syenite; 3. alkaline feldspar syenite with hornblende; 4. microcrystalline syenite; 5. monzonite; 6. microcrystalline alkaline feldspar syenite; 7. quartz-feldspar schists ; 8. quartzite; 9. sericite - graphite schists; 10. unknown area; 11. tectonic line; 12. contour line.

PETROGRAPHICAL CHARACTERIZATION OF THE 'GRANITOID ROCKS'

In this study, we intended to collect characteristic and common features that made the classification of the granitoid rocks possible. Moreover, textural and microstructural characters indicating the rock forming processes were observed. Of course, these studies themselves do not make reaching remote conclusions possible; a petrographical description only serves as a source for the genetic studies.

Granitoid rocks of the study area was described as red and grey coarse or fine grained granites (JAKAB et al., 1987). By macroscopic studies the following rock types could be distinguished:

- hypidiomorphic-granular 'granite' with potassium feldspar megacrystals;
- medium grained, hypidiomorphic-equigranular 'granite';
- cataclasites (tectonometamorphic rocks).

These rocks are dominantly leucocratic, pale grey, withish yellow, pink, pale red. Results of volume percentage composition measured in thin section (Table 1) are figured in diagrams (*Fig. 2.*) accepted by the IUGS (LE MAITRE, 1989). Rock analyses are in nine fields of the QAP diagram: alkaline granite, syenogranite, monzogranite, (alkaline) quartz syenite, quartz monzonite, (alkaline) syenite, monzonite and foidic monzosyenite (1 specimen). Results of the modal analyses show that petrography of the study area is more complex than it could have been expected on the basis of its geological map or the concerning literature.

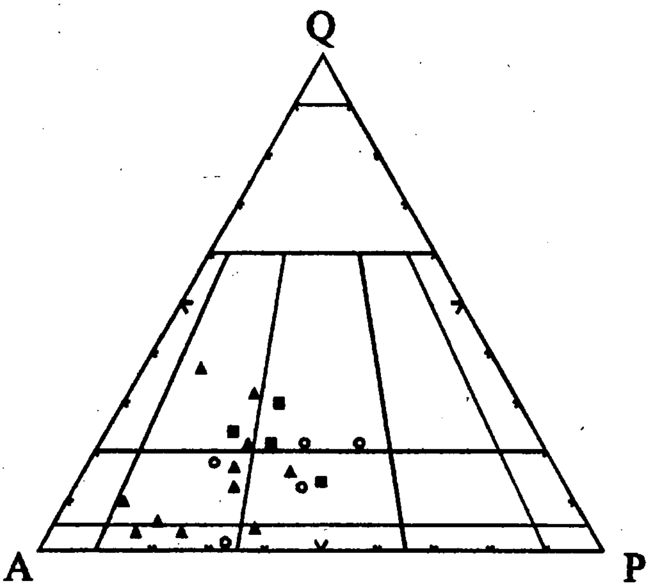

Fig. 2. Modal composition of the studied samples (LE MAITRE, 1989)

By the modal analyses and the textural studies, rocks of the Ditró Massif described as granites can be divided into the following groups:

1. syeno- and monzogranites

    a, with equigranular texture;

b, with potassium felspar megacrystalline texture;
c, alkaline granites.
2. syenites, quartz syenites, alkaline syenites, foidic monzosyenites
3. monzonites, quartz monzonites
4. cataclasites

Further on, petrographic features of the main groups are shown.

TABLE I

Results of the modal analyses for the QAP diagram

locality	sample number	A[2] (%)	P[3] (%)	Q[4] (%)	felsic constituents (%)	mafic index (%)	rock name
1. Török creek	ÁGK-6824	60	22	18	87	13	quartz syenite
	ÁGK-6826	47	40	13	92	8	quartz monzonite
	ÁGK-6827	32	46	22	75	25	monzogranite
	ÁGK-6829	66	32	2	90	10	syenite
	ÁGK-6831	42	35	22	91	9	monzogranite
2. Laposbükk creek	ÁGK-6835	48	30	22	84	16	monzogranite
	ÁGK-6836	67	21	F[5]11	79	21	foidic monzosyenite
	ÁGK-6838-B	43	43	14	87	13	quartz monzonite
	ÁGK-6839	54	22	24	92	8	monzogranite
	ÁGK-6842	53	22	24	995	5	syenogranite
3. Nagyág creek	ÁGK-6845	80	15	4	97	3	alkaline syenite
	ÁGK-6846	63	38	5	92	8	monzonite
	ÁGK-6847	53	10	37	98	2	syenogranite
	ÁGK-6848	72	23	4	89	11	syenite
	ÁGK-6849	76	18	6	92	8	quartz syenite
	ÁGK-6850	57	26	17	98	2	alkaline quartz syenite
	ÁGK-6851	59	28	13	90	10	quartz syenite
	ÁGK-6852	47	36	16	99	1	quartz monzonite
	ÁGK-6853	46	22	32	97	3	syenogranite
	ÁGK-6854	80	10	10	94	6	alkaline quartz syenite
	ÁGK-6856	51	27	22	98	2	syenogranite

1. Main textural features of the granites

The main felsic rock-forming minerals are as it follows: microcline, orthoclase, plagioclase of albite-oligoclase composition, quartz. Microcline and plagioclase often occur as hypidiomorphic megacrystal of 0.25-4 mm. Quartz is xenomorphic, its size ranges from 0.25 to 1.5 mm. The felsic components are in special microtextural relation to each other. In most cases, microcline is the most frequent felsic component. Their megacrystals are perthitic because of the albite ribbons (*Fig. 3.*). In many cases, it has a poikilitic texture, and contains quartz, plagioclase and (rarely) biotite as inclusions. Distribution of the inclusion is not equal in the crystal, but they can be found along the

[2] A: odal (volume percentage) ratio of potassium feldspars and An<5% (albite) in the Streckeisen diagram
[3] P: Modal (volume percentage) ratio of An>5% plagioclase feldspar in the Streckeisen diagram
[4] Q: Amount of the modal quartz in the Streckeisen diagram
[5] F: Modal amount of the feldspathoids in the Streckeisen diagram

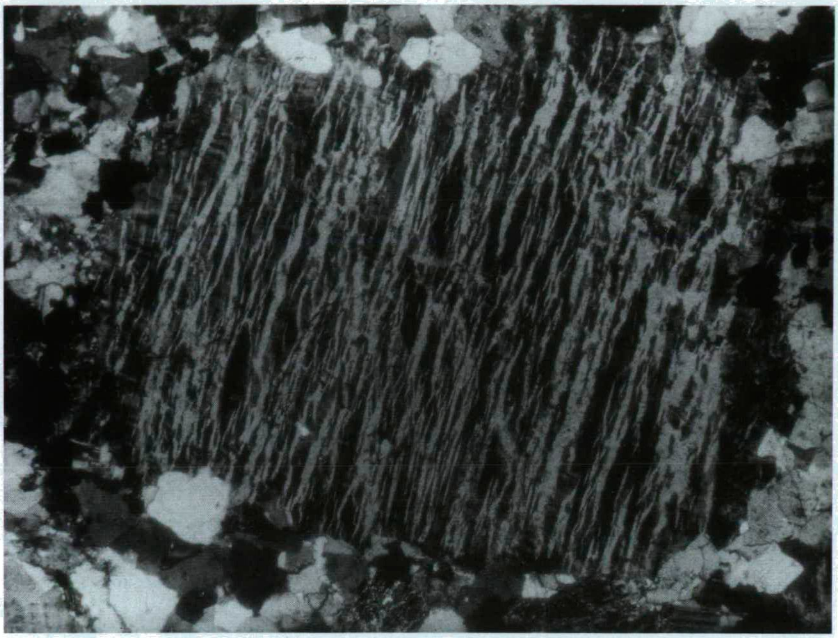

Fig. 3. ÁGK-6906 Microcline with perthite ribbons, 45x, +N

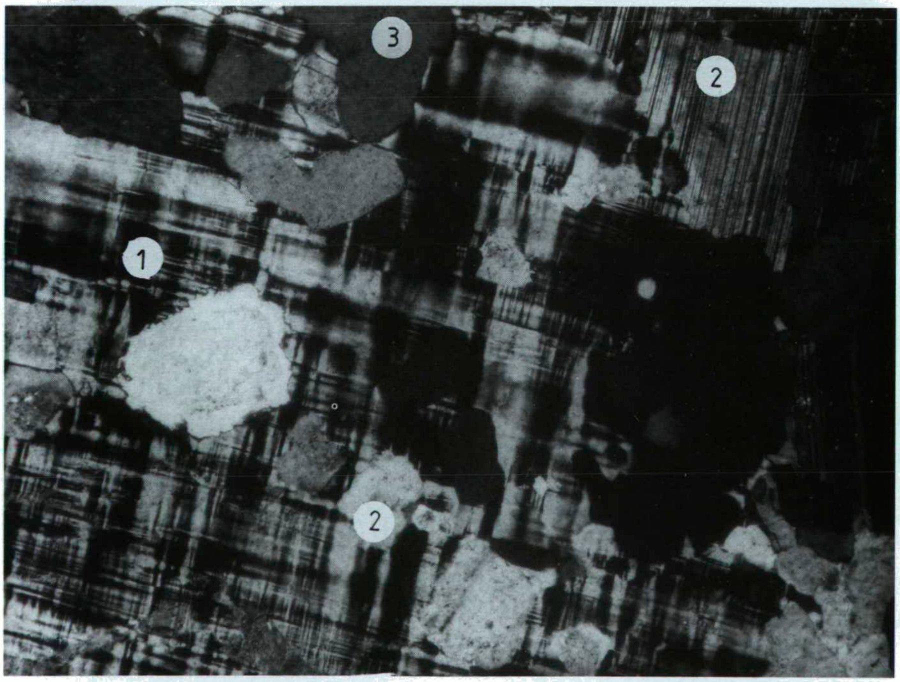

Fig. 4. ÁGK-6831 Microcline with plagioclase and quartz inclusions, 90x, +N
1. microcline; 2. plagioclase; 3. Quartz

Fig. 5. ÁGK-6842 Resorption embayment between microcline and quartz, 180x, +N
1. microcline; 2. Quartz

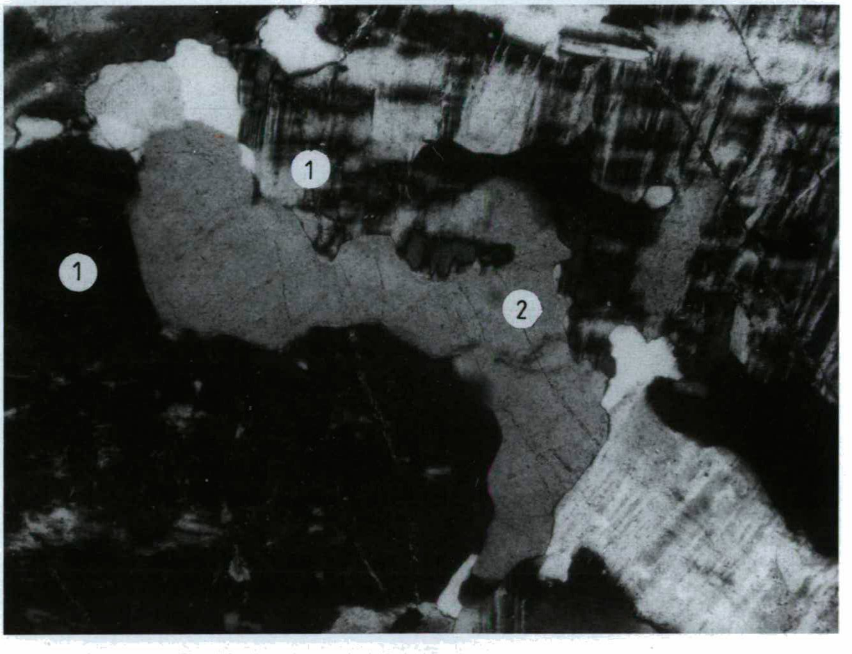

Fig. 6. ÁGK-6851 Resorption embayment between microcline and quartz, 90x, +N
1. microcline; 2. Quartz

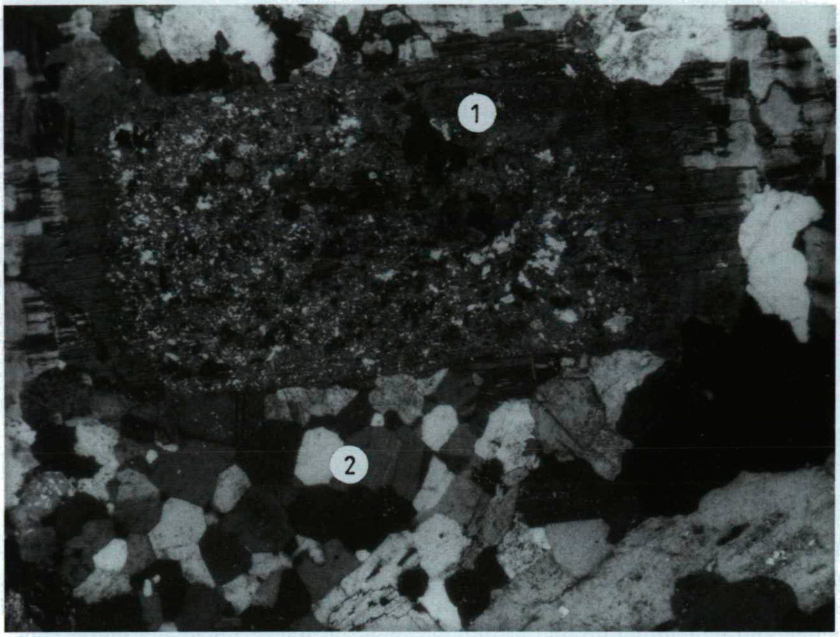

Fig. 7. ÁGK-6831 Primary sericitic plagioclase and secondary myrmekitic plagioclase, 45x, +N
1. plagioclase of first generation; 2. myrmekitic plagioclase of second generation

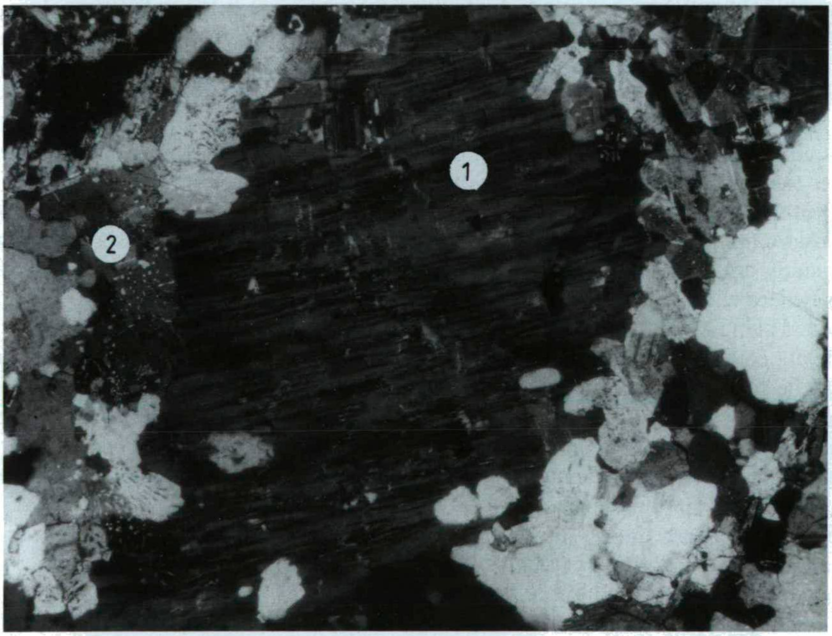

Fig. 8. ÁGK-6831 Microcline megacrystal and myrmekitic plagioclase, 45x, +N
1. microcline megacrystal; 2. myrmekitic plagioclase

margin as an inclusion belt (*Fig. 4.*). It is quite common that the much smaller quartz and feldspar grains are crowded between the big microcline megacrystals. The inclusions are embayed; it indicates gaining ground the host mineral (*Fig. 5.* and *6.*). These signs suggest that poikilitic texture of the microcline is not syngenetic with the other felsic constituents (i.e., it did not form during the crystallization) but it is a result of a secondary endomagmatic effect. Plagioclase feldspars have two generations. In general, the first has a megacrystalline habit, it is zoned, sericitic and slightly saussuritic (*Fig. 7.*); the second is smaller and often myrmekitic (*Fig. 8.*).

The dominant mafic rock-forming minerals are biotite, hornblende and alkaline amphiboles. Biotite can occur as single mafic constituent in the granites, while hornblende can occur only together with the biotite. The hornblende is generally weathered, relict, and associated with biotite, epidote and opaque grains (*Fig. 9.*). In some cases, the biotite is weathered, chloritized, and secondary rutile and titanite aggregates can be found along the cleavage faces (*Fig. 10.*). Its accessory minerals are apatite, zircon, orthite and primary opaque grains (magnetite).

2. Petrographic features of the syenites

In this part textural features of syenite, quartz syenites and alkaline syenites are summarised. It is true that volume percentage ratio of the felsic constituents is varying, however, their texture is similar to that of the granites in many respects. Dominance of microcline and its gaining ground to the detriment of that of felsic and mafic constituents can be found in the syenites of the study area. Compared to the granites, the special alteration of the amphiboles (hornblende and alkaline amphibole) is a new phenomenon. The amphibole structure became to be porous, the pores are filled with microcline grains, and an advance of microcline can be found at the margins, too (*Fig. 11.*). These xenomorphic amphiboles of perforated habit suggest secondary processes. A mineral association of alkali amphiboles and aegirine is quite frequent. The aegirine seems to be relict, and turned into alkaline amphibole (*Fig. 12.*). The alkaline amphibole can hardly be identified by optical way; they may belong to the arfvedsonite-eckermannite series and/or have a riebeckite composition. Accurate determination of their composition demands further mineral chemical analyses.

A foidic monzosyenite sample should also be mentioned here. This is a unique sample in the study area, however, its occurrence is known along the Török and the Laposbükk creeks where the foidic rocks attach to granites. This sample differs from the above mentioned samples in the higher volume percentage ratio of the mafic constituents (21 %) and the appearance of feldspathoids. It contains many idiomorhic, primary titanite crystals that can be found in lower amount in the above mentioned samples. The feldspathoids are altered; pseudomorphs of zoisite, muscovite and sericite aggregates after them can be seen. Possibly, they are liebneritized nepheline grains, and the isometric ones can be of sodalite origin. Of the mafic constituents, biotite and hornblende are fresh, augite is altered and surrounded by an amphibole crown.

Textural characterization of monzonites and quartz monzonites is not mentioned because, beside the volume percentage ratio of the QAP constituents, their microscopic features do not differ from those of the granites.

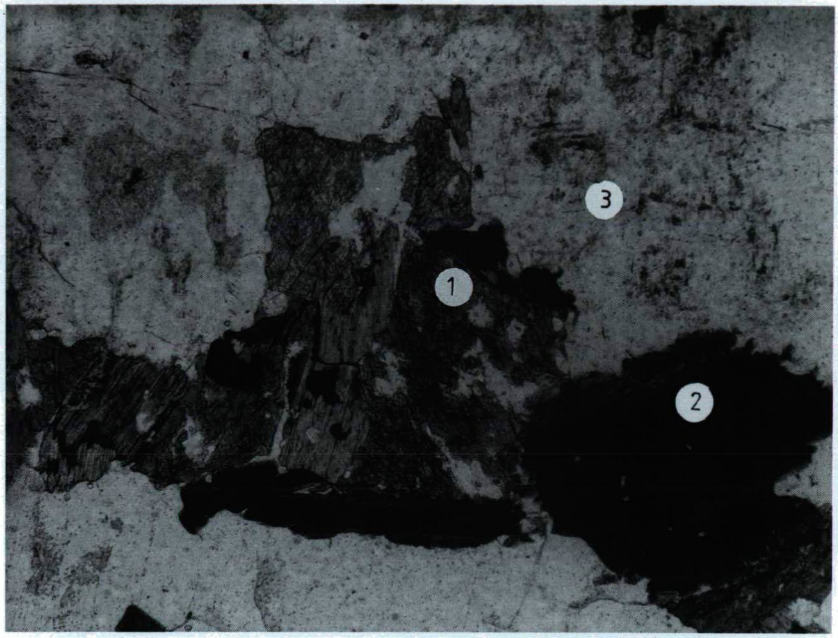

Fig. 9. ÁGK-6827 Biotite-amphibole-chlorite mineral association, 90x, 1N
1. hornblende; 2. chloritized biotite; 3. Microcline

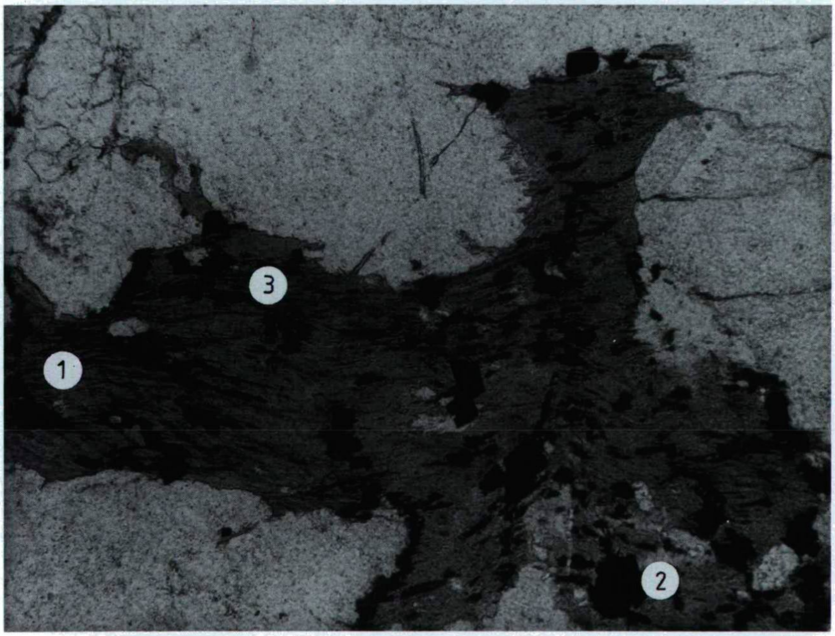

Fig. 10. ÁGK-6838-b Chloritized biotite with secondary rutile and opaque grains, 90x, 1N
1. chlorite pseudomorph after biotite; 2. opaque grain (magnetite); 3. secondary rutile

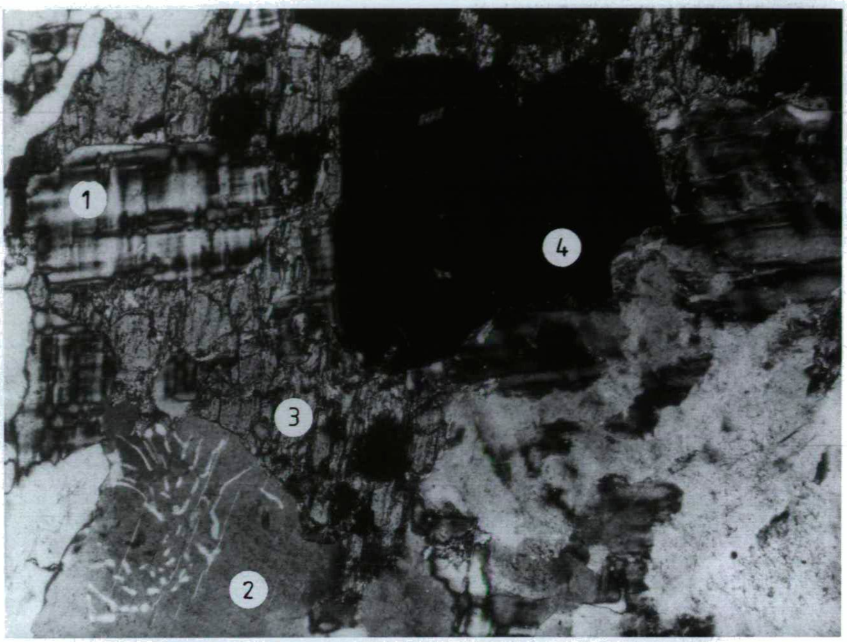

Fig. 11. ÁGK-6851 Myrmekite and microcline in altered amphibole, 90x, +N
1. microcline; 2. myrmekitic plagioclase; 3. hornblende; 4. opaque grain

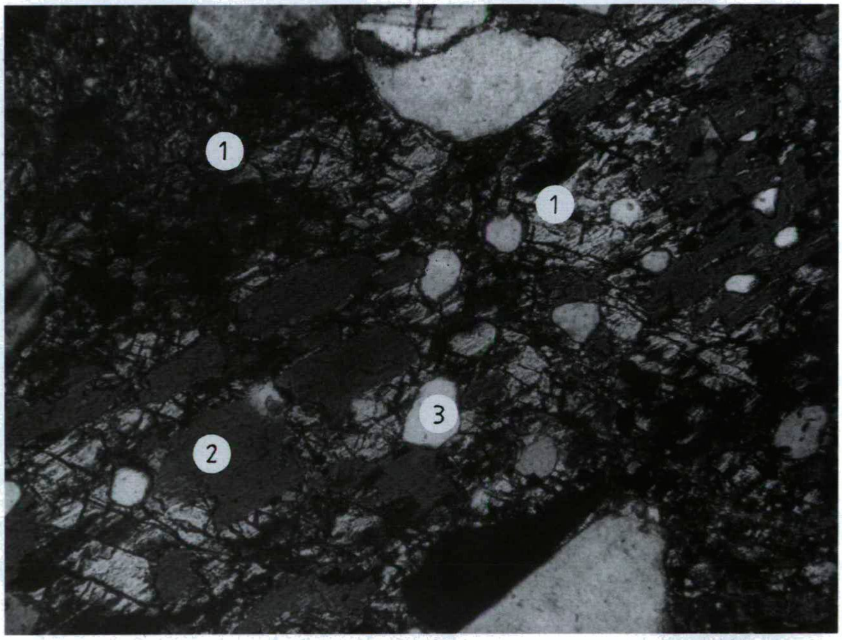

Fig. 12. ÁGK-6845 Aegirine of perforated texture and alkaline amphibole, 180x, +N
1. aegirine; 2. alkaline amphibole; 3. Microcline

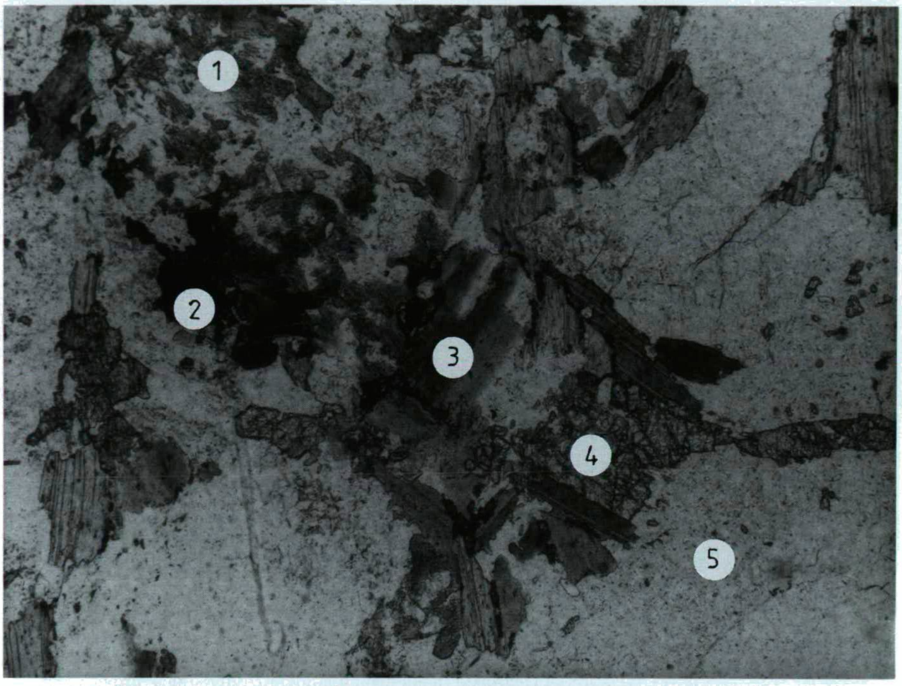

Fig. 13. ÁGK-6827 Amphibole-biotite-epidote mineral association, 90x, +N
1. hornblende; 2. opaque grain; 3. chloritized biotite; 4. epidote; 5. microcline

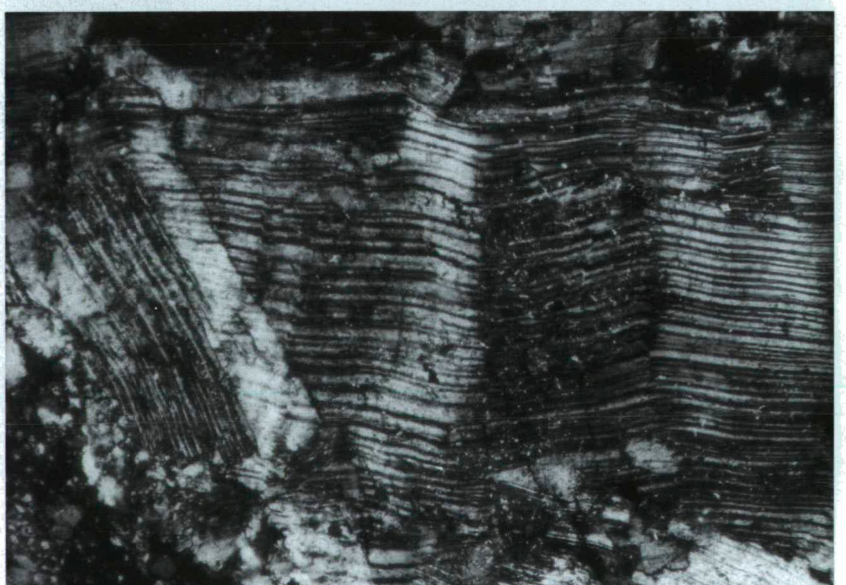

Fig. 14. ÁGK-6838-a Plagioclase with undulatory twins (kink-band), 90x, +N

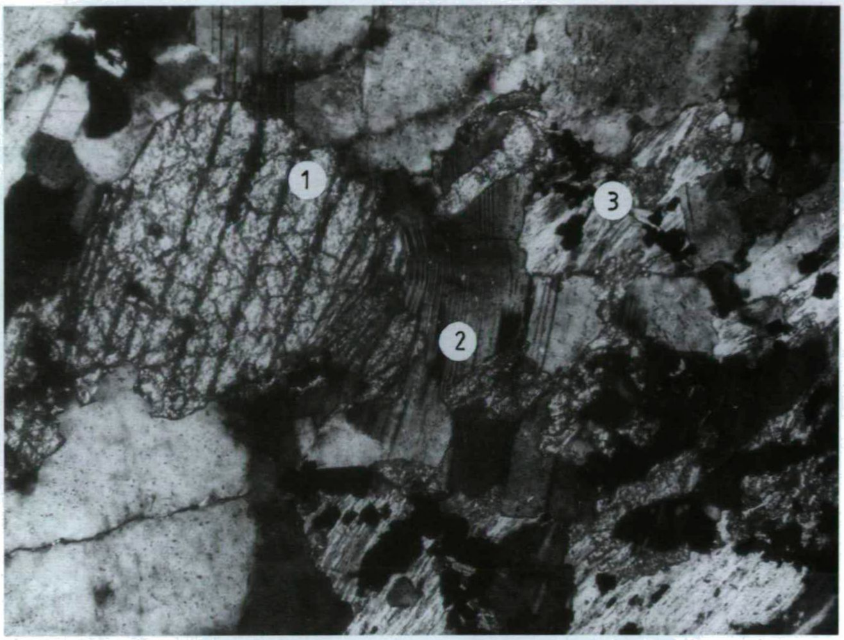

Fig. 15. ÁGK-6839 Deformed titanite and plagioclase, 90x, +N
1. titanite; 2. plagioclase; 3. chloritized biotite

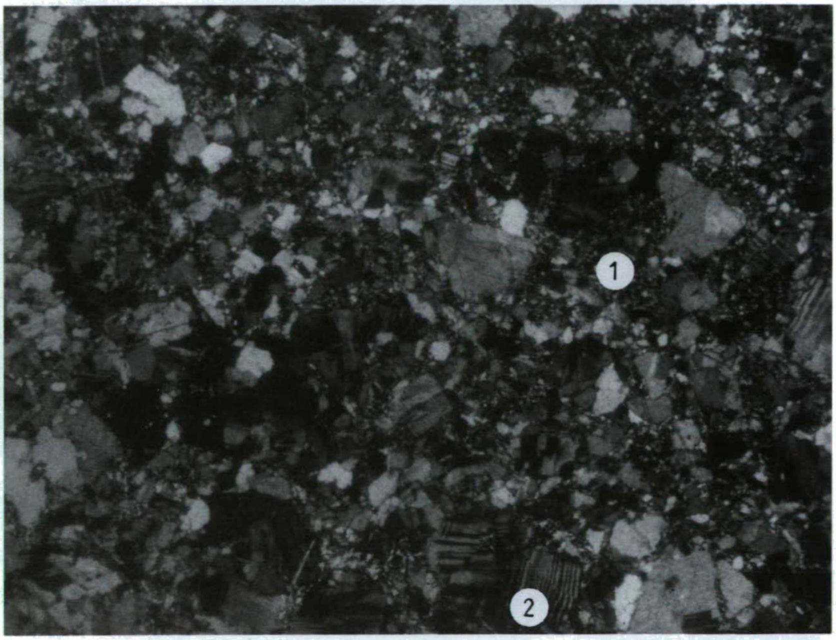

Fig. 16. ÁGK-6841 Fine-grained matrix of cataclasite, 45x, +N
1. matrix; 2. deformed plagioclase

3. Secondary textural features

Three processes can change the primary magmatic texture. These are: endomagmatic processes, weathering and tectonic deformation (MACKENZIE et al., 1984). Signs indicating *endomagmatic processes* have been mentioned above. One of them is the subsequent growth of the microcline to the detriment of the quartz and plagioclase crystals. Perforated structure of the alkaline amphibole can also be explained by these processes. Alteration of aegirine into alkaline amphibole, and that hornblende into biotite and epidote (*Fig. 13.*) can be resulted by an endomagmatic process, too. Mineral pseudomorphs of secondary, fibrous biotite can also be attributed to it. Microscopic studies alone do not make it possible to identify these secondary effects, and to distinguish them from the deuteric processes.

Weathering processes is suggested by several mineral associations. Of the mafic constituent, biotite is chloritized, bayeritized and opacitized. Pseudomorphs of biotite contain secondary rutile that can be found at the margin of the grains and along the cleavage faces. The amphibole turned into limonite and chlorite, and opaque minerals can often be found in the altered mineral associations. These alterations are resulted by meteoric water at low temperature (SHELLEY, 1993) (*Fig. 9., 10. ,13.*).

Third type of the textural alteration is resulted by *tectonic deformation*. It is often associated with weathering processes since continuity of the rocks is ceased by the deformation, and the meteoric water may induce more intensive weathering processes along the faults. In the study area, cataclasites indicate the tectonic effects. During a deformation under low temperature grains do not recrystallise but go to pieces and form a matrix around the intact grains. Rocks of the study area represent different grades of the tectonic metamorphism. Lower pressure results in deformation of the mineral grains: quartz grains show undulatory extinction, and the polysynthetic twins of the plagioclase are wavy (*Fig. 14.* and *15.*). Due to the increasing deformation effect the constituents become smaller and smaller, and form fine-grained matrix. On the basis of the ratio of the matrix, protocataclasite and cataclasite can be distinguished (*Fig. 16.*). The felsic constituents are dominant in the tectonometamorphic rocks because the mafic ones, which can be found in low (2-25) volume percentage as well, altered, and remained as chlorite-limonite aggregates and veins.

CONCLUSION

Previous classification of the granitoid rocks of the Ditró Massif was subjective and sketchy. The rock types were figured in too simplified way on the geological maps. It is a fact, however, that mapping of the granites and syenites is difficult, and changes of the modal composition may not be registered in many times.

Rocks described as granites could be divided into exact groups by more objective studies. On the basis of textural analyses, it has been shown that primary texture of the different rock types was transcribed by endomagmatic activity and weathering processes. Gaining ground of the microcline minerals to the detriment of plagioclase and quartz grains has been interpreted as an endomagmatic phenomenon since it is possible that their particular poikilitic texture and appearance in resorption embayments are results of potassium metasomatism. Dominance of the microcline is a general feature – it is characteristic for most of the petrographic groups. Alteration of mafic constituents, mainly that of hornblende, alkaline amphibole and biotite, is also frequent. Most cases, origin of these alteration processes is not known. A characteristic transcription of the primary texture of the rocks was resulted by tectonic deformation forming protocataclasites and cataclasites.

General occurrence of processes transcribing the primary texture of the studied rock types suggests that these rocks had similar development. This rock genetic problem requires other analyses; the results are to be published soon.

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