GEOLOGICKÝ ZBORNÍK — GEOLOGICA CARPATHICA, 32, 5, BRATISLAVA, OCTOBER 1981, Pp. 615—626

ŠTEFÁNIA DÁVIDOVÁ*

POTASSIUM FELDSPARS OF GRANITOID ROCKS OF THE VEPORIDE CRYSTALLINE

(Tab. 1, Figs. 6)

Abstract: In the work are presented the results of investigation of the properties of potassium feldspar megacrysts, of the porphyric varieties of granites to granodiorites of the Veporide crystalline of the West Carpathians. On the basis of the study of triclinity of angle 2 V and the total microscopic character of potassium feldspars it has been established that the megacrysts of potassium feldspars crystallized as monoclinic orthoclases, which in further development altered more or less into intermediate orthoclases, microclines to maximum microclines.

Резюме: В статье приведены результаты исследований свойств калийных полевошпатовых мегакристов порфировых разновидностей гранитов в гранодиориты Вепорского кристаллиникума Западных Карпат. На основе исследований триклиниты угла 2 В и также общего микроскопического характера калийных полевых шпатов было установлено, что калийные полевошпатовые мегакристы кристаллизовали как моноклинические ортоклазы, которые в их следующем развитии изменялись более или меньше в переходные ортоклазы, микроклины, до максимальных микроклинов.

Introduction

The potassium feldspars have an important rôle in clearing up of some problems of petrogenesis of magmatic rocks. The structural-optical properties are a result of complicated processes and are influenced by many factors, in various geological environments the main rôle falls to other factor. The choice of the correct factor requires a wide study of feldspars also in the frame of relations to other minerals. The most important factors, which influence the origin of one or another modification of potassium feldspar are the temperature of crystallization, rate of cooling of rock and rate of crystallization connected with it, the chemical composition of environment and melt, tectonic conditions during and after crystallization of potassium feldspars. However, the structural-optical properties, which reflect the conditions of origin, are not stable. Whe the potassium feldspar is getting into unbalanced conditions, its properties are changing. It means, that the properties of K-feldspars, which we observe in the rock, are a result not only of the conditions of crystallization, but also the result of postmagmatic and lare magmatic and post-tectonic effects.

Properties of potassium feldspars

Potassium feldspars from granitoid rocks of the Veporide crystalline were observed from the Kráľova hoľa and Kohút zones. From the massifs of Hron-

* Doc. RNDr. Š. Dávidová, CSc., Department of Mineralogy and Crystallography of the Faculty of Natural Sciences of the Comenius University, Gottwaldovo nám. 19, 886 02 Bratislava.

čok, Sihla, Sinec and their varieties with development of potassium feldspar megacrysts designated as porphyric and porphyry facies of Vepor and Ipeľ type. In granitoid rocks of the Veporide crystalline 2 types of potassium feldspars were established, which mainly differ in their development, their structural-optical properties often appear to be equal. About the existence of 2 generations of K-feldspars not only their different development testifies, the first group forms megacrysts of macroscopically automorphous delimitation and the second interstitial grains, but also enclosing of orthoclase in microcline was observed (Fig. 1).

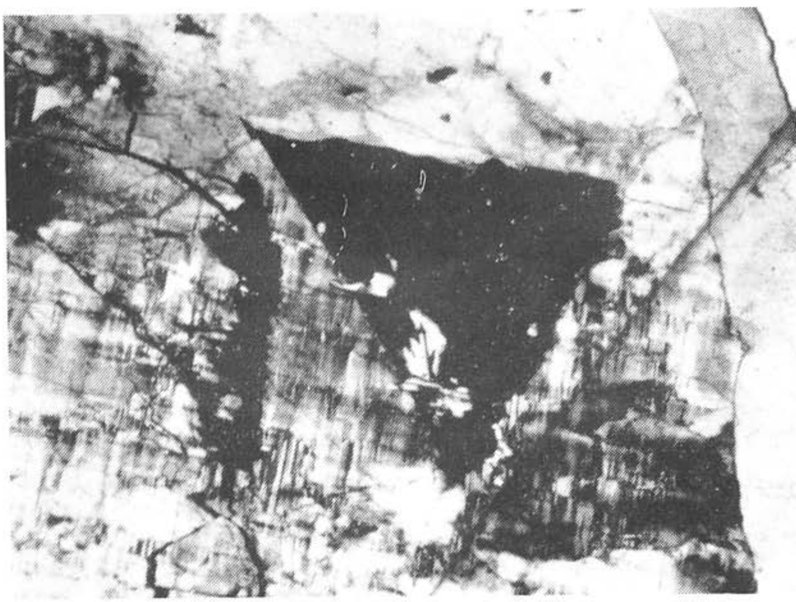

Fig. 1. Grain of orthoclase (dark) enclosed in microcline with typical polysynthetic cross — hatched twinning. Porphyric granite — Prašivá type. Quarry oposite to the dump pile of antimonite mines in Dúbrava, in the Križanka valley, south of the village Dúbrava. Magnif. 30 x, nic. xx; photo by Osvald.

From structural properties was traced the degree of order expressed by X-ray triclinity ($\triangle_r$), which was calculated according to J. R. Goldsmith — F. Laves (1954 a,b) from differences of diffraction lines of 131 and $1\bar{3}1$ planes. From optical propertiesthe angle 2V was traced, which can be used best as criterion of the degree of order of potassium feldspars. Submicroscopic twinning has only insignificant influence on the value. 2V. The influence of cryptoperthite content is also insignificant, because according to A. S. Marfunin (1962) 2V changes 5 to 7° when the content of cryptoperthite increases by 40 %. For comparison with X-ray triclinity from the values of angle 2V the optical triclinity ($\triangle_o$) was calculated according to A. S. Marfunin (1962), the calculation constant was used 0.0228 regarding to determination of 2V angle up to 88°α. The obtained values of the structuraloptical characteristic are mentioned in Tab. 1. In the Hrončok, Sihla and Sinec granitoids the X-ray triclinity values represent the average, which includes potassium feldspars of the whole rock. In these rocks the potassium feldspar was separated from the whole amount of crushed rock. From granites of Vepor and Ipeľ types megacrysts of pink potassium feldspars were selective separated and further treated. The results in Tab. 1, when also not representative (they represent only the results of maximum 8 measurements for one type), I consider as preliminary, which provide data for orientation.

Table 1

Structural — optical characteristics of potassium feldspars

Type of granitoid	$2V\alpha$	$\triangle_r$	$\triangle_n$	Modification of KŽ
Hrončok	84 — 86	0.90 — 0.96	0.91 — 0.93	maximum microcline
Sihla	60 — 74	0.00 — 0.30	0.49 — 0.68	orthoclase, intermediate orthoclase
Sinec	82 — 84	0.88 — 0.95	1.00 — 0.91	maximum microcline
Vepor	50 — 86	0.00 — 0.88	0.17 — 0.96	orthoclase to maximum microcline with intermed. types
Prašivá	50 — 88	0.00 — 0.88	0.17 — 0.96	,,
Prašivá Lukáčik 1978		0.00 — 0.93		,,

The representation of morphologically two different types of potassium feldspar in individual granitoid rocks is different and often changing from place to place. Roughly we can say that the interstitial type prevails in the Sihla granodiorite to trondhjemite, when also its amount is small here and some — times occurs as accessoryc mineral-E. Krist (1979). In other granitoid types of the Vepor crystalline rocks are prevailingly macroscopically automorphous crystals of K-feldspar.

Tab. 1 shows that in potassium feldspars from granitoids with prevalence of megacrysts or from such ones in which only the properties of megacrysts were traced the X-ray triclinity varies from 0 to 0.95, pointing to the presence of orthoclase to maximum microcline. This dispersion of feldspar modification forced to closer study of macroscopically automorphous crystals of potassium feldspars. This investigation was extented to feldspars from the Prašivá granites, which appear to be most representative in the so called autometamorphosed granites of the West Carpathians. The feldspars from the Vepor and Prašivá types of granites are not sporadical in the West Carpathians. Macroscopically and as it was further established in structure and optical properties they are very similar.

The potassium feldspar froms macroscopically automorphously delimited tabular crystals. Microscopically the boundaries of potassium feldspar with surrounding minerals are irregular and af amoebe-like to lobe-like course. The size of tabular crystals is variable on an average around 1 to 2 cm, sometimes attains the size of 3 cm along the longer edge. Its content in the rock varies from place to place. The prevailing colour is light-pink, buff, sporadically pink.

The degree of perthitization is varying and not connected with the size of crystals. Mostly spread are the film perthites — designation according to O. Andersen (1928), H. L. Alling (1938), A. Spry (1966) and short, also longer string-perthites. In places are developed band and patch perthites. The film perthites take their course most often along the plane of murchisonite cleavage $(\overline{15}.0.2)$, which only very little deviates from plane (001). The thickness of filaments sometimes of 0.05 mm length does not exceed 0.008 mm. They always are found in the uncross-hatched twinned part of the potassium phase and form blocks in grains. They are typical perthites of unmixing. The string perthites are following several directions in the potassium feldspar, $(\overline{15}.0.2)$,(110) and $(1\overline{1}0)$. They occur in greater blocks and their orientation is not always strict, so braided distribution originates. The thickness of strings varies from 0.01 to 0.1 mm. From the genetic viewpoint in formation of string perthites partly the processes of exsolution and partly the processes of segregation take part, so that in the sense of the classification of S. A. Rudenko (1954) we may designate them as exsolution — segregation perthites. The band perthites are sporadical and can take up even 30 % of the feldspar volume. The width of the bands varies from 0.1 mm to 0.3 mm. Their direction often changes, but essentially they follow the planes (110) and less $(1\overline{1}0)$, connecting into braiding. Their origin is in close connection with the autometasomatic effect and probably connected with younger albitization, which affects granitoids in some areas often in form of development of chessboard albite. Rare are patch perthites. Perthite intergrowths of the plagioclase phase form irregularly bordered spots of average size up to 0.4 mm. The boundaries of intergrowth phases are unsharp. Their morphology and mutual relations point out that they originated by recrystallization of enclosed plagioclase grains. The first 2 types of perthites we can designate according to the classification of L. Laves — K. Soldatos (1963) as micro-and the last as macro-perthites. A part of grains of potassium feldspar does not show micropertitization, not excluding the possibility that they are cryptoperthites.

Sporadically feldspars have a zonal structure (Fig. 2). Maximally 4 zones were found, the zoning is sometimes indicated by distribution of inclusions.

Megacrysts contain a great amount of inclusions sporadically the inclusions form up to 30 % volume of potassium feldspar. The prevailing enclosure are plagioclases, less is biotite and sporadically as inclusions apatite and iron oxides are found. Enclosed grains of plagioclases preserve the shape of tables or form irregular grains. In the majority of cases they are sericitized, sporadically saussuritized with development of acid albite fringes. Two-grade fringes of different orientation were also observed. The grown on fringes are mostly without intergrowths, sometimes of orientation uniform with the core. The cores of the plagioclase inclusions are sometimes intergrown according to polysynthetic albite of Carlsbad albite low. The cores of enclosed plagioclases are even 5 times smaller than the surrounding plagioclases of granite.

It is known, that in experimental conditions it was nat succeeded to perform inversion of the monocline phase into triclinic, when also many authors, on the basis of crystallographic observations, suppose this transition (F. Laves, 1950, 1952; F. Laves — J. R. Goldsmith, 1954 a,b; A. S. Marfunin, 1962; A. S. Marfunin — S. V. Rykov, 1961) and petrochemical (R. I. Harker, 1954, 1962; H. Ramberg, 1961; J. V. Smith — R. C. Stenstrom, 1965; B. Nilssen — S. B. Smithson, 1965; E. W. Heinrich — D. G. Moore, 1970; V. Marmo, 1955, 1971).

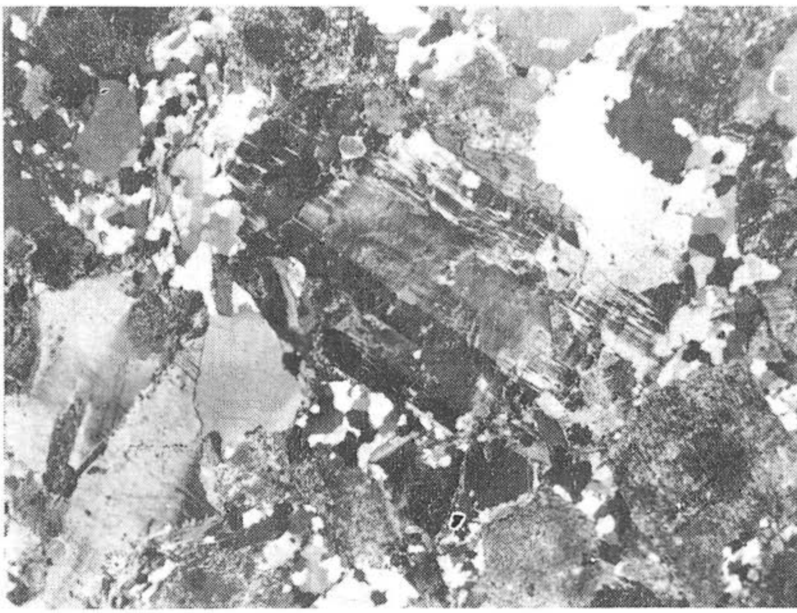

Fig. 2. Zonar orthoclase partly microclinized. The zonal structure is running through the growth plane of Carlsbad twinning. Porphyric granodiorite. Quarry 2 km north of Český Brezov. Magnif. 12,5 x, nic. xx; photo by Osvald.

The megacrysts of potassium feldspar in autometamorphosed rocks of the Vepor crystalline are characterized by two types twins. Perhaps 20 % crystals are twin according to simple Carlsbad law and the great majority are twin according to complicated albite — pericline law of polysynthetic character forming typical microcline cross-hatched twinning. At the Carlsbad twinning always only 2 individuals grow together. The twin plane (010) is prevailingly direct, in places with steps in its direction. In zonal crystals the zones are of symmetrical distribution to the plane of Carlsbad twinning. The polysynthetic albite — pericline twinning are only in certain parts of K-feldspar. On the series of pictures I want to point to the secondary character of this twinning, which originated after crystallization of the originally monocline phase. In Fig. 3 we observe orthoclase (2V = 50°) twin from two individuals according to the Carlsbad law. The arrangement of inclusions follows partly the concentric structure in symmetric distribution on the contrary to the twin. In Fig. 4 we observed again a twin of orthoclase ($2V = 56°$) intergrown according to Carlsbad twinning law. In the lower part of the light coloured individaul of the twin we observe domains with intergrowths according to the albite- pericline law. The intergrown domains similarly as the enclosures follow the concentric structure of K-feldspars. The higher amount of domains intergrown according to the albite — pericline law is shown in orthoclase ($2V = 76°$) in Fig. 5. The often microclinized ($2V = 78—84$) parts are distributed around enclosures, which are as nuclei of microclinization, and at the margin of grain (Fig. 6).

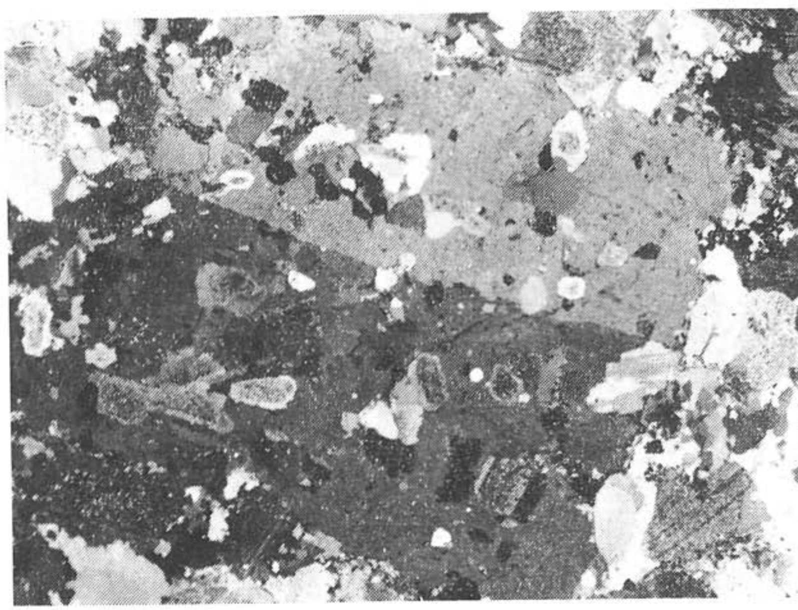

Fig. 3. Orthoclase twinning according to simple Carlsbad law. The enclosures of plagioclases are partly ordered concentrically to the growth. Porphyric biotite granite — Vepor type. Road cut in the Rimavica valley, about 250 m SE of the gamekeeper's cottage Ďurkovka. Magnif. 12.5 x, nic. xx; photo by Osvald.

The twinning only of two individuals, the elongation of crystals according to the twin plane, the straight direction of the twin plane in places with steps, the course of zoning through the twin plane and symmetry around the twin plane according to J. A. Vance, 1969; K. E. Seifert, 1964 and others are a characteristic feature for feldspars, which crystallized from the magma. Therefore I consider the Carlsbad twinning as primary. A. Köhler (1948) points to the fact that when the orthoclase forms penetration twin according to the Carlsbad law, so it crystallized from not fluidal solutions, when contact twins, to it originated from the residual melt.

The polysynthetic character of albite — pericline twinning, elliptic boundaries of lamellae, occurrence in domains often developed around inclusions or at the periphery of grain, the presence of twinning domains in the monoclinic phase twinning according to the Carlsbad law, point to the secondary character of albite — percline twinning. With the mechanism and theory of twinning in feldspars many works were dealing: R. C. E m m o n s — R. H. G a t e s (1943), M. J. B u e r g e r (1945), J. A. V a n c e (1961), K. E. S e i f e r t (1964), R. T. C a n n o n (1966 a,b), T. W. D o n n e l l y (1968).

2 types of secondary twinning are taken into consideration — transformation and mechanic (S. C a p e d r i, 1973). The transformation types originate, when a change of symmetry occurs usually with sinking temperature. Its formation is supported by stress. The mechanic twinning is brought about

Fig. 4. Twin of potassium feldspar grown according to Carlsbad law, with domains twinning according to the albite and pericline law, which indicate the concentric structure of the twin regardless of the growth plane. Porphyric biotite granite — Ipeľ type. Road cut of Drábsko — Utekáč, 550 m of elev.p. Hŕbak (765.6). Magnif. 12.5 x, nic. xx; photo by Osvald.

by stress, which results from the regional deformation of rocks or from local interaction caused by thermal contraction of the environment. It depends on the activation energy; when this is low, also only an insignificant pressure causes twinning (J. S t a r k e y — W. Z. B r o w n, 1964). The origin of cross-hatched twinning is according to W. S. M a c k e n z i e (1954 a), J. V. S m i t h (1974) controlled by chemical composition of the K-phase, which changes with exsolution of Na-phase.

It results from the above mentioned, that the potassium feldspars in autometamorphosed Vepor granites crystallized as monoclinic orthoclases and later they were microclinized to a various degree. For determination of the degree of microclinization as the method most suitable was shown 2V measurement. In oriented sections of K-feldspar we can observe the change of 2V also in the frame of one grain. The determination of the degree of triclinity on the basis of X-ray methods provides the average value.

The temperature of K-Na feldspar crystallization changes according to N. L. Bowen — O. F. Tuttle (1950) and J. F. Schairer (1950), H. S. Yoder — D. B. Stewart — J. R. Smith (1957) from 1063 to 695° at presence of water in conditions of pressure 100 to 500 MPa, the composition is stable 65—70 % Ab components. Under natural conditions, according to N. L. Bowen — O. F. Tuttle (1951) the lower limit of crystallization temperature changes from 660 to 698° at 100 to 500 MPa with composition of

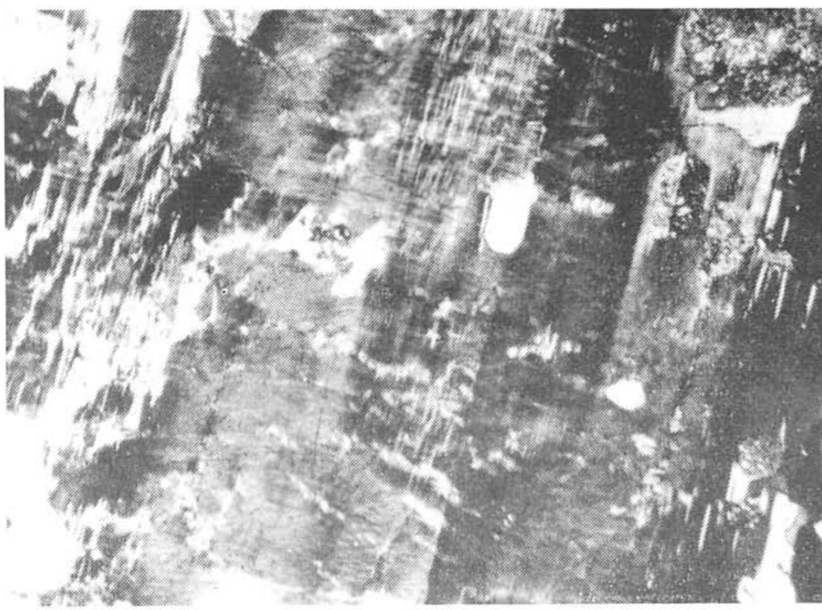

Fig. 5. Zonar potassium feldspar twinning according to simple Carlsbad law, highly microclinized. Porphyric granodiorite. Quarry 2 km N of Český Brezov. Magnif. 48 x, nic. xx; photo by Osvald.

Ab_{66} to Ab_{42}, it is valid that with purer K-feldspar the temperature of its equilibrium crystallization is lower. N. F. Čeliščev (1967) obtained experimentally a solid solution of orthoclase and albite at 750 °C and pressure 200 MPa. The orthoclase is stable within the range of 600 to 700 °C (I. S. Sedova — N. V. Kotov, 1967), according to L. Laves (1952) it can originate as the stable phase above 700 °C and below this temperature as metastable phase, which tends to pass into stable microcline with slow cooling. Microcline is stable in conditions below 525 °C and pressure 50 MPa H_2O (J. R. Goldsmith — F. Laves, 1954 b). I. S. Sedova — N. V. Kotov (1967) mention the stability field of microcline up to 600 °C. With rising temperature it changes into disordered monoclinic phase.

The alteration of monoclinic K-feldspar into triclinic points to the thermal history of granites, which began to form at temperatures higher than 600 °C.

The process of arrangement, e.g. the inversion of the monoclinic phase into triclinic is influenced by various petrochemical and petrogenetic factors in connection with pT conditions of formation, the development and growing old of the granitoid massif. The triclinization of feldspars begins below 500 °C and is indirectly proportional to the rate of cooling.

The process of arrangement is often linked with the process unmixing of perthites.

In the inversion of feldspar phases the chemical composition of the environment plays an important rôle. According to F e r g u s o n (1979) the de-

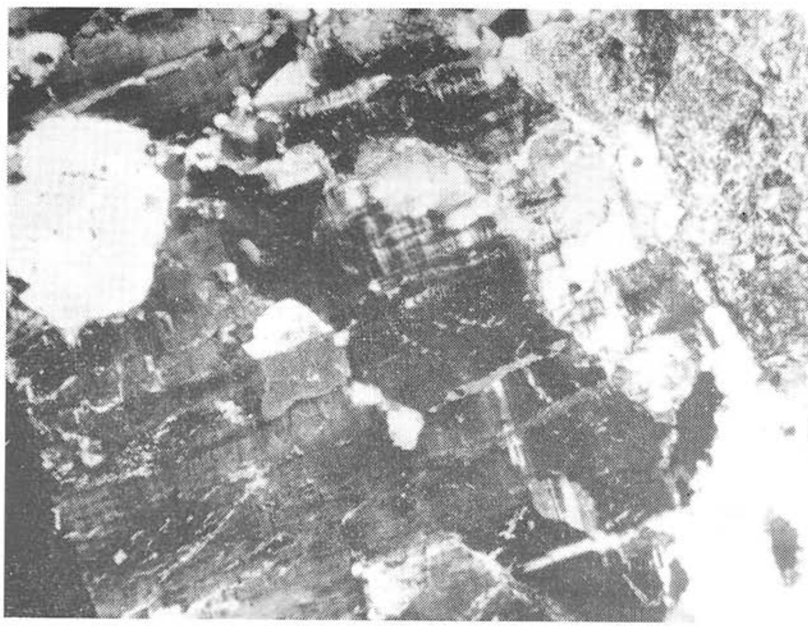

Fig. 6. Highly microclinized orthoclas. Albite and pericline twinning of polysynthetic character is developed mainly around inclusions. Porphyric granite — Vepor type. Outcrop in the old road to Lom n/Rimavicou, 300 m SW of elev.p. 768.4. Magnif. 30 x, nic. xx; photo by Osvald.

cisive factor is the ratio of F-feldspar to the sum of K and Na in the original environment. According to Ch. V. G u i d o t t e (1978) the high activity of Al_2O hinders the process of the arrangement and formation of the triclinic phase. The high content of fluidal components, mainly the high partial pressure of H_2O works as a catalyzer in the change of the monoclinic phase into the triclinic.

A higher temperature of K-feldspar crystallization in the Vepor granite is indicated by the presence of exsolution perthites in K-feldspar and myrmekites. The perthites are characterized as solid solutions stable at 700 °C (T. F. B. B a r t h, 1969) to 750 °C (N. F. Č e l i š č e v, 1967). With slow cooling the original homogeneous solid solutions decompose — are unmixing. According to the works of R. J. Jahns — C. W. B u r n h a m

(1958) the temperature of unmixing is 650—550 °C, according to N. I. Bowen — O. F. Tuffle (1950) for binary feldspars Or_{23} Ab_{77} 610 °C. For solid solutions with 76—85 % Or components T. L. Wright (1964) determined the temperature of unmixing with 550—500 °C and complete unmixing occurred at 460—430 °C. The size and shape of perthite unmixings are a function of diffusion and depend mainly on the rate of colling. P. Michot (1961) and F. Chayes (1952) have established that the perthite type does not depend only on the temperature but also on deformation with the raising of intrusion.

Discussion

The megacrysts of the potassium feldspars in porphyric granitoids of the Vepor crystalline crystallized as monoclinic orthoclases, which were later microclinized to a various extent. The petrogenetic relations permit to suppose that the megacrysts of potassium feldspars originated after cooling of the first stage of granite (many enclosures of plagioclase and biotite). The crystallization was taking place in a quiescent tectonic period (growth of large undisturbed crystals). So we can range the origin of crystals of potassium feldspar into a timely later crystallization stage, characterized by temperatures (above 600 °C), during which the monoclinic orthoclas formed. This crystallization phase is closely linked with formation of independent pegmatite veins.

In the further process of the cooling and senility of the granitoid complex arrived a partial of complete triclinization of the monoclinic phase. The preservation of the monoclinic phase as orthoclase or only partial triniclinization either point to a faster cooling than the rate of inversion of feldspar phases, or to the absence of fluid components, mainly of low partial pressure of water steam. To what an extent the triclinization is evoked by the effects of later shear-stress, it can be established only with detailed investigation of the feldspar character in areas variously disturbed tectonically.

In the last postmagmatic stages albitization of potassium feldspars takes place. It is either shown by the origin of chessboard albite, which to a various degree replaces the potassium phase, or by the origin of band or coarse-braid perthites. In these areas also formation of younger (Alpine?) potassium feldspars as the low-temperature albitization was observed.

Translated by J. Pevný.

REFERENCES

ALLING, H. L., 1938: Plutonic perthites. J. Geol. (Chicago), 46, p. 142—165.
ANDERSEN, O., 1928: The genesis of some types of feldspar from granite pegmatites. Nor. geol. Tidsskr. (Oslo), 10, p. 116—207.
BARTH, T. F. W., 1969: Feldspars. Wiley — Interscience, New York, p. 261.
BOWEN, N. L. — TUTTLE, O. F., 1950: The system $NaAlSi_3O_8$ — $KAlSi_3O_8$ — H_2O. J. Geol. (Chicago), 58, p. 489—511.
BUERGER, M. J., 1945: The genesis of twin crystals. Amer. Mineralogist (Washington), 30, p. 469—482.
CANNON, R. T., 1966 a: Plagioclase zoning and twinning in relation to the metamorphic history of some amphibolites and granulites. Amer. J. Sci. (New Haven), 264, 7, p. 526—542.

CANNON, R. T., 1966 b: Zoning and twinning in metamorphic plagioclases. Geol. Soc. Amer. Spec. Papers (New York), 87, p. 279—280.
CAPEDRI, S., 1973: First evidence of secondary glide twinning in K-feldspar. Tschermaks mineral. petrogr. Mitt. (Wien), 19, p. 51—59.
CHAYES, F., 1952: On the association of perthitic microcline with highly undulant or granular quartz in some calcalkaline granites. Amer. J. Sci. (New Haven). 250, p. 281—296.
ČELIŠČEV, N. F., 1967: Experimentaľnoe izučenie posledovateľnosti kristallizacii polevych špatov v uslovijach menjajuščejsia ščeločnosti granitovovo razplava. Exper. issled. v obl. miner. i geoch. red. elem., (Moskva), p. 47—52.
DONNELLY, T. W., 1968: Kinetic considerations in the genesis of growth twinning: a reply. Amer. Mineralogist (Washington), 53, p. 344—346.
EMMONS, R. C. — GATES, R. M., 1943: Plagioclase twinning. Bull. Geol. Soc. Amer. (New York), 54, p. 287—304.
FERGUSON, R. B., 1979: Whence orthoclase and microcline. A Crystallographer's interpretation of potassium feldspar phase relations. Canad. Mineralogist (Otawa), 17, 3, p. 515—525.
GOLDSMITH, J. R. — LAVES, F., 1954 a: The microcline — sanidine stability relations. Geochim. cosmochim. Acta (London), 5, p. 1—19.
GOLDSMITH, J. R. — LAVES, F., 1954 b: Potassium feldspars structurally intermediate between microcline and sanidine. Geochim. cosmochim. Acta (London), 6, p. 100—118.
GUIDOTTI, Ch. V., 1978: Muscovite and K — feldspar from two — mica adamellite in northwestern Maine: composition and petrogenetic implications. Amer. Mineralogist (Washington), 63, p. 750—753.
HARKER, R. I., 1954: The occurrence of orthoclase and microcline in the granitic gneisses of the Carn Chuinneag — Inchbae complex, E. Ross — shire. Geol. Mag. (London), 91, p. 129—136.
HARKER, R. I., 1962: The older ortho-gneisses of Carn Chuinneag and Inchbae. J. Petrol. (Oxford), 3, p. 215—237.
HEINRICH, E. W. — MOORE, D. G., 1970: Metasomatic potash feldspar rocks associated with igneous alkalic complexes. Canad. Mineralogist (Otawa), 10, p. 571—584.
JAHNS, R. H. — BURNHAM, C. W., 1958: Experimental studies of pegmatite genesis Melting and crystallization of granite and pegmatite. Bull. Geol. Soc. Amer. (New York), 69, p. 88—89.
KÖHLER, A., 1948: Erscheinungen an Feldspaten in ihrer Bedeutung für die Klärung der Gesteinsgenesis. Tschermarks miner. petrog. Mitt. (Wien), 3, 1, p. 51—67.
KRIST, E., 1979: Granitoid rocks of the southwestern part of the Veporide crystalline complex. Geol. Zbor. — Geol. carpath. (Bratislava), 30, 2, p. 157—180.
LAVES, F., 1950: The lattice and twinning of microcline and other potash — feldspars. J Geol. (Chicago), 58, 5, p. 548—571.
LAVES, F., 1952: Phase relations of the alkali feldspars. I. Introductory remarks. II. The stable and pseudo-stable relations the alkali feldspar system. J. Geol. (Chicago), 60, 6, p. 436—450, 549—574.
LAVES, F. — SOLDATOS, K., 1963: Die Albit Mikroklin Orientierungs — Beziehungen in Mikroklinperthiten und deren genetische Deutung. Z. Kristallogr. (Wiesbaden), 118, p. 69—102.
LUKÁČIK, E., 1978: Niektoré geologicko-petrografické problémy kryštalinika západnej časti ďumbierskeho pásma Nízkych Tatier. Rigorózna práca. Rukopis. Bratislava, Geofond, 43 p.
MARFUNIN, A. S., 1962: Polevye špaty fazovije vzaimootnošenija optičeskije svojstva, geologičeskoje razpredelenije. Trudy Inst. Geol. rud. Mestorožd. Petrogr. Mineral. Geochim. (Moskva), 78, p. 1—272.
MARFUNIN, A. S. — RYKOVA, S. V., 1961: Optičeskije i strukturnije osobenosti promežutočnovo maximalnevo mikroklín — pertita iz pegmatitov Tajmira. Trudy Mineral. Muz. (Moskva), 12, p. 26—38.
MAC KENZIE, W. S., 1954: The orthoclase — microcline inversion. Mineral. Mag. (London), 30, p. 354—366.
MARMO, V., 1955: On the microcline of the granitic rocks of central Sierra Leone I. Schweiz. mineral. petrogr. Mitt. (Wien), 35, p. 155—167.

MARMO, V., 1971: Granite petrology and the granite problem. Elsevier Amsterdam, 244 p.
MEHNERT, K. R., 1968: Migmatites and the origin granitic rocks. Elsevier Amsterdam, 327 p.
MICHOT, P., 1961: Structur der Mesoperthite. Neu. Jb. Mineral. Abh. (Stuttgart), 96, p. 213—216.
NILSSEN, B. — SMITHSON, S. B., 1965: Studies on the Precambrian Herefoss granite I. K-feldspar obliquity. Nor. geol. Tidsskr. (Oslo), 45, p. 367—396.
RAMBERG, H., 1961: Artificial and natural photoelastic effects in quartz and feldspars. Amer. Mineralogist (Washington), 46, p. 934—951.
RUDENKO, S. A., 1954: Morfologo-genetičeskaja klasifikacia pertitovych srastanij. Zap. Vsesojuz. mineral. Obšč. (Moskva), 83, 1, p. 23—36.
SEDOVA, I. S. — KOTOV, N. V., 1967: Strukturnoe sostojanie kalievych polevych špatov v granitoidach različnych genetičeskich tipov. Izv. Akad. Nauk SSSR (Moskva), Ser. geol., 8, p. 49—65.
SEIFERT, K. E., 1964: The genezis of plagioclase twinning in the Novewang granite. Amer. Mineralogist (Washington), 49, p. 297—320.
SCHAIRER, J. F., 1950: The alkali — feldspar join in the system $NaAlSiO_4$ — $KAlSiO_4$ — SiO_2. J. Geol. (Chicago), 58, 5, p. 512—517.
SMITH, J. V., 1974: Feldspar Minerals I. II. Springer — Verlag, Berlin, 627 p. 690 p.
SMITH, J. V. — STENSTROM, R. C., 1965: Electron — excited luminescence as a petrologic toal. J. Geol. (Chicago), 73, p. 627—635.
SPRY, A., 1969: Metamorphic Textures. (Oxford) p. 320.
STARKEY, J. — BROWN, W. L., 1964: Künstliche Erzeugung mechanischer Zwillinge in Anorthit $CaAl_2Si_2O_8$. Z. Kristallogr. (Wiesbaden), 120, p. 388—392.
VANCE, J. A., 1961: Polysynthetic twinning in plagioclase. Amer. Mineralogist (Washington), 46, p. 1097—1119.
VANCE, J. A., 1969: On Synneusis. Contr. Mineral. Petrology (Berlin), 24, p. 7—29.
WRIGHT, T. L., 1964: The alkali feldspars of the Tatoosh pluton in Mount Rainier National Park. Amer. Mineralogist (Washington), 49, p. 715—735.
YODER, H. S. — STEWART, D. B. — SMITH, J. R., 1957: Ternary feldspars. Annual Rep. Director Geophys. Lab. Carnegic Inst. Washington Year Book, 55/56, (56/57), 190.

Review by M. ŠÍMOVÁ Manuscript received June 2, 1981

This article was presented in the Symposium on geochemistry of endogenous and exogenous processes, petrogenesis and minerogenesis, which took place in Smolenice on 4 — 8 May 1981.