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QUARTZ GRAIN TYPES IN THE LOWER TRIASSIC CLASTICS OF THE WEST CARPATHIANS

(Fig. 1—13)

Abstract: The distinguishing of quartz grain types helps to identify the source of clastic material in sediments composed mostly of quartz. Therefore this method has been used for petrologic study of the Lower Triassic clastics in the Tatrics of the Central West Carpathians.

Резюме: Определение типов зерен кварца служит для уточнения источника кластического материала в седиментах состоящих главным образом из кварца. Поэтому был этот метод применен для петрографического изучения нижнетриасовых кластических пород Центральных Западных Карпат.

Introduction

Quartz is most frequent mineral in the Lower Triassic clastics, so called "quartzites". These sedimentary rocks are composed of rather monotonous mineral association — beside quartz there occur fledspar (mostly kalium), micas, chert fragments and heavy minerals (zircon, rutile, tourmaline, leukoxene, apatite). The attempts to indicate the origin of clastic material in such clastic rocks led to more detailed study of quartz grain types. Fundamental research was done by H. Blatt (1959, 1967, H. Blatt and J. M. Christie (1960, 1963), application of this method can be found in the paper by Z. Kukal (1967).

Basic features for distinguishing the quartz grain types is their inner structure, undulosity, and presence of several quartz crystals in a grain (polycrystallinity). Conformably to the mentioned criteria, quartz grains can be distinguished according to their origin as follows:

1. quartz from massive plutonic rocks
2. quartz from gneisses
3. quartz from schists
4. quartz from effusive rocks
5. vein quartz.

The above cited authors attained by experimental work how to define the individual quartz grain types. The author of the presented paper have used thin-sections of the "mother" rocks for comparison, which were kindly lent by Dr. D. Hovorka, CSc. and Dr. I. Rojkovič, CSc. whom she should like to express many thanks.

Quartz grain types

The grains from massive plutonic rocks are polycrystalline, rather large in size (about 1 mm) and consist of a small number of crystal individuals. It results from this fact, that these types are the most frequent in coarse-grained sediments, their content in fine-grained sediments is low. It can be explained that the large quartz grains from plutonic rocks disintegrated, and as a result smaller monocrystalline grains appear. Nice and well-distinguished grains of the described origin are on fig. 1 and 2.

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Fig. 1. Large coarse-polycrystalline grain from massive plutonic rocks. Loc. Malý Kriváň, Malá Fatra Mts., s. 72, X nicols, magnified 43 ×. Photo C. Michalíková.

Fig. 2. Polycrystalline grain from massive plutonic rocks with undulatory oriented overgrowth. Loc. Lipt. Lúžna, Nízke Tatry Mts., s. 150, X nicols, magn. 43 ×. Photo C. Michalíková.

Grains from gneisses are polycrystalline, of the same size (1 mm) as from the plutonic rocks, but they consist of a great amount of crystal individuals. These crystals have usually bimodal distribution and preferred orientation (fig. 3).

Grains from schists are similar to the previous type, but they are half as small. They are composed of preferentially oriented quartz crystals, but their number is half as less than in grains from gneisses, similarly to the grains from massive plutonic rocks (fig. 4).

Quartz from effusive rocks is very typical in its appearance, it is monocrystalline quartz of bipyramidal habitus with corroded rims and with large inclusions of aphanitic mass (fig. 5, 6).

Vein quartz is polycrystalline, consists of wedge-like crystals. It is very difficult to distinguish it, however, in thin-section, from other polycrystalline grains, because its appearance depends strongly on sectioning the grain in thin section. For illustration

Fig. 3. Fine-polycrystalline grain from gneisses. Loc. Lipt. Lúžna, Nízke Tatry Mts., s. 4, X nicols, magn. 43 ×. Photo C. Michalíková.

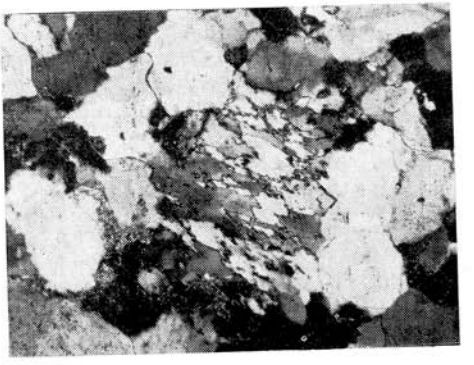

Fig. 4. Polycrystalline oriented quartz with bimodal distribution of crystals from schists. Loc. Donovaly, Nízke Tatry Mts., s. 4, nicols, magn. 43 ×. Photo C. Michalíková.

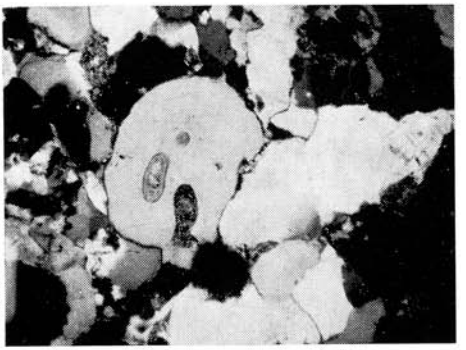

Fig. 5. Monocrystalline quartz from effusive rocks, it has bipyramidal habitus and preserved features of corrosion and inclusions. Loc. Lipt. Lúžna, Nízke Tatry Mts., s. 174, X nicols, magn. 43 ×. Photo C. Michalíková.

Fig. 6. Monocrystalline quartz from effusive rocks. Loc. Smrekovec, Malá Fatra Mts., X nicols, magn. 43 ×. Photo C. Michalíková.

serves fig. 7, where quartz vein occurs in the investigated "quartzite", there can be seen the typical so called "comb-like" quartz grains. Chalcedone, coming probably from the vein filling, is on fig. 8.

All the types of quartz grains can bear the marks of the cataclastic deformations, e. g. pressure folds, small quartz crystals along the zones of discontinuity (fig. 9, 10), on polycrystalline grains there occur various deformation of the individual crystals.

The important feature, which accompanies the cataclastic marks, is the undulosity. Undulatory monocrystalline grains are large and come commonly from plutonic rocks. At the same time, these grains can be the source of relatively non-undulatory smaller monocrystalline grains, after disintegration along the zones of discontinuity. H. Blatt and J. M. Christie (1960, 1963) expressed the opinion that non-undulatory grains come probably also from schists and perhaps gneisses, and from quartzose extrusive and pyroclastic rocks as well. Undulatory monocrystalline grains come from plutonic

Fig. 7. Vein quartz from small vein in quartzite. Loc. Lipt. Lúžna, Nízke Tatry Mts., s. 190, X nicols, magn. 43 ×. Photo F. Martančík.

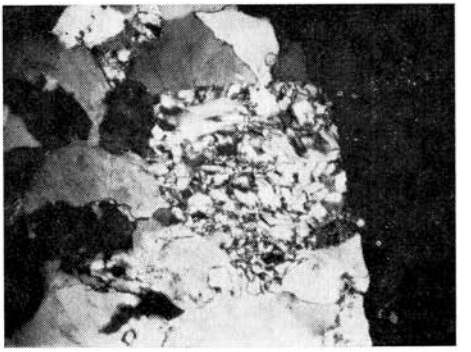

Fig. 8. Chalcedone grain from vein filling. Loc. Lipt. Lúžna, Nízke Tatry Mts., X nicols, magn. 43 ×. Photo C. Michalíková.

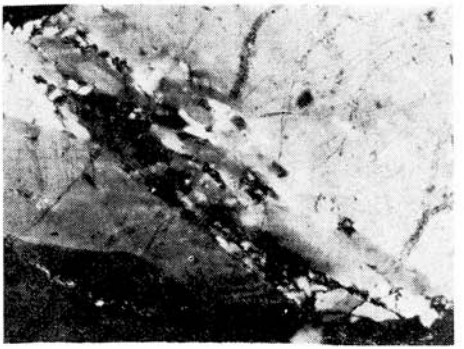

Fig. 9. Monocrystalline undulatory grain with new small quartz crystals along the zones of discontinuity. Loc. Donovaly, Nízke Tatry Mts., s. 7, X nicols, magn. 43 ×. Photo C. Michalíková.

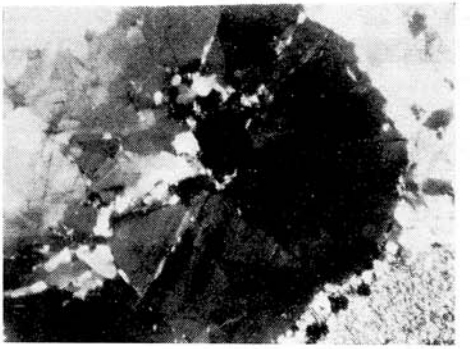

Fig. 10. Monocrystalline undulatory quartz, the zones of discontinuity can be very well seen. Loc. road-cut to Srdiečko, Nízke Tatry Mts., X nicols, magn. 43 ×. Photo C. Michalíková.

rocks. The above mentioned authors found out that the angle of extinction has no genetic importance for finding out their provenance. Undulatory extinction occurs very seldom on polycrystalline grains. Very interesting is the undulatory extinction on the oriented overgrowths on quartz grains, partly on monocrystalline grains (fig. 11), partly on polycrystalline grains (fig. 2). Fig. 12 represents the epimetamorphosed quartzite from the Lower Triassic of the Eubietová zone (Veporic). It illustrates very instructively, how polycrystalline quartz grains from schists can, as a matter of fact, arise.

Discussion

Quartz grain types were examined in 321 thin-sections of the Lower Triassic clastics from the Malé Karpaty Mts., Vysoké Tatry Mts., Malá Fatra Mts., Nízke Tatry Mts., and from the Eubietová zone. Contents of the four most frequent types of quartz

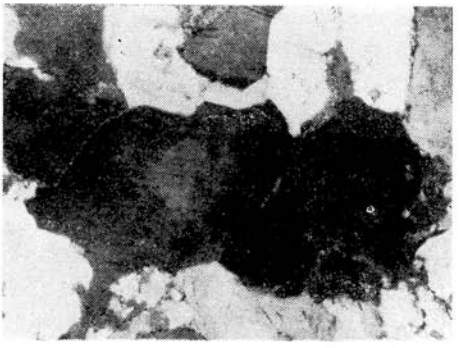

Fig. 11. Monocrystalline undulatory quartz with undulatory oriented overgrowts. Loc. Smrekovec, Malá Fatra Mts., s. 5, X nicols, magn. 43 ×. Photo C. Michalíková.

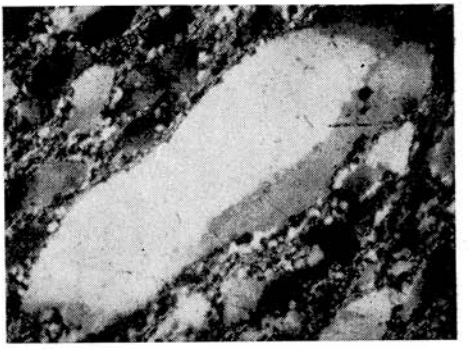

Fig. 12. Quartz grain which uderwent a week metamorphose. All grains are oriented, note new small quartz crystals. Loc. Hronec, Eubietovská zone, X nicols, magn. 43 ×. Photo C. Michalíková.

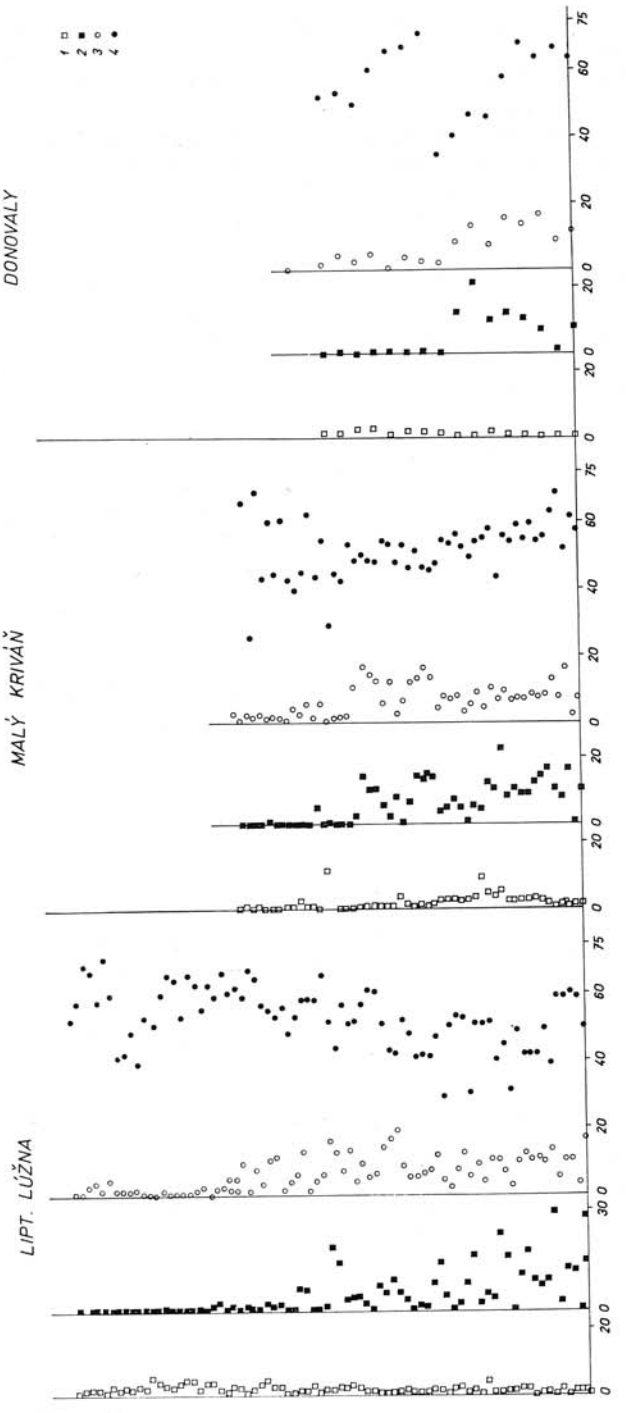

Fig. 13. Comparison of the contents of common quartz grain types from localities Lipt. Lúžna, Donovaly and Malý Kriváň. 1 — quartz from schists, 2 — quartz from massive plutonic rocks, 3 — quartz from gneisses, 4 — monocrystalline quartz.

grains (from plutonic rocks, gneisses, schists and monocrystalline quartz) were compared between and along the three complete sections of the Lower Triassic complex (localities Malý Kriváň, Donovaly and Liptovská Lúžna), how they were computed by modal analyses (fig. 13).

Content of monocrystalline (undulatory and non-undulatory) quartz increases upwards to the overlier to the detriment of other types. Obvious decrease (up to zero contents) can be observed in the content of polycrystalline quartz grains from massive plutonic rocks, less obvious decrease is in the content of grains from gneisses. On the other hand, quartz from schists presents less expressive increase upwards to the overlier.

It can be pointed that the Lower Triassic clastics turned upwards into more fine-grained ones, coarse-grained types are more frequent at the begining of the section, very fine-grained sediments — siltstones and sandy claystones occur commonly at the top of the section. It results from the above mentioned facts that there is a dependance between grain size and quartz types, there is more quartz from plutonic rocks and gneisses in coarse grained clastics, monocrystalline quartz and then quartz from schists strongly predominate in fine-grained clastics. It can be explained due to breaking of the large polycrystalline grains into smaller monocrystalline individuals during the transport, so that also undulatory quartz disintegrates into non-undulatory one, which results in the increase of monocrystalline quartz grains, however, without any possibility to determine their origin.

The problem in determining the quartz grain types is in their sectioning in thin-sections. It can easily happen, that such types as vein quartz, polycrystalline quartz from gneisses and plutonic rocks, can be mistaken mutually. These types can have various appearance, as it has been illustrate comparing them with "mother" rocks, they can appeare as a typical, but there are also various transitional appearances (O. F e j d i o v á 1973).

When the recogniton of quartz grain types is combined with other characteristic features of the complete series of strata (granulometry, mineral composition, type and amount of matrix, colour of the rocks and structural features), then this method can serve as a good paleogeographic and paleoclimatic indicator.

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Review by R. MARSCHALKO.