POLSKIE TOWARZYSTWO MINERALOGICZNE – PRACE SPECJALNE
MINERALOGICAL SOCIETY OF POLAND – SPECIAL PAPERS
Zeszyt 22, 2003; Volume 22, 2003

Katarzyna JARMOŁOWICZ-SZULC [1]

THE SECRETS OF THE MARMAROSH DIAMONDS

INTRODUCTION

In 1905, so approximately one hundred years ago, Julian Tokarski wrote in the bulletin ”Kosmos” of the Lvov publication office: ”...I have begun studies on the structure, features and topics of a special variety of the mountain crystal, known in the scientific references as the Marmarosh diamonds or dragomites, while ”the gragomites” by the mountaineers from the area where the mineral occurs... In general – among all minerals, the quartz in its varieties has been mostly studied in detail and best learned, especially because of its specific geometric and physical features. Therefore, provided that some new characteristics should be eventually discovered, my personal work faced some difficulties at the very beginning. With a progressive research, however, I was lucky to discover some interesting effects in this mineral, not found out till present...” (Tokarski 1905).

This interesting quotation is a perfect introduction into the problematics of the Marmarosh diamonds.

While Tokarski (op. cit.) presented in his paper the results of mostly and microscopic analyses, the present studies of this type of the mineral combine microscopy (polarization, uV, CL), isotopic analyses and gas chromatography (Jarmołowicz-Szulc and Dudok, 2000**).**

LOCALIZATION

The Marmarosh diamonds, i.e. the special type of the quartz, occur in different areas in the Western and Eastern Carpathians (e.g. Matkovskij 1961; Hurai et al. 1989; Dudok et al. 1991). The area of the Marmarosh massif in Roumania represents the stratotypical localization of this mineral variety.

In Poland the Marmarosh diamonds have been described in the Carpathians in: - the Bystra lense (Wieser 1978); - in the Mszana Dolna tectonic window (Karwowski and Dorda 1986); - in the pre-Dukla zone (Kozłowski and Młynarczyk, oral information 1995); in the Magura nappe (Tokarski et al. 1999; Świerczewska et al. 1999); - in the tectonic zones of the Silesian and Dukla nappes in the south-easternmost part of Poland with a continuation in the Ukrainian side (Jarmołowicz-Szulc 2001; Jarmołowicz-Szulc and Dudok 2000).

[1] *Polish Geological Institute, Rakowiecka 4 , 00-975 Warsaw, Poland; kjar@pgi.waw.pl*

PRESENT CHARACTERISTICS OF THE MARMAROSH DIAMONDS

From the introductory words of Tokarski (1905) a significant conclusion may be drawn. If one wants to learn secrects of this very specific mineral variety, it is imperative to study the crystal centre and crystal geometry.

The crystal habit of the Marmarosh diamonds is a combination of a hexagonal prism, a rhomboherdorn and a trigonal pyramid (Karwowski and Dorda 1986).

The bipyramidal quartz crystals display an excellent reflection, which leads to their macroscopical similarity to the real diamonds. That is why a determination „the Marmarosh diamonds" has been introduced to the bibliography.

The presence of fluid inclusions is a very characteristic feature of the Marmarosh diamonds. It was already sygnallized by Tokarski (1905) who pointed to "libellae" inside the quartz. In the polarized light the inclusions in quartz display one, two or more phases, being colourless or slightly brownish (Jarmołowicz-Szulc 2000). Their shapes are mostly oval. The inclusions are either separate in the crystals (primary ones) or arranged in groups (some primary inclusions, some evidently secondary ones connected with fissures). Different types of fluorescence may be noticed in the ultraviolet light. There occur inclusions showing no fluorescence at all and inclusions of bluish to white fluorescence. Some yellow to orange fluorescing individuals are present, too. These features together with freezing-heating determinations point to two general types of inclusion fillings in the Marmarosh diamonds – aqueous and hydrocarbon (Jarmołowicz-Szulc and Dudok 2000). The hydrocarbon filling corresponds to a variety of composition – from pure methane inclusions, through gas condensates, light oil to a heavy oil. The homogenization temperatures obtained due to the freezing and heating runs in Fluid Inc. System (PGI, Warsaw) oscillate between –82 ˚C and + 89 ˚C being indicative for the different hydrocarbon fluid composition in individual inclusions. Phase transitions together with temperature determinations lead to interpretation of fluid composition, trapping conditions etc.(e.g. Vityk et al. 1996 in Ukraine).

Another secret of the Marmarosh diamonds is their isotopic composition. The $\delta^{18}O_{SMOW}$ values for quartz determined using the SIMS methodology of Hervig et al. (1992) show an oscillation of in the studied crystals between 20 and 25‰. Some tendency of a decrease in average oxygen data may be observed from NW to NE (Biesczady region), the data being, however, exemplary.

MINERAL PARAGENESES

The marmarosh diamonds occur in the fissures in the tectonic zones, which are also filled by calcite and the organic matter. The calcite seems to be the earliest one, while the quartz and bitumens are later in the sequence. The quartz occurs in the central part of the veins, being present in the bitumen veins even microscopically non visible, proved, however, in X-ray diffractograms (Dudok 1991).

RECAPITULATION

Due to the studies conducted in the quartz of the Marmarosh diamond type from the tectonic zones in the south-easternmost part of Poland, different fluids of the aqueous and hydrocarbon composition have been proved within the inclusions. These facts point to a migration of mixed fluids through the zones that resulted in formation of mineral fillings, in that of the quartz. The migrating fluids were rich in water, methane, and oil, in some areas also in carbon dioxide.

REFERENCES

DUDOK I. V., 1991: Mineralogical and geochemical features in the vein formation of the flysch deposits in the Ukrainian Carpathians (in respect to oil and gas content). Manuscript, 172 pp., Lvov (in Russian).

DUDOK I. V., KALIUŻNYJ V. A., VOZNIAK D. K., 1997: The particularities of phase composition and the problems of systematics of the hydrocarbon fluid inclusions in „Marmarosh diamonds" of the Ukrainian Carpathians, XIV ECROFI. Nancy, France, 96 - 97.

HERVIG R. L., WILLIAMS P., THOMAS R. M., SCHAUER S. N., STEELE I. M., 1992: Microanalysis of oxygen isotopes in insulators by secondary ion mass spectrometry. Intl. J. Mass. Spec. Ion Proc., 120, 45 – 63.

HURAI V., FRANCU J., BAJOVA L., GAVACOVA H., 1989: Hydrocarbon inclusions in „Marmarosh diamonds" from flysch sediments of Eastern Slovakia. W : Fluids in geological processes, Czechoslovakian Contributions to the Session devoted to Fluid Inclusions, Bratislava, Abstracts, 5 – 6.

JARMOŁOWICZ-SZULC K., 2001: Characteristic features of vein fillings in the southeastern part of the Polish Carpathians (calcite, quartz, bitumens). Przegl. Geol. 49, 785-792 (in Polish with English summary).

JARMOŁOWICZ-SZULC K. & DUDOK I. V., 2000: Fluid inclusion studies in vein minerals of the Capathians, Poland – Ukraine. Abstracts of XIth Congress of Regional Commitee in Mediterranean Neogene Stratigraphy, Fes, Morocco, 132.

KARWOWSKI Ł., DORDA J., 1986: The mineral forming environment of „Marmarosh diamonds". Min. Pol. vol. 17(1), 3 – 12.

MATKOVSKIJ O. I., 1961: On the so called Marmarosh diamonds . Mat. Kom. Mineral. Geochim., 1, 149 - 158.

ŚWIERCZEWSKA A., HURAI V., TOKARSKI A. K. & KOPCIOWSKI R., 1999: Quartz mineralization in the Magura nappe (Poland): a combined microstructural and microthermometry approach. Geologica Carpathica, 50, 174-177.

TOKARSKI J., 1905: On the Marmarosh diamonds, Kosmos 30, Lwów. 443-460.

TOKARSKI A. K. , ZUCHIEWICZ W. & ŚWIERCZEWSKA A. , 1999: The influence of early joints on structural development of thrust-and-fold belts: a case study from the Outer Carpathians (Poland). Geologica Carpathica, 50, 178-180.

VITYK M. O., BODNAR R. J., DUDOK I. V., 1996: Fluid inclusions in Marmarosh Diamonds: evidence for tectonic history of the folded Carpathian Mts, Ukraine, Tectonophysics 255, 163 – 174.

WIESER T, 1978: Metamorphic rocks from the borehole Bystra IG1. Kwart. Geol. 22, 946-947 (in Polish).