THE RIES IMPACT DIAMONDS: DISTRIBUTION, MICROSCOPY, X-RAY AND SOME OTHER DATA.

S. Vishnevsky[1] & N. Palchik[1], [1]Inst. of Geology & Mineral., Novosibirsk, 630090, RUSSIA (svish@uiggm.nsc.ru).

Introduction: First find of Ries impact diamonds, RIDs, was made 35 years ago (Special report 15350-15, 1975, unpublished, [1]), and licenced for press [2] but was out of interest for a long time until the finding was repeated [3] and attracted the attention of western colleagues. Since the moment, a broad international study of RIDs was started, with a peak of the activity in 1995-2003. Various teams [3–11**,** and refs. therein] described a number of RIDs features, including their 2 principally-different genetic types, namely: i) shock-induced apographitic paramorphs, AGPs, (*Greek,* after graphite) [2, 3, 6], and ii) carbon-vapor-deposition, or CVD-diamonds, in terms of [4], derived from the Ries plasma fireball. The data obtained are rather interesting for the shock mineralogy of the carbon system and impact cratering as well. Nevertheless, some questions are still open and need a further study.

Spatial distribution of RIDs: AGPs are found in both fallout and fallback suevites from many points of crater and its surrounding (Altebürg, Aumühle, Hainsfarth, Heerdorf, Hohenaltheim, Otting, Seelbronn, Zipplingen, drill hole Nördlingen-1973 [2, 3, 5–11]), and in glass-bearing bottom breccia dyke Unterwilfringen [9]. The main AGP carriers are the glass bombs and shocked gneiss fragments. The AGP concentrations in the rocks are as 0.06÷0.7 ppm. A lack of the diamonds in Ries massive impact melt rocks [9] looks like unusual: their equivalents, tagamites, are diamond-bearing in Popigai and some other sites. CVD RIDs are found in Otting suevite glass, but are supposed to be of a broad extent both in Ries and other impact sites [4].

Optical & SEM/TEM microscopy of RIDs: AGPs, ranging in size from <50 to 300 μ, are mainly flat ones of 5÷40 μ in width [2, 6]; grains of <5–10 μ in size are also known in shocked graphite [3, 10]. Many of AGPs are pseudo-hexagonal elongated para-crystals resembling morphology of the precursor graphite, including its various twinning features. The platelet intergrowth is the most common among the features [3, 6]. Some grains are kinked or bent; xenomorphic grains are very rare [9]. Both primary (inherited PG features) and secondary (planar deformation elements formed together with the AGPs) hatching [6], of one to several systems per grain, is common for some flattened diamonds. The hatching is well-expressed in luster, color and relief [5, 6]. Many of APG grains show various intensity of surface etching which took place in the hot impact melt by the action of K, Na and OH^- components. The color of APGs varies from white or colorless to yellow, brown, gray and black. Lamellar or hatching fabric can control the distribution of dark masses (graphite or amorphous carbon?) within the AGPs. Light-colored grains are transparent and birefringent [2, 3, 6]. Birefringence, 0.007÷0.020, is correlated with lonsdaleite content (25÷75 %, respectively, data by [6]). CVD-diamonds [4] are the skeletal aggregates of cubic diamond crystallites, of 0.01÷2 μ in size, showing the epitaxial intergrowth with SiC crystallites of up to 1 μ in size.

X-Ray data on AGPs composition: Following to these data, the grains are fine to superfine polycrystalline aggregates made up of cubic+hexagonal diamond phases mixed up in various proportions, from entirely cubic ones to those with up to 75 % of lonsdaleite [6]. The size of the crystallites is varying from 10÷100 nm to ~1 μ [2, 3, 6]; at this, the cubic phase is more "coarse" in respect to hexagonal one [3, 6]. Laue patterns of crystallites show their preferred orientation, but its degree can vary from moderate to well-expressed one, up to that which is equal to the state of "mono-crystal". Dark-colored AGPs and grains with black lamellae inclusions show X-ray detected graphite impurity [6, 8]; sometimes, d-spacing equal to chaoite (lines of 0,43 and 0,403 nm) is also present [6].

Density and carbon isotopy of RIDs: Density dispersion, <3.28÷3.48 g/cm^3, is found for AGPs, correlating with their color (the darker the color the lower the density [3]). Following to [8], $\delta^{13}C$ of RIDs is either –16‰ to –17‰ or –25.2‰ to –26‰, indicating heterogeneous sources of C; at this, the "lighter" Otting AGPs are equal to the basement graphites.

Summary: The data presented above, describe the RIDs main features. Other features and still open problems on the topic are shown in [12] and refs. therein.

References: [1] Vishnevsky S. (2007) *Astroblemes.* Novosibirsk: Nonparel Press. 288 p. (in Russian). [2] Rost R., et al. (1978) *Doklady AN SSSR, 241,* 695-698 (in Russian). [3] Masaitis V., et al. (1995) *Proc. Russ. Min. Soc., 4,* 12-19 (in Russian). [4] Hough R., et al. (1995) *Nature, 378,* 41-44. [5] Vishnevsky S., et al. (1997) *Impact Diamonds: their features, origin & significance.* Novosibirsk: SB RAS Press. 110 p. (in Russian & English). [6] Valter A., et al. (1998) *Mineralogichesky Zhurnal, 20,* 3-12 (in Russian). [7] Abbot J., et al. (1998) *MAPS, 33,* A7. [8] Siebenschock M., et al. (1998) *MAPS, 33,* A145. [9] Schmitt R., et al. (1999) *MAPS, 34,* A102. [10] El-Goresy A., et al. (1999) *MAPS, 34,* A125-A126. [11] El-Goresy A., et al. (2001) *American Mineralogist, 86,* 611-621. [12] Palchik N., Vishnevsky S. (2010) *Nördlingen-2010, Print-only section*. Abstract.