The structure of high lonsdaleite diamond grains from the impactites of the Belilovka (Zapadnaja) astrobleme (Ukraine)

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The Belilovka (Zapadnaja) astrobleme is situated on the Ukrainian shield (49°23´ N; 29°03´E) and appear to be deeply eroded explosive meteorite crater with the present diameter $D_1 \approx 4$ km and the initial one was estimated to be $D_2 \sim 5{,}5$ km. The impactites of this astrobleme have a high content of diamonds: up to 8 ppm in the representative geological sampling [1]. Belilovka impact diamond grains have an average lonsdaleite content some higher than a Popigai ones [2].

The most lonsdaleite-rich variety of impact diamond grains is the black graphite-bearing one with lonsdaleite : cubic diamond ratio estimated by X-Ray data near 1. Such grain was studied in this work. The grain revealed to have a graphite-like morphology with some kink-band - like and etching pit surface features (Fig.1). It have been destroyed under room temperature. Thin particles to be transparent for electron propagation were studied by TEM methods. Among those particles the such ones consisted of blocks with dimensions 0.1-0.3 mcm are frequent. These blocks have a different phase contents and some different structures orientation.

The typical blocked particle is shown on the fig.2. The block «a» with the elements of a regular faces is practically monocrystalline diamond with [112] axis to be normal to the plane of picture. The weak reflections of [111] type also are present.

The block «b» consist of lonsdaleite and graphite. The peculiarity of the SADP of this block is the presence of two so-called triple textures [1010] lonsdaleite|| [0001] graphite which were turned one to another at 30°.

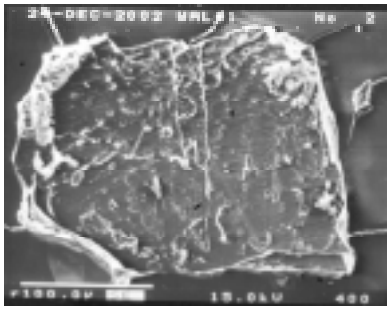
The block «c» is fragmented graphite particle: near 100 reflections a weak tails exist which show the stacking disorder on the basic plane.

Conclusion. SADP of studied block areas are typical for the case of martensite-like graphite - lonsdaleite - diamond transformation [3]. This conclusion is confirmed by the typical orientation of structures and by the kink-band - like surface features also. Such features were typical for shock metamorhosed graphite grains [2].

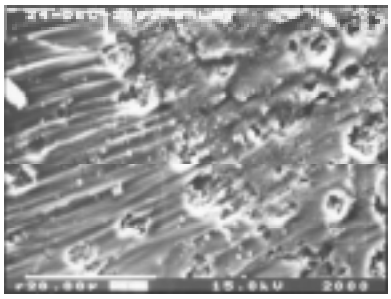
The peculiarities of «b» block SADP one can explain by Veselovskiy twin of initial graphite grain [2].

The initial appearance of blocks of some different orientation of the graphite structure one can connect with shock deformation of graphite in precursor wave and for unloading after its propagation. The kink-band structures are typical for shock metamorphosed graphite [2]. Such «folding» conserves also in the morphology of diamond grains formed upon graphite (Fig.1). The origin of block (Fig.2) be selected by micro fractures with some different orientation of graphite structure were have been formed in unloading stage. So, these blocks had a some different orientation according to the front of main shock wave. In this case the observed blocks can be deformed in some different compression stages: the maximum one for pure diamond block «a», the intermediate one for diamond-lonsdaleite-graphite block «b» and the minimum one for graphite block «c».

References. 1.Valter A.A. et al., LPS Conf.. XXXI., 2000, #1215. 2. Valter A. A. et al. Shock metamorphogenetic carbon minerals.Kiev,1992,171 p. (in Russian). 3. Kourdjumov A.V. et al. Polymorphic modifications of carbon and boron nitride. Reference book. Moscow, 1994, 320 p (in Russian).

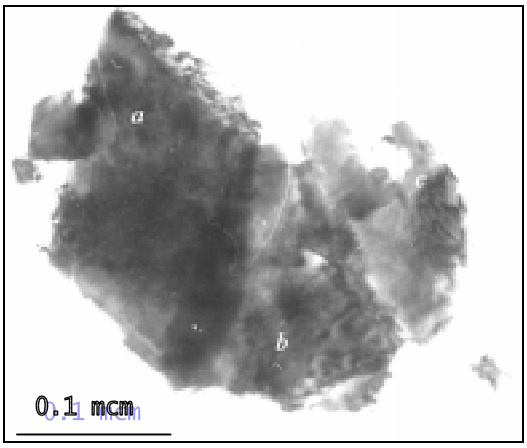


A

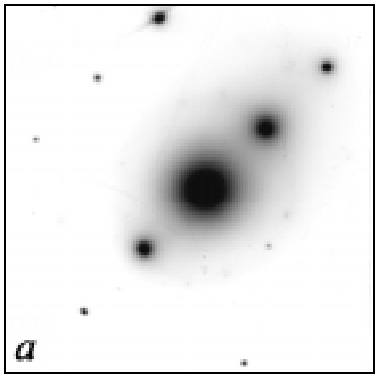


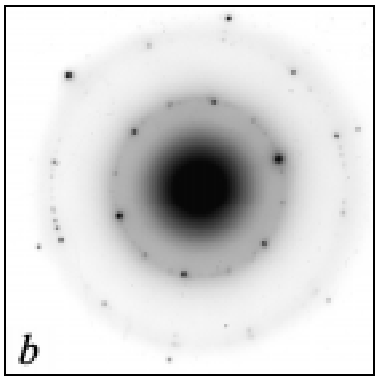
B

Fig.1. The SEM picture of impact diamond grain (A);
detail of its surface (B)



A





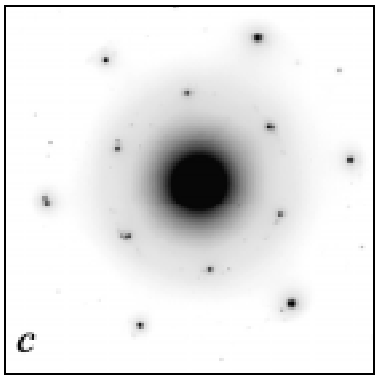


Fig.2. TEM picture of the impact diamond particle (A);
Electron selected area difraction pictures from the blocks (B):
a — $[112]_d$
b — $[10\bar{1}0]_l \parallel [0001]_g$
c — $[0001]_g$