SHOCK METAMORPHISM OF QUARTZ AND ESTIMATION OF MASSES MOTION IN THE BASES OF BOLTYSH AND ILYINETS ASTROBLEMES OF THE UKRANIAN SHIELD A. A. Valter*, Yu. P. Dobryansky**, E. E. Lasarenko*, V. K. Tarasyuk**. *Institute of Geological Sciences, Ukr.SSR Akad. Sci., 252054, Kiev, USSR. **Institute of Engineering Thermophys., Ukr.SSR Akad. Sci., 252057, Kiev, USSR

The Boltysh (90 mln. years) and Ilyinets (400 mln. years) astroblemes (1,2) are the ones which are best of all studied in the Ukranian shield. Their size and main features of geological structure are demonstrated in their sections (Figs. 1,2).

The values of effective impulse pressures were estimated by P. B. Robertson's method (3). The data obtained were compared with the model calculation results which allowed to evaluate the amplitude of the rock uplift at the central parts of the craters and to make assumptions on masses motion in the base. The gradation of quartz alterations accepted by the authors differs from that by P. B. Robertson by mroe details and lower values of effective pulse pressures which reflects the dependence of strains on the pulse action durability (4). The calculation of the shock-explosion process progress at the meteorite fall has yielded the value of the pressure action durability more that 10 GPa 0.I s for the Boltysh crater and 0.02 s for the Ilyinets one.

The following gradations of quartz alteration were assumed: I - less than 5.8 GPa for Boltysh crater and less than 6.7 for Ilyinets crater. Planar elements are absent. The estimation was carried out by thin blocking which is determined by X-ray and optical analysis. II - 6.5 and 7.5 GPa, respectively - basal planar elements. III - 9.5 and 10.5 GPa - planar elements oriented by ω - {1013}. IV - 12 and 13 GPa - planar elements oriented by {1013} and {2241}. V - 15 and 16 GPa - there is π - {1012} present orientation of planar elements. VI - 23 GPa - is encountered only in the Boltysh crater rocks, ω - and π - orientations are present in about equal ratio.

Shock wave propagation in the rocks was calculated on the model of the deepened explosion in the hydrodynamic approximation. The power of the explosion W and the depth of the location H were determined by the ratio

$$W = a\ D^{3.4};$$
$$H = \lambda\ W^{0.29};$$

where D - crater diameter, a and λ - parameters which were selected by the data of investigations (5.6).

For the Boltysh crater $W = 9 \cdot 10^4$ MT. H = 1000 m; for the Ilyinets; $W = 1.2 \cdot 10^3$ MT. H = 300 m.

The value comparison of the observed and calculated pressures in the rocks of the central peak of the Boltysh crater (Fig. I) indicates that center uplift's amplitude is approximately 2.3 - 2.5 km.

For the Ilynets crater (Fig. 2) the estimation of the center uplift's amplitude yields the value 650 - 700 m.

In the base rocks of the circular trough of the Ilynets crater the quartz alteration appeared to be more significant than it follows from the intial position of the isobars. This permits to suggest that the movement of the masses in the base at the Ilynets crater formation occured on the intermediate mechanism between the supposed ones (6) for the simple and complex craters: first radial (centrifugal) flow of the extremely compressed material and then small uplift of the rocks in the center were observed.

The comparison of the obtained values of the central uplift amplitudes and the available (6.7) data too for the layered sedimentary rocks (Fig. 3) permits to come to the conclusion that the central uplift amplitudes and crater diameter lineary grow. So, their values are determined by the meteorite energies. The nature of this dependence is close for the various types of the target.

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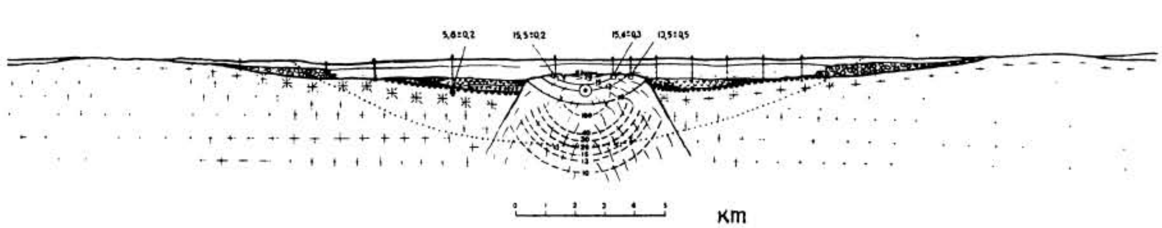

Fig. 1

BASES OF BOLTYSH AND ILYINETS ASTROBLEMES

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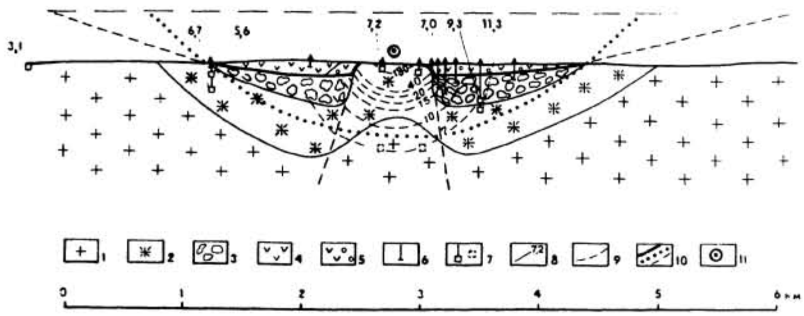

Fig. 2

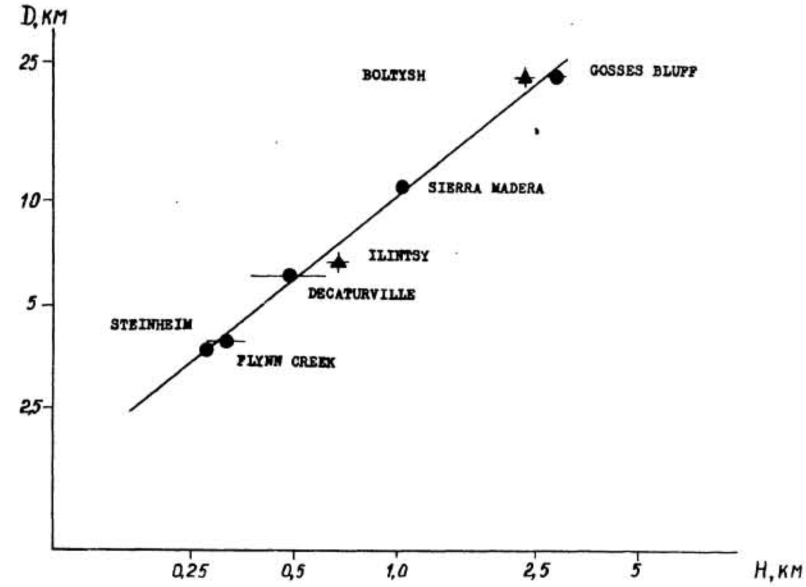

Fig. 3

Figs. 1 and 2 - Schematic geological sections of the Boltysh (Fig. 1) and Ilyinets (Fig. 2) meteorite craters and the reconstruction elements of impulse pressure in the rocks of the base. 1 - granites, 2 - brecciated granites, 3 - gneisses, 4 - granulites, large-blocked breccia (allogenic and authigenic), 5 - glassy impactites, 6 - suevites, 7 - rock flour, 8-9 - sedimentary filling of the Boltysh crater: 8 - aleurolites, shales - Cretaceous system, Paleogene, 9 - sands, clays - Neogene, Anthropogen, 10 - holes, 11 - the position of the samples for which the pressure impulse estimation was done: continuous contour - present position, dotted line - supposed initial one, 12 - impulse pressure estimation (in GPa) by the quartz alteration, 13 - calculated meteorite deepening (reduced explosion depth), 14 - present (continuous line) and initial (dotted line) position of isobars of impulse pressures, 15 - crater contours: present (continuous line), excavation phase (dotted line), calculated by (6), the Ilyinets crater up to erosion (Hachures - dotted line).

Fig. 3. Dependence of central uplift amplitudes (H) on crater diameter (D). ▲ - Data of the present work; ● - Data for the craters in layered sedimentary rocks (6,7).