

FORMATION OF THE BOLTYSH IMPACT STRUCTURE: CATASTROPHE OF REGIONAL SCALE

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The Boltysh impact crater is a circular depression about 24 km in diameter and 920 m depth formed in crystalline rocks of the Ukrainian shield. The central uplift, about 580 m height and 4 km in surface diameter, is surrounded by deep inner basin, 11 km in diameter and to 500 m depth. The inner basin is filled with impact melt rocks, suevites and breccias. Impact melt rocks form a circular sheet to 220 m thick around the central uplift. It is supposed that impact melt formed a circular lake around the central uplift in the deepest part of impact structure. The peripheral part of the crater is a shallow circular depression around the inner basin. A broken layer of allogenic breccia covers the depression floor [1]. The Boltysh structure is filled with post-crater sediments that are predominantly argillites and siltstones. Commercial reserves of oil shales occur in sedimentary crater fill.

Estimates of energy of the Boltysh crater formation were made using relationships in [2]. Energy limits are from $5 \cdot 10^5$ Mt in case of vertical impact to $1.1 \cdot 10^6$ Mt at impact by an angle of about 45° to the surface. Thus energy of the Boltysh crater formation was accepted to be about $1 \cdot 10^6$ Mt. The consequences of impacts with energy in range from $1 \cdot 10^5$ to $1 \cdot 10^6$ Mt are considered as transitional events from regional to global scale and may be compared with consequences of nuclear war [3].

One of the most important consequences of impact is formation of ballistic ejecta layer. Intensively eroded ejecta now are a broken layer of allogenic breccia preserved in the area of about $6,500 \text{ km}^2$. The thickness of breccia ranges from meters to some tens of meters and depends on distance from the crater center and pre-impact relief in this region. Edges of preserved ejecta layer are close to estimated margins of initial ejecta layer from 10 m thick and more. Estimated area of initial ejecta layer from 0.1 m thick to some hundreds meters thick near the crater rim is about 100000 km^2 . The breccia layer is composed of granite and gneiss clasts in fine matrix of the same composition. Rare clasts of intensively weathered impact melt rocks and sedimentary rocks occur in the breccia. Granite blocks up to 8 m in diameter are distributed within the ejecta basal horizon.

Ejecta of the high temperature dust plume into the stratosphere by gigantic impacts have a very severe effect on the environment. The thickness of fireball sediments formed by an impact with an energy of about 10^6 Mt is about 0.03 mm in case of a uniform distribution on whole Earth surface accordingly to relationship in [4]. Now this problematic layer of the Boltysh impact is unknown, although the Boltysh crater, 24 km in diameter, and the Steen River crater, 25 km in diameter, are mentioned as only two known impact structures formed at or near of the Cenomanian-Turonian boundary [4].

Another consequences of the Boltysh crater formation are not yet known, but the estimated area affected by a catastrophic earthquake and blowout of the atmosphere around the crater is about $100,000 \text{ km}^2$. The Boltysh impact structure was formed in continental conditions, thus, no tsunami originated from that impact event. Therefore, the formation of the Boltysh crater was a catastrophic event of a regional scale on the territory of the Ukrainian shield and adjacent areas.

References. [1] Gurov E.P., and Gurova E.P. (1991) Geological structure and rock composition of impact structures. Kiev: Naukova Dumka Press, 160 p. (in Russian). [2] Shoemaker E.M., Wolfe R.F., Shoemaker C.S. (1990) Geol. Soc. Amer. Spec. Paper, 247, 155-170. [3] Toon O.B., Zahnle K., Morrison D., (1997) Rev. Geophys. 35, 41-78. [4] Rampino M.R., and Haggerty B.M. (1996) Geol. Soc. Amer. Spec. Paper, 307, 11-30.