THE GAGARIN RING STRUCTURE, RUSSIA: A POSSIBLE METEORITE CRATER. K.V. Krivosheya[1] G. D. Badyukov[1], D. D. Badjukov[2], and J. Raitala[3]. [1] Faculty of Geology, Moscow State University, Leninskie Gory, 119899, Moscow, Russia, kvk@geophys.geol.msu.ru, [2]V.I.Vernadsky Institute RAS, Kosygin str., 19, 11991, Moscow, Russia, badyukov@geokhi.ru, [3]University of Oulu, FIN 90401, Finland, jouko.raitala@oulu.fi

Introduction. The Gagarin ring structure has been described as a proposed meteorite crater in 1975 [1]. The assumption was based on morphological details of the structure and geophysical data. Here we report new data which support the possible impact origin of the structure.

Description of the structure. The Gagarin ring structure is located 20 km north-west of the town of Gagarin (former Gzhatsk), the Smolensk district**.** It is centered at 55^{O}41'55"N and 33^{O}40'1"E. The structure is well recognizable in satellite images (Fig. 1) due to different vegetation types on boggy and dry areas. The inner part of the structure is partly a cornfield. The structure morphology consists of two concentric annular depressions with approximate diameters of 800 and 1400 m. The central part of the structure is 2 meters higher than the depressions and seems to be slightly convex in shape. There are no natural outcrops within the structure and in its vicinity. The structure occurs within the western margin of the Moscow syncline. Geological setting of the region is characterized by different sedimentary units. Quarternary fluvioglacial, alluvial, and clayish and sandy moraine deposits, 20 – 40 m thick, cover Lower Carboniferous limestone and terrigenic sediments, which are underlain by 800 m thick Middle and Upper Devonian limestone, dolomite, and sand [2]. The structure is located close to the linear fault zone in basement rocks.

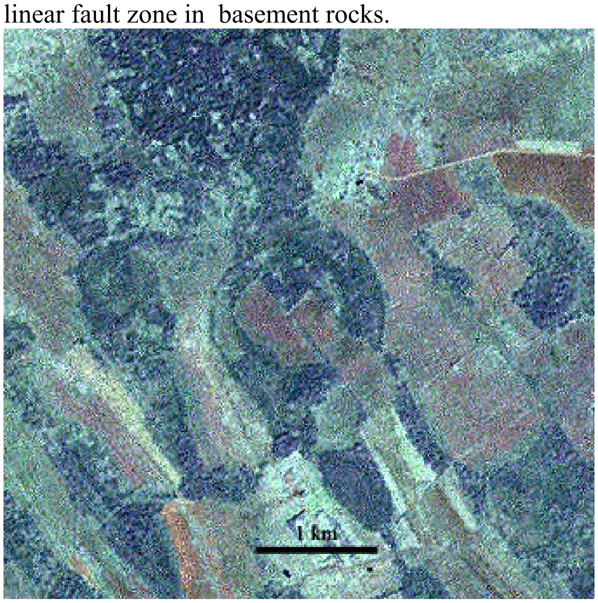

Fig. 1. Landsat7 ETM+ image of the Gagarin structure [5]. The image has resolution of 14,25 m and was synthesized using bands 1, 2, and 3 (images p180r021, acquisition date: 2001-07-21). The woodland has dark greenish-blue colors while agriculture fields are light.

The structure is well displayed in geophysical data [1]. A gravity anomaly corresponds the structure and has the local low at the center and local highs at the margin. The intensity of the central low is 0.3 mgal. The regional magnetic field has a strong gradient that is weakened within the structure. The local magnetic highs and lows**,** visible after subtracting the regional background, are situated at the annular depressions. The local magnetic anomalies coincide with the local gravity anomalies.

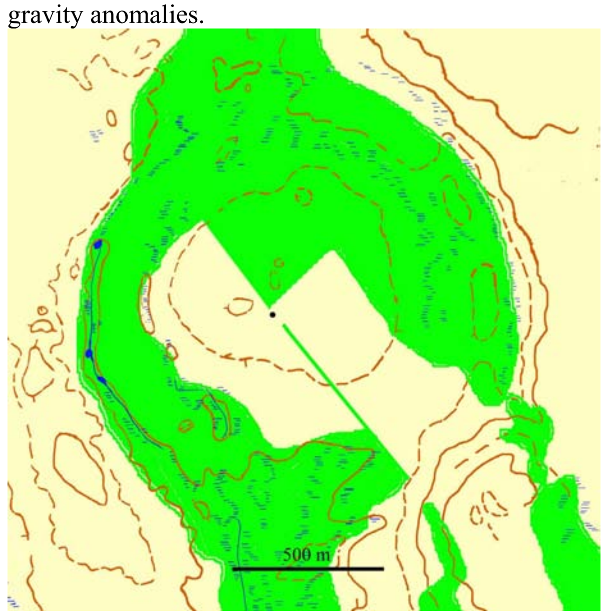

Fig.2. Schematic map of the structure. The contour interval of solid lines is 5 m. Woody areas are green, fields are yellow. Elevations at the south-east and south-west margins of the structure can be interpreted as remnants of the rim. The black dot denotes a location of the drill hole.

Observations. Our short field work in the structure in 2004 revealed a very strong magnetic anomaly right at the geometrical center of the structure. We concluded that the anomaly has an artificial origin and that the reason for it is a casing pipe of an old drill hole. The digging at the center of the anomaly resulted in a discovery of a cylindrical man-made boulder consisting of cemented fragments of gray siliceous Lower Carboniferous limestone. It was evident that the boulder was a cap under the wellhead and that the limestone fragments were the drill core material. The limestone fragments have a well developed "gries" structure formed by a net of closed irregular cracks shattering the rock into 0.1-1 cm blocks. The structure is typical for sedimentary rocks shocked at low pressure in impact events but it is not a critical diagnostic feature of shock metamorphism. Because the limestone contains rare grains of detrital quartz, a piece of it was dissolved in hydrochloric acid and the residual > 0.2 mm fraction of quartz, feldspar and other minerals was examined using an optical microscope in order to search PDFs in the quartz grains. Some quartz grains contain sets of tectonically deformed lamellae. However, few quartz grains (<0.05 %) contain sets of optical discontinuities (Fig. 3) which morphologically are very close to PDFs [3,4]. Measured crystallographic orientations of these planar features correspond to $\{10\bar{1}3\}$ and $\{10\bar{1}1\}$ forms.

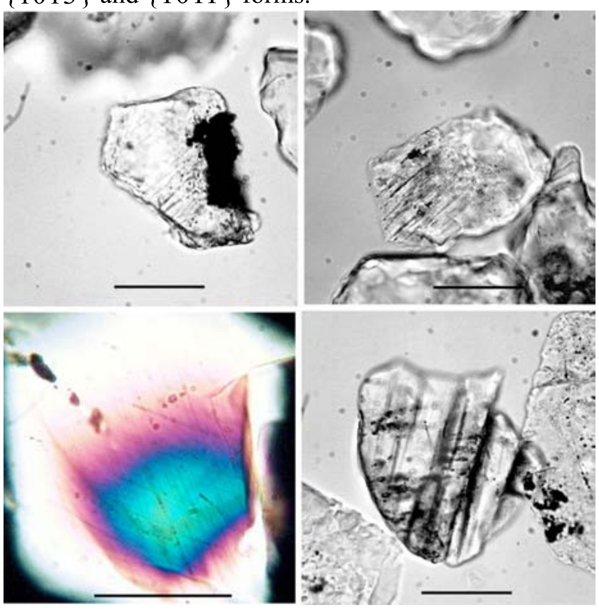

Fig. 3. Planar features in quartz grains derived from Lower Carboniferous limestone. Scale bars are 50 µm

One grain contains a PDF set with the (0001) orientation. Usually, quartz grains display only one set of the features, and only a few grains have two sets. However, the planar features in the quartz grain differ from typical PDF structures in quartz by having larger distances between the planes (2-4 µm) and by being smaller in number in each set. We assume that this can be due to their formation by low shock pressures (lower than 10-8 GPa) but this assumption needs further studies. At this time we can not claim that the found planar features represent real impact-generated planar deformation features.

Conclusions. Morphological, geophysical and mineralogical data strongly support the idea of impact origin of the 1.4 km Gagarin ring structure. However, further evidences are necessarily in order to proof this in an unambiguous way. It seems that a new drilling of the structure and a study of the drill cores is the only way to resolve the problem.

Acknowledgments. This study was supported by Academy of Finland (DDB). The sattelite image was produced using data from Global Land Cover Facility, University of Maryland, College Park, USA.

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