FURTHER EVIDENCE SUPPORTING IMPACT ORIGIN OF PORZADZIE STRUCTURE IN POLAND.

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Introduction: Porzadzie (52°41'32"N 21°28'09"E) is one of 4 structures discovered in 2014 (based on LiDAR data) [1], which has specific features suggesting possible impact origin. Most of observations were discussed in detail in previous papers, e.g. [2]. In morphometry of Porzadzie there can be recognized traces of shock waves similar to those present during hypersonic flow and observed e.g. as an airburst shape of extraordinary bright meteors [3]. There is also preserved feature analogous to downrange plume of vapor and dust recorded during "The Deep Impact oblique impact cratering experiment" [4] (shown on Fig. 2. and marked on Fig. 1). But according to current criteria, on Earth it may be considered still as not enough to confirm the crater [5]. For smaller structures there is usually problem to prove that they were formed by hypervelocity impact (e.g. Morasko, Kaali, Ilumetsa where presence of shatter cones, multiple planar deformation features, high pressure mineral polymorphs within in situ lithologies was up to now not confirmed).

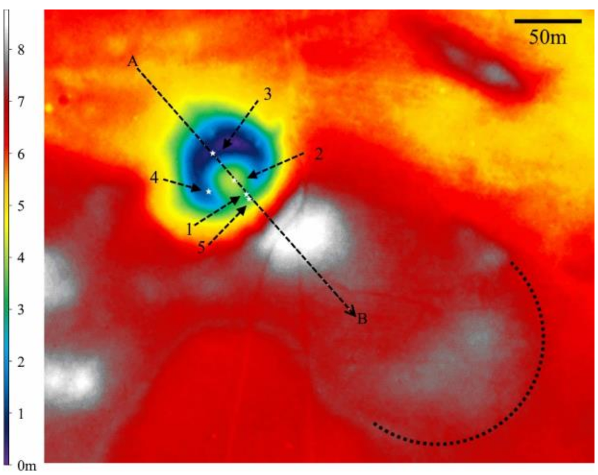

Fig. 1. Location of outcrops in the crater

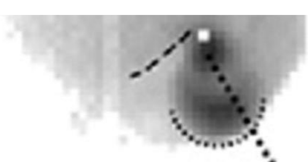

Fig. 2. Downrange plume of vapor and dust recorded during oblique impact experiment (Schultz et al. 2007)

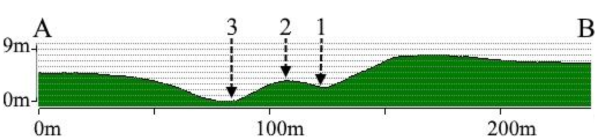

Fig. 3. Cross section according to line from Fig. 1

The subject of our present study was to search for additional traces, supporting previous observations.

Methods: There were prepared 5 outcrops inside cavity of Porzadzie structure. First 3 locations were chosen based on estimated trajectory (marked with white stars on Fig. 1 and cross section on Fig. 3). Pits no 4 and 5 were done to verify previous observations from outcrops 3 and 1. Researches were performed during 3 journeys between 12.08.2018 and 16.09.2018. Size of outcrops was determined individually, related to local conditions and it was limited in total by permission up to 2 square meters (because of forest protected area) so their maximum dimensions were 40cm x 80cm wide and up to 160cm deep. Samples of soil from various depth levels were collected to clean plastic bags.

Results and discussion: At the bottom of first outcrop (100–120cm) there were present fragments of some kind concretions or sedimentary breccias, having various shape and size, containing small mussels (surprisingly they were not met even in near pit no. 5). Currently samples are studied at the University. In pit no. 2 (inner uplift) there was observed continuous layer of highly cemented soil (90–130cm) divided by parallel fractures at 92, 94, 96 and 100cm. Below 130cm there was loose sand. Outcrop no 3 at depth of about 50–60cm was rich in charcoal pieces (Fig. 4). Similar observation was done in pit no. 4. In pit no. 5, at the same depth there were also noticed single fragments, so probably in first 2 outcrops they were present but overlooked. Charcoal fragments may be considered as additional factor confirming impact as they were discovered also e.g. in proximal ejecta around Kaali and Ilumetsa craters in Estonia (and were used to estimate their age [6][7]). Please note that during oblique impact (assumed case for Porzadzie) significant part of ejecta returns to cavity (is offset downrange), forbidden zone forms uprange.

Fig. 4. Outcrop no 3 – soil abundant in charcoal pieces

In all pits there were observed distorted soil layers including presence of individual (different soil) clasts.

The most interesting sample was acquired from the bottom (120cm) of pit no. 5. There was collected stone (Fig. 5) recognized as granite containing quartz and feldspar grains. Few of those grains have visible (using magnifying glass) exceptionally parallel "lines" (Fig. 6). Light microscope analysis revealed that observed lamellae are very narrow (~1µm), closely spaced (usually 2–5µm), straight, oriented parallel to the base c (0001) crystallographic plane (Fig. 7, Fig. 8) in the host quartz grain. They seem to be fresh and independent of some other (probably older) fractures or deformations. In literature, e.g. [8], such microstructures are described as Planar Deformation Features (PDFs) and are clearly distinct from non-shock effects like e.g. tectonic deformation lamellae (Böhm lamellae) or cleavages. Similar narrow "lines" exist in feldspar grains (Fig. 9). Recognition of only basal (0001) PDFs is typical for smaller craters (for pressure between 7,5–10GPa[8]) and was detected for e.g. Barringer Crater but may be observed even for very large structures like Vredefort.

Fig. 5. Granite stone with marked large quartz grain

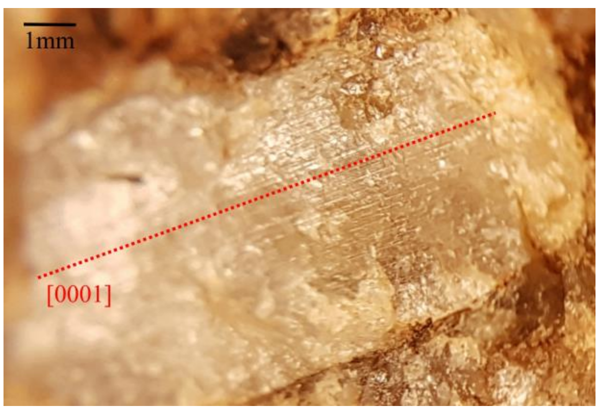

Fig. 6. Visible parallel lamellae along large quartz grain

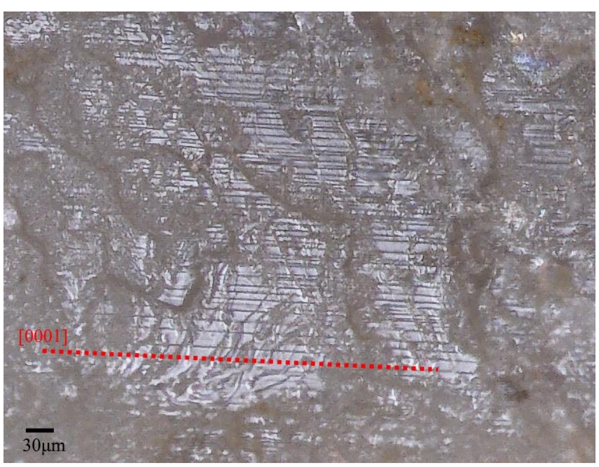

Fig. 7. Parallel lamellae under light microscope

Fig. 8. Part of previous large quartz grain with narrow line spacing (1–2µm), visible under light microscope

Fig. 9. Lamellae in feldspar in another part of the stone

References: [1] Walesiak, T. M. (2015) LPSC 46 Abstract #2233 [2] Walesiak, T. M. (2016) Acta Soc. Metheoriticae Polonorum, 7, 151–176 [3] Walesiak, T. M. (2017) LPSC 48 Abstract #1713 [4] Schultz, P. H. et al. (2007) Icarus 190, 295–333 [5] Earth Impact Database, PASSC, Univ. of New Brunswick, Canada [6] Losiak, A. et al. (2016) MAPS 51, No 4, 681–695 [7] Losiak, A. et al. (2017) LPSC 48 Abstract #1879 [8] French, B. M. (1998) Traces of Catastrophe, LPI contribution #954, Houston