EJECTA BLANKET FROM THE MORASKO METEORITE IMPACT – FIRST RESULTS.

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Introduction: The shower of iron meteorite "Morasko" was the largest event of this kind documented in Central Europe. The evidence of this fall include many pieces of meteorites and at least 7 small impact craters located in the present "Morasko Meteorite" protected area in northern Poznań (Poland). The impact took place in unconsolidated sediments and the preserved craters field is one of the few of this kind world wide [1], [2].

The Morasko meteorite impact is relatively young and its age has been assessed to be about 5000 BP. It was determined on the basis of palynological analysis and radiocarbon dating by AMS ^{14}C of sediments taken from the craters, as well as thermoluminescence dating of the meteorite crust [3].

Despite many analyses carried out for the Morasko meteorite and extensive field studies of the proximal part of impact craters, there are still discussed two hypotheses of the genesis of depressions. The first one, introduced by Pokrzywnicki, who supports the impact genesis [4] and the second, proposed by Karczewski, who is in favor of glacial origin [1].

During the previous works the ejecta deposits from the impact have not been confirmed. Thus the main objectives of the present work were:

1) to identify ejecta blanket sediments from the Morasko meteorite impact,

2) to provide new assessment of the age of the impact based on pre-impact paleosoils ^{14}C dating.

Study area: Study has been concentrated on the proximal part of the crater A, whose position is presented in Figure 1. This is the largest impact crater with the diameter of around 90 meters and the depth of about 11.5 meters. The crater is formed in a pushed moraine which was formed during the Vistulian glaciation. The moraine includes glacitectonically deformed Neogene clays, glacial tills and glaciofluvial sands and gravels.

Materials and methods: 52 sediment cores were taken along 6 profiles, approximately up to 100 meters from the rim of the largest crater (fig. 1), with lengths ranging from 1.9 to 9.5 meters. The longest cores were collected on the peak areas of the rim. The total length of cores amounted to 158 meters. During the study, two trenches located close to the crater have been also excavated to the maximum depth of 2 meters. All cores and trenches have been subjected to the detailed description and served as the basis for the correlation and development of geological cross-sections. During the laboratory work samples from drilled paleosoils have been dated with AMS ^{14}C.

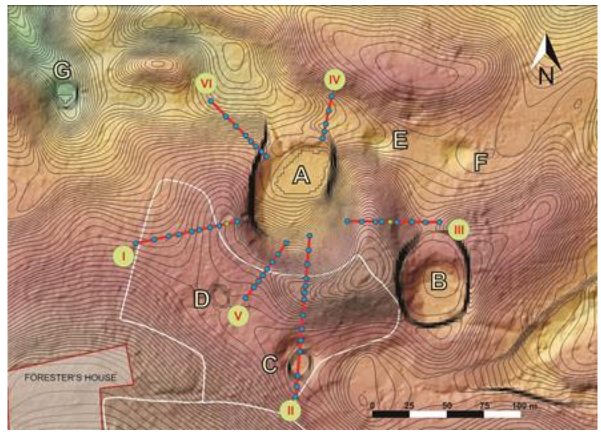

Fig.1 Location of craters in the "Morasko Meteorite" nature reserve (A-G) and the distribution of research profiles (I-VI), together with coring sites ( ).

Results: The performed analysis of macroscopic descriptions of cores conclude that geological context of impact side is highly complex. During the research has been separated four groups of sediments, locally with preserved palaeosoil horizons (fig.2).

Dominating sediment types and stratigraphy:

1) Neogene clays, which formed base of crater A and in some cases are found also in the near surface in a reversed stratigraphical position,
2) Quaternary sandy-gravel deposits, which are characterized by large variations in grain size and a variable admixture of silt and clay fractions,
3) Quaternary diamictons containing angular clay clasts of Neogene age,
4) Quaternary diamictons, which are characterized by variability in the composition of finer grain size fractions.

Quaternary glacial sediments generally occur on the Neogene sediments but in some cases reversed stratigraphy is observed. The presence of diamictons is highly variable and discontinuous. The same relationship is observed in sandy-gravel sediments. In many cases, the boundary between Neogene clays and glacigenic Quaternary deposits is sharp and erosive.

Paleosoil and their age: Paleosoil horizons were found in a few cores. They have a small thickness and mostly occur in very fine and fine sands, which are the most likely of the greatest preservation potential. The AMS ^{14}C ages of two paleosoil samples were in ranges of 4875-5280 and 5300-5460 calibrated years BP (2sigma ranges) and provide maximum age of the impact.

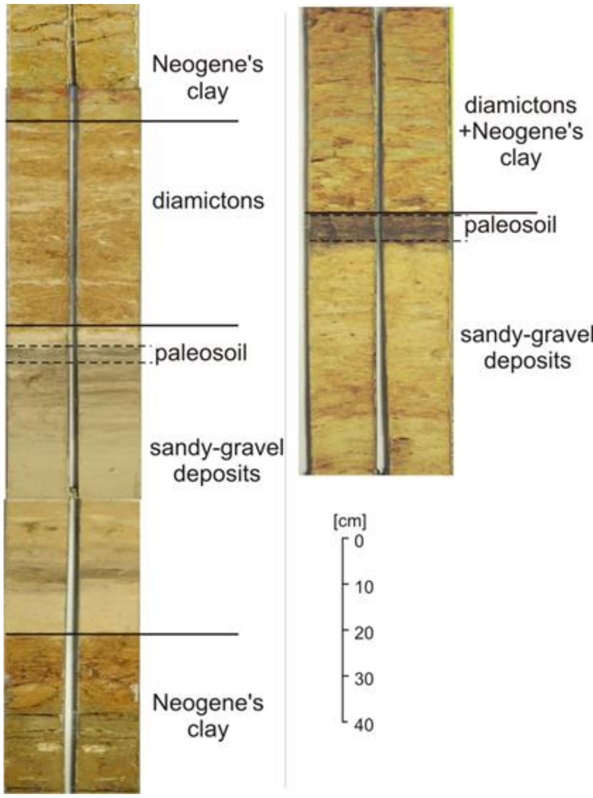

Fig.2 Examples of proximal ejecta layer (above paleosoil).

Discussion: *Dominating sediment types and stratigraphy:* What is known about the ejecta blanket:

1) The occurrence of palaeosoil horizons showed that ejecta blanket was formed from complex mixture of all the locally present sediment groups.
2) In many cases, diamictons with clay clasts of Neogene age were observed close to the ground surface. This layer seem to be characteristic for the ejecta blanket.
3) On the southern part of the crater was observed a sequences where Neogene clays covered glacial diamictons and glaciofluvial sediments with developed paleosoil within. Below, the same types of sediments were observed in reversed order (i.e. sands and gravels, above diamictons and clays of Neogene age). This indicates the presence of the reversd stratigraphy, which could be formed as a result of impact.

Paleosoil and their age: The earlier results [3] on the oldest organic sediments infilling the craters are in range of 4970-5300 calibrated years BP. Thus, the new dating results of paleosoils overlap with them and suggest that the impact took place the most likely between c. 5000 - 5300 years BP, and the organic sediment accumulation within the crater started shortly after the impact.

Conclusion: The recognition of ejecta blanket is not a simple task because the local geological structure is very complicated. The evidence for the interpretation of ejecta are paleosoil horizons preserved in sandy sediments, the presence of reversed stratigraphy and probable diamictons with clay clasts of Neogene age. The recognition of these sediments and finding other indicators will be possible only at a distance of several metres from the crater rim.

Work plans: In the next step these several questions are substantial:

1) Could the difference of compaction be an indicator of ejecta blanket?
2) Could the anisotropy of magnetic susceptibility (AMS) be an indicator of impact?
3) Will it be possible to find any indicators using the grain size analysis, calcium carbonate content, carbon, nitrogen and sulfur content (CNS) and total organic carbon content (TOC)?
4) What is the probability of finding planar deformation features (PDFs) or planar fractures (PFs)?

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References: [1] Hurnik H. et al. (1976) Polish Scientific Publishers AMU. [2] Muszyński A. et al. (2012) Bogucki Polish Scientific Publishers. [3] Stankowski W. (2008) Polish Scientific Publishers AMU. [4] Pokrzywnicki J. (1964) Studia Geologica Polonica, 15: 1-176.