

## INITIAL RESULTS OF GEOMAGNETIC SURVEY IN MORASKO METEORITE CRATER FIELD.

Tomasz Walesiak<sup>1</sup>, <sup>1</sup>65/4, Skarbka z Gor Street, Warsaw, 03-287, Poland (tomasz.walesiak@wp.pl).

**Introduction:** According to historical reports in 14 February 1271 there was observed large scale devastation in western Poland. As it is compliant with archeological researches, as well as with chosen results of <sup>14</sup>C radiocarbon dating, it leads to conclusion that Meteorite Morasko crater field was formed during that event [1]. Locations and well-defined shape of identified structures, recognized thanks to precise topographical data (LiDAR), allow to compare their features with other known impact craters, results of laboratory experiments and computer modeling. It suggests that trajectory was very shallow, with angle between 10 and 20°. Projectile was coming approximately from NW [2].

Smaller cavities in Meteorite Morasko Restricted Area have comparable dimensions to Campo del Cielo craters (20 – 30 m), where giant iron meteorites were located and excavated [3][4]. Structures in Argentina were formed during oblique impact and in similar target soil so maybe further analogy exists. Single shrapnels discovered in proximal area of Morasko craters do not remind explosion effects known from e.g. neighborhood of Whitecourt crater in Canada [5] where over 4000 fragments of this type were collected. The question is, if impact into deeply frozen soil (typical in Poland in February) shouldn't be compared with impact into competent rocks as basalts or granites [6]. Then only single, small projectile fragments (except regmaglypted individuals separated during atmospheric flight) would survive event, like during formation of Kaalijarv craters in Estonia.

The purpose of current researches is to determine, if there are magnetic field anomalies, which in fact may be result from presence of large buried masses, groups of smaller fragments or higher iron oxides content.

**Methods:** First, there was required special permission to perform planned activities inside Morasko Meteorite Restricted Area. As soon as it was obtained, there was chosen one of smaller cavities in the crater field (Fig. 1, marked with letter "F"). It has diameters approximately 20 x 16 m and actual depth of about 3 m. What is important this cavity is always free of water, what makes easier to make measurements. Readings were taken using Deep Geotech proton precision magnetometer in grid of points every 60 cm. Because old forest causes difficulties in reading GPS coordinates, there were set additional lines to control proper position. Distance between lines was 1.8 m (horizontally) and was crossed on 0, 9, 18 and finally on 24<sup>th</sup> meter inclosing rectangular area 24 x 21.6 m. Finally, data

were collected from 1200 readings, taken always from the West to the East, to avoid discrepancies having source in opposite sensor arrangement.

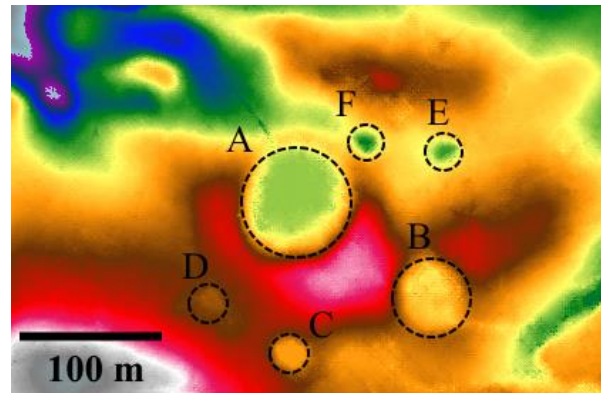


Fig. 1. Map of Morasko craters



Fig. 2. Chosen "F" cavity after placing positioning lines

**Results and discussion:** The model of expected magnetic anomaly is presented on Fig. 3. If we look at data collected e.g. in Campo del Cielo crater field, we must realize, that real picture is usually distorted.

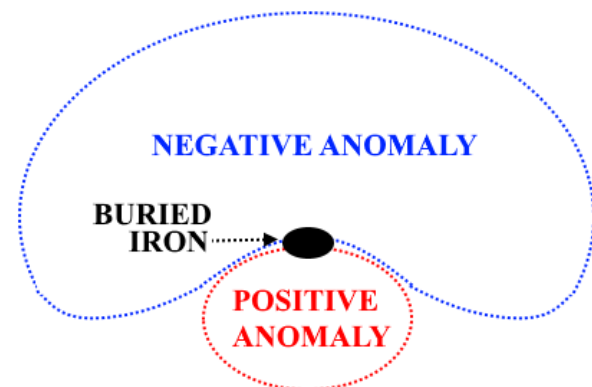


Fig. 3. Expected result valid for northern hemisphere

On Fig. 4 there is presented magnified view of crater "F". Below (Fig. 5), there is shown map of measured magnetic field with marked shape of cavity.

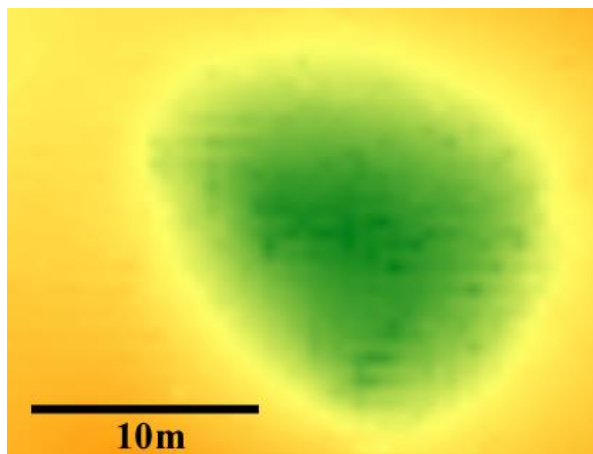


Fig. 4. Morasko crater "F" – magnified view

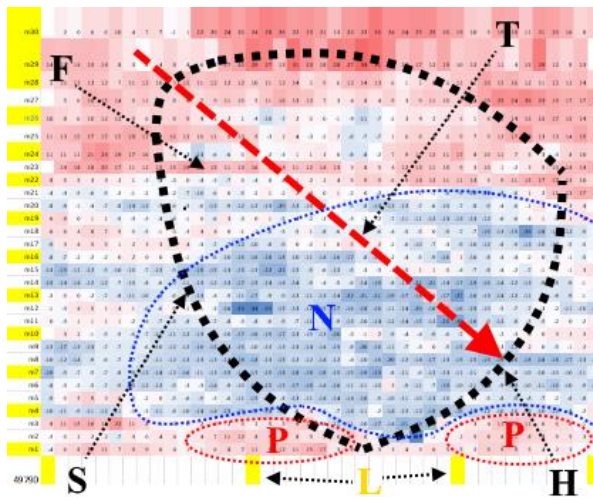


Fig. 5. Measured total magnetic field

S – shape of cavity, L – positioning lines, H – traces of frontal bow shock wave (specific for hypersonic flow model), T – trajectory estimated based on cavity features: elongation from NW to SE, symmetry in this axis as well as components of hypersonic flow model (bow shock in SE and neck in NW), P – positive anomalies, N – large negative anomaly, F – probably faulty line of readings (possibly either the sensor was hold in opposite direction or because of some temporary variation in Earth's magnetic field).

Excluding local anomalies (one was caused by some man-made piece of iron laying right on the surface) there shows up large negative one, filling almost whole southern part of cavity. Attempt to recognize its source, taken within VLF metal detector was unsuccessful.

Past researches in Argentina, for crater no 6 (where there was used similar equipment) gave chaotic anomaly covering area of 10 x 15 m, having amplitudes +20 / +25 in northern part and -30 / -35 in southern. It was caused by mass of 5688 kg buried on the depth of about 5 m. Anomaly in Morasko covers even larger area but has approximately 30 % lower amplitude.

At this moment it is too early to define proper conclusions. Geomagnetic survey was started in December 2017 and it is expected to be completed in May 2018. After preparation of the first magnetic field map it turned out, that additional readings to the East and to the South would be very useful. Detected negative anomaly looks incomplete on its right side. Central point of main anomaly seems to be in SE part of the crater (bit outside), approximately at elongation of dashed line reflecting estimated trajectory. If we consider all collected data (readings, crater shape and dimensions, information of 261 kg regmaglypted individual discovered in 2012 near crater "A" at the depth of 218 cm) and knowing results of researches from Campo del Cielo impact area, it seems possible, that anomaly visible on our map is caused by large iron meteorite with estimated mass between 1 to 5 metric tons, buried at depth 5 – 8 m below the level of pre-impact surface. Instead, swarm of smaller fragments cannot be excluded, what may exist also in southern part of cavity.

In case of oblique impact events (even larger), shape of the final crater may preserve components of hypersonic flow model (known e.g. from observation of great fireballs [7]). If we can identify such features, then we will be able to evaluate easily impact direction. It is valid not only for described in this paper crater "F" in Morasko Meteorite Restricted Area. Similar front bow shock and neck (in uprange) can be recognized e.g. in Campo del Cielo craters (10 and 13). The most important thing is that in Argentina, there were discovered giant meteorites, exactly on the extension of trajectory drawn from hypersonic neck to hypersonic front bow shock (so the same as Morasko), what gives very strong argument allowing to prove the hypothesis.

**References:** [1] Walesiak, T. M. (2017) Acta Societatis Meteoriticae Polonorum, 8, 123-148 [2] Walesiak, T. M. (2017) Acta Soc. Met. Polon., 8, 149-168 [3] Cassidy, W. A., Lenard, M. L. (1996) Meteoritics & Planet. Sci., 31, 433-448 [4] Vesconi M. A. et al. (2011), Meteoritics & Planet. Sci., 46, 7, 935-949 [5] Newman J. D., Herd C. D. K. (2013) LPSC 44, Abstract #2316 [6] Croft S.K. (1981) LPI [7] Walesiak, T.M. (2017) LPSC 48 Abstract #1713