MORPHOLOGY OF MORASKO CRATER FIELD: AN INTERACTION OF GLACIAL AND IMPACT LANDFORMS.

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Introduction: Origin of the Morasko crater field is the subject of multidisciplinary discussion from 1950s. While mineralogical, geochemical, geological and radiometric studies have provided many data to support impact nature of crater field, then from the geomorphological perspective it is not clear in which degree impact craters transformed primary glacial landforms. It is problematic because of some similarity between rimmed and circular impact craters and knob-and-kettle topography resulting from melting of dead-ice in glaciated areas. Moreover, regarding the small sizes of impact craters, their potential superimposition on primary glacial landforms may be complex. This study reveals an interaction of glacial and impact landforms in the area of the Morasko Hill push moraine based on digital terrain modelling. The primary topography results from glaciotectonic deformations produced during Vistulian and probably Saalian glaciations. Moreover, ice-marginal landforms including many depressions of evorsive origin and kettles produced by dead-ice melting had developed during the last deglaciation. First transformation of glacial landforms due to incision of small intermittent stream valleys was during the postglacial and Holocene periods. Impact craters were formed before 5000 BP as is indicated by radiometric dating of oldest organic strata filling the craters [1].

Digital terrain modelling: Digital elevation model (DEM) was created on the basis of c.a. 11,500 accurate elevation points surveyed with a Leica TS02 total station supported by GPS-RTK measurements. The well dispersed elevation points allowed gridding elevation data with optimal spatial resolution of 0.5 x 0.5 m according to the point pattern analysis method [2]. Gridding was performed using the Topo to Raster interpolation method under the assumption of estimation error of 0.15 m which was computed on the basis of geostatistical analysis of nugget variance. Resulted DEM was denoised using effective feature-preserving algorithm to avoid over-smoothing data and softening sharp topographic features [3].

DEM-based geomorphometric analysis was performed to visual expert-based boundary delimitation of circular features related to impact craters. DEM was processed to derive maps of slope, aspect, profile curvature, convergence index and vector ruggedness. Slope and aspect gradients as well as smoothed and artifact-free patterns of ridgelines and terrain roughness were used to define external borders of circular features and then to calculate Feret diameters (min-max), elipticity, slopes (min-max), depths of craters (min-max) and volumes of ejected materials. To calculate the latter parameter we reconstructed pre-impact topography using the Topo to Raster interpolation method for input data masked out to exclude elevation points surveyed within craters. The resulted model was mosaicked with the original DEM using the fuzzy logic to obtain the final model of pre-impact topography

Superimposition of circular structures upon glacial topographic features: Obtained results show that impact craters are perfectly circular where ratio between maximum and minimum crater diameters ranges from 1.03 to 1.102. The volume of ejected materials assuming that it equals to the apparent crater volume ranges from 483 m^3 to 35213 m^3. The craters are only partially bordered by rims which display different heights above the crater bottom. The morphological cross-sections perpendicular to rims usually do not show breaks in slope between outer rim surfaces and surfaces of neighbor landforms. Therefore we conclude not impact origin for some of the analysed rims. The impact craters are superimposed on different primary landforms including slopes of small moraine hills, dead-ice kettle and small intermittent stream valleys.

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