

**THE SO-CALLED "SÖLLE" LATE PLEISTOCENE CIRCULAR FORMATIONS IN THE BRANDENBURG AND MECKLENBURG-VORPOMMERN FEDERAL STATES (NORTHERN GERMANY): EVIDENCE OF METEORITE IMPACT CRATER STREWN FIELDS.** J. Poßekel and K. Ernstson <sup>1</sup>Geophysik Poßekel Mülheim, Germany (jens.possekkel@cityweb.de) <sup>2</sup>University of Würzburg, 97074 Würzburg, Germany (kernstson@ernstson.de).

**Introduction:** The terrain depressions of mostly circular to oval shape, which occur in tens of thousands especially in the federal state of Mecklenburg-Vorpommern and in adjacent areas of western Poland, represent a peculiar landscape element (Fig.1), which is generally associated with the end of the last glaciation and is predominantly interpreted as dead ice formation.



Fig.1. Typical *Sölle* on the Rügen island. The diameter of the circular forms is on the order of 50 m. Google Earth.

The very different terms, definitions (*Soll*, true *Soll*, pseudo *Soll*; plural *Sölle*), historical considerations and formation models are discussed in what is currently probably the most informative and critical paper [1]. Here, we report on the attempt of a completely new approach to the problem of the *Sölle*, made possible by the access to and use of the extremely high-resolution Digital Terrain Model (DTM) and its enormous possibilities of data processing.

**The Digital Terrain Model (DTM):** The DTM is available and has been used in this study in highest resolution with a 1 m grid and a vertical resolution of 0.1 - 0.2 m (DGM 1 in Germany), which via interpolation may even be reduced.



Fig. 2. Location map for selected pan concentrations. R = Rügen island, J = Jarmen, S = Schwaneberg, H = Hohengüstow, P = Premnitz.

**The investigations:** The new approach to the *Sölle* phenomenon with the DTM is due to a coincidence, when during a geophysical campaign west of Berlin in the DTM a concentration of several clusters of small circular structures appeared, which immediately reminded of the clusters and concentrations of the

"*Sölle*" much further north (Figs. 3, 4). To our knowledge, this occurrence is not known and probably represents the southernmost occurrence of this species at the extreme southern margin of the maximum ice advance (Brandenburg phase) of the last (Weichsel) glaciation.

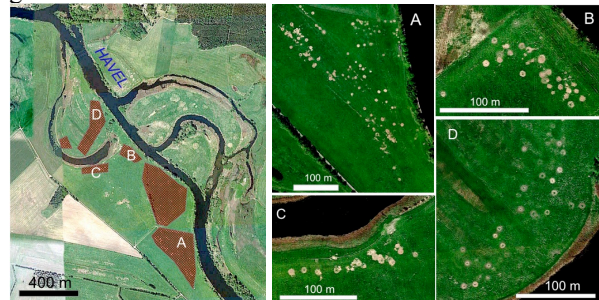


Fig. 3 A. Clusters of pans at the Havel river near Premnitz.

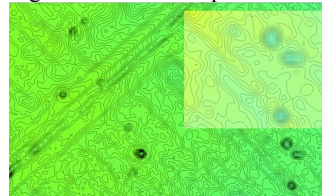


Fig. 3 B. Typical DTM section of a larger pan cluster (Fig. 3A, to the right, image A).

The area close to the city of Premnitz on the Havel River (Fig. 2) is geologically located in the Holocene Havel valley floodplain with sandy-loamy floodplain sediments. The Holocene age and the special location of the structures in a flat landscape are the reason for a preliminary focus here on this particular occurrence, with a brief extrapolation to the more northerly regions of the *Sölle* comparatively included. Since the term "*Sölle*" is practically always used and understood genetically in the sense of dead-ice holes, and other formations are just addressed here, too, we will use the neutral and not genetically loaded term of "pan" in the following.

**Results:** Of the pan clusters in Fig. 3, Fig. 4 shows a compilation of typical DTM profiles of highest resolution down to the decimeter range with a brief description in the figure caption. Specifics will be addressed in the discussion.

Of the other clusters of pans considered so far (Fig. 2), the occurrence near Hohengüstow is cited here as an example, with a Google Earth section of the widespread and well-known *Sölle* areas, as well as DTM examples of perfectly circular pans that also

occur here. These observations are also valid for the pans ("Sölle") especially known from the island of Rügen and for the occurrences of Jarmen and Schwaneberg.

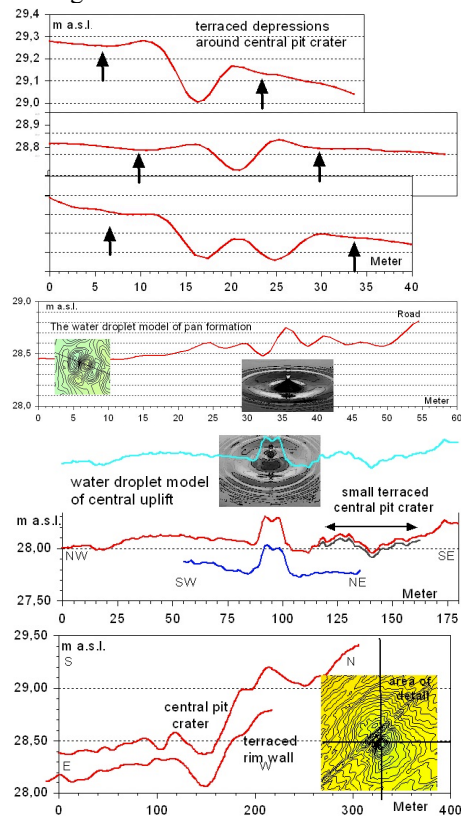


Fig. 4. Typical DTM profiles across circular pans in the Premnitz clusters. From top to bottom: Small rimmed pans with peripheral depressions. - Wavy profiles similar to droplet-into-water shapes. - Larger ca. 250 m-diameter pan with terraced rim.



Fig. 5. Google Earth image of Hohengüstow with typical *Sölle* accumulations of circular and irregular form. The white spots indicate strong soil influence on vegetation, not always seen in Google Earth historical maps.

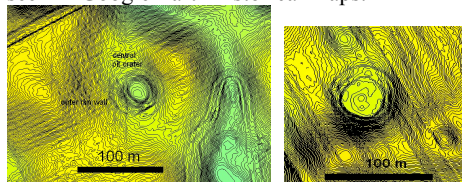


Fig. 6. DTM of larger perfectly circular, multi-ring pans among the Hohengüstow *Sölle* (Fig. 5). Three small pans are accompanying the large one (right image).

**The Chiemgau impact strewn field analog:** The new consideration of the pans in northern Germany is purposeful in that we are dealing in many respects with an exact copy of the phenomena of the crater strewn field of the Chiemgau impact ([2], and references therein) (Fig. 7).

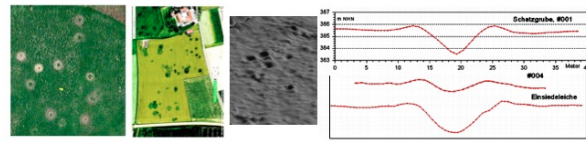


Fig. 7: Well-known observations of the Chiemgau impact corresponding to the North German pans. Left: Clusters of pans near Premnitz and in the Chiemgau. Middle: cluster of Chiemgau pans in the DTM (surface plot). Right: small selection of pan DTM profiles (Chiemgau). Compare Fig.4!

**Discussion and conclusions:** Summarizing we list:

-- The basis for the new investigations on the *Sölle* in northern Germany is the DTM (DGM 1 in Germany) with extremely high resolution and data processing possibilities. The earlier research did not have these tools. -- The new hypothesis we present here involves: The forms commonly referred to as *Sölle* (by us now as pans) have, at least in part, no relation whatsoever to glacial processes. -- The accumulation of absolutely circular pans in dense clusters with almost constant diameter throughout (Premnitz!), as well as exactly circular pans with diameters of more than 100 m, both with ring walls and central elevations, absolutely exclude dead ice formation. -- Our alternative model, which does justice to the observations, is: The pans are cluster-forming impact structures in larger strewn fields, like in the crater strewn field of the Chiemgau impact in almost identical shape and size [2] (e.g. terraced craters, as known from the Moon and recently from Mars [3]). -- The pans with fresh sculpture occurring near Premnitz in Holocene valley floodplains show that the dating of all *Sölle* into the late Pleistocene has to be reconsidered. -- For the time being still speculation about a connection is the finding of a probable larger Holocene impact (Sachsendorf Bay structure [4]) in direct vicinity of the pans stringing between Rügen and west of Berlin. -- The ice age research with the theory of dead-ice forms in northern Germany (like the already questioned Alpine dead-ice theory) would thus face a paradigm shift.

**References:** [1] Martin, M. R. (2014) *Eiszeit-glaziologie-Theorie*, 17, 18, viademica.verlag, Berlin. [2] Rappenglück, M.A. et al. (2017) *Z. Anomalistik*, 17, 235-260. [3] Rappenglück, M.A. et al. (2021) 12th Planetary Crater Consortium, this meeting. [4] Ernstson, K. et al. (2021) 12th Planetary Crater Consortium, this meeting.