THE SAARLOUIS SEMI CRATER STRUCTURE: NOTABLE INSIGHT INTO THE SAARLAND (GERMANY) METEORITE IMPACT EVENT ACHIEVED K. Ernstson[1], W. Müller[2], A. Gawlik-Wagner[3], [1]Faculty of Philosophy I, University of Würzburg, D-97074 Würzburg, Germany (kernstson@ernstson.de), [2]Diefflerstr. 217, 66809 Nalbach, Germany (edumueller@t-online.de), [3]Antoniusweg 3, 86763 Dillingen, Germany (andigawa@gmail.com).

Introduction: Some years ago finds of peculiar samples by one of the authors (W.M.) initiated a few analyses of glass fragments that were speaking in favor of a Holocene possible meteorite impact site in the Saarland region at Nalbach near the town of Saarlouis [1, 2] (Fig. 1).

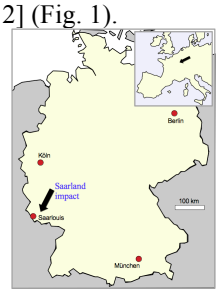

Fig. 1. Location map.

More finds of rocks and glasses with typical impact features strengthened the impact hypothesis [3] and initiated comprehensive new mineralogical analyses at the university of Trier [4]. From thin-section analyses strong shock metamorphism (shock-produced melt, quartzite cobbles completely transferred to diaplectic glass, diaplectic sanidine, ballen structures merging into cristobalite and tridymite, toasted quartz, multiple sets of planar fractures and PDF in quartz, strongly kinked mica, spallation fractures in quartz grains) was established [5]. The strong shock metamorphism initially remained enigmatic because a related impact crater was missing until W.M. could identify a nearby rimmed 200 m-diameter crater, which in the dense forest became fully obvious only by studying the Digital Terrain Model [5]. Preliminary field work revealed strongly fractured rocks and melt rocks surrounding the crater up to larger distances, which were interpreted as ejected material. Using impact scaling laws an impactor to have produced this 200 m-diameter crater may have had a size of the order of only a few decameters. Hence, doubts were raised whether such a relatively small impact was able to produce these widespread highest shock levels. Here we report on new findings by author A.G. and analyses providing new insight into the so far described Saarland impact site.

Results. *The Saarlouis semi crater.* Not very often a meteorite crater of some size is discovered within the densely populated region of a town. This happened last year when author A.G., a layman interested in impact research, came across strange rocks completely abnormal in the region but strongly resembling a suevite breccia known to him from the impact literature (Fig. 5). Rapidly he became aware that meteorite craters need not necessarily be a round structure, if it was later strongly overprinted by erosion and sedimentation, and he established a structure that had always escaped the attention of everybody, geographers and geologists included, and that we now call the Saarlouis meteorite semi crater (Fig. 2). The relic of a full crater is easily understood from erosion and removal by the near Saar river the valley of which is today reaching into the semi bowl of the crater (Fig. 2). Originally seen in Google Earth map only, the semi crater is clearly delineated by high-resolution Digital Terrain Model (DTM) data processing (Fig. 2). A random formation of the semicircular edge of the valey can easily be excluded because upside the closely associated rim wall geologically speaking doesn't make any sense. Moreover, delineating the rim wall crest along the semi crater a nearly perfect circle is achieved (Fig. 2). Extrapolating the rim crest to a full circle, a diameter of 2.3 km for the original Saarlouis crater results. Geologically, the sharply countoured semi crater also portrays the stratigraphy fixing the deposition of the Lower Terrace as an upper limit for the age of the postulated event, that is an impact in the Pleistocene or older.

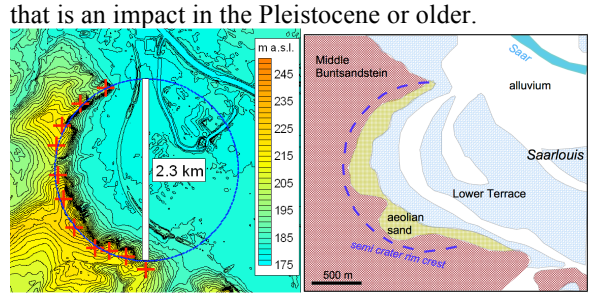

Fig. 2. The Saarlouis semi crater: The rim wall crest (+) is forming a segment of a nearly perfect 2.3 km-diameter circle. **Fig. 3**. Geological map; simplified from [6].

Fig. 4 conveys a further strong argument for the reality of the impact event. In the map of the shaded relief seven radial DMT profiles for topographical sections across the rim wall are plotted, and comparing the shape of the semi crater and its rim wall with cross sections of young bowl-shaped proven meteorite craters with diameters of roughly the same order an amazing similarity is evident.

Suevite. The rock having reminded A.G. of a suevite had been excavated by a farmer on the plateau

immediately outside the rim wall being probably impact ejecta. Macroscopically and from thin-section analysis we are dealing with a polymictic breccia composed of sharp-edged, in part vesicular rock fragments in a finer-grained matrix of dominantly quartz, calcite and rarely glass splinters.

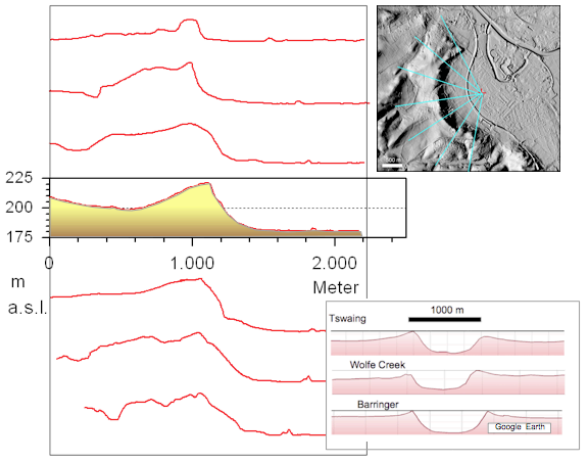

Fig. 4. Map of shaded relief of the DTM and profiles across the rim wall. For comparison other typical crater profiles are shown.

The dark components prove to be basaltic andesite both in a dense form and as vesicular melt rock, which will in more detail be addressed later. The grading and the adjustment of particles (nw - se) indicates flow texture. Close-up shows vesicular melt rock particles with metallic spherules (see the insertion in Fig. 5.)

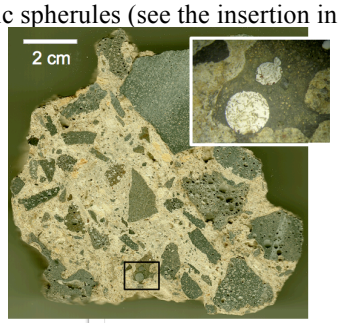

Fig. 5. Cut face of suevite from the Saarlouis semi crater (see text).

Preliminary SEM-EDS analyses of a few spherules (Fig. 6) show an iron core with vermicular carbon inclusions embedded in basaltic andesite of the breccia component. A host of more elements contribute, however in general at < 1 wt%.

With the verification of melt particles and shock effects (Fig. 7) and with regard to the common impactite nomenclature the Saarlouis polymictic breccia can reasonably be called a suevite impactite strongly supportimg the hypothesis of a Saarlouis meteorite crater.

Target rocks. For the time being we avoid going into details of the postulated impact cratering process and the affected stratigraphy. The basaltic andesite contributing to the suevite breccia is not exposed in the Saarlouis vicinity but is closest exposed and exploited 10 km apart.

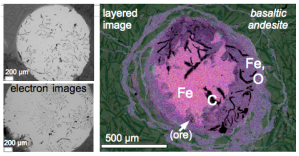

Fig. 6. Electron image of metallic spherules and EDS layered image (see text).

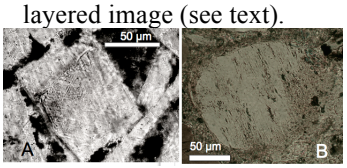

Fig. 7. Moderate shock effects in the suevite breccia. A: multiple sets of planar deformation features (PDF) in feldspar, B: PDF in quartz.

Hence, the impact excavation should have met a so far unknown basaltic andesite complex below the today's crater floor in the Saar valley possibly at a depth of several hundred meters. Interestingly, two big basaltic andesite "erratic" blocks have earlier been excavated from a purely loamy ground near the town of Nabach 8 km apart without having ever understood the process of emplacement. The now proposed Saarlouis impact excavation and ejection could well have been the source.

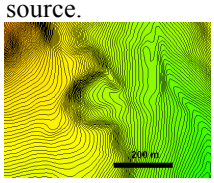

Fig. 8. The Nalbach crater - probable companion to the Saarlouis crater.

Conclusions: With the discovery of the 2.3 km-diameter Saarlouis crater the earlier discussed Nalbach impact event and its inexplicably widely disseminated strongly shocked rocks [5] can be seen in a completely new context. Together with the previously established smaller crater near Nalbach (Fig. 8) a paired impact within a distance of roughly 8 km and a related much broader impact reach make perfect sense. However, the geologically established age - Pleistocene or older - makes an earlier suggested hypothetical relation with the Chiemgau meteorite impact event [3] obsolete.

Acknowledgement: We thank Dr. M Hiltl for the SEM-EDS analysis.

References: [1] Buchner, E. et al. (2011) *74th Ann. Meteoritical Soc. Meeting,* Abstract #5048. [2] Schmieder, M. et al. (2011). *74th Ann. Meteoritical Soc. Meeting.* Abstract #5059. [3] Ernstson, K. et al. (2013) *Meteoritics & Planet. Sci.,* 48, s1, Abstract #5058. [4] Berger, N. (2014*) Diploma thesis*, University of Trier. [5] Berger, N. et al. (2015) 46th LPSC, Abstract [6] geoportal.saarland.de. - DTM data from LVGL Saarland.