HYDROCODE MODELING OF IMPACT CRATERS: CHIEMGAU LOW-ALTITUDE AIRBURST IMPACT STREWN FIELD, GERMANY. A. West and K. Ernstson[1], [1]Comet Research Group, Prescott, Arizona 86301, USA (allen7633@aol.com), [2]University of Würzburg, 97074 Würzburg, Germany (kernstson@ernstson.de).

Introduction: Hydrocode modeling of impacts uses computer programs to simulate extreme, short-duration events, such as impact cratering (e.g., [1, 2]). It models the behavior of materials under extreme conditions, e.g., shock waves, and simulates pressures, temperatures, stresses, and material deformations and movements, where physical testing is impossible or too costly. Here, for the first time in impact research, we present hydrocode modeling, which we apply to impacts in a very large crater strewn field created by a low-altitude touchdown airburst impact in loose sediments.

The Chiemgau impact: The Chiemgau meteorite impact, suggested some 20 years ago, is now established as the world's currently largest Holocene impact site, dated to 900-600 B.C. in the Bronze Age/Celtic era. We have been using the Digital Terrain Model DTM (DGM 1 in Germany) with extreme 1 m horizontal and 0,1 m vertical terrain resolution for several years to systematically search the Chiemgau impact strewn field for new impact findings applying this extremely high-resolution method, which has now led to well over 100 new structures with diameters up to 1,300 m [e.g., 3-6]. In addition, the DTM has led to the Chiemgau crater strewn field now being understood as the result of a low-altitude "touchdown" airburst impact with associated crater shapes, some of which are highly complex [3].

The Chiemgau impact hydrocode modeling: Although the origin of the impact has been clearly proven for many years (despite being ignored by the so-called impact community), using all internationally recognized impact criteria, it has only recently become increasingly understood that the Chiemgau impact event, with its practically unmistakable large impact inventory, can only be understood as a low-altitude airburst [3, and references therein], which we would like to substantiate here with two examples of hydrocode modeling.

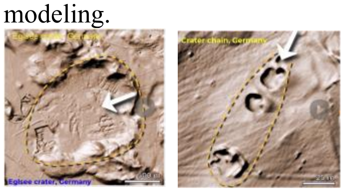

Fig. 1. The modeled Eglsee crater and crater chain. DGM 1 surface

Model parameters: Chiemgau strewn field - age 900-600 B.C. - 1.2 km comet - entry 30 km/s at 15°, 2 km/s at ground level - density 500 kg/m3 - comet breaks up 100 km high - fragments up to 100 m - 70 km x 8 km debris field - shallow craters up to 1.3 km - energy 18,000 Mt - temperature >1,800 K - shock speed 6 km/s - pressure >5 GPa - tons of glass, spherules - shocked minerals (quartz, feldspar, mica, calcite)

The Eglsee 1.3 km-diameter crater: The Eglsee crater is the largest crater in the strewn field so far.

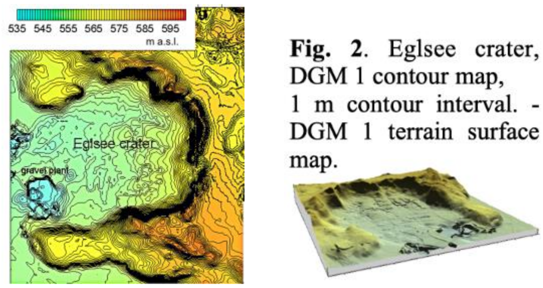

Fig. 2. Eglsee crater, DGM 1 contour map, 1 m contour interval. - DGM 1 terrain surface map.

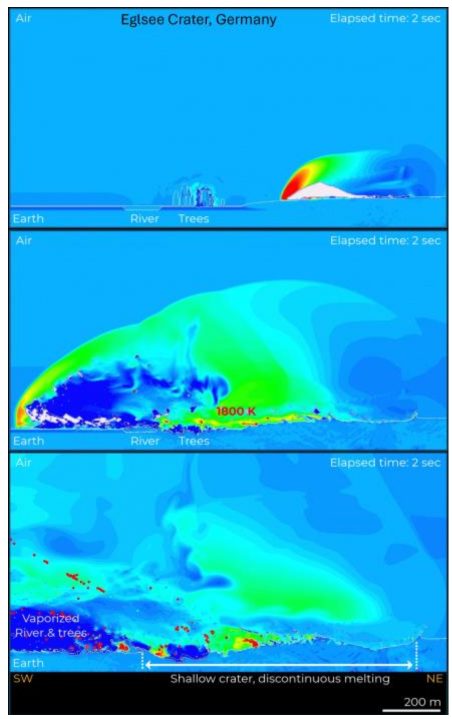

Fig. 3. Eglsee crater hydrocode modeling, selection of video still images.

The modeled crater chain: In addition to individual craters, multiple structures, and crater clusters, more or less regular crater chains are a key feature of the crater strewn field and thus a significant feature of the postulated touchdown impact.

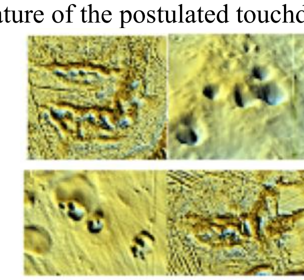

Fig. 4. Typical crater chains in the Chiemgau impact strewn field. Top left: Hydrocode modeled (Fig. 1). Size of the individual craters is around 10 m.

Hydrocode modeling, touchdown airburst impact, and impact-petrographic documents: From the far northeast (craters 004, 001) to the southwest (Lake Tüttensee) of the impact ellipse, the impact evidence is widespread in craters and directly on farmland, where a wide variety of impactites with and without shock metamorphism, spherules, and melt glasses can be collected [3, and references therein]. A very limited selection is shown in Fig. 6.

Fig. 6. Top left to lower right: Carbon spherules, precipitated from vaporized trees, widespread in the Chiemgau ellipse. Millimeter-sized. - Impact melt glass, also partly widespread over large areas. - Black glass particles, widespread on farmland. - Microtektites; from soils in the Alpine foothills, 100 µm scale bars.

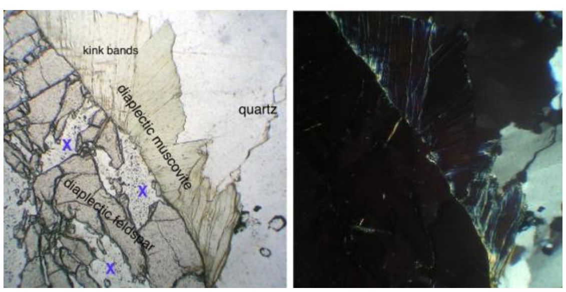

Fig. 7. Shock metamorphism: diaplectic plagioclase and muscovite (phengite?); PPL and crossed polarizers. #001 Schatzgrube crater. x = voids. 1 mm x 1 mm size.

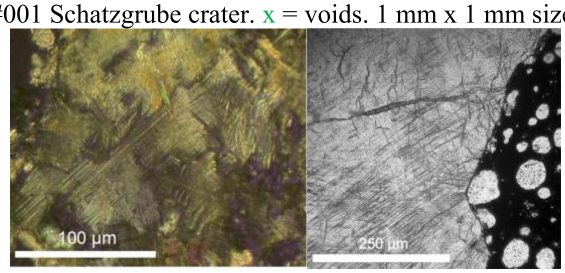

Fig. 8. Shock metamorphism. PDF in plagioclase, crossed polarizers, Lake Tüttensee crater melt rock. - PDF in quartz, contact with glass particle, PPL, #004 Emmerting crater.

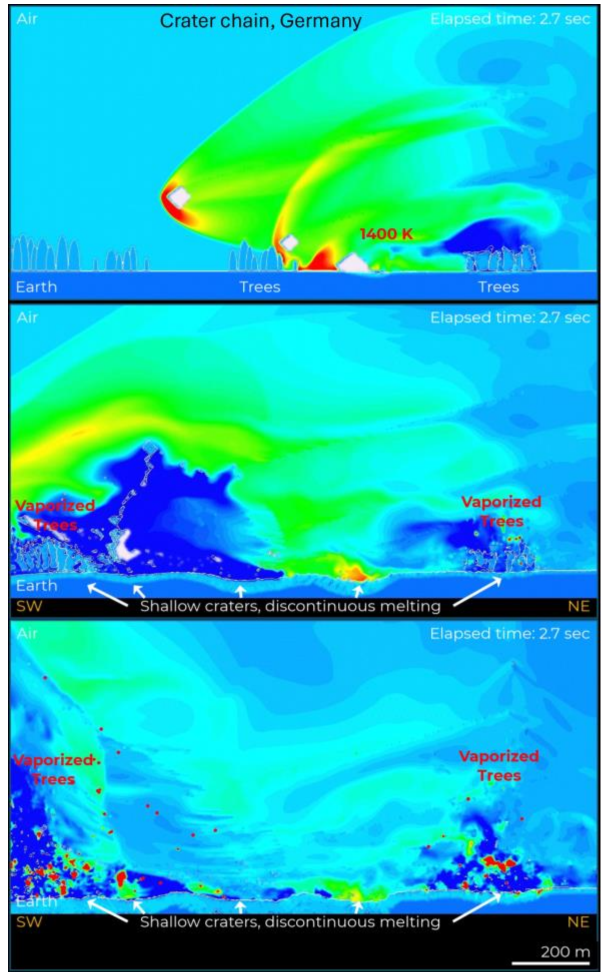

Fig. 5. Crater chain hydrocode modeling, selection of video still images.

Discussion: Already 20 years ago, when the Chiemgau impact was first postulated, speculation had focused on a projectile from a kilometer-sized broken comet or a very loosely bound asteroid, due to the size of the crater strewn ellipse. Then, over the following two decades, the assumption of a massive airburst impact became increasingly prevalent. Now, our current hydrocode modeling contributes enormously to understanding and classifying the majority of our previously almost unmanageable terrain findings and the widespread impact effects (meteorites, melt rocks, glasses, spherules, shock, vaporized vegetation).

References: [1] West A. et al. (2024) *Airbursts and Cratering Impacts,* 2(1). DOI10.14293/ACI.2024.0004. [2] Silvia, P.J. et al. (2024) *Airbursts and Cratering Impacts,* 2(1). DOI10.14293/ACI.2024.0005. [3] https://www.impact-structures.com/, and subpages.