EVIDENCE OF A METEORITE IMPACT-INDUCED TSUNAMI IN LAKE CHIEMSEE (SOUTHEAST GERMANY) STRENGTHENED. K. Ernstson, Faculty of Philosophy I, University of Würzburg, D-97074 Würzburg, Germany, kernstson@ernstson.de

Introduction: In the context of the investigation of the Holocene Chiemgau meteorite impact event [1-8] geological observations have repeatedly been made that suggest a tsunami as a result of the impact of a meteoroid into Lake Chiemsee evidenced by a doublet crater at the bottom of the lake (Fig. 1). Unusual rock debris that fishermen brought up from the lake bed and geologic-archeological excavations around the lake uncovering documents of a young catastrophic event [9-12] also attracted attention. Tsunami deposits are known from earlier geologic periods, and a tsunami to have occurred in a lake (Lake Lucerne, Switzerland) has been discussed [13]. Tsunamis as a consequence of major meteorite impacts into the sea have also been the subject of advanced research [e.g., 14]. Here, I report on a recently discovered outcrop in a gravel pit about 2.5 km off the shore of Lake Chiemsee and on additional compelling geologic evidence of a giant tsunami.

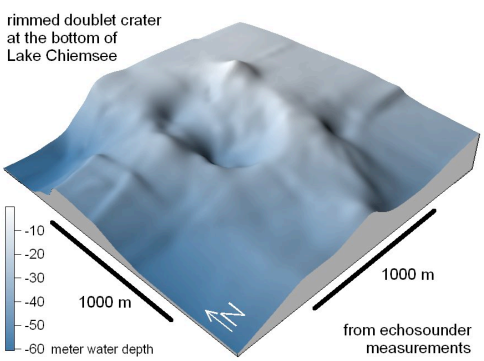

Fig. 1. The rimmed doublet crater postulated to have originated from meteorite impact into the 80 km^2-sized Lake Chiemsee. Coordinates 47.890° N, 12.495° E.

Observations: In the gravel pit under exploitation a wall exhibits an impressive cross bedding that occupies the complete height of the wall with a great number of mostly curved layer units of different wavelengths (Figs. 2, 3). The individual layer packages turn up to be markedly separated by an abrupt change of the grain size from big boulders in a block horizon to silt (see arrow).

The rock material establishing the cross bedding is a diamictite that is in part strongly hardened and consists of a multicolored extremely bad-sorted rock composite. The grain size ranges from silt to blocks with a diameter of up to one meter (Fig. 4). The typical attribute of diamictites that is a mixture of rounded and sharp-edged components is found down to smaller fractions (Fig. 4). Rather unusual for a diamictite, limestone cobbles may show multiple sets of intersecting scratches all around that even may merge into a polish.

Fig. 2. A prominent cross bedding in the wall of the gravel pit with in part strongly varying grain sizes (arrow). The exposure shown is about 20 m wide and 8 m high.

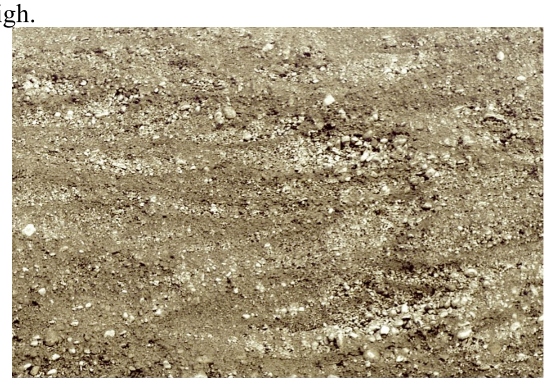

Fig. 3. Close-up of a few smaller cross-bedding units; width of photo about 2 m.

Fig. 4. Big boulders contribute to the cross-bedded diamictite and (upper right) may reveal distinct open, tensile, fractures as a probable result of impact shock spallation. The finer fraction (lower) shows the typical facies of a polymictic, badly sorted sediment with rounded and sharp-edged components.

Discussion: Cross bedding is a common phenomenon in geology. Also diamictites belong to the geologic sedimentary inventory consisting of a mostly polymictic, badly or not at all sorted material with rounded and angular components. The term does not imply a genetic attribution; it is however frequently and mistakenly put on a level with tillite that is with glacial processes and glaciers. Indeed, quite different processes may lead to the formation of diamictites.

The herein discussed diamictite showing a distinct cross bedding is something unusual. Because of its occurrence in the glacially characterized pre-Alps landscape one is rapidly willing to think of ice age, glaciers and moraines, in particular with regard to the deposit exposed very near to the Lake Chiemsee glacier end moraines mapped around the lake [e.g., 15, 16]. A formation of the cross bedding by wind transport can reasonably be excluded straightway. A water transport must have been so energetic as to have transported even big blocks up to meter size. The transport route must have been short, because otherwise the fragmented small and larger components, in particular the sharp-edged limestone ones, would have acquired rounding. The intersecting sharp scratches and distinct polish to be observed around cobbles would have disappeared at the latest after a few tens of meters of water transport. Because of the relatively short wavelengths of the cross bedding units erosion and sedimentation across a broad front must be excluded. Instead current conditions changing briefly and on a small scale are rather to be expected.

Hence, bearing these findings in mind all considerations that relate the cross-bedded diamictite to any ice age processes are doomed to failure. This directs a view to a process that although not yet understood in all its details provides the probably sole explanation for the interpretation of this quite unusual geologic setting: a huge tidal wave (a tsunami) that emerged in the nearby Lake Chiemsee and with enormous energy overprinted vast areas of the Lake Chiemsee environs also geologically. Initial point is the discovery of a rimmed doublet crater at the bottom of Lake Chiemsee (Fig. 1). This structure with dimensions c. 900 m x 400 m was very probably formed by the impact of a broken cosmic projectile into the lake. As computations show [12, 17] the impact of a projectile measuring only 2 m into the water of Lake Chiemsee produces a more than 25 m high tidal wave on the banks which overruns vast areas on land. According to common estimates the size of the projectiles that produced the doublet crater could have been of the order of 20 – 40 m. Ideas about the tidal waves that must have been caused by such an impact into a lake some 60 m deep on average are beyond estimate for now as it is the case for more precise ideas about the individual processes: excavation of a primary transient doublet craters of the order of 100 m depth at the bottom of Lake Chiemsee and the propagation of a first giant tsunami – collapse of the transient doublet crater with a resurge of water and rock masses – morphology-driven backwash of the first big tsunami towards Lake Chiemsee – new wave propagation starting from the collapsed transient crater and its central peak to form a second accumulating tsunami and backwash – multiple reflections of high flood waves at the banks of Lake Chiemsee, interferences and steepening to smaller fresh tsunamis that inland inundate several times.

Conclusions: The outcrop in the gravel pit exposing the cross-bedded diamictite and its most notable features as in proof of a giant Lake Chiemsee tsunami is one more module for a better understanding of the Chiemgau meteorite impact processes which should have modified the post-glacial geology of the region such eminently. Hence, for some aspects of the regional ice age research a review of familiar and long-accepted geologic conceptions [15-16, 18-20] may be necessary with a special focus on the ice age inventory around Lake Chiemsee.

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