Lake Bärnsee in the Chiemgau Holocene impact strewn field (Germany): ice-age tongue basin lake vs. Holocene low-altitude touchdown airburst impact formation

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The poster can be enlarged considerably on the monitor.

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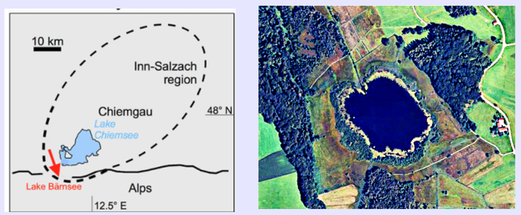
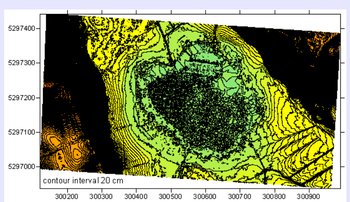
Introduction: The Lake Bärnsee near Lake Chiemsee and on the northern edge of the Alpine foothills (location map below) is a popular destination for day trips with hiking trails and designated as a nature reserve. Geologically, the depression is generally interpreted as a former tongue basin lake of the Prien/Inn-Chiemsee glacier, which over many thousands of years shrank to a small bog due to silting up. Here and applying analyses of the high-resolution Digital Terrain Model DGM 1 ([1]) we reject the ice age formation of Lake Bärnsee and instead find the typical characteristics of a touchdown airburst impact, which identifies Lake Bärnsee as a new larger member of the impact crater family of the Holocene Chiemgau impact [2, and references therein].

The Digital Terrain Model: The Digital Terrain Model DTM (in Germany the DGM 1) is a relatively new representation of the topography of the earth's surface with a dense data network obtained from laser scanning from an airplane (LiDAR). The DTM data used here for a 1 m x 1 m grid at a vertical resolution of 10 cm capture the bare ground without buildings and vegetation, even in dense forests and swamps.

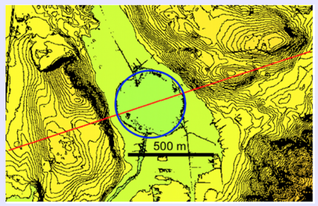


Location map of Lake Bärnsee at the southwestern rim of the elliptically shaped Chiemgau meteorite impact strewn field, - Lake Bärnsee in a Google Earth aerial view (2024). The rounded, almost circular vegetation and soil color are striking.

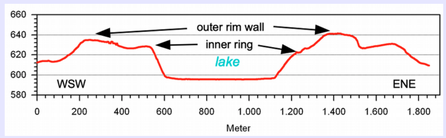


Lake Bärnsee in the digital terrain model DGM 1, topographic map, contour line interval 20 cm. The LiDAR image taken in summer shows a dense carpet of aquatic plants on the lake surface.

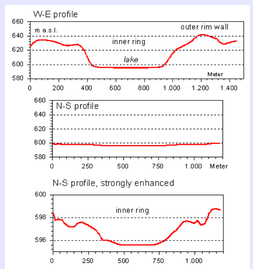
Lake Bärnsee - The Digital Terrain Model and the circular feature



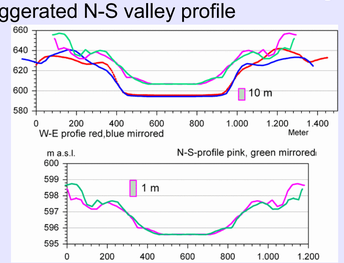
Contour map (contour interval 2 m) of the German Digital Terrain Model DGM 1; the lake shore forms a nearly perfect circle (blue line).



A DGM 1 diametral profile (red line above) across Lake Bärnsee, 0.1 m height resolution. Significant is a double ring structure with a wall-to-wall diameter of the main ring of approximately 1100 m.

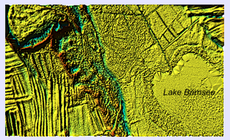


Crossing W-E and N-S DGM 1 profiles revealing the valley morphology. The double-ring structure is even evident along the exaggerated N-S valley profile

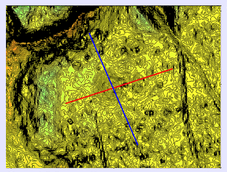


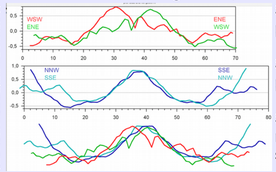
Mirroring and superimposing the W-E and N-S profiles shows almost perfect symmetry of the Bärnsee profiles, and a comparison in the upper image also reveals impressive circular symmetry despite the original differences in level.

The Bärnsee crater and the Digital Terrain Model of its impact environment



Northwestern rim wall region of Lake Bärnsee, where the following examples of smaller and larger crater structures have been selected. The map shows the DGM 1 3D surface map after a removal of a general terrain trend by strong low-pass data filtering and thus centering the contours to a zero level, which applies also to the following examples



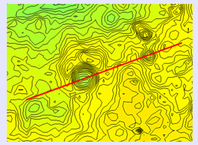


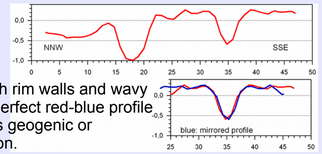
Superposition of the red profile and its mirror profile.

Superposition of the blue profile and its mirror profile.

Superposition of all profiles revealing the circular symmetry.

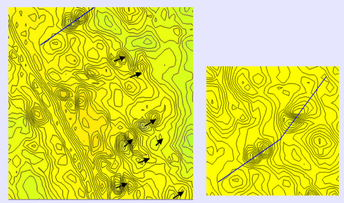
Ca. 100 m-diameter pan crater with distinct central mound.



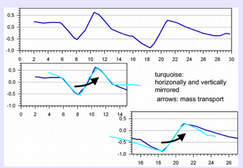


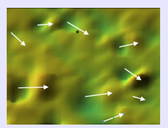
Two simple craters with rim walls and wavy outer rim zones. The perfect red-blue profile superposition excludes geogenic or anthropogenic formation.

The crater-pimple mound bipolar structures

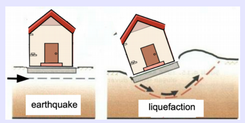


DGM 1 maps and profile. The more or less uniform orientation of the bipolar structures of equal size suggests a uniform, simultaneous formation process, which has not been fully clarified. The perfect superimposition with the horizontally and vertically mirrored profiles illustrates the closed process of mass displacement. In earthquakes, this occurs through liquefaction caused by the earthquake waves, which can happen analogously during impact.





DGM 1 surface.



Modified from Bakir and Baran Karasin (2016)

Field evidence and rocks

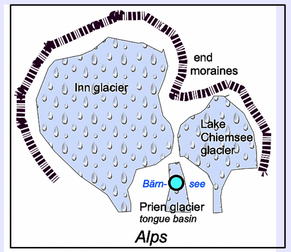
Sampling ejecta rocks from the Lake Bärnsee rim wall. The rubble of sharp-edged rock fragments argues against a terminal moraine. Below: Selection of original samples of polymictic breccias and strongly deformed rocks from the outcrops.

Discussion - The Chiemgau low-altitude touchdown airburst impact [4-7]

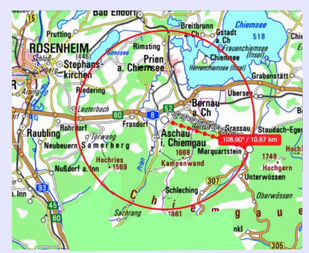
- Lake Bärnsee DTM (DGM 1) analyses show a double-ring nearly perfect circular basin of roughy 1,100 m diameter and max. 20 m depth.
- The N-S valley overprint of the crater is suggested to result from immediate post-impact produced erosive heavy rain floods down from the Alps' foothills.
- The Lake Bärnsee's rim zone is densely pockmarked and blister-marked due to the cosmic projectile's (comet or asteroid) explosion bombardment as proposed by new hydrocode models, and by touchdown impact „earthquake“ soil liquefaction.
- Blister- and pockmarked features often combine to a kind of bipolar structures similar to earthquake shock liquefaction.
- The generally rimmed companion depressions and those with a central peak exclude any dead-ice formation.
- Impact-typical sharp-edged polymictic breccias and strongly deformed cobbles are extracted abundantly from the Lake Bärnsee's rim wall.

Conclusions

- The Lake Bärnsee shows all evidence of an impact structure and thus belongs to the Holocene Chiemgau meteorite crater strewn field.
- The very flat circular depression and the blister- and pockmarked rim region expressively underline a touchdown airburst origin of the whole Chiemgau impact event.
- The Lake Bärnsee is not an as many as 10,000 years remnant of the Würm glaciation.



The location of the Lake Bärnsee in the finger-shaped Prien glacier wedged between Inn and Lake Chiemsee glaciers (simplified from Darga . 2009 [3]).



Within the red circle with a diameter of 20 km around Lake Bärnsee there is not a single other lake (except for Lake Chiemsee), which also makes the existence of a Prien glacier tongue basin rather questionable. Map [1].

The Lake Bärnsee impact cancels the Prien glacier and tongue basin

References: [1] © Bayerische Vermessungsverwaltung (2024); Data source: Geoportal Bayern www.geoportal.bayern.de. [2] Chiemgau Impact: A Bavarian meteorite crater strewn field. https://www.chiemgau-impact.com. [3] Darga, R: Auf den Spuren des Inn-Chiemsee-Gletschers. Verlag Dr. Friedrich Pfeil, München 2009. [4] Ernstson, K. and Poßekel, J. (2024) AGU 24, Abstract #EP01-29. [5] Ernstson, K. and Poßekel, J. (2024) LPSC 55th, #1658. [6] Poßekel, J. and Ernstson, K. (2025) LPSC 56th, #2770. [7] Ernstson, K. et al. (2024) LPSC 55th, #1641.