THE WYOMING IMPACT CRATER FIELD: SECONDARY CRATERING VS. PRIMARY CRATERING

Kord Ernstson[1], Hans-Peter Matheisl[2], Jens Poßekel[3] and Michael A. Rappenglück[4]

[1] University of Würzburg, 97074 Würzburg, Germany (kernstson@ernstson.de), [2] Chiemgau Impact Research Team, 83308 Trostberg, Germany(hp.matheisl@chiemgaucomet.com), [3] Geophysik Poßekel Mülheim, Germany (jens.possekel@cityweb.de), [4] Institute for Interdisciplinary Studies, D-82205 Gilching, Germany (mr@infis.org)

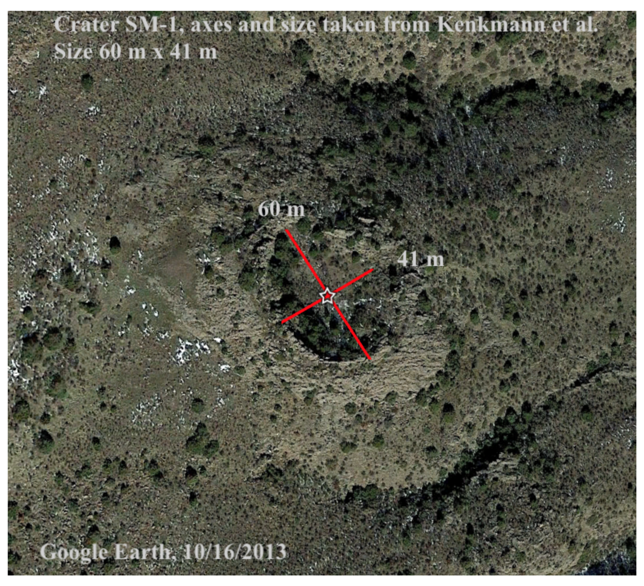
Introduction

In 2022, an article (Kenkmann et al.2022,) was published in the GSA Bulletin claiming that a secondary crater field of a major impact structure has been detected for the first time in the state of Wyoming in the United States, as has long been known from the Moon, other planets, and their moons. 31 craters are confirmed by shock effects, and more than 60 are considered possible craters. Here we discuss the article and disapprove of the arguments for a secondary cratering.

The secondary-cratering model (Kenkmann et al.)

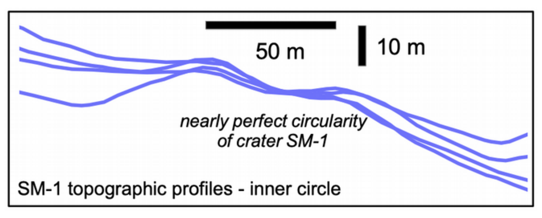
Two findings are highlighted as evidence: the axial directions of elongated craters within four separately occurring clusters of craters. The elongated axis directions span four acute-angled corridors that overlap at a distance of roughly 200 km, where they are thought to mark the presumed primary crater from which projectiles were launched along the corridors to create the secondary craters. The landing of these projectiles after ballistic trajectory are then supposed to have produced the elliptical to ovoid asymmetric shapes of the secondary craters. In the intersection region of the three corridors, there should exist a significant negative gravity anomaly of a hypothesized primary impact crater measuring perhaps 50 km. Third, it is argued that such a large Wyoming strewn field, measuring close to 90 km, could never be attributed to a primary impact according to theoretical modeling and considerations.

Shedding new light on the Wyoming crater field

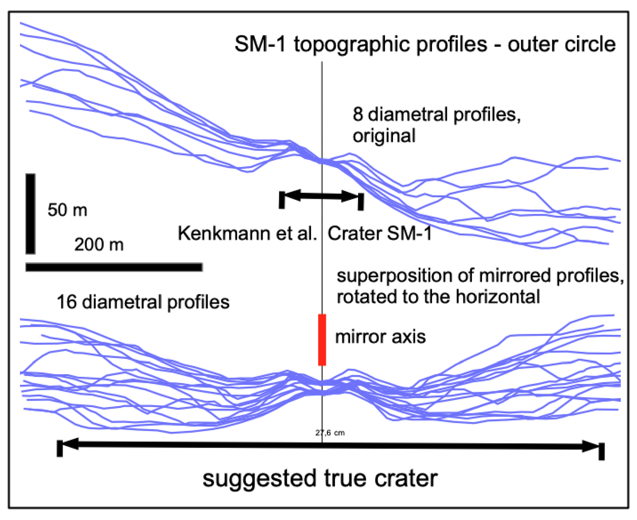


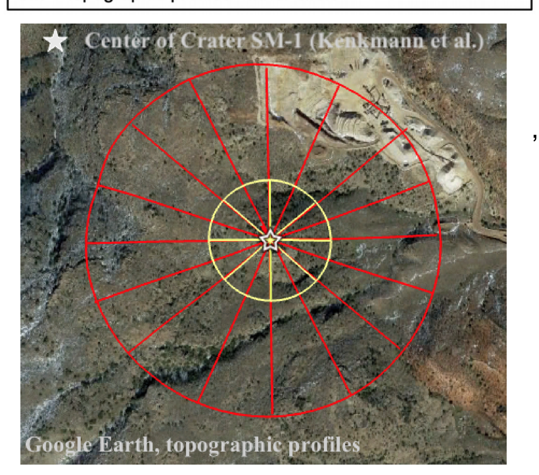
Counter argument 1

The elongated asymmetric crater SM-1 with measured axis direction as an example for the whole strew field is a fundamental misinterpretation. The crater according to Kenkmann et al. is on the one hand almost perfectly circular, on the other hand not an individual crater but the peak ring of a much larger crater with a diameter of roughly 600 m, as far as we can tell.

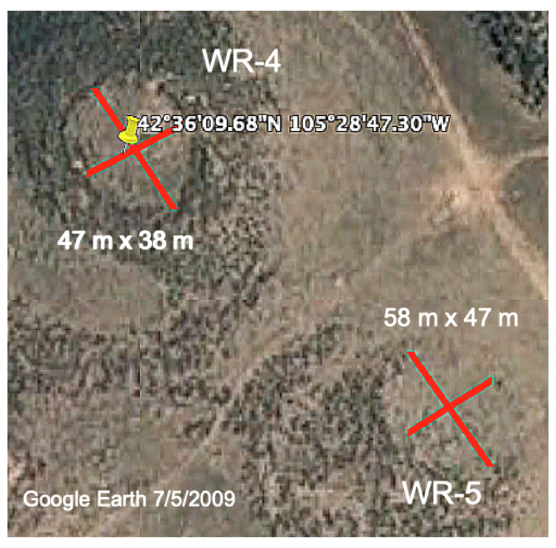


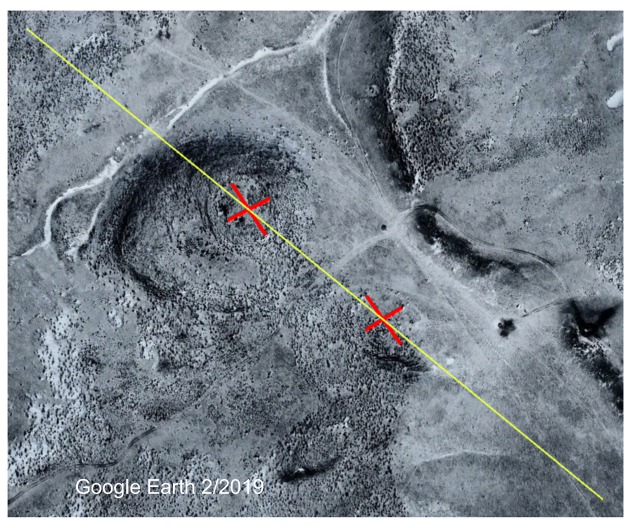
SM-1 topographic profiles - inner circle

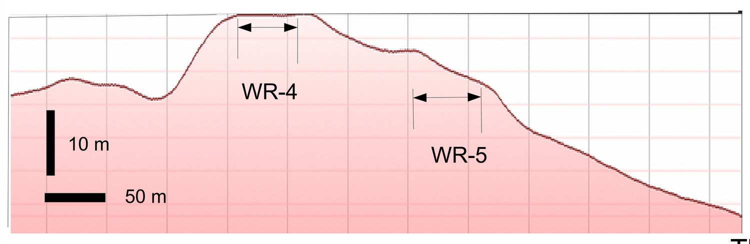


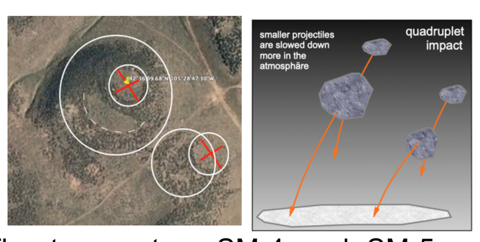


Shedding new light on the Wyoming crater field, 2

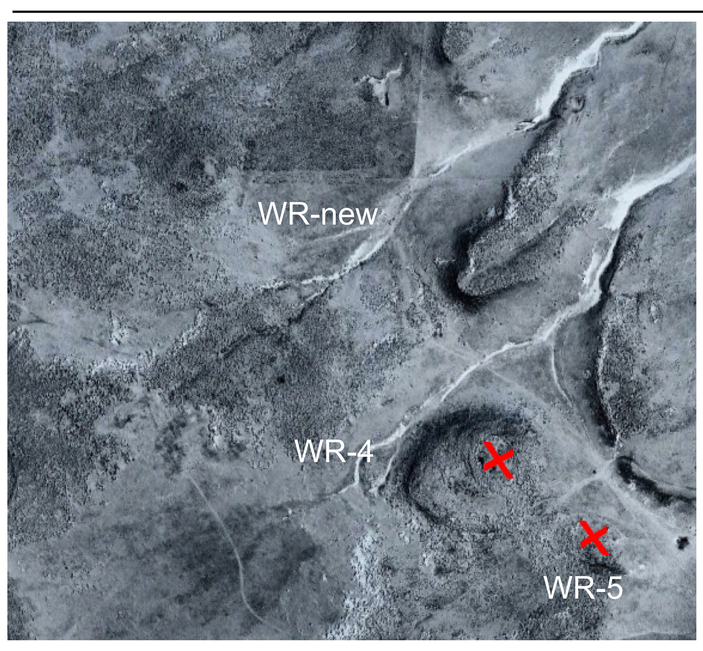


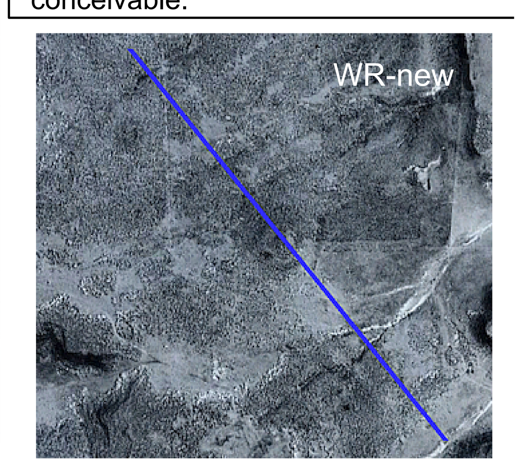


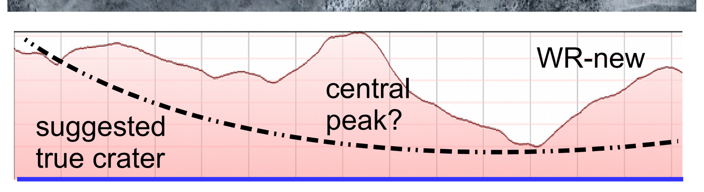




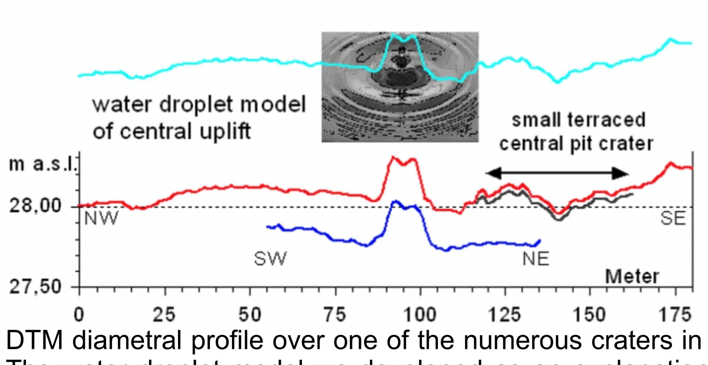
The two craters SM-4 and SM-5 show even more clearly the peak-ring character with their significantly elevated position on an uplift of two larger structures each. A double impact large and small is conceivable.







Apparently overlooked or not further investigated by Kenkmann et al. is another structure located not far from WR-4/WR-5 in an almost straight line, which we have analyzed as WR-new according to the previous specifications. The Google Earth elevation profile clearly shows the close relationship to the other two structures with the same origin. Particularly significant here is the prominent hill with the ring-shaped crest within a wide-spanned depression. We see here a process that we have called the water droplet model in previous studies of soft ground impacts.

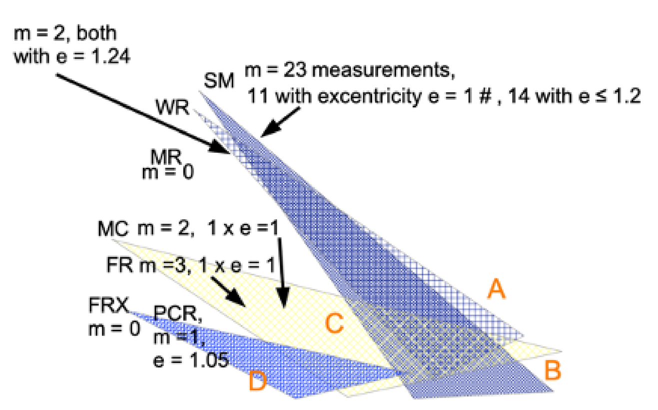


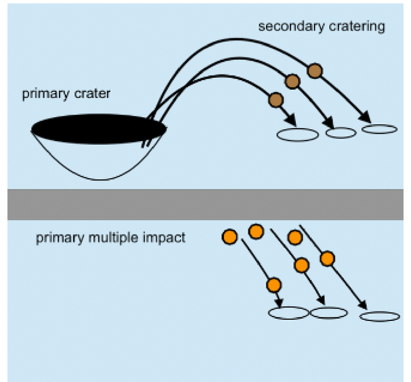
DTM diametral profile over one of the numerous craters in the Premnitz (Germany) strewn field. The water droplet model we developed as an explanation for the unusual crater shapes there also lends itself to the alleged Wyoming secondary craters that are thought to have formed in a soft rock target.

Counter argument 2. The crater asymmetry pointing to the assumed primary impact crater

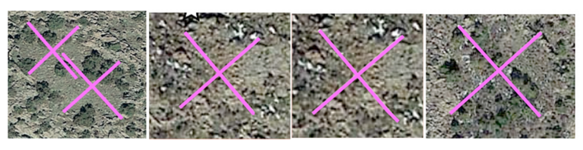
A major argument for the origin of the Wyoming crater strewn field as ejecta impacts from a large primary crater is the elongation of portions of the craters in a limited direction from which the associated projectiles came and produced the elliptical to ovoid structures on oblique impact. We have taken from the Supplemental material in the Kenkmann et al. article (file:///Users/kordernstson/Downloads/B36196_SuppMat.pdf the original measured data for the 31 craters designated and measured as proven, and analyzed them in detail. From the text of the article and the Supplementary Material, we deduce that the argument of asymmetry of the crater axes must be rejected.

Of the 31 craters classified and measured as proven,
-- 15 have an eccentricity e = 1, that is, they are circular. With an e ≤ 1.2, 19 of 31, well over half, are also practically round.
-- Of 23 crater measurements in cluster SM, 11 have an e = 1, meaning they are round, and with e ≤ 1.2, 14, more than half, are also practically circular.
-- In the WR and PCR clusters, only 2 and only one crater, respectively, were measured, but trajectory triangle corridors were constructed for the intersection of the assumed primary crater.





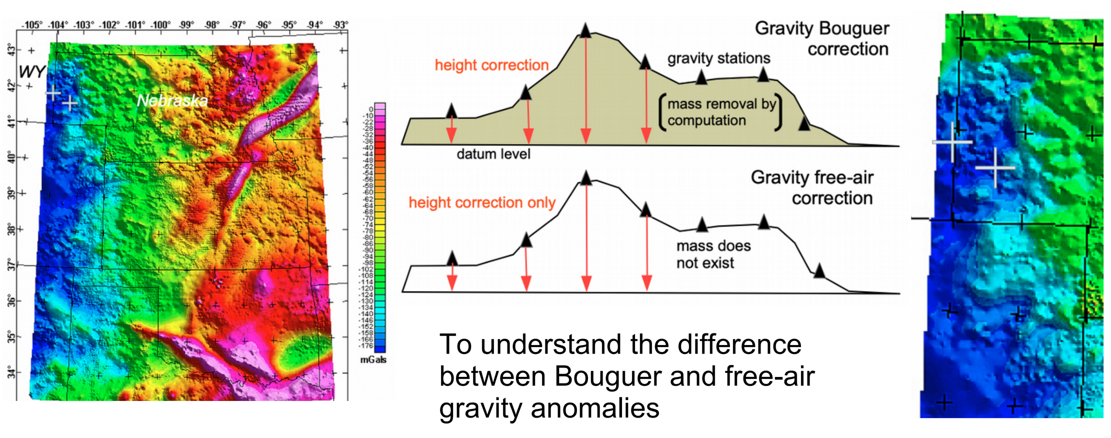
Misleading



Selection out of 15 craters with an excentricity e = 1, that is they are circular. The axes have been taken from Kenkmann et al. used for their diameter measurements. For all e = 1 circular craters the same cross with SW-NE and NW-SE axes directions have been drawn in the supplementary compilation, that is to talk the reader into thinking the same cross orientation as have the elongated craters pointing to the suspected primary crater.

Counter argument 3: The alleged gravity anomaly of the suspected primary crater

The suspected primary crater at the intersection of the above trajectory corridors is based also on a negative free-air gravity anomaly. The use of the free-air anomaly instead of the correct Bouguer anomaly makes the statement about a primary crater there completely worthless.



BOUGUER gravity map of Nebraska and the westerly adjacent Wyoming. The two crosses top left (excerpt to the right) mark the location of the suspected big primary crater allegedly seen in the map of the free-air gravity anomaly. Apart fromt the free-air gravity methodical blunder the here shown correct BOUGUER gravity map does not show the faintest hint of an impact structure with a diameter of the order of 50 km.

Counter argument 4: The size of the Wyoming crater field of about 90 km allegedly excludes a primary impact strewn field.

That the extension of the Wyming strewn field of about 90 km excludes a primary impact formation is based on rather old model calculations and ignores several actually existing larger primary terrestrial crater strewn fields, which the article does not list. Instead:

Crater strewn fields referenced by Kenkmann et al. for comparison with the Wyoming crater field:

Morasko, 8 craters, 5 -100 m diameter
Odessa, 5 craters, a few meters - 160 m
Wabar, few craters, 110 m
Henbury, 12 craters or more, - 157 m
Sikhote Alin, >120 craters, - 28 m,
Kaalijärv, 9 craters, - 110 m
Macha, 5 craters 60 - 300 m

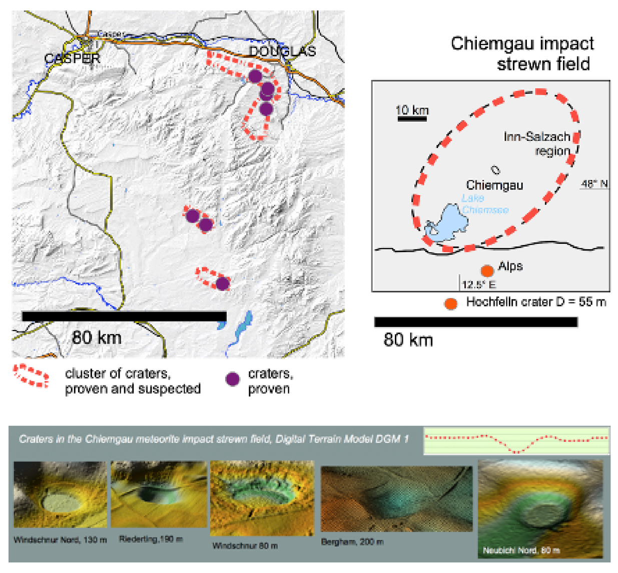
Crater strewn fields ignored by Kenkmann et al. for comparison with the Wyoming crater field:

Campo del Cielo, >26 craters, largest ≈ 100 m
Bajada del Diablo, 189 craters, 100-400 m
Chiemgau, far more than 100 craters, 5 m - 1300 m
Carolina Bays, some 10,000 bays, pobably secondary cratering, YDB impact.

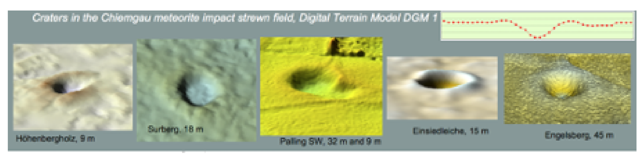
A comparison of the Wyoming field with the Chiemgau impact field of similar extent but with far more than 100 craters in an elliptical strewn field shows that practically all features of the Wyoming craters described occur in almost identical formation in the Chiemgau craters. The Chiemgau impact event, dated to 900 - 600 BC and meanwhile established as the currently most prominent Holocene impact crater strewn field worldwide, is mentioned by Kenkmann et al. despite extensive literature presence with not a single word. Therefore, in the next column, we compile the most important features, which show that, figuratively speaking, both strewn fields with their findings can be superimposed almost exactly, so to speak.,

A more comprehensive article on the Chiemgau impact crater strewn field in comparison with the Wyoming crater field can be downloaded here:
http://www.impact-structures.com/wp-content/uploads/2022/04/Wyming-article-text.pdf
Likewise comprehensive is the References compilation listed at the end of the article.

Counter argument 4 Two of a kind - the Wyoming crater strewn field and the Chiemgau impact crater strewn field

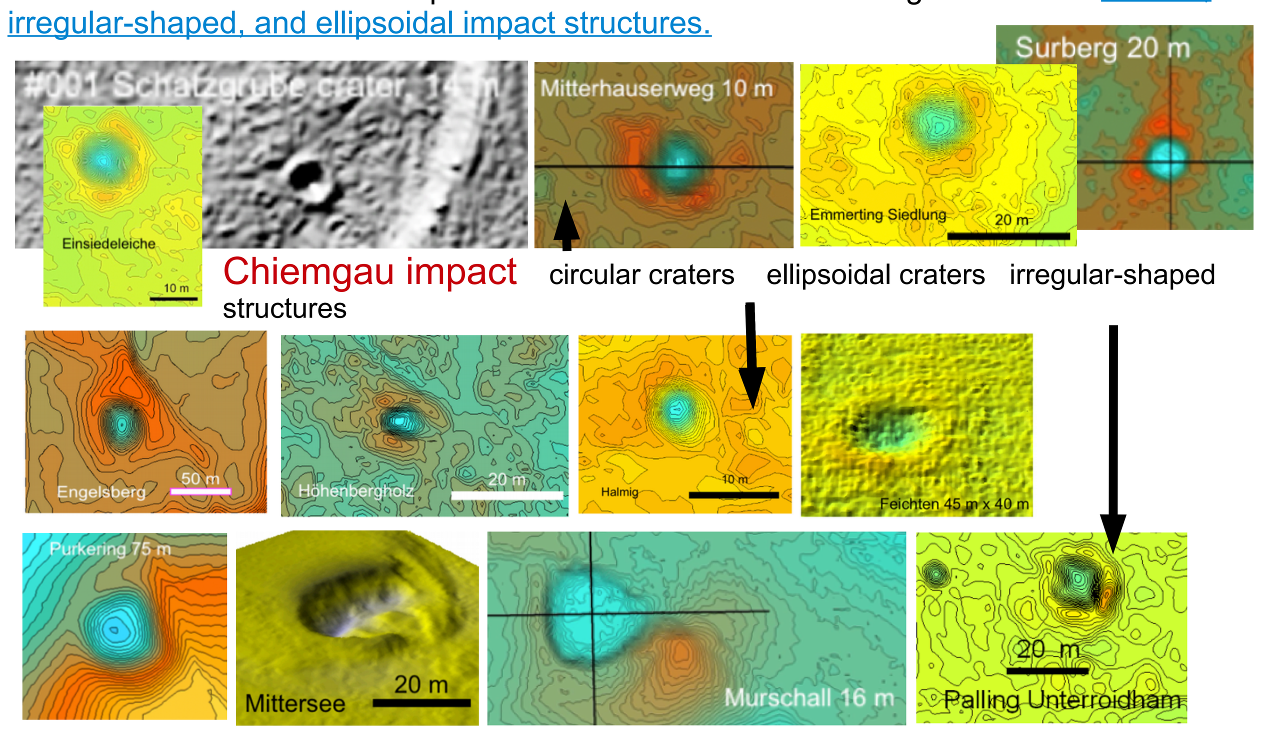


Extension of the strewn fields; roughly elliptical elongation. - Number of structures: 90 (proven and suspected; Wyoming) and more than 100 (suspected more than 200; Chiemgau).

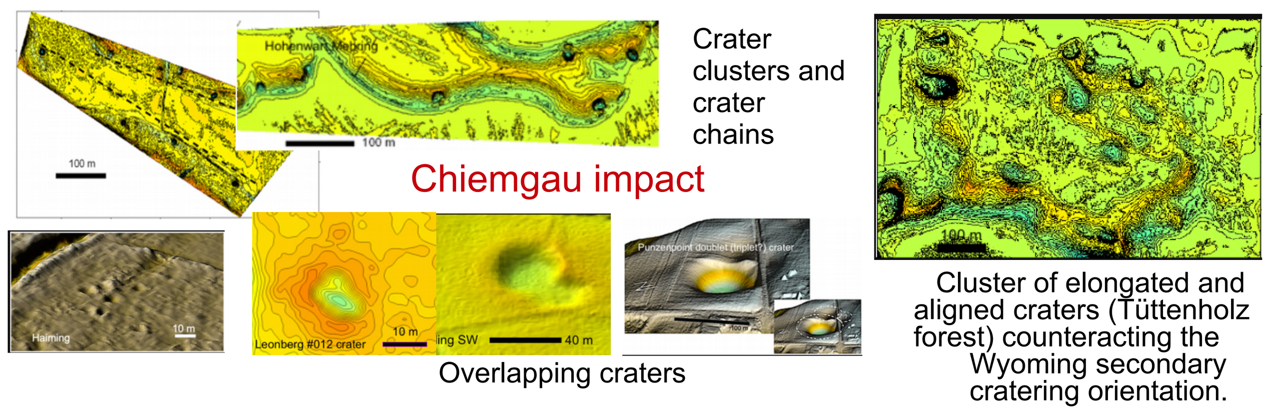


Characteristic craters in the Chiemgau impact strewn field. Diameters of these examples 10 m - 250 m.

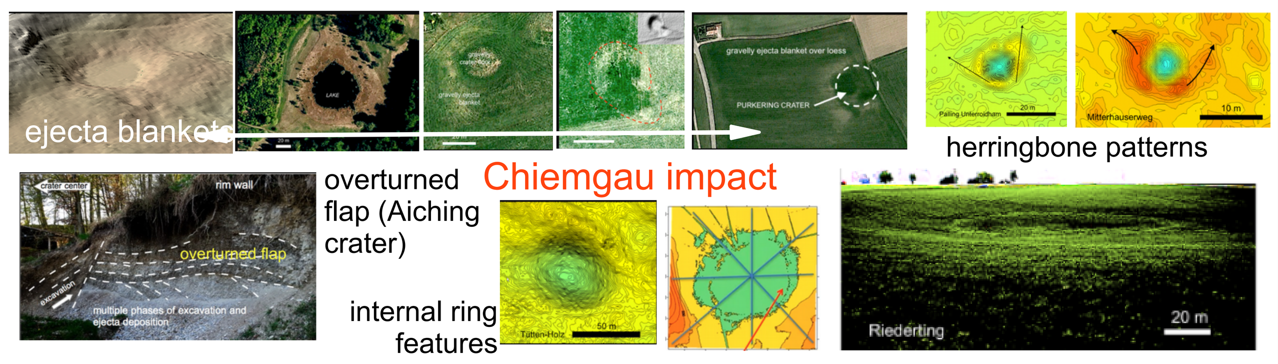
References Kenkmann et al. - Sheep Mountain (SM) The crater field at the northeastern flank of the Sheep Mountain anticline contains a large number of circular, irregular-shaped, and ellipsoidal impact structures.



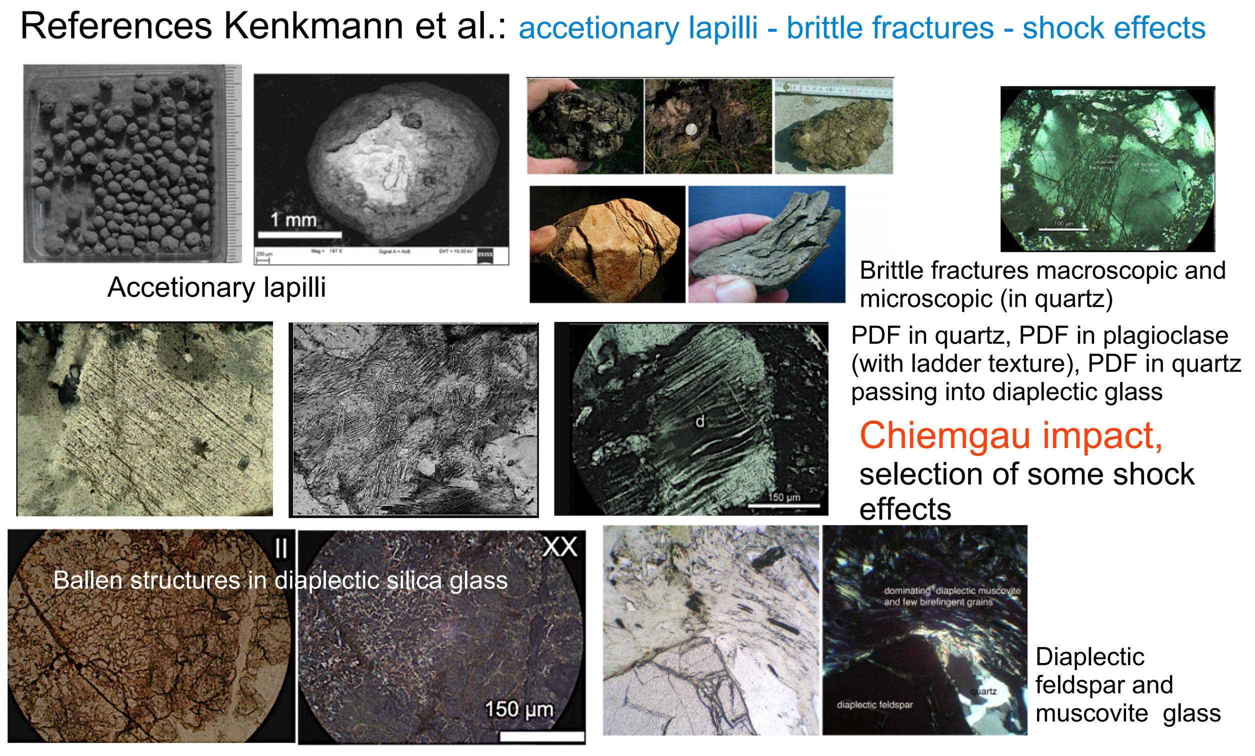
References Kenkmann et al. We observe irregular crater clusters and crater chains, where craters partly overlap.



References Kenkmann et al. The freshest craters contain steep crater walls, raised rims with overturned ejecta flaps, and remains of the proximal ejecta blankets ... relics of ejecta interferences patterns ... known as herringbone patterns .... crater structures show internal ring features instead of a central morphological depression.



References Kenkmann et al.: accetionary lapilli - brittle fractures - shock effects



Discussion and conclusion

We summarize: ► The elongation of the postulated secondary craters (but only for roughly half) as assumed „signpost" to the primary crater remains without significance. Such an asymmetry can arise at the impact of a previously disintegrated asteroid or comet, or at the impact of the ejecta launched from a primary crater. Elongated craters may be also the result of overlapping double craters suggesting only an apparent impact direction. ► Apart from these limitations, our reprocessing of the Google Earth craters presented by Kenkmann et al. with the data of proven structures shows that the evaluation of Kenkmann et al. cannot be replicated in the vast majority of cases. The conclusions derived from the data regarding a direction of corridors to a primary crater must be considered irrelevant. ► For many of the craters, our evaluation of the broader environment, apparently ignored by Kenkman et al., shows that the alleged secondary craters are not independent structures, but are exposed and centered circularly symmetrically on a hill. We interpret the alleged secondary craters as a type of peak ring formed during a major impact into an unconsolidated target according to the water drop model. ► A secondary crater field logically requires a primary large impact crater. Such a primary crater does not exist so far, neither morphologically nor geologically. The negative gravity free-air anomaly (which is not shown in the article) is a fundamental methodological mistake, because geophysically relevant is the Bouguer anomaly. At the location of the free-air anomalies the map of the Bouguer anomalies does not show any special feature suggesting a large impact structure there. ► The claim that a crater strewn field as extensive as Wyoming's would not be consistent with a primary impact ignores reality.The claim is supposedly supported by a 20 years old model calculation and by a comparison with some densely clustered small fields what we have mentioned in the text before. The claim is contradicted by the three larger impact strewn fields of Campo del Cielo, Bajada del Diablo (very likely), and Chiemgau, which are best described in the literature but are not mentioned with a single word. We also miss in the reference the Carolina Bays probable true secondary crater field of the suspected YDB impact. A comparison of the Wyoming field with the Chiemgau impact field of similar extent but with far more than 100 craters in an elliptical strewn field shows that practically all features of the Wyoming craters described occur in almost identical formation in the Chiemgau craters.

We conclude that the Wyoming secondary crater field is a pure fiction and not supported by anything. Nowhere is there any robust evidence for the existence of an associated primary crater