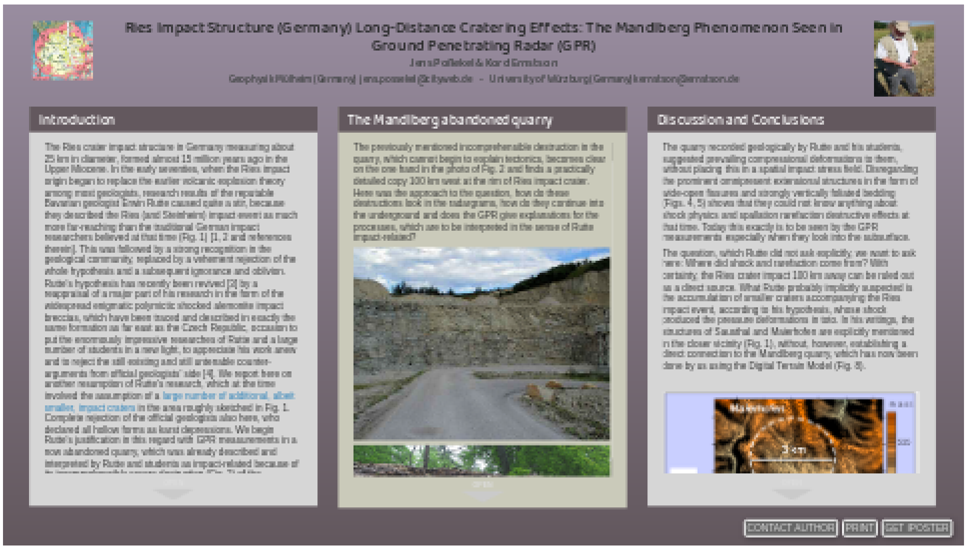
# Ries Impact Structure (Germany) Long-Distance Cratering Effects: The Mandlberg Phenomenon Seen in Ground Penetrating Radar (GPR)




Jens Poßekel & Kord Ernstson

Geophysik Mülheim (Germany) jens.possekel@cityweb.de - University of Würzburg (Germany) kernstson@ernstson.de




**PRESENTED AT:**

## INTRODUCTION

The Ries crater impact structure in Germany measuring about 25 km in diameter, formed almost 15 million years ago in the Upper Miocene. In the early seventies, when the Ries impact origin began to replace the earlier volcanic explosion theory among most geologists, research results of the reputable Bavarian geologist Erwin Rutte caused quite a stir, because they described the Ries (and Steinheim) impact event as much more far-reaching than the traditional German impact researchers believed at that time (Fig. 1) [1, 2 and references therein]. This was followed by a strong recognition in the geological community, replaced by a vehement rejection of the whole hypothesis and a subsequent ignorance and oblivion. Rutte's hypothesis has recently been revived [3] by a reappraisal of a major part of his research in the form of the widespread enigmatic polymictic shocked alemonite impact breccias, which have been traced and described in exactly the same formation as far east as the Czech Republic, occasion to put the enormously impressive researches of Rutte and a large number of students in a new light, to appreciate his work anew and to reject the still existing and still untenable counter-arguments from official geologists' side [4]. We report here on another resumption of Rutte's research, which at the time involved the assumption of a large number of additional, albeit smaller, impact craters (https://www.hou.usra.edu/meetings/lpsc2021/pdf/1851.pdf)in the area roughly sketched in Fig. 1. Complete rejection of the official geologists also here, who declared all hollow forms as karst depressions. We begin Rutte's justification in this regard with GPR measurements in a now abandoned quarry, which was already described and interpreted by Rutte and students as impact-related because of its incomprehensibly severe destruction (Fig. 2) of the otherwise well-bedded Jurassic limestones.

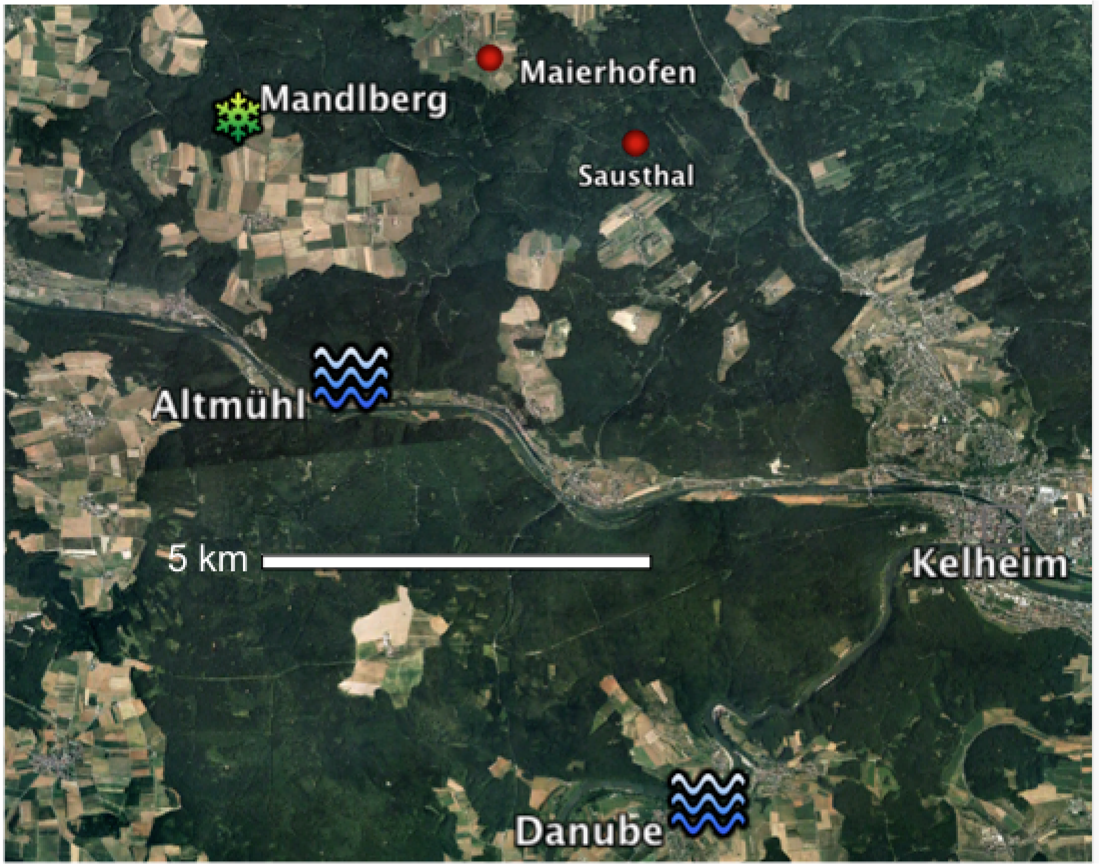



**Fig.1. Location maps. M = Mandlberg and Maierhofen in the hatched area (upper map) = concentration of Rutte's research.**

# THE MANDLBERG ABANDONED QUARRY

The previously mentioned incomprehensible destruction in the quarry, which cannot begin to explain tectonics, becomes clear on the one hand in the photo of Fig. 2 and finds a practically detailed copy 100 km west at the rim of Ries impact crater. Here was the approach to the question, how do these destructions look in the radargrams, how do they continue into the underground and does the GPR give explanations for the processes, which are to be interpreted in the sense of Rutte impact-related?

**Figs. 2. How the images resemple each other: For comparison: Malmian limestone at the Ries crater rim near Wemding (upper, photo 2001) and 100 km apart in the Mandlberg quarry (lower), which is uncompatible with any normal tectonic concept.**

### *Data*

GPR equipment Transient Technologies VIY3-300, 300 MHz antenna (Fig. below); total length of GPR profiles about 1,200 m in and around the quarry (Fig. 3); registration depth 8 m, sampling rate 0.03 m; data processing with program REFLEX.

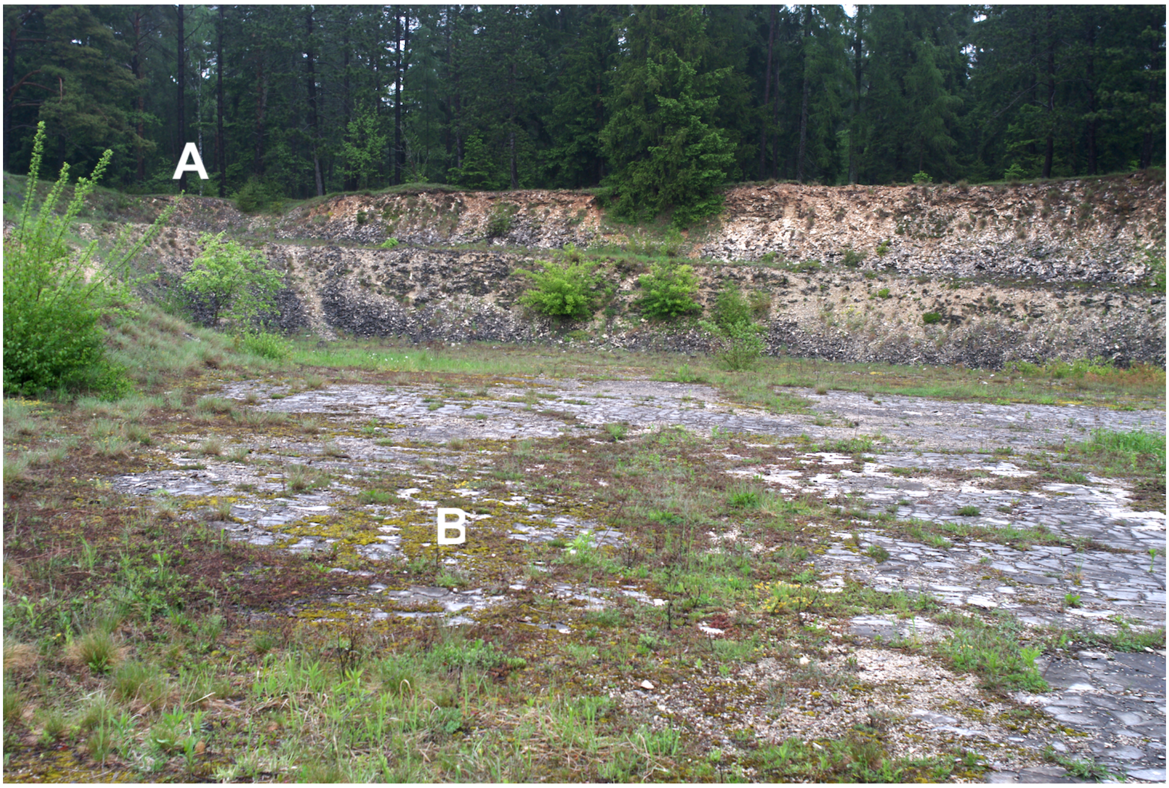



**Fig. 3. The places for which radar results are discussed here: A = above the quarry wall in Fig. 2, B = on the in-situ limestone of the quarry floor.**

### *GPR results*

The largely preserved quarry walls have provided a fine opportunity to compare the geologic evidence directly with the image of radargrams measured immediately above the quarry edge (Fig. 4). The assignment of the reflection patterns to the bedding of the limestones is remarkably good.

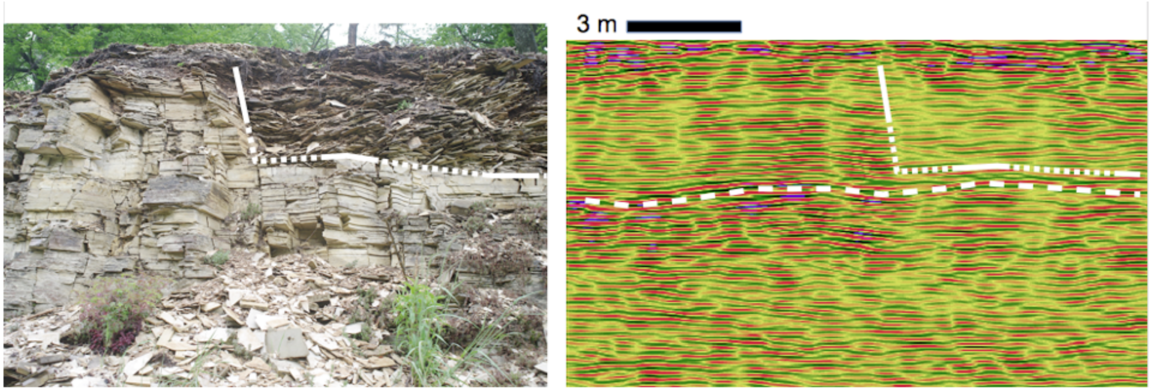



**Fig. 4. Corresponding geology and GPR for the exposure in Fig. 2.**

***Verical shock rarefaction stress***

In Fig. 5 a structural peculiarity is marked, which can be described as a kind of opening of the destroyed stratification, which raises the question of what caused this spreading. Something comparable is known from the Jurassic limestones of the Azuara (Spain) impact structure (Fig. 5), where it is explained as a rarefaction spallation effect of shock wave reflection. It seems reasonable to assume the same effect in the Mandlberg quarry.

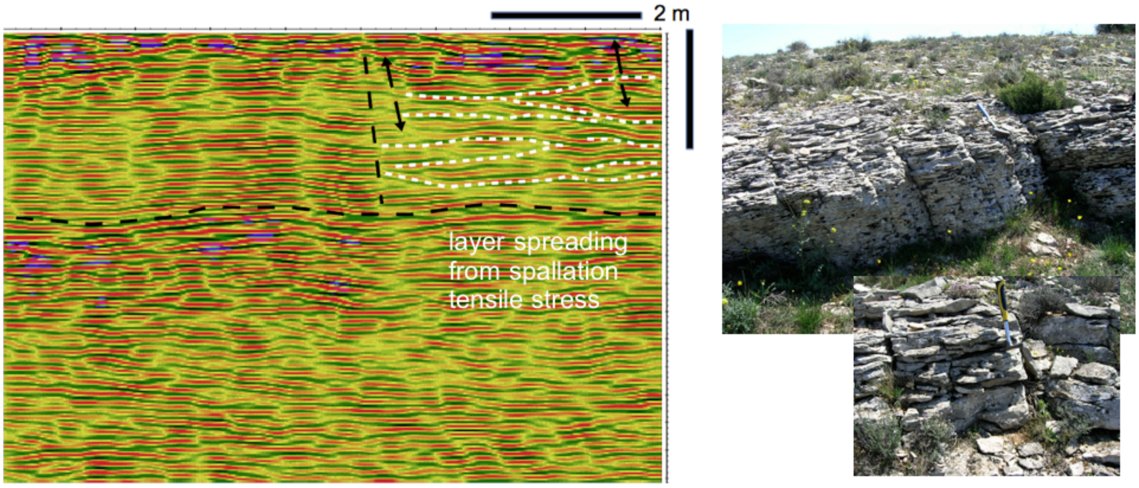



**Fig. 5. Vertical spreading of limestone beds in the Mandlberg quarry (Fig. 4) and comparable rarefaction shock effects in Jurassic limestones, Azuara impact structure.**

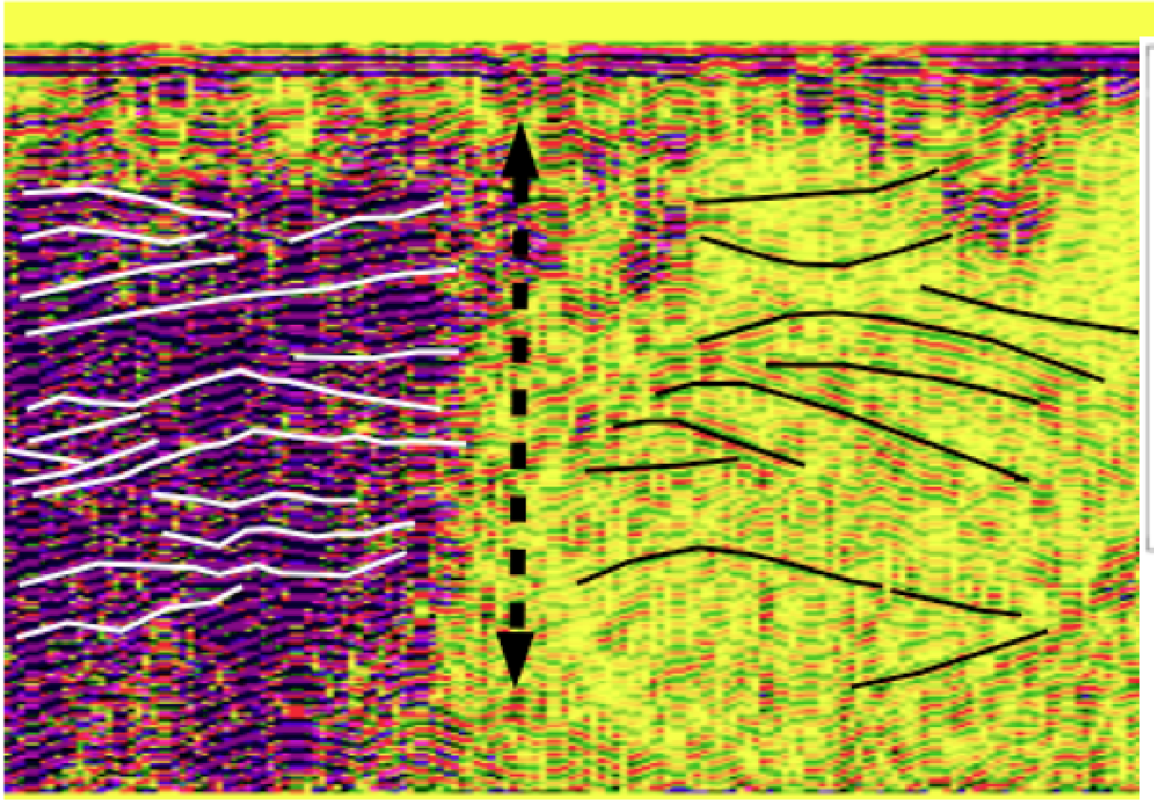


**Fig. 6. More vertical spreading of the Malm limestone stratification from spallation tensile stress; here down to several meters below the quarry floor. Vertical and horizontal spreading meet on the long profile of Fig. 7. The latter is discussed below.**

***Horizontal shock rarefaction stress***

A completely different aspect is shown by the longer profile on the quarry floor (Fig. 7.) with a split into partly sharply vertically bounded blocks of strongly different reflectivities, which in turn are divided into vertical reflection bands of 5-10 m width with a certain periodicity.

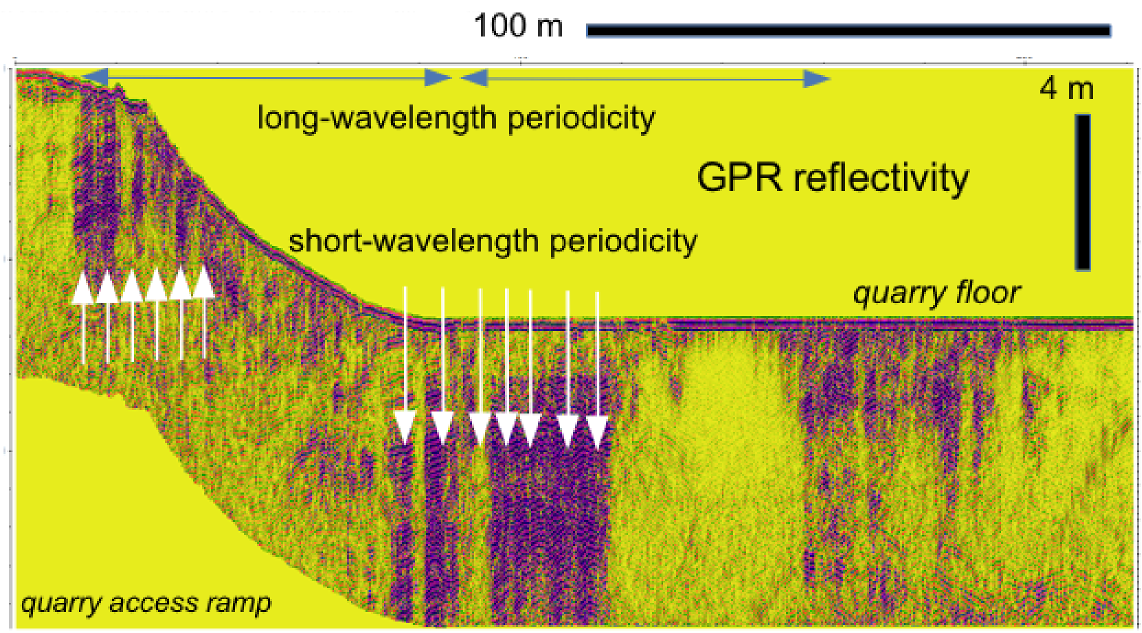



**Fig. 7. Horizontal shock rarefaction stress: note for comparison the experimentally shocked glass rod in Fig. 8.**

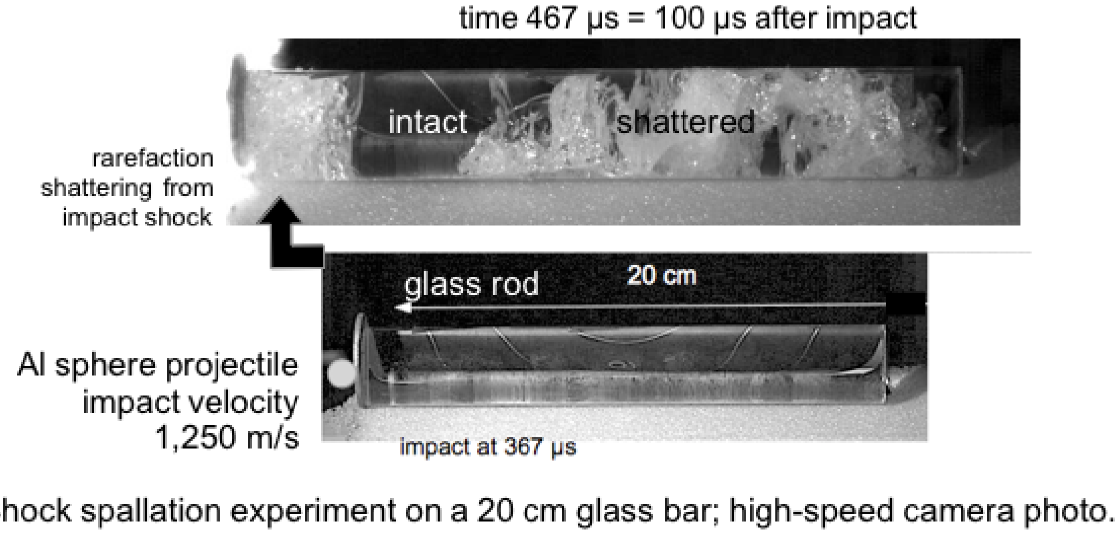



**Fig. 8. Shock spallation experiment on a 20 cm glass bar; high-speed camera photo. Only 100 µs after the impact of the 6 mm aluminum projectile, about 2/3 of the glass rod is shattered by the shock of the reflected rarefaction, with sections remaining completely intact. Experiment and camera W. Mehl. Click here for more information on impact spallation and experiments.. (http://www.impact-structures.com/impact-educational/meteorite-impact-spallation-from-mega-to-micro-scale/)**

Normal geological processes (diagenesis, tectonics) for this structure, which extends to a depth of at least 8 m (= about 15 m below terrain surface), are ruled out, but this is strongly reminiscent of a destruction structure in shock experiments (Fig. 8). In this sense and in the context of the impact discussion for the Mandlberg, horizontally propagating shock and rarefaction waves would have to be considered as the engine of these remarkable structures.

## DISCUSSION AND CONCLUSIONS

The quarry recorded geologically by Rutte and his students, suggested prevailing compressional deformations to them, without placing this in a spatial impact stress field. Disregarding the prominent omnipresent extensional structures in the form of wide-open fissures and strongly vertically foliated bedding (Figs. 4, 5) shows that they could not know anything about shock physics and spallation rarefaction destructive effects at that time. Today this exactly is to be seen by the GPR measurements especially when they look into the subsurface.

The question, which Rutte did not ask explicitly, we want to ask here: Where did shock and rarefaction come from? With certainty, the Ries crater impact 100 km away can be ruled out as a direct source. What Rutte probably implicitly suspected is the accumulation of smaller craters accompanying the Ries impact event, according to his hypothesis, whose shock produced the pressure deformations in toto. In his writings, the structures of Sausthal and Maierhofen are explicitly mentioned in the closer vicinity (Fig. 1), without, however, establishing a direct connection to the Mandlberg quarry, which has now been done by us using the Digital Terrain Model (Fig. 8).

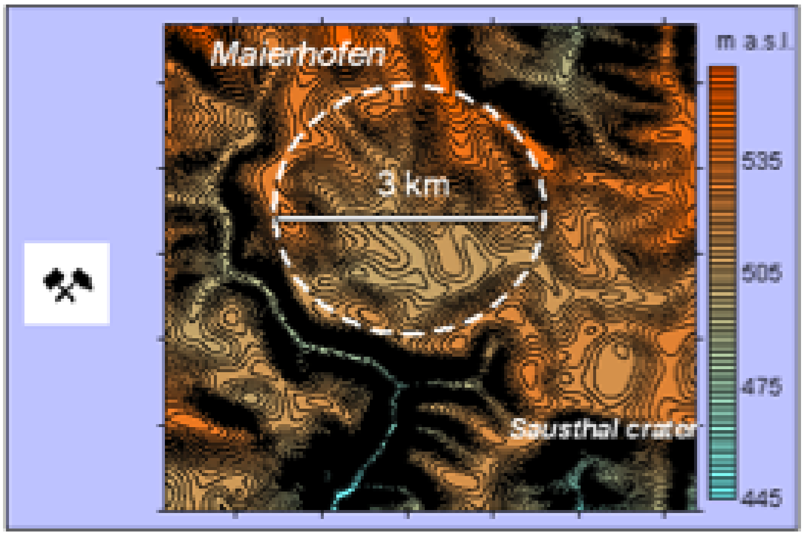



**Fig. 9. Digital Terrain Model (DGM 25) of the Maierhofen crater with an (inner?) rim wall diameter of 3 km. The Mandlberg quarry is in the very proximity. Also click HERE.. (https://www.hou.usra.edu/meetings/lpsc2021/pdf/1851.pdf)**

### *Conclusions*

The details of the shock and rarefaction processes in the Mandlberg quarry are still not understood, but amazing similarities with experimentally generated spallation structures are very remarkable. The extensive and prominent features found with GPR exclude a reference to "normal" geological processes. The objections to the Rutte hypothesis and the past and present rejections of official geological positions to a much larger impact event that had an effect far beyond the mere formation of the Ries crater are no longer acceptable and a fundamental rethinking of official Bavarian geology is urgently needed.

#### *References*

[1] Rutte, E. (1971) Geoforum, 7, 84- 92, ] [2] Rutte, E. (2003) Land der neuen Steine, 110 p., Regensburg (Univ.Verlag); [3] Ernstson et al. (2019) 50th LPSC, 1370.pdf; [4] Eichhorn, R. et al. (2012) Nicht von dieser Welt - Bayerns Meteorite (LFU, ed.), 126 p.;