SHATTER CONES IN LITERMONT QUARTZITES: SAARLOUIS/NALBACH (SAARLAND, GERMANY) METEORITE IMPACT EVENT STRENGTHENED. [1]U. Siegel, [2]J. Rommelfangen, [3]W. Müller, [4]S. Michelbacher and [5]K. Ernstson, [1,2]University of Luxembourg, Dept. of Physics and Materials Sciences, Luxembourg (jonathan.rommelfangen@uni.lu, ulrich.siegel@uni.lu) [3]66809 Nalbach, Germany (edumueller@t-online.de) [4]Historisches Museum Wallerfangen, 66798 Wallerfangen, Germany (hmw-miba@t-online.de) [5]Universitity of Würzburg, 97074 Würzburg, Germany (kernstson@ernstson.de).

Introduction: The Saarland impact (Fig. 1) [1-5] has been an established event for several years with the existence of two craters with diameters of about 200 m (Nalbach) and Saarlouis (2.3 km). Finds of rocks and glasses in a strewn field (Fig. 1) with typical impact features (e.g. suevites) strengthened the impact hypothesis and initiated comprehensive mineralogical SEM-EDS and thin section analyses establishing strong shock metamorphism. Here we report on recent finds of shatter cone fracture markings diagnostic of meteorite impact shock.

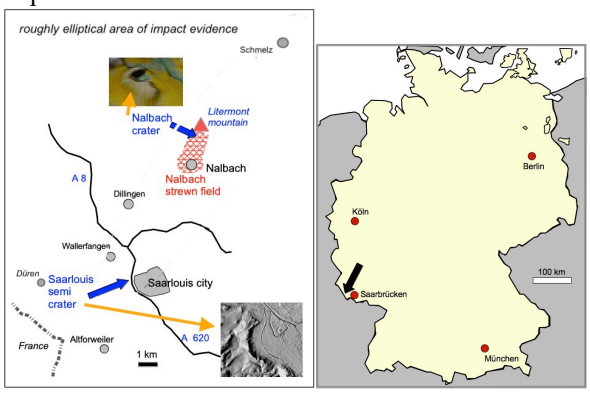

Fig.1. Location map for the Saarland impact event.

Shatter cones: Shatter coning in rocks is generally considered in impact research a result of shock stress under high pressure (2 GPa and more) and thus diagnostic for meteoritic impact. Shatter cones are not known from other geological processes. Often incorrectly called striae or striations (even by impact researchers), they are fracture surface markings that form on cone-shaped fractures in the rock during the passage of a shock wave. In many cases, these markings (Fig. 2) are typically referred to as horsetail structures, which significantly distinguish them from other fracture surface markings.

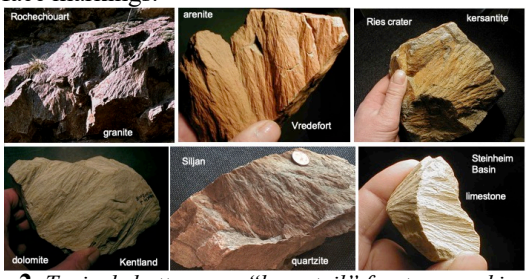

Fig. 2. *Typical shatter cone "horsetail" fracture markings in various lithologies from various impact structures [6].*

Litermont geology: The Litermont is a well-known elevation in the impact region under discussion and has always caused interest among geologists. It is at its core a Permian rhyolite mantled by silicified rocks of the Lower Rotliegend (silicified conglomerates and pure quartzite layers), which were uplifted with the rhyolite uplift. The subsequent overlying Buntsandstein was largely eroded, so that the old hard volcanic and quartzitic rocks now form the outcrop. The diversity of the rocks has repeatedly led to mining activities.

Fig. 3. *Quartzite blocks with shatter cones in the field.*

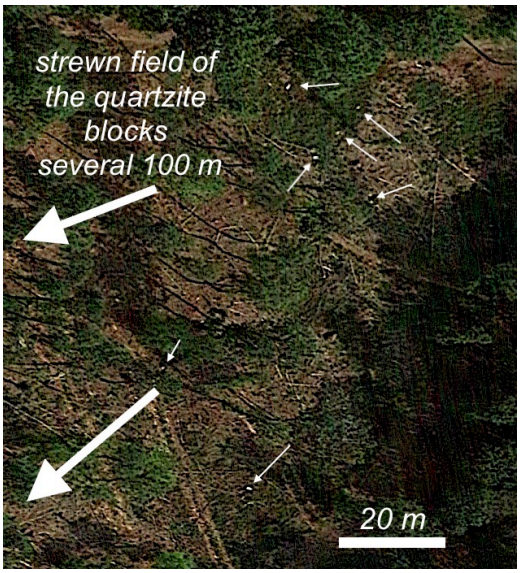

Fig. 4. *Enigmatic distribution of the widespread isolated big quartzite blocks (arrows) at the Litermont. Google Earth.*

The Littermont shatter cones: The recently discovered shatter cones in the Litermont area are attached to more or less large quartzite blocks, whose origin can be seen in the Lower Rotliegend strata uplifted with the rhyolite. The occurrence of these blocks and their bedding can be described as enigmatic, which is conveyed by Figs. 3 and 4. In sizes up to 2 m, mostly angularly broken, they extend over several 100 m from the Litermont and lie completely isolated in the distance of some decameters practically without deepening on the forest floor (Fig. 4). Partially they are crossed by open fissures (Fig. 6). However the most remarkable are internal breccia pockets (Fig. 6), which prove that brecciation occurred internally from the material of the quartzite blocks, which excludes tectonic stress. Geological opinions on this matter are not available. Among the population the strangeness of the spreading of the quartzite blocks is well known, but it is attributed to "the volcano". For a time, the quartzites at the Litermont were quarried for heat-resistant furnace walls. A connection with the isolated blocks scattered over hundreds of meters and weighing up to several tons requires a fair amount of imagination. The now discovered fracture surface markings of the Shatter cones (Fig. 5U.) show up in these blocks.

Fig. 5. *Shatter cone fracture markings in quartzite blocks at the Litermont. Weathering of the old fracture surfaces has dulled the horsetail structures for photography, which is illustrated with the arrows drawn in. What is known for the shatter cones in other impact structures is also seen here in the form of individual cones (above) and as a manifold superposition.*

Discussion: Shatter-coning in quartzite blocks at the Litermont is generally accepted in impact research as evidence of shock stress and meteoritic impact. We specify:

-- The find joins the previous extensively and widely demonstrated impact geology of the Nalbach/Saarlouis impact event.

Fig. 6. *Quartzite block with internal breccia pockets. S C = shatter cone. Note the open (tensile) cracks without lateral displacement.*

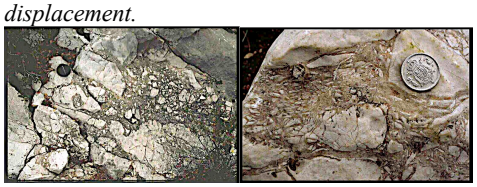

Fig. 7. *Breccia pockets in limestones; Azuara impact structure (Spain).*

Discussion (cont.)

-- A model so far not completely clarified sees recently increasingly discussed violent impact airbursts (e.g., [7], which hit the Earth's surface with enormous pressures and extreme temperatures of many 1,000 degrees without creating particularly large craters. The Saarland impact with large extension of strong impact evidence of at least 10 km with only two relatively small craters speaks for such an event.

-- At the Litermont the following could have happened: An airburst jet of extreme pressures and temperatures collides with the towering mountain, the shock waves produce the shatter cones in the Rotliegend quartzites, and the strong mass flow behind the shock front distributes the fractured quartzite layers as blocks which have survived the later weathering as hardened bodies until today.

-- More impact evidence is shown by the quartzite blocks with the open, tensile fractures pointing to shock spallation, and the internal breccia pockets, which have counterparts in other impact structures (Fig. 7).

-- The described model is a conception, which must be further verified.

References: [1] Ernstson, K. et al. (2013) *Meteoritics & Planet. Sci.*, 48, Issue s1, Abstract #5058. [2] Berger, N. (2014) Diploma thesis, University of Trier. [3] Berger, N. et al. (2015) *46th LPSC*, Abstract #1255. [4] Ernstson, K. et al. (2018) *49th LPSC*, Abstract #1876. [5] Ernstson, K. et al. (2021) *52nd Lunar and Planetary Science Conference*, Abstract #1350. [6] Ernstson, K. and Claudin, F. [http://www.impact-structures.com/impact-rocks-impactites/the-shatter-cone-page/shatter-cones-from-impact-structures-worldwide. [7] Boslough, M. (2015) Airburst Modeling, https://www.osti.gov/servlets/purl/1328668.