GREAT SALT LAKE ASTROBLEME (GSLA): IMPACT GEOLOGY FIELD EVIDENC.

R. C. Fox[1] and K. Ernstson[2], [1]Geophysicist/Geologist, retired, 5 Gott Lane, Salmon, ID 83467, USA (geofox67@gmail.com), [2]University of Würzburg, 97074 Würzburg, Germany (kernstson@ernstson.de).

Introduction: In 1987, Dr. Robert E, Cohenour, recipient of a PhD in Geology from the University of Utah in 1957, published a paper titled "The Asteroidal Impact Theory and Some Geologic Evidence for Asteroidal Impacts on Earth" [1]. It presented a logical argument for terrestrial impacts and their associated effects at a time when there was little knowledge about or interest in terrestrial impact geology. Exactly in this spirit and in the same year he published a paper titled "The Great Salt Lake Astrobleme (GSLA)" [2]. This paper based on an enigma related to the "Northern Utah Highland", a geologic feature devoid of approximately 10,700 meters of Paleozoic sediments. These sediments occur in the surrounding mountain ranges, but abruptly terminate at the margin of the 'highland', exposing primarily Precambrian rocks overlain by early Tertiary rocks. The missing section of rocks was professed to be the source of heat and pressure that produced the, now exposed, underlying Precambrian Farmington Canyon metamorphic complex. Cohenour's 1987 paper was virtually ignored by the local geological community, a community seemingly unfamiliar with and disinterested in impact geology, which, however, could give no explanation for the missing 10.7 km sedimentary section. Revisitation of the GSLA in the last decade was induced by an awareness of recent and ongoing geological investigations [3], misguided by a lack of acceptance and appreciation **of** its effects.

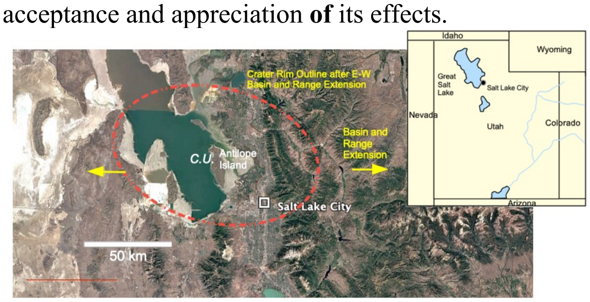

Fig. 1. *Map of the proposed impact structure. Google Earth. The elliptical shape is attributed to Basin and Range deformation. Antelope Island is suggested to be part of a central uplift (C.U.) formation.*

Using Cohenour's description of the Great Salt Lake astrobleme, and its probable outline in Fig. 1, the field sites in Fig. 2 were examined for evidence of impact geology associated with an enormous K/Pg impact event centered on Antelope Island.

Impact features: The following compilation of a small selection of geologic outcrops with impact evidence is divided into the following groups for clarity: Landscape Exposures - Outcrops - Samples (impactites in the broadest sense).

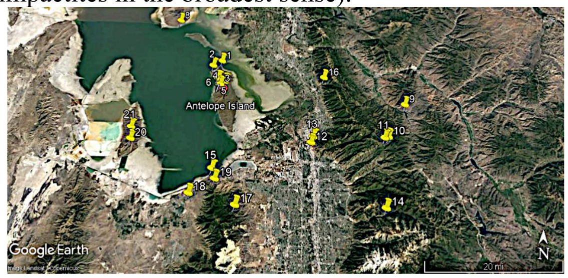

Fig. 2. *Location map of the visited 21 impact sites to be presented here.*

Landscape Exposures: Over large areas, the landscape of the GSLA is formed by characteristic formations alien to "normal" geology (Fig. 3). These include huge megabreccias, exemplarily and conspicuously exposed on the postulated Antelope Island central uplift and in the Paleozoic of the crater rim, in massive blankets up to several 100 m thick of spreading ejecta masses, as well as massive overturned and fragmented mountain complexes.

Fig. 3. *Impact Landscapes*, *From upper left to lower right: Megabreccias on Antelope Island proposed GLSA central uplift - Ejecta blanket, 500 m exposed thickness, Mt. Dell Canyon, SR-65 - Stansbury Island looking northerly, overturned anticline, west directed – Stansbury Island west side, generally brecciated Paleozoic bedrock, product of gravity slide from SW impact crater rim.*

Outcrops: From the immense amount of typical impact outcrops, as they are known from impact structures all over the world, only a few GSLA examples can be presented here. Dominating are breccia outcrops with monomictic and polymictic breccias, multiple breccia generations and breccia dikes in monomictic and polymictic facies, and, in impact structures of this importance, impact shock-produced shatter cones.

Fig. 4. *From upper left to lower right: Brecciated Tintic quartzite, west side of Antelope Island (AI) visitor center – Impact megabreccia, Split Rock Trail (AI) – Shatter cones, N side of Buffalo Point (AI) – Breccia dikes, Split Rock Trail (AI) - Evidence of over-pressure degassing vents in fractured Kelley Canyon dolomite – mega-brecciated red granite gneiss, central uplift region.*

Impactite Samples - Breccias: Breccias are a significant constituent of impact structures due to the established contact/compression, excavation and modification stages of impact cratering. The GSLA is no exception, and the richness of megabreccias, monomictic, polymictic and dike breccias in the field may even be called characteristic.

Fig. 5. *Various aspects of GSLA impact breccias: Polymictic and monomictic breccias; breccia generations. From left to right: Impact breccia, Split Rock Trail (AI) – Mineral Fork, Big Cottonwood ejecta blanket – Polymictic impact breccia with flow texture, Harkers Canyon, Oquirrh Mtns – Shocked (PDFs) polymictic breccia, East Canyon Reservoir dam site.*

Samples – Deformations: What is easy to see, the abnormal physical processes such as extreme temperatures and pressures within extremely short time also play an essential role in the purely mechanical stress with characteristic deformations of pebbles, cobbles and boulders. Known and described in detail, such deformation has been observed for the Ries crater and the Rubielos de la Cérida impact basin from the multiple Azuara impact event, but also from the Chicxulub ejecta and from the Araguainha impact structure (e.g., [4-7]), where high-pressure/short-term deformation and spallation are the particularly significant features. In the GSLA ejecta they occur unmistakably and abundantly (Fig. 6).

Fig. 6. *Impact deformations in GSLA ejecta deposits.*

Samples – Shock Metamorphism: Shock effects, as an unmistakable feature and diagnostic of impacts, are found primarily in the widespread quartzites, especially in the central uplift of Antelope Island. Multiple sets of PDFs are the rule (Fig. 7), and in some thin sections up to 80% of the quartz grains show PDFs.

Fig.7. *Multiple sets of planar deformation features (PDFs) in quartz prove impact shock.*

Discussion and conclusion: Cohenour's 35 years old model and textbook knowledge of meteorite impact cratering as an established geologic process, were (and are) unerring guides to geologic characteristics uniquely associated with impacts. Tectonic and glacial models, even today, adhered to by Utah local geologists, are unable to explain the multitude or the host of these typical impact features, not to speak of the stratigraphic "impossibility" of the absence of an almost 11 km thick Paleozoic sedimentary sequence, associated with some 50,000 km^3 of disappeared masses in the area of the impact structure. There is little doubt that the GSLA should be considered a large impact structure that formed around the K-Pg boundary.

References: [1] Cohenour, R.E. and Sharp, B.J. (1987) *Utah Geol. Ass. Publ.*, 16, 105-132. [2] Cohenour, R.E. (1987) *Utah Geol. Ass. Publ*., 16, 133-150. [3] King, J.K. and Willis, G.C. (2000) *Misc. Publ. 00-1, Utah Geol. Surv*. [4] *http://www.impact-structures.com/meteorite-impact-germany/the-ries-impact-structure-germany/deformations* [5] Claudin, F. et. al. (2001) *6th ESF IMPACT workshop, Impact Markers in the Stratigraphic record*, Abstracts pp. 15-16. [6] Ernstson, K. et al. (2001) *Geology*, 9, 11-14. [7] Rampino, M.R. et al. (1996) Abstracts with Prog., Geol. Society of America, 28, A-182.