PRELIMINARY RECONNAISSANCE OF THE BELTON STRUCTURE, A POSSIBLE IMPACT CRATER IN CASS COUNTY, MISSOURI. R. E. Beauford[1] and K. R. Evans[2]. [1]Arkansas Center for Space and Planetary Sciences, MUSE 202, University of Arkansas, Fayetteville, AR, 72701, USA. rbeaufor@uark.edu. [2]Geography, Geology, and Planning, Missouri State University, Springfield, Missouri 65897, USA. kevine-vans@missouristate.edu.

Introduction: Initial field and laboratory investigation of the Belton Structure was undertaken in order to determine whether the structure could represent a small to medium sized meteorite impact crater. Consideration of existing descriptive literature, rock samples and new digital elevation modeling (figure 1) suggests that renewed examination of the structure is justified. Thin sections produced from rock samples collected within the raised central area of the structure produced inconclusive but suggestive evidence in the form of intense mechanical twinning in calcite, while acid reduction of the same carbonate samples produced very limited data. While no unambiguous evidence was found during initial study, we propose that a reinterpretation of previously reported morphology, combined with our initial results, justifies tentative consideration of the structure as a possible impact crater.

Location, History, and Timing Constraints: The Belton Structure is located beneath and southwest of the city of Belton, Missouri, (figure 2) in the northwest corner of Cass County, about 30 km south of Kansas city, Missouri. It is recorded in the Belton 7.5-minute quadrangle [1]. The structure is centered at approximately 38° 47' 30" N. by 94° 33' 15" W., and measures approximately 5.5 km from elevated rim to elevated rim. High angle normal faults encircle an inner area approximately 3.5 to 4 km in diameter [1], consisting of an annular basin surrounding a raised center. The raised central area of the structure falls largely within Section 22 Township 46 North Range 33 West. The age of the disturbance is stratigraphically constrained to the late Pennsylvanian or later [1].

The first report of stratigraphic disturbances and faulting at the Belton location was published by Wilson [3], during investigations for oil and gas in the region. Clair [4], again investigating for oil and gas resources, described and named the structure the Belton Fault Complex. Wilson reported extreme folding and faulting that made up a region that was "so complex as to prohibit practical representation" [3] within the context of his mapping. Gentile, in 1984 [1] described an "intensely folded and faulted structure," and mapped and described it in significant detail. Gentile renamed the structure the Belton Ring-fault Complex.

Investigation: An abrupt, encircling rampart is strikingly evident during fieldwork. Within the structure, deep topsoil currently covers nearly all rock outcrops, making surface investigation challenging. Two samples were collected from the central rise.

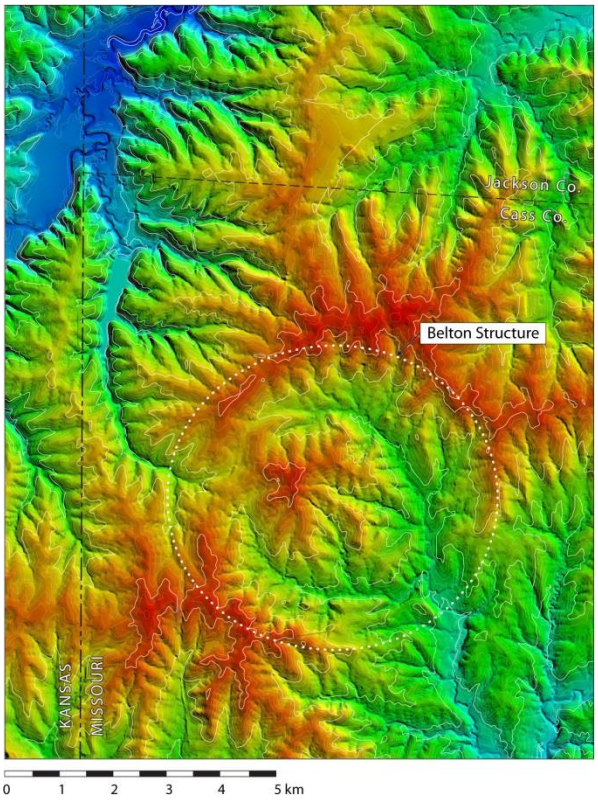

Figure 1. A 5.5 km elevated rim, inconsistent with a karst origin, encircles the previously mapped 3.5 to 4 km [1] Ring-fault Complex with its associated annular basin and central rise.

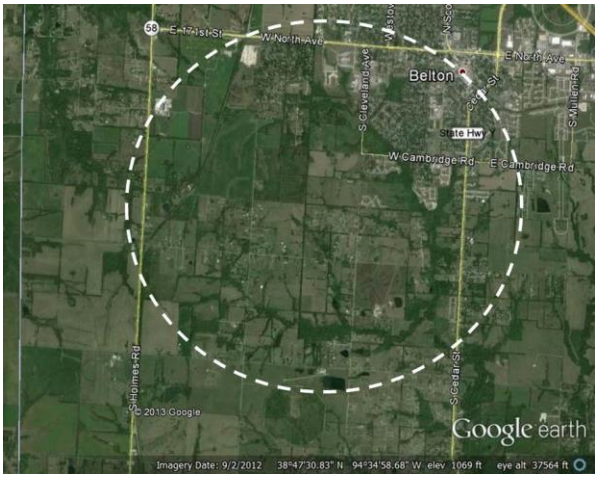

Figure 2.. The city of Belton overlaps the northeast corner of the structure. The remainder is lightly populated or agricultural. Drainages follow the annular basin.

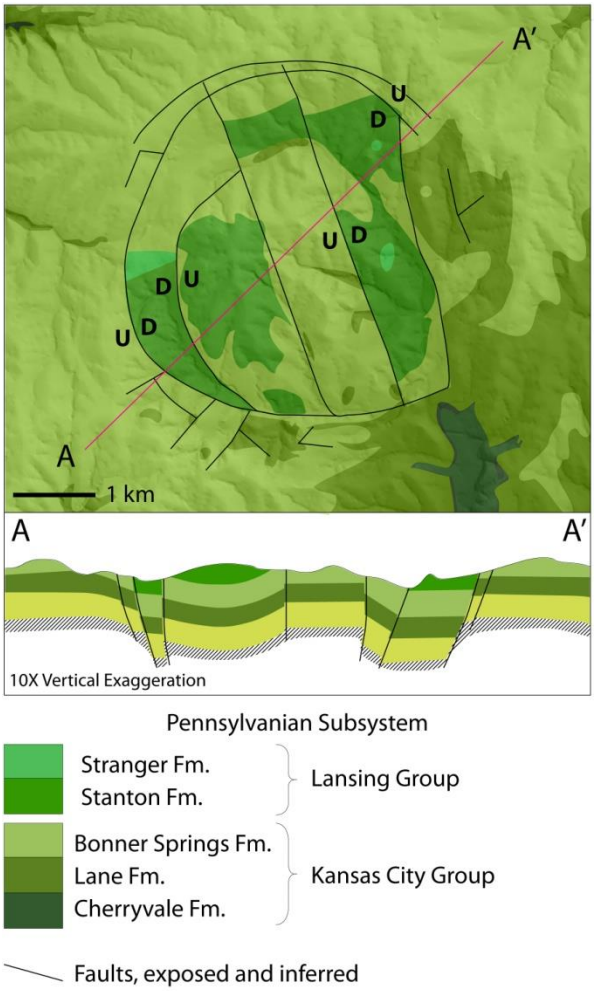

Figure 3. Cross section and top-down maps present a nearly 'textbook' resemblance to morphology expected in a small complex crater. Modified after Gentile, 1983 [1].

Thin sections prepared from the samples revealed abundant mechanical twins in calcite (figure 4). In addition to the portions of the sample that were prepared and examined as thin sections, one kg of sample material was subjected to acid digestion. The technique produced less than 0.1 grams of very small silicate grains. A grain mount produced from this material has produced several possible incidents of planar fractures in quartz, but no clear examples. Future work will be necessary in order to test inconclusive findings and to differentiate mechanical twinning in calcite due to tectonic strain from similar results that can be produced by shock [5].

Discussion: Gentile [2], examining the results of drilling in the area, proposed an origin through karst collapse into solution cavities >300 meters below the surface, near the igneous basement. He reported extremely complex faulting and folding and extensive brecciation. The structure is delineated by a strongly circular perimeter of high-angle faults surrounding a circular, depressed annular basin, which in turn encircles a slightly raised central region. Gentile also mapped, but did not discuss, a raised rim which surrounds the structure, overlapping the circular faulted zone. This is more clearly revealed in the present DEM (figure 1). Both the depth of the structure and the presence of an encircling elevated rim are strongly inconsistent with typical karst processes. Gentile's [1] cross-sectional diagram presents an almost 'textbook' illustration of a small complex structure with a rebounded center (figure 3).

Conclusions: We observe a raised rim surrounding the ring-fault complex previously described by [2]. The presence of a raised rim and the reported depth of the disturbance are factors specifically inconsistent with previous interpretation and are typical of a complex impact structures preserved in sedimentary rock, an origin to which the structure morphologically conforms in several other regards as well. We propose that morphological evidence, combined with observations of significant mechanical twinning in calcite from the raised central area of the structure, suggests that consideration of the structure as a 'possible' impact crater is not unreasonable, and that further investigation to confirm or refute the possibility is strongly justified.

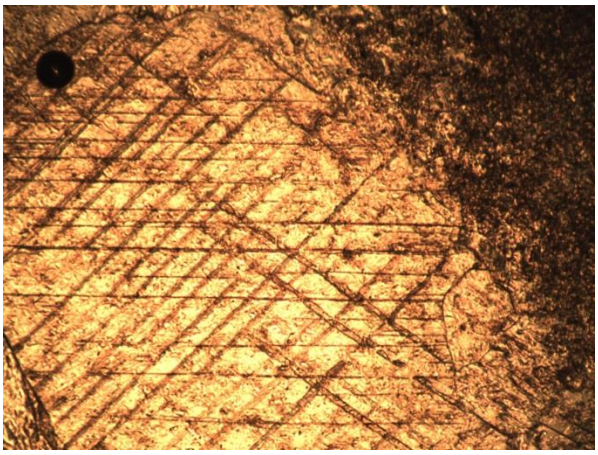

Figure 4. Mechanical twinning in calcite revealed in thin section.

Acknowledgment: Thank you to Jerri Stevens for assistance during field work.

References: [1] Gentile R. J. (1983) Missouri Geo. Survey RI-69 pl-1, Bedrock Geology. [2] Gentile R. J. (1984) Missouri Geo. Survey Report of Inv. 69. [3] Wilson M. E. (1918) Missouri Bureau of Geology and Mines. [4] Clair J. R. (1943) Missouri Geo. Survey and Water Resources, 2nd ser., v. 27. [5] Osinski G. R. and Pierazzo E. (2013) Wiley-Blackwell.