MAPPING THE CENTRAL UPLIFT OF THE SERPENT MOUND IMPACT STRUCTURE; IMPLICATIONS FOR CRATER DIAMETER AND TIMING OF THE IMPACT EVENT. L. P. Jacobs, Department of Geological Sciences, Ohio University, Athens OH 45701 (lj639412@ohio.edu)

Introduction: The Serpent Mound impact structure is a complex crater by type located in southern Ohio along the western edge of the Appalachian Basin. Previous studies [1] utilized morphometric relationships derived from impact craters throughout the Solar System to suggest a final crater diameter that ranges from 10 - 25 km. This contradicted earlier mapping work that suggested a final crater diameter ranging from 7 – 8 km [2]. Using a different morphometric approach, this study sought to estimate the Serpent Mound impact structure's final crater diameter and use this information to further constrain the timing of the impact event.

Methods: This study has involved re-mapping the central uplift of the Serpent Mound impact structure and producing a detailed bedrock geologic map and cross section that properly identifies the lithologic units comprising megablocks within the central uplift. This has allowed for several morphometric relationships to be used in effort to estimate specific dimensions of the original impact crater.

Attempting to constrain the final crater diameter **(D)** was accomplished by determining the total amount of structural uplift **(SU)** within the central peak, and applying the morphometric relationship $\mathbf{SU = 0.086 D^{1.03}}$ [3]. Since structural uplift (SU) is characterized by the observed amount of displacement undergone by the deepest marker horizon [4]; the oldest most uplifted geologic unit within the central peak was used as the "marker horizon" for this study. In order to identify this unit, rock descriptions, structural measurements, and geospatial data was collected at each found rock exposure within a ~1.5km radius about the geographic center of the impact structure (39.0356° N, 83.4039° W). Lithologic units were described in detail based on mineralogy, textures, grain size, and faunal assemblage and compared to descriptions by [5] and [6].

Discussion: Prior to this study, the oldest rocks exposed within the central uplift were mapped as undifferentiated Ordovician material [2]. However, with a more detailed understanding of the faunal assemblage, several Ordovician geologic units can be differentiated in this region. This study discovered Middle Ordovician, Kope Formation at the surface within the central uplift based on the trace fossil *Cryptolithus tessellatus* [7]. Using the presence of this trace fossil as the marker horizon, the maximum amount of observable structural uplift is ~439m. When this value is plugged into the morphometric relationship derived by [3], the final crater diameter is calculated to be a mere 4.9km. This diameter is contradicted by the topographic expression of the ring graben that is 7-8km in diameter [2], and by studies that suggest a minimum crater diameter of 8.5-10km [1,8]. This discrepancy is likely due to the fact that the impact structure has experienced extensive erosion (>1400 ±390m [8]), and the idea that uplift decreases with depth as erosion ensues [4]. In order to reassess the crater diameter using a morphometric relationship, erosion of the feature used in the equation needs to be insignificant or miniscule.

One feature of complex craters that does not experience much change in position as erosion ensues, is the subsurface ring syncline relative to the central peak [9]. Using the extent of concentric normal faulting mapped by [2] as the diameter of the crater floor (D_f = 7-8km), and the morphometric relationship $\mathbf{D_f=0.19D^{1.25}}$ [10]; the final crater diameter (D) is calculated to be ~19km. In order to estimate the timing of the impact event, the original position of the target rock during the time of impact can be solved by use of the morphometric relationship regarding depth of excavation (d_e) and final crater dimeter (D) and $\mathbf{d_e=0.06D^{1.1}}$ [4]. The derived amount of excavated material at Serpent Mound is ~1.5km. Comparing this value to the combined thickness of undisturbed geologic units outside of the impact structure, places the impact event above Pennsylvanian strata. Therefore, any attempt to constrain the timing of the impact is well beyond a comparison to the exposed strata found within the state of Ohio.

References: [1] Milam K.A. (2010) *Ohio J. of Sci., 110(3),* 34-43. [2] Reidel et al. (1975) *Ohio Div. of Geol. Survey Bedrock Geology of the Serpent Mound Cryptoexplosion Structure, Ohio Div. of Geol. Sury.* [3] Grieve and Pilkington (1996) *J. of Aus. Geol. & Geophy., 16(4),* 399-420. [4] Grieve et al. (1981) *LPS, XII,* 37-57. [5] Swinford (1985) *Ohio J. of Sci., 85(5),* 218-230. [6] Baranoski et al. (2003) *Ohio Div. of Geol. Surv. Rep. of Investigations No. 146,* 48-53 [7] Fossils of Ohio (1996*) Bulletin 70,* 95. [8] Schedl (2006) *EPSL, 244,* 530-540. [9] Abels et al. (2000) *Springer,* 309-326. [10] Pike R. J. (1977) IEC, 489-509.