The Serpent Mound Impact Structure

The Serpent Mound Impact Structure is a hypothesized complex impact structure that existed between 10 and 25 km, proposed by Millan (2013), and that evidence of a crater rim exists and has not been removed by erosion.

Methods

Field Work
Field work for this study was completed during June and July 2016 and some time spent again in January 2017. Data collected during field work included topographic descriptions, geologic soils, and structural measurements. Data was collected from the outer margins of the impact structure approximately 5 km to 12.5 km away from the crater center based on the extent of deformation proposed by Reidel (1970) and Millan’s (2013) budgeted rim to diameter. Areas affected by glaciation were avoided because it is likely that the related erosion has removed these structures. The area affected by glaciation is in the northwest, west, and south of the impact structure so the study area was confined to the east.

Data Collection
Wherever there was exposure with exposed bedrock surfaces multiple entire and dip measurements were taken and averaged to reduce measurement error. Depending on the quality of the outcrop, between three and six measurements were taken at each site. It was important to dissemble between each tool, with the stacked pieces of the impact event are clearly visible, a trowel was taken to measure the expose and dip of large outcrop. The use of a large outcrop is necessary to avoid the influence of the strike and dip measurement. Where measuring entire and dip of the outcrop, the dip and strike, the orientation towards the line of the exposure and dip were taken to ensure accuracy.

The geographic position of field sites were recorded using a Global Positioning System (GPS) and by triangulation on USGS quadrangle maps with a compass when possible. The GPS used was a handheld Garmin Colorado map. A Brunton compass with an inclinometer was used to measure the strike and dip of strata surfaces. The field site was recorded using the GPS and the position was taken from the USGS map to aid in documentation.

Cartography
The geometric map and cross sections were drawn using Adobe Illustrator. Basemaps are USGS 7.5 minute topographic maps. The map and cross sections were formatted using the Federal Geographic Data Committee’s digital cartographic standards for geologic maps.

Results

The amount of offset recorded in the contacts never exceeded approximately 10% of the maximum amount of relief between the upper and lower bounding rocks. No faulting could be reported. However, the average dip of the outcropping rocks in this region is approximately 2° in the east. Some of the dips recorded during this study were found to vary quite considerably from their average. Additionally bedding was not noted across the mapping area.

Conclusion
Based on contact evidence, there is no faulting; therefore erosion has not removed the crater rim faults. The local variations in dips extend to approximately 4.5° (±0.5°) from the crater center, which are quite considerably from the regional dip which strongly suggests that they are associated with the impact. Local normal faults are the primary structures that facilitate the crater rim collapse (Keananm et al. 2014). The crater has been extensively eroded so the present ground surface may be in close proximity to the base of the crater rim faults. At the base of the crater, normal faults the primary component of displacement to lower rather than throw. The variable dips may be caused by local induced compression at the base of the fault scarp causing the rock to fail from. Another interpretation is that the minor faults are local compressional structures that form due to construction of the crater rim axis to its displaced downward and in the crater center (Keananm et al., 2014; Keananm et al., 2016). If either of these interpretations is true then the lack of local compressional structures associated with the impact event is approximately 10 km from the crater center which confires the hypothesis that the true crater rim diameter of the Serpent Mound structure is between 10 and 25 km, proposed by Millan (2013), and that evidence of a crater rim exists and has not been removed by erosion.