ELECTRICAL RESISTIVITY SURVEY OF A POSSIBLE IMPACT STRUCTURE, BRUSHY CREEK FEATURE, ST. HELENA PARISH, LA Don R. Hood[1], M. Horn[2], S. Karunatillake[1], C. Matherne[1], A. Webb[1], A. Sivils[1], the Brushy Creek Exploration team. [1]Louisiana State University Geology and Geophysics (dhood7@lsu.edu), [2]Louisiana Geologic Survey

Introduction: The Brushy Creek Feature (BCF, Fig 1) is a 2-km wide depression in eastern Louisiana first suggested in 2003 [1] to be a Pleistocene-age impact structure. This was originally evidenced by an abundance of fractured grains in the vicinity of the structure as well as planar deformation features, all of which were lacking in the surrounding Citronelle sediments. Since 2017, several geophysical surveys have been conducted at the BCF to search for evidence of the feature's impact origin. Previous surveys included Ground Penetrating Radar (GPR) [2] across the feature and gravity surveys [3]. In September 2019, we performed a new survey of subsurface resistivity along the same transect examined by GPR (Fig 1).

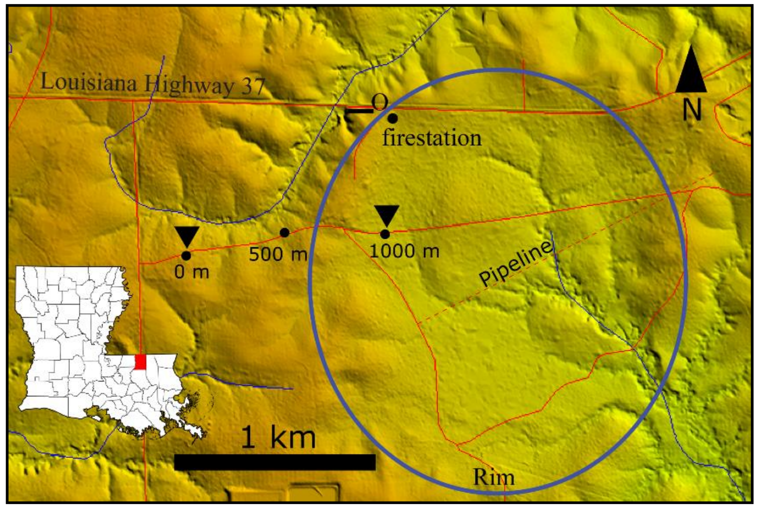

Figure 1. *Lidar DEM of the BCF with annotations. Reference locations, such as the intersecting highway, are marked. The blue ellipse marks the "rim" of the feature, a topographical high, and the dashed red line marks a buried pipeline. The traverse examined in the resistivity pseudosection (Fig 2) is marked with black triangles.*

Methods: The survey used a L&R instruments, four-terminal electrical resistivity meter in a dipole-dipole arrangement, with both the current and probe electrodes spacing (*a*) at 10m and the distance between the electrodes varying from 10-80m. This electrode arrangement was repeated to create a total survey length of 1100m (Fig 2). We surveyed along a road that intersects the structure "rim" (Fig 1) on the western side, avoiding the buried pipeline that runs NE across the property (Fig 1). The pipeline would likely introduce anomalies to any survey of the eastern "rim", making our transect optimal to examine geologic contacts near the rim. After collection, the measured resistances are processed using the GEOTOMO RES2DINV software which performs a 2-D inversion of the data to model the resistivity profile (Fig 2).

Results: The results of the 2-D inversion are shown in Figure 2 A, with a horizontal and vertical resolution of 5m. The profile is preliminary, and not topographically corrected, but the total relief along the survey is approximately 5m, so topographic corrections will be minor. The resistivity varies by approximately 2 orders of magnitude across the survey, with the lowest values east of the "rim" and within the BCF. The western portion shows a consistent layering of ~10m of lower-resistivity surface sediment, underlain by ~10m of higher resistivity sediments between. A lower-resistivity unit appears below ~20m on the western side of the survey and is laterally fairly consistent from 0-500m in the survey. There is an apparent high-resistance anomaly at ~500m between 10-20m below the surface. Between 700-800m, ~50m after the topographic "rim", there is a drastic shift in the resistivity pattern. The high-resistivity unit between 10-20m below the surface disappears, and the subsurface appears lower in resistivity and lacking in layering. Some higher-resistivity units appear at >20m below the subsurface in the eastern portion of the survey, but it is unclear if these represent a single consistent unit.

Interpretations: Figure 2 B shows the initial interpretations of the survey. The resistivity values in the survey are generally consistent with poorly consolidated sediments with varying porosity and the presence of groundwater. The Citronelle formation is known to vary vertically in granulometry both generally and within the vicinity of the BCF [4], so it is feasible that such variations are the principle cause of the changes in resistivity. However, the patterns of resistivity observed do not fit a simple model of vertically stratified and laterally continuous units. Both the units from 0-10m (MR) and 10-20m (HR) on the western side of the survey pinch out between 700-800m, replaced by lower-resistivity sediment (LR2). Given that the top unit (MR) is at least 10m thick, this cannot be explained topographically by the

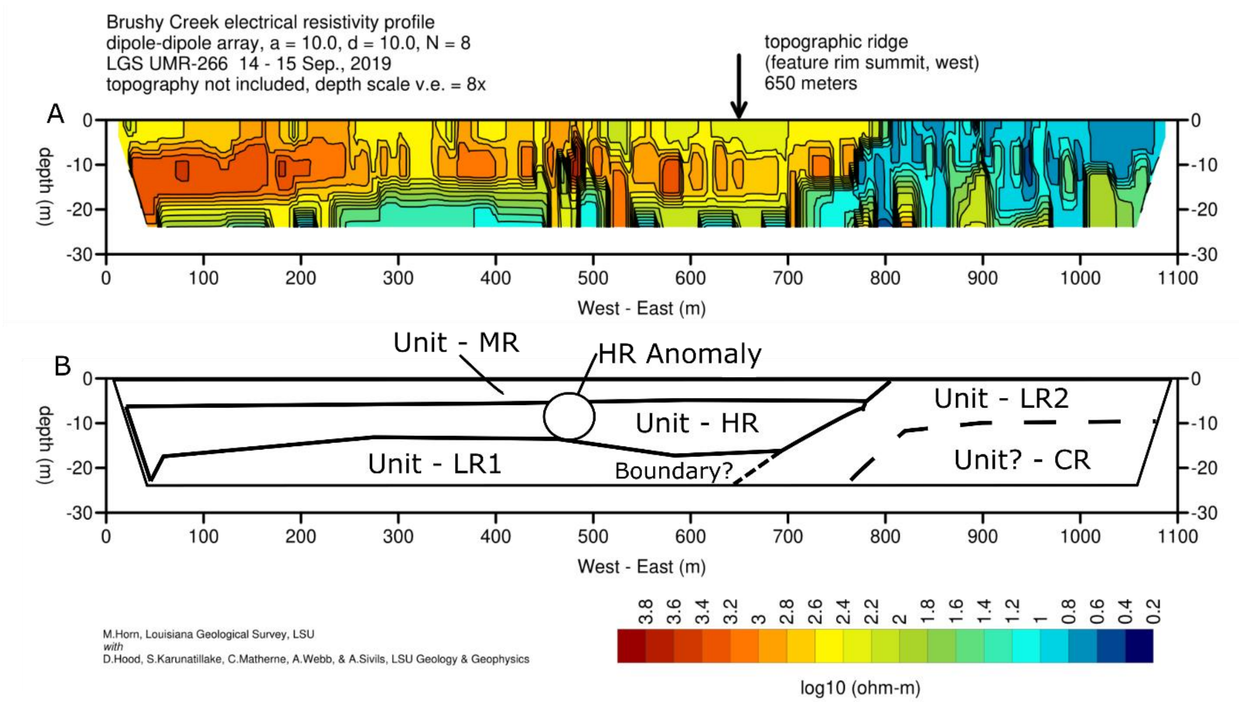

Figure 2. *Resistivity profile (A) and initial interpretation (B) of the western portion of the BCF exterior, rim, and interior. Unit names correspond to: HR – High Resistivity, MR – Medium Resistivity, LR – Low Resistivity, CR – Chaotic Restivity. Initial interpretations do not rule out an impact origin, and the unit LR2 is difficult to explain without a significant change in sediment properties*

vertical relief of ~5m. It is possible that the low-resistivity unit on the eastern side of the survey (LR2) is continuous with the low-resistivity unit underlying the western side (LR1), suggesting that the unit has been uplifted from its original position and erosion has removed the stratigraphically higher units. Another interpretation is that the two are unrelated, and the low-resistivity unit LR2 represents more porous material, consistent with poorly consolidated infill following an impact. The high-resistivity feature at ~500m (HR Anomaly, Fig 2B) may have a counterpart in the GPR survey (Fig 3). It is possible that this anomaly marks a fault or other structural boundary, possibly due to inward collapse of material, though further examination is warranted.

Conclusions: The resistivity survey carried out in September of 2019 in the BCF yielded informative results, and may present evidence consistent with an impact origin for the BCF. The survey effectively characterized layering of subsurface resistivity at 10-m scales and identified an anomalous change in resistivity near the "rim" of the BCF. We interpret the layering present to be consistent with either porous infill or uplifted,

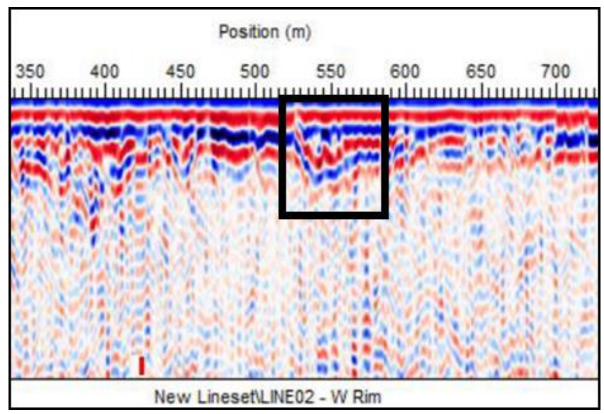

Figure 3. *Section of the W Rim GPR survey from the 2017 fieldwork* [2] *with an anomaly marked with a black outline. The base of the box is ~4m below the surface and is roughly co-located with the HR anomaly in Figure 2.*

lower-resistance material, both of which could be consistent with an impact origin for the BCF.

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References: [1] P. V. Heinrich, *GCAGS/GCSSEPM Transactions*, 2003. [2] A. Webb, et. al., *49th LPSC 2018*, p. 1619. [3] P. B. James and A. I. Ermakov, *49th LPSC 2018*, p. 1512. [4] C. J. Campbell, Tulane, 1971.