Shocked Minerals: Evidence of the Chicxulub Impact event within the K-Pg boundary in Alabama. M. M. Wielicki[1], M. D. Wielicki[1], J. Mulcahy[1] and C. Fiechtner[1], [1]Department of Geological Sciences, University of Alabama, Tuscaloosa, AL.

Introduction: Extraterrestrial impacts are thought to have led to lunar formation (ca. 4.5 Ga; [1]), substantially resurfaced inner solar system bodies at ca. 3.85–3.95 Ga [2], and profoundly influenced the habitability of Earth [3,4]. However, their role in major mass extinctions remains poorly understood. Impact craters are rare on Earth, due to the constant resurfacing by weathering and erosion, though evidence of such events can be found within the rock record in the form of shocked minerals [5, 6]. Identifying such shocked minerals within the rock record provides a marker by which to gauge the effects of such high energy events on the fossil record. Comparing the fossils before, or below the layers containing the shocked minerals, to those that occur after, or above, provides essential information into understanding the role of large asteroid impacts on mass extinctions.

One such large impact event is thought to have occurred at the K-Pg (Cretaceous–Paleogene), formerly known as the K-T (Cretaceous–Tertiary), boundary approximately 65 million years ago, causing a major mass extinction that included the end of the dinosaurs [5]. The location of this asteroid impact is thought to have occurred on what is present-day Yucatan Peninsula, Mexico, resulting in the buried 180-km-diameter Chicxulub impact structure [7]. At the time of impact, ~65 Ma, sea-levels were substantially higher than today such that the Alabama coastline extended into the interior of the state which was approximately 1000km's from the impact location. Roughly ~20 localities contain evidence of this impact event spanning parts of the U.S. Western Interior, the U.S. Gulf and Atlantic Coastal Plains, the eastern Mexican Coastal Plain, and some Deep-Sea Drilling Project (DSDP) and Ocean Drilling Program (ODP) drill sites (e.g., Sites 536 and 540; [8]). Uniquely, Alabama contains four sites which have been identified as containing some evidence of the Chicxulub impact event [9], however the lack of access to these sites, either due to private land ownership or obscured by vegetation, has hindered the discovery of more sites.

It has been well documented that shocked minerals can survive transport through river systems [10] and thus allow for sampling of large drainage areas as opposed to single locals to better assess the abundance of such minerals within the K-Pg boundary in Alabama.

Samples: We have sampled river and creek sands that run along the K-Pg boundary at two sites in Marengo County, Alabama to isolate certain minerals for evidence of impact induced shock. Current samples include Chickasaw Bogue (N32°17'5.7", W87°37'50") and Double Creek (N32°20'10.4", W87°49'37.6") located along Al-43 and AL-28, respectively (fig.1).

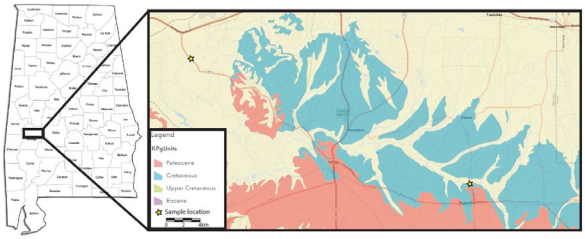

Figure 1. Map showing sample locations and unit ages of the K-Pg boundary in Marengo County, AL. Image courtesy of Geologic Survey of Alabama.

Approximately 1kg of each sample was collected. Samples consist of sand to clay size grains with abundant quartz.

Methods: Each site was processed through heavy liquids (Tribromomethane and Methylene Iodide) to isolate dense minerals such as zircon ($ZrSiO_4$) and monazite ($(Ce,La,Nd,Th)(PO_4,SiO_4)$). Light separates were also saved to investigate the presence of shocked quartz however due to the large amount of quartz in the samples these investigations will only take place if shock evidence is identified in the heavy separate. Sample grains were handpicked and mounted on double sided carbon tape and coated with carbon to reduce charging while imaging. Grains were imaged with a JEOL 7000 FE Scanning Electron Microscope within the Central Analytical Facility at the University of Alabama.

Preliminary results: We have processed approximately 500g of each sample and isolated a few hundred zircon and monazite grains. Although no shock features have thus been identified from Double Creek (~100 grains surveyed) we have found three zircon grains with evidence of planar deformation features from Chickasaw Bogue (CB_001-CB_003; ~100 grains surveyed). Zircon CB_001 shows two sets of planar microstructures approximately 1µm thick and 7µm apart and intersecting at an angle of ~35° (fig. 2). Chickasaw Bogue crosses the K-Pg boundary in multiple locations and thus we interpret these shock features as being associated with Chicxulub impact ejecta that has been identified in other locals in Alabama. Although our goal is to identify the actual exposures from which these shocked grains are being shed into the creek system, land access up these creeks remains an

issue as many of these are non-navigable waterways and thus are not public lands. Our goal is to work with land owners to find new exposures of the K-Pg boundary with evidence of the Chicxulub impact event.

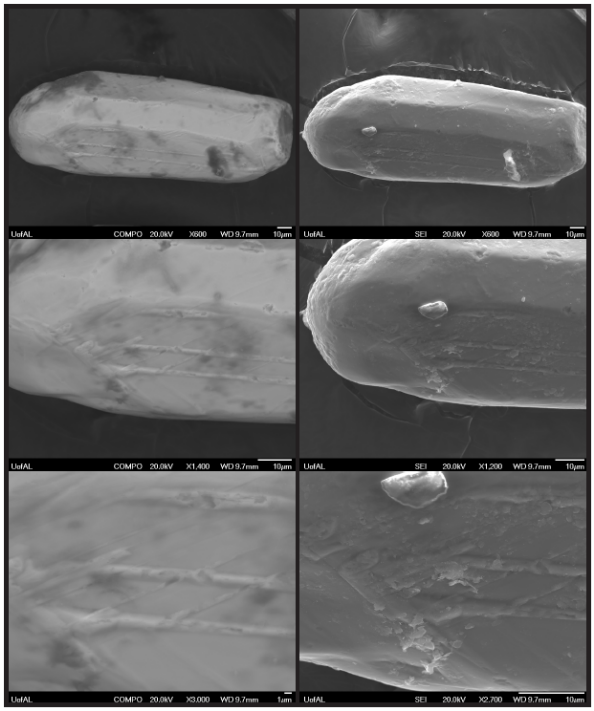

Figure 2. SEM images of zircon CB_001 from Chikasaw Bouge (BSE on left and SEI on right) clearly displaying multiple sets of planar deformation features thought to be associated with the Chicxulub impact event.

Future work: Shocked zircon and monazite will be mounted into 2.54cm epoxy rounds for U-Pb geochronology at the UCLA Secondary Ion Mass Spectrometry (SIMS) lab, utilizing the new CAMECA-1290. Unpolished grains will be depth profiled, along with an AS3 standard [11], to identify if shock microstructures are also associated with Pb migration and age-resetting. Post SISM analysis grains will be polished to expose inner portions for further imaging and EBSD analysis, in the ZAPlab at Western University, to better understand the amount of crystal deformation associated with the shock features. The identification of new K-Pg boundary sites within Alabama can provide novel research opportunities to further understand the effects of large asteroid impact events as well as new material to constrain the timing of the Chicxulub event.

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