Looking for Clues to the Chicxulub Impact: Detrital Zircon Geochronology of the K-Pg Boundary at Moscow Landing AL, USA. R. P. Culp[1] and M. M. Wielicki[1], [1]Department of Geological Sciences, The University of Alabama, Tuscaloosa AL (rpculp@crimson.ua.edu)

Introduction: Determining the direct influence of large meteorite impacts on the biosphere requires accurately identifying the impact event within the geologic record. Moscow Landing, Alabama is a well-documented K-Pg boundary location [1,2,3], however, a precise date has not been determined. The two main sedimentary units above and below the K-Pg boundary at Moscow Landing are: the Late Cretaceous Prairie Bluff Chalk and the Early Paleogene Clayton Formation [1], respectively. The disconformity between the two units [1,3] is hypothesized to have been caused by megawaves generated by the Chicxulub impact [3,4]. Detrital zircons ($ZrSiO_4$) from the Basal Clayton Formation and Upper Prairie Bluff Chalk can provide an accurate timing of the Chicxulub impact within the sedimentary record giving geologists an additional tool for studying the end-Cretaceous extinction; as well as resolving the origin of the Basal Clayton sand structures at Moscow Landing.

Detrital zircons have been found in the USA [5], Canada [6], and in Europe [7] and have been subsequently linked to the Chicxulub event. Analyzing zircon ages from impact-related localities has proven to be useful in correlating K-Pg sites that are widely spaced apart [6]. U-Pb isotopic values from zircon found at Moscow Landing, along with the presence of impact-induced shock features and possibly reidite [8], can provide conclusive evidence that the Chicxulub impact is recorded in the sedimentary rocks at Moscow Landing Alabama.

Geologic Background: The K-Pg site at Moscow Landing Alabama is approximately 1200 km from the Chicxulub crater. The four K-Pg boundaries within Alabama are unique as they record direct impact-related deposition rather than a thin ejecta layer. Moscow Landing's proximal distance to the impact crater makes it a an excellent conduct this study. Lower Paleogene rocks lie disconformably over Upper Cretaceous rocks and there is local normal faulting thought to have been produced by the impact [3,4,9]. At Moscow Landing, the Upper Cretaceous rocks are comprised of gray, massively bedded, silty to sandy, fossiliferous chalk and the Lower Paleogene rocks are comprised of quartz-rich sandstone, siltstone, marl, and limestone [1]. Impact related spheroids have been found within the lower Clayton Formation at Moscow Landing [4], and within the Lower Clayton Formation at Shell Creek AL, and interpreted as altered tektites [2]. This provides additional evidence that the K-Pg boundary at Moscow Landing is impact related.

The Chicxulub impact structure [10,11] is 180- km in diameter and sits off the present-day Yucatan Peninsula 300[12]. Distal K-Pg ejecta deposits are found ubiquitously containing high concentrations of iridium first identified by [13] as being extraterrestrial in origin. Recently, new information uncovered through IODP-ICDP projects that have provided information on the effects shortly following the impact [14]. A tsunami was generated upon impact and reached the far side of the gulf within 2-3 hours after the impact [13] and these time values agree with previously published results [15], further enforcing the megawave hypothesis present at Moscow Landing.

Zircons have been found at multiple K-Pg localities including the United States [5], Canada [6] and Europe [7], and linked back to the Chicxulub crater. The age of the Yucatan target rocks is 550 ± 5 Ma [5,6,7,16]; this value is crucial in correlating K-Pg sites to the impact.

Methods: Samples will be collected from three localities along the Tombigbee River near Moscow Landing Alabama, from the Lower, Middle, and Upper Clayton Formation and the Upper Prairie Bluff Chalk. A field map (Figure 1) and stratigraphic column [3] will be used to decide the places along the river to sample. Approximately 1-2 kg samples of the Clayton and the Prairie Bluff will be sampled directly above and below the K-Pg boundary. Field pictures of each collected sample and notes on lithology, fossils present, and any other identifying sedimentary structures will be noted.

Samples will be processed into individual grains using a jaw crusher and disc mill and then put through a 250 µm sieve to ensure single mineral grains and not aggregates are present. Decanting with water will remove any clay minerals in preparation of heavy liquids separation.

Methylene Iodide (MEI), which has a specific density of 3.85 g/cm^3, will be used to isolate zircon from minerals with lower specific gravities, such as quartz and feldspar, in the Basal Clayton samples and calcareous material in the Prairie Bluff samples. The sink that is collected from the MEI separation, which contains the isolated zircons, will then be rinsed with acetone to remove any excess MEI and dried under a fume hood.

Zircons will be hand-picked and mounted into 2.54 cm epoxy rounds for geochronology and SEM analysis.

U-Pb isotopic analyses will be conducted at either the University of California Los Angeles Secondary Ion Mass Spectrometer (SIMS) Lab or the University of Arizona LaserChron Lab. The JEOL-7000 FE-SEM, located in the Alabama Analytical Research Center at the University of Alabama will be used for electron imaging of zircon, backscattered electron imaging (BSE) will be used to identify shock features within zircon, and electron backscatter diffraction (EBSD) will be used to look for the presence of reidite and other high-pressure phases [17]. Energy dispersive x-ray spectroscopy (EDS) will be used to run elemental analysis on each sample [17].

Projected Results: Detrital zircons are crucial in providing geologists with an accurate timing of impact events since this information can provide further research into extinction and climactic influence. Zircon is a highly durable mineral that has the unique ability to record both its original crystallization age and the time of impact [6] which makes it an appropriate mineral to use in this study (Figure 2). I expect to find zircon ages that of Yucatan target rocks, impact age, and Paleozoic orogenic events [18]. During the early and into the late Cretaceous, western Alabama had sediment input sourced from the Appalachian-Ouachita fold and thrust belt that would have most likely contributed zircons of Grenville, Taconic, Acadian, and Alleghenian age [18]. Six samples from the K-Pg boundary at Moscow Landing have already been collected to date, and zircons have been isolated in all six samples. Zircon abundance varies from sample to sample; however, multiple samples have sufficient zircons for detrital zircon geochronology (n=200-400/sample). These preliminary results indicate the first-time detrital zircons have been found in both the Upper Prairie Bluff Chalk and the Basal Clayton Formation at Moscow Landing.

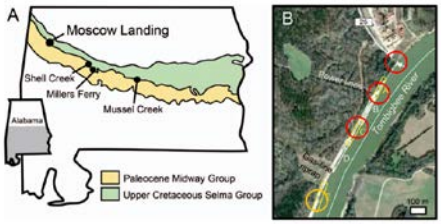

Fig 1. (A) Map of the four main K-Pg sites in Alabama. **(B)** Map of Tombigbee Rover at Moscow Landing, AL. The red circles are outcrops that have already been sampled and the orange circle is an outcrop to be sampled in the future; modified from [3].

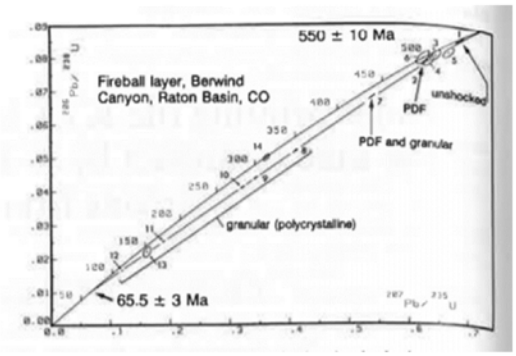

Fig 2. A mixing line showing the distribution of zircons found in Colorado that are related to the Chicxulub impact. Zircons found at the top of the line are unshocked and represent Yucatan target rock ages and zircons found at the bottom of line are shocked and have had their U-Pb ratio reset by the impact [5].

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