Buck, R., Them, T., "Mercury Geochemistry of a Terrestrial Transect Across the End-Cretaceous Mass Extinction."

Roxanne Buck Research Statement:

What killed the Dinosaurs? The question that I am hoping to solve this summer is related to the end-Cretaceous mass extinction (ECME) and the Cretaceous/Paleogene (K/Pg) boundary. The cause of the ECME has been a focal point in the paleontological and geological fields over the last century. In 1980, it was suggested that an asteroid collided with the earth at approximately the same time as the mass extinction event (e.g., Alvarez et al., 1980). Later, the Chicxulub impact crater was discovered in the Yucatan Peninsula and has been dated to within error of the K/Pg boundary age. This hypothesis has been largely supported by the scientific community until very recently. Several papers have been published that challenge the impact hypothesis (e.g., Keller, 2012; Keller et al., 2018, 2020; Schoene et al., 2019; many others). Instead, these authors argue for the possibility that volcanism was the main factor in the extinction of the dinosaurs. The evidence is focused on the emplacement of the Deccan Traps in India, where the stratigraphy shows a blanket of flood basalts ranging from the Late Cretaceous to early Paleogene. During this emplacement, climate-altering gases spewed out by the volcanic province may have led to biogeochemical changes on Earth that led to the extinction of many organisms including the non-avian dinosaurs. To test the competing hypotheses regarding what killed the dinosaurs, I would like to study the chemistry of sediments that span the Upper Cretaceous to early Paleogene. My advisor, Dr. Them, has received samples from southeastern Colorado from a colleague at the Denver Museum of Science and Nature. I plan to analyze the concentration of mercury in a subset of these samples, which has the potential to resolve whether volcanism or an impact played the most important role in the ECME. It is known that an asteroid impact can increase the atmospheric mercury levels for a short time. Therefore, I expect that my samples will show a very sharp increase followed by a rapid decay in mercury concentrations during the interval that correlates with the asteroid impact. On the other hand, if I observe a large but more gradual increase in sedimentary mercury concentrations, then that will instead support the volcanism hypothesis, as LIPs are thought to emit significant quantities of mercury to the atmosphere (e.g., Grasby et al., 2019). I expect to process and analyze the samples (~200 in total) for this project this upcoming summer at the Geochemistry of Ancient and Modern Environmental Systems (GAMES) Laboratory at the College of Charleston, following the methods of Them et al. (2019). This research project would give me my first real experience working in the field where I would like to have a career. Until the fall 2020 semester, I was not confident in what field I wanted to pursue. There are so many different paths a college student has the opportunity to go down and I have been searching for the right one for me for the last three years. When I first joined the College of Charleston, my focus was archaeology, and geology was a secondary major that I did not think I would use during my future career; I thought that geology was just another concentration that would assist my career in archaeology. After taking introductory archaeology doing my archaeological field school my freshman year, there seemed to be very few classes for my archaeology degree that excited me. I enrolled in my first geology course during my sophomore year, which I loved, along with courses like Classical Archaeology, which I did not. By the end of my sophomore year, I had realized that I was not as interested in archaeology as I believed I would be when I first started college. At that point I did not have a clue regarding what I wanted to do so I emailed several geology professors about the possibility of working with them on research over the summer, and that is how I met Dr. Them. Last summer, Dr. Them took me and a couple of other CofC students to the Sierra Nevada Mountains where we hunted ammonites for a week in the beautiful Sailor Canyon. After that trip, it was clear geology was the right path for me. I wanted to focus on ancient earth, not ancient people. With a future full of fieldwork and uncovering the secrets of the Earth on my mind, I decided to drop my archaeology degree, changed my Geology B.A. to a B.S., and began my journey as a true geologist. I took Dinosaurs and Mass Extinctions last semester, which helped me expand on the specific field of geology I wanted to work toward. I was so intrigued learning about all of the great mass extinction events that have taken place over geologic time. Mass extinction events are something I know I want to learn more about, and this research project will help me achieve that goal. I am so grateful I was able to start my geology research journey with Dr. Them, and this project will let me continue it and begin a career I know I am passionate about. I began my research experience with archaeological fieldwork at the Hampton Plantation in Georgetown, South Carolina in the summer of 2019.1 worked with Dr. Chadwick in February and March of 2020 on Mesozoic dike samples from Kershaw, South Carolina. I have been working with Dr. Them since the middle of July on mercury

concentrations across glacial-interglacial timescales from a core retrieved from Bear Lake, Utah. Last summer, I also had the opportunity to do fieldwork in Sailor Canyon in the Sierra Nevada Mountains, California hunting for ammonites and scouting future field sites.