Personal, Background, and Future Goals Statement

Personal Overview: As a young student, I discovered a deep passion for science and became enthralled with the natural world. Throughout middle and high school, my passion for science continued and I developed skills in communication, writing, and electronics. In high school, a shift occurred in my life after experiencing a serious personal trauma. I became depressed, disinterested in my education or self-betterment, and withdrawn personally. This condition endured to my early college years. In my first few years of being an undergraduate, I continued to be affected by this depression, leading to a poor performance in early courses. However, through dedication, effort, and by seeking help from others, I was able to pull myself out of this downward spiral. Positive changes began with the decision to change my major to Technical Communications (TCM) from Informatics. TCM is a discipline of engineering which involves the succinct, direct communication of technical details as well as an emphasis on team management. I regained a passion for my studies and have gone on to utilize these skills while working as an undergraduate and graduate researcher, leader of student organizations, and educator, at Indiana University–Purdue University Indianapolis (IUPUI).

My experiences as an educator began as an undergraduate and include being a tutor to high school students through Indy Learning Centers (an organization at IUPUI) and a service-learning assistant at IUPUI's Center for Earth and Environmental Science (CEES). With Indy Learning Centers, I visited high schools in the Indianapolis area to tutor students in English and mathematics. At first, connecting with the students was challenging, but eventually I learned how to effectively communicate the importance of their studies by discussing the utility of higher education with them and by getting to know them as individuals. As a service-learning assistant at CEES, I led groups of my peers (5-20 college age students at a time) through service-learning activities which focused on restoring healthy wetland ecology and the removal of invasive species from local waterways. I also engaged with the public (all ages) in a variety of ways, including: working with elementary school students in their after-school science clubs, participating in outreach events at STEM festivals, and giving interactive demonstrations of scientific concepts pertaining to fields such as meteorology, zoology, and ecology. These experiences gave me the confidence to speak publicly about science and relate complex concepts to a general audience; skills I continue to use during my ongoing mentorship of undergraduates. **These experiences strengthened my abilities as a science communicator and leader, which I believe will be instrumental to my success as a graduate student and science professional.** If chosen as an NSF Graduate Research Fellow, I will use the communication, teamwork, and leadership skills I developed in these positions to better present the results of my research to scientific and public audiences through conference proceeding and outreach events, respectively.

About halfway through my college career, I decided to double-major, adding a Geology degree to my academic track. This decision marked another significant and positive shift in my attitude, both personally and professionally. Not only does my transcript reflect this change in attitude, but I also felt confident enough to take on additional responsibilities, including being a mentor and teaching assistant to IUPUI's Mineralogy and Petrology courses, respectively. These unpaid positions, which I took on in addition to my full double-major undergraduate course load, gave me the opportunity to practice my communication skills as a mentor and taught me how to foster a healthy learning environment in the classroom. At this time, I also sought out a position as an undergraduate researcher and was given the opportunity to work in Dr. Catherine Macris's Experimental Geochemistry Lab at IUPUI.

My initial research involved tabulating a geochemical database of tektites (a particular kind of natural glass produced during large impact events on Earth). This task involved the manual collation of thousands of data points across dozens of papers spanning decades of research. I also became adept at multiple lab techniques and a skilled user of delicate technologies. For example, I prepared rock sections for electron microscopy using saws and polishing equipment. I set up a new wire saw in the lab and created a standard operating procedure (SOP) to teach others to use it. I was also trained in the use of the lab's Aerodynamic Levitation Laser Furnace (ALLF) and went on to assist and train others, including members of my lab and students from other universities in the use of the instrument. To analyze my ALLF

experiments, I also learned to operate the department's scanning electron microscope (SEM) with energy dispersive X-ray spectroscopy (EDS).

During my last semester as an undergraduate I served in leadership positions for two clubs: I was president of IUPUI's Earth Sciences Club (ESC) and treasurer of the IUPUI chapter of the Students for the Exploration and Development of Space (SEDS). As ESC president, I gained further insight into how to act as a leader to my peers, and in SEDS I played a key role in writing and presenting our chapter's application to NASA's Revolutionary Aerospace Systems Concepts Academic Linkage (RASC-AL) program. Working with the other SEDS leaders, we synthesized the information from multiple groups into a combined 20-page written proposal and video presentation. **As president of the ESC, I gained experience as a leader, while as treasurer of SEDS, I served as a member of a team, working together toward a singular objective. I believe the best scientists know when to take on leadership and when to use teamwork to best suit their research goals.** These positions afforded me opportunities to further develop my leadership and teamwork skills significantly.

The lessons I learned during my academic career have changed the way I approach challenges and awakened a passion for teaching. Today, I continue to dedicate myself both to my own education and to the mentoring of undergraduates, all while also performing my research responsibilities. I am on track to be a leader and educator in Earth, planetary, and space sciences. So far, I have earned two BS degrees, in Geology and Technical Communications, and am now a student in the Geology MS program at IUPUI. Ultimately, I plan to involve myself deeply with the effort for human colonization of the Solar System.

Intellectual Merit: The research I will perform as an NSF Graduate Fellow will involve high temperature experiments on felsic and mafic material in a levitation furnace to simulate the conditions that exist in an impact plume seconds to minutes after an impact occurs. **Current mixing models used to predict the relative contributions of target materials to tektite compositions do not consider rates of loss of volatile components from tektite-forming melts while entrained in the hot impact plume immediately following an impact – a phenomenon which I have observed in exploratory heating/vaporization experiments using the ALLF.** By constraining the rates of volatilization, I expect the results of this project to improve our understanding of both impact processes and the nature of tektite parent materials. Specifically, this research will investigate why tektites do not form from mafic starting materials on Earth, a long-standing ambiguity in the field. The results of this pioneering experimental approach, combined with intensive computational research, seek to quantify the physical and chemical changes that occur in the explosive aftermath of an impact event and the volatilization that occurs in the impact plume. The resulting models will be used to analyze (or reanalyze) terrestrial impact products and their target lithologies. Performing this research will allow me to continue focusing my passions for space, science, and computational analysis.

In the summer of 2020, I co-authored a technical paper titled "Nuclear Thermal Rocket With Fissile and Reaction Fuel from Lunar ISRU" which has been accepted to the 71st International Astronautical Congress (IAC). My role in this project was to teach myself about topics such as the intricacies of extraction, organic and nuclear chemistry, and the establishment of resource extraction facilities on the Moon. Currently I am writing a manuscript reporting the results of the research I started as an undergraduate with Dr. Macris. **For this project, I developed an extensive database of published tektite compositional data (perhaps the largest of its kind), and used it to perform intensive statistical analyses using the R programming language to develop a new classification tool for tektite provenance.** I am also working on converting my code into a publicly available web-based application that anyone could use to predict the geographic origin of an unknown tektite sample, given its composition. I plan to publish the results of this work before the end of my first year as a graduate student. **My ability to efficiently learn new information, synthesize it with my existing knowledge, and propose innovation are strengths I have developed as an undergraduate and graduate student.** These abilities have been critical in securing past and current funding for my research. As an undergraduate I was awarded a grant from IUPUI's Undergraduate Research Opportunities Program (UROP; $1200) and a scholarship from the Earth Science Gem & Geology Society ($3000). As a graduate student, I have been awarded a scholarship from the Andromeda Movement ($1000),

as well as the prestigious Mirsky Fellowship ($21,000), a full year of support given to one outstanding graduate student each year from the Earth Sciences Department at IUPUI.

Broader Impacts: While conducting my research as a first-semester geology graduate student, I have already used my past experiences as an educator and mentor to benefit my department. This year, I chose to volunteer and assist with the creation of curricular material for IUPUI's Mineralogy course and in adapting the coursework into an online-focused format. So far, I have helped create new assignments, instructional documentation, and software (CrystalMaker™) walk through videos. I also now attend synchronous online class sessions for this course to serve as a resource for the students and engage with them directly. I believe that having a human connection and fostering community building with the students benefits them in their course work and on a personal level. I intend to continue this type of work, not only as a graduate student, but for the remainder of my academic and professional career.

I was recently invited to participate in a project with Dr. Macris to create new teaching materials for the entire IUPUI Earth Sciences Department focusing on issues at the intersection of Earth sciences, ethics, and equity. This project involves the creation of 'Geo-Equity Challenge Modules,' which are stand-alone lessons for introductory and mid-level Earth Science courses that introduce students to a geoscience-related topic that negatively impacts underrepresented groups and marginalized communities on local, national, and global scales, with guided discussions framed in the context of ethical decision making. My role in this project will be to beta-test these newly created modules and analyze the assessment results, both quantitatively and qualitatively, with the goal of finding out how to improve the modules for future classes. **As an NSF Graduate Research Fellow, I will continue improving my analytical and computational skills, allowing me to perform analyses which will directly impact the undergraduate population at IUPUI. Doing so will further my goals of engaging with Earth Sciences undergraduates in discussions about issues related to equity in geosciences, increasing awareness of the lack of diversity in the field, and creating a more informed and just citizenry.**

On a personal note, I strongly believe that changes in the culture of STEM are necessary to create positive change regarding the lack of diversity, equity, and inclusivity in sciences – especially in geosciences. Such change requires commitment and decisive action from individuals in STEM community. To this end, I became a founding member of the IUPUI Earth Sciences department's Geosciences COmmunity for Racial Equity (GeoCORE). This community seeks to identify and enact actionable changes in policy and culture within the department with a focus on building a more welcoming and equitable environment for underrepresented groups. I am currently the only graduate student member of this group and am working with ES faculty and staff on strategies for creating a more culturally responsive environment in our department. In one of the early meetings of GeoCORE, I came up with the idea for the Mineral Eponym Crowdsourcing Initiative (MECI), an effort to facilitate an examination, analysis, and synthesis of the origins of mineral names, and the messages this historic naming system has created. This initiative has expanded beyond my department and is currently being led by members of the Mineralogical Society of America (MSA) Diversity Task Force (my advisor is a member) to seek funding for its execution (I will be included as key personnel on the project).

Career Goals: I cannot foresee a future for myself without the study of the Earth and planets of the Solar System. Following graduate school, I hope to gain experience in the field, potentially with the Antarctic Search for Meteorites (ANSMET) or investigating terrestrial analogs for extraterrestrial surfaces. I also plan to continue STEM outreach activities engaging underrepresented groups as early as possible in their educational careers, with the belief that society will benefit from the collective intelligence and innovative designs of those who have historically been discouraged from participating in the discussion. Ultimately, I hope to integrate my passions for the sciences and social equity to help pave the way for an equitable and progressive future on Earth, and beyond. Receiving this award will give me the opportunity to conduct novel research in my field, continue my work with the public on STEM education, and catapult my career as a future leader in STEM. My goals include not only excellence in research, but in education, outreach, and equity in the field.