Jonathan Anaya - Project Profile

2023 AGeS-Grad awardee
Project Title: Detrital Thermochronology of Mesozoic Strata in the Mongolian Altai: Implications of Inherited Structures for Intracontinental Deformation
Lab: Basin Analysis and Thermochronology Lab at UConn
Lab Mentors: Dr. Julie Fosdick

What scientific question(s) does your research address and what motivates this work?
The Mongolian Altai, located in western Mongolia, are part of the largest intracontinental orogenic system in the world. Scarce low temperature thermochronological data preserve Jurassic and Cretaceous cooling ages; however, the tectonic significance of those cooling ages remains understudied. Some authors have proposed that the last time the Altai were involved in a plate boundary setting was during the eastward closure of the Mongol-Okhotsk Ocean and its subsequent gravitational collapse.

In this study, we performed detrital zircon double-dating to sandstones collected along two complete sections within the Mongolian Altai basins. Those sections contain Jurassic, lower Cretaceous, Oligocene, and Miocene continental strata which record the tectonic evolution of the Altai. Our goal is to extract the cooling histories of potential source rocks by defining detrital zircon U-Pb-He modes. This method allows us to reconstruct the cooling history of the Altai ranges and test different models of evolution of the Altai prior to the onset of the Oligocene-Miocene intracontinental orogenesis. These data will test the role of inherited topography in intracontinental orogenic systems in Central Asia.

What chronometric tool did you employ and why?
In this project, I leveraged the large amount of the detrital zircon U-Pb data that I got from my main research project to improve provenance interpretations and expand our knowledge about the tectonic evolution of the Altai prior to the Cenozoic. I used detrital zircon double dating (U-Pb and (U-Th)/He) to constrain the thermal evolution of source rocks from late Jurassic to Miocene strata. This technique allows to determine the crystallization (U-Pb) and cooling ((U-Th)/He) ages of single zircon crystals. We used a

novel methodology consisting in defining detrital zircon U-Pb-He modes (defined by their similar U-Pb and cooling dates). This approach has been used to reconstruct the t-T histories of source terranes and correlate them with main tectonic episodes reported in the Altai region.

Figure 1. The Mongolian Altai crew in our last day of fieldwork.

What were some of the key takeaways of your research?

1. Our detrital zircon (U-Th)/He dates show three dominant cooling episodes during the late Carboniferous, early Permian, and Triassic. Those episodes of cooling correlate with main magmatic fluxes and the development of sedimentary basins.
2. We have documented that the Altai were close to an active volcanic region as suggested by zircon grains with similar U-Pb and He ages.
3. Our preliminary t-T modeling of selected detrital zircon U-Pb-He modes indicates that most of the source rocks were cooled during the early Permian-Triassic. Our preliminary interpretation is that this was the last time the Mongolian Altai were involved in a plate boundary setting.

Figure 2. First round of zircon aliquots to be degassed at UConn.

What new experiences, opportunities, and collaborations did you gain as an AGeS-Grad awardee?

This award allowed me to participate in a collaborative research project. This participation involved several steps that I had no experience. This grant allowed to expand my main research topic while I was learning a new thermochronological technique. I had the opportunity to participate in an amazing lab group at the University of Connecticut. Finally, I was able to see (and do) how detrital zircon (U-Th)/He dates are generated from the aliquot preparation, degassing, date calculation, and data interpretation.

Figure 3. Group photo of UConn lab members and myself.

What is one piece of advice you have for future AGeS-Grad award applicants or awardees?

For future awardees, I would advise to start soon preparing your research proposal and reaching out potential lab mentors. While writing your proposal, I would consider potential scenarios in case your data do not support your initial hypothesis.