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Research Statement

My research objective is to better understand the structural and metamorphic conditions deep in subduction zones. Subduction zones play an important role on Earth's deep time evolution. The continuous subduction of continental and oceanic crust is critical for plate tectonics and long-term elemental and volatile cycling, but most of the rock record that reaches the great depths of subduction zones is recycled in the mantle. Because in situ conditions can only be measured remotely, I focus on analyzing rocks that were subducted and then later exhumed to the surface, called "subduction complexes". These rocks contain vast information that are generally not well understood because of their complicating history and overprinting of earlier fabrics and the alteration of minerals but can also yield insights about the structural, metamorphic, thermal, and rheological evolution of convergent margins.. With my research I seek to understand the deformation, timing and geochemistry taking place in the deep subduction interface by analyzing the exhumed record with field-based geochronometric techniques, metamorphic petrology, and structural geology. With my research I want to better understand the of mechanisms that cause rocks to be underplated and exhumed, metamorphic conditions, the role of fluids and the mass/chemical cycling.

I first became intrigued with studying subduction complexes during my undergrad when I realized that the island my family is from is a metamorphic core complex with fascinating geology. The idea of studying, understanding and possibly giving back to the local community was intriguing to me. Hence, for my undergraduate thesis I worked on Andros Island, located in Northern Cyclades, which is part of the larger Hellenic subduction zone. I mainly worked on macro- and mesoscopic-scale structures as well as in thin sections of metamorphic rock samples. I was able to differentiate the different generations of foliations and set relative time constraints on the subduction and exhumation processes. I also spent some time mapping various tectonostratigraphic units and improving the geological map of the island, which I found highly satisfying to take spatial relationships from the micro (thin section) scale to regional outcrop scale. My desire to take this research further and set absolute time constraints on these complicated rocks was the motivation to pursue a Master's degree and work in UTChron laboratories with Dr. Stockli to develop my geochronologic skills.

My Master's thesis was on the Southern Cyclades on Sikinos and Ios Islands where I used zircon U-Pb and U-Th/He geochronometric methods to define the paleogeographic evolution of the northern margin of Gondwana and the subduction interaction with the Eurasian plate, the evolution of the Hellenic subduction zone, and the multi-stage exhumation history of the CBU in the Aegean core complexes. During my master's I developed a novel approach to study the coherency of subducting sediments from the application of combined geochronology and detailed field observations. By dating the zircon minerals in rocks, we can approximate the absolute age that they entered the subduction zone. Using field observations, we can describe the current arrangement and order of these units. Combing these two pieces of information allows

us to understand how these rocks were deformed, which provides a record of subduction zone deformation (Poulaki et al., 2019).

The complicated deformation and metamorphic history as well as the lack of detailed geochronology in subduction complexes sparked my interest to continue studying these complicated regions. Hence for my PhD I transitioned to the Internal units of the Betic Cordillera, a subduction complex in Southern Spain. I used a suite of geochronologic and geochemical analyses on zircon including U-Pb and trace elements split-stream analyses as well as 2D elemental mapping techniques. I integrated these with metamorphic petrology and structural geology to set constraints on the provenance and paleogeographic position of the different units within the Internal Betics and the spatial relationship between them. More specifically I determined the initial stratigraphic architectures and examine how the rocks were subsequently deformed during subduction/exhumation (coherent vs. incoherent packages) as well the paleogeographic evolution of the area.

Additionally, with samples from Greece and Spain I investigated the geologic conditions during metamorphic growth of zircon, to better understand the timing and geochemistry of metamorphic zircon grains. Zircon rims record various metamorphic reactions and fluid interactions within the rock and they are especially suitable to unravel the timing and tectonometamorphic conditions of subducted rocks due to its durability and resistance to alteration under the high pressures and temperatures reached in subduction zones. I used a novel integrated geochronometric and geochemical approach with zircon split-stream U-Pb and TE depth profiling, zircon U-Pb and Trace Elements 2-D mapping, and $\delta 18O$ analyses on rock samples from exhumed subduction complexes. The combination of these techniques produced a complete 3-D isotopic and trace elemental map of zircon grains from the rim to core. Furthermore, integration of zircon rim architecture with bulk rock and fluid geochemical data are necessary to evaluate the precise conditions during zircon rim growth and evolution.

As part of my research, I have actively developed analytical techniques for measuring and interpreting zircon U-Pb and trace element LA-ICP-MS split-stream and 2-D elemental map data. Additionally, I have coded Python workflows to visualize, categorize, and interpret these data. During my graduate studies, my pursuit as a geoscientist has taken me at all parts of the earth from Greece to the United States to Svalbard (Norway), Spain and Morocco as part of research, class projects and educational opportunities. I was fortunate enough to be part of NORAM (Norway, Russia, America) collaboration and collaborate with different institutions and participate in Arctic research in which I completed an independent project titled “Paleocurrent, stratigraphic analyses and the detrital zircon record of the Devonian strata in the Arctic region” and got involved in further research in the Arctic. These geology related travels have allowed me to interact with a diverse group of geoscientists, where I have learned and benefitted from the unique viewpoints of others.

I am excited to take this research a step further and apply the combined field observations with laboratory analytical techniques to other subduction zones around the world. I am also looking forward involving undergraduate students in my research. I will be able to bring students in the field to conduct structural and petrographic observations and following perform laboratories procedure in the University XX.