

1. Requires further support from Climate Change and NES.

We have met with Mr. Wayne King, who expressed interest in supporting this research and our permit application. We anticipate that this support may include identifying a local counterpart and, if appropriate, providing a letter of support to accompany the application. We also discussed our enthusiasm for engaging Cook Island students in our field efforts and scientific discussions.

2. Resource local counterpart this could include letter of support from local counterpart.

Please see answer above.

3. Question around location of sites and why?

This project aims to understand how sea level has changed in the past across the southern Cook Islands by studying fossilized coral reefs that formed when sea level was higher than today. These fossil reefs act like natural markers, allowing us to compare past sea levels between islands and determine whether differences are due to natural land movement or changes in the ocean itself. We target the southern Cook Islands because there is documented evidence of raised ancient coral reefs, but existing elevation measurements and age determinations are not precise enough to test hypotheses about past sea level changes.

The southern Cook Islands: Rarotonga, Mangaia, Atiu, Mitiaro, and Mauke, were formed long ago by volcanoes that are no longer active and are now rimmed by modern coral reefs and carbonate sediments. Around the central volcanic hills of each island are flat, rocky areas made of ancient reef limestone, which preserve fossil corals that grew when sea level was higher than it is today during the Last Interglacial (LIG) and the early Holocene. Fossils from The Holocene show that sea level at that time was about 1.8 meters higher than present across all the islands, but fossils from LIG show much larger differences between islands, ranging from about 2.5 to over 12 meters higher than today. These large differences are unlikely to be caused simply by volcanic processes or sinking of the islands, because the volcanoes are very old and should have already settled by that time. Moreover, if subsidence of Rarotonga, the youngest volcano at ~2 Ma, was responsible for uplifting the surrounding islands, the LIG reef on Rarotonga would lie well below sea level rather than at ~3 m above present sea level. To understand whether these differences reflect real changes in sea level, movements of the land itself, or misidentification by previous researchers, more precise measurements of the age and elevation of these ancient reefs are needed. By studying the limestone geology on Rarotonga, Mangaia, Atiu, Mitiaro, and Mauke, this project will help identify any land movement, account for local geological effects, and improve reconstructions of past sea levels across the southern Cook Islands.

4. More information on storage of samples.

All hand samples collected for this project will be securely stored at our respective home institutions, either at the Lamont-Doherty Earth Observatory (LDEO) or the University of Florida (UF), depending on the laboratory in which each phase of analytical work is performed. Upon arrival at the lab, each hand sample will be slabbled into two components: a working slab and an archive slab. Both slabs will be carefully and permanently labeled following standard geological curation protocols, and a corresponding digital catalog will be created to record key metadata (sample ID, provenance, preparation date, storage location, and any subsequent subsampling information).

The working slab will be used for all destructive analyses. It will be drilled for U–Th sampling, and a small ~100–200 mg aliquot will be extracted in the ultra-clean laboratory for chemical preparation and U–Th dating. Where analytical replication is required, additional material may be removed from the same working slab, and the slab may be resampled multiple times as needed to ensure data quality and reproducibility.

Any remaining material, including offcuts from sample preparation and the intact archive slab, will be securely stored in appropriate sample bags, or archival boxes designed to prevent contamination, degradation, or loss. These materials will remain in curated storage at either LDEO or UF to ensure their long-term preservation. The archive slabs will be maintained as permanent reference material, enabling potential reanalysis, application of new analytical techniques, or future collaborative studies.

Access to stored samples will follow appropriate data-sharing agreements, institutional policies, and ethical guidelines. Requests for further use of the material will be evaluated to ensure responsible stewardship and to maintain the scientific integrity of the archived collection.

5. Requires Island awareness & support. It will be very important to create island awareness and support possibly through the island council etc.

We recognize the importance of island awareness and local support for this research. We are committed to engaging with relevant island authorities and communities before and during fieldwork and would welcome guidance on the appropriate points of contact, such as Island Councils or other local governance bodies, for Rarotonga, Mangaia, Atiu, Mitiaro, and Mauke. We are also enthusiastic about engaging local students in the fieldwork process, and scientific discussions. We respectfully request assistance in identifying the correct contacts to ensure that our work is well communicated, culturally appropriate, and supported at the island level.