Reconstructing the Ancient Rainfall Drought History of Guam

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Current research on climate dynamics around the world is revealing, regional climates everywhere are typically characterized by decadal, centennial, and even millennial scale oscillations. Unfortunately, the long-term historical rainfall record for Guam begins only at the end of World War II and even the oldest of historical records—which date at best from the early Eighteenth Century—are too short to document such long-term cycles. It is becoming increasingly important for economic planners and managers, however, to be able to anticipate or understand the likely duration and severity, if not the causes, of long-term or persistent shifts in weather and climate patterns. Of particular interest in the west Pacific Ocean region are the patterns of flooding/drought, prevailing winds, and the frequency and severity of major storms, which are already known to follow cycles of decadal and longer duration. To characterize long-term rainfall and temperature patterns prior to the historical record, however, requires making estimates of them from proxies, i.e., indirect evidence recorded in natural features such as ocean or lake sediment layers, pollen and tree-ring records, or cave deposits, to name only a few.

One the most productive sources of long-term pre-historic climate data is speleothems, i.e., calcite mineral deposits that are precipitated from cave dripwater. With current laboratory techniques, stalagmites (which develop distinct and datable layers, like tree rings, as they accumulate on the floors of caves) can reveal datable changes in certain chemical parameters that can be resolved at intervals ranging from seasons to millennia and spanning histories ranging from decades to hundreds of millennia. Changes in the amount and/or sources of rainfall and sometimes above-ground temperature can be inferred from the chemical parameters and changes in rate of growth, especially if the relationship is known between the chemistry of the modern calcite layers and the dripwater from which they precipitate. Fortunately, WERI researchers working over the past decade have identified and mapped a number of accessible caves on Guam that contain promising stalagmite records from which the pre-historical climate record of Guam might thus be reconstructed

This project will capitalize on previous work by WERI researchers to collect monthly samples of dripwaters from caves in which speleothems have been collected, and which are currently undergoing analysis at the Jackson School of Geosciences at the University of Texas at Austin, in a separately funded project. More important, the proposed project would support a detailed investigation of the geologic and speleogenetic history of the caves from which the climate data are to be derived. This will provide researchers with an understanding of the sequence of deposition and its relation to the changes in the cave environment over time, which in turn will provide additional data and insights with which to make more confident inferences regarding the actual climate and environmental conditions of the island over time. Finally, the project will be an important element in a larger collaborative project that includes similar work on caves in Borneo, The Philippines, The Solomon Islands, and Vanuatu to determine the climate history of the entire western Pacific region.