Reconstructing the Pre-Historic Rainfall-Drought History of Guam

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At its 2008 meeting, the Guam Water Resources Advisory Council identified as one of its research priorities "expanding and updating the rainfall database for Guam," to include long-term rainfall variability (Item 16, under *Water Quantity Issues, Guam's Critical Water Resources Research, Education And Training Needs*). This need was reiterated at the 2009 meeting. Although the instrumental climate record for Guam begins only at the end of World War II, current research is revealing that regional climates everywhere are characterized by decadal, centennial, and millennial scale oscillations. Even the oldest of historical instrumental records in the world—which date at best from the early Eighteenth Century—are too short to document 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 estimating 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.

One the most productive sources of long-term pre-historic climate data is stalagmites, i.e., layered calcite deposits precipitated from cave dripwater. With current laboratory techniques, stalagmites 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 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 continue and extend the very promising work begun during the past year to collect regular 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. The proposed project would continue the detailed investigation of the chemical environment from which the climate data are to be derived. Instrumentation of one of the caves in northern Guam has produced very promising data so far. Moreover, since the current year has brought a fairly strong El Nino, we now have an opportunity to capture a representative El Nino signal. Finally, the project will be an important element in a larger collaborative project for which we have applied for National Science Foundation funding, and that will include similar work on caves in Borneo, The Philippines, The Solomon Islands, and Vanuatu to determine the climate history of the entire western Pacific region.