

Tales from the South (and West) Pacific in the Common Era: A Climate Proxy Perspective (Invited)

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The southwest Pacific is a major source of tropical climate variability through heat and moisture exchanges associated with the Western Pacific Warm Pool (WPWP) and the South Pacific Convergence Zone (SPCZ). These variations are especially significant at the annual, interannual (El Niño–Southern Oscillation, ENSO), and multi-decadal timescales. Gridded SST data products are available in the pre-satellite era in this region for the past ~130 years, although data density is a significant issue for the older half of these records. Time series of salinity (SSS) and rainfall from this region are exceedingly rare. Thus, climate proxy records must be used to reconstruct SST, SSS, and rainfall variations in the Common Era (CE) in the tropical Pacific. The analytical laboratory for paleoclimate studies at UT has focused its research efforts into producing climate proxy time series from southwest tropical Pacific using modern and fossil corals, and speleothems. Our most recent results are summarized in this presentation, although much of this work is still in progress.

Coral climate records have been generated from Sabine Bank, Vanuatu (16°S, 166°E) and Misima Island, Papua New Guinea (10.6°S, 152.8°E). The Vanuatu coral record of monthly resolved Sr/Ca variations extends back to the late 18th century. All strong ENSO warm phase events of the 20th century observed in the instrumental record are also observed in the coral record. We note that several ENSO warm phase events in the 19th century portion of the coral record are comparable in size to that recorded in response to the 1982/1983 and 1997/1998 events. The Misima coral record of monthly resolved $\delta^{18}\text{O}$ and Sr/Ca variations spans the interval ~1414–1645 CE — the heart of the Little Ice Age. Amplitude modulation of interannual variability is observed in this LIA record, much like what is observed during the relatively quiescent period of 1920–1950 in the 20th century instrumental and proxy records of ENSO. However, the amplitude of individual ENSO warm phase events in the LIA record is reduced, relative to that of the 1941/1942 ENSO warm phase events observed in a near modern coral record from Misima.

Speleothem climate records have been generated from Espirito Santo, Vanuatu (15.5°S, 167°E) and Guadalcanal, Solomon Islands (~9°S, 160°E). The Vanuatu record of $\delta^{18}\text{O}$ variations is from a fast-growing speleothem (~1–3 mm/year), which yields a record of rainfall variability spanning ~1670–2005 CE, as dated by U–Th disequilibrium techniques. Interannual changes in speleothem $\delta^{18}\text{O}$ appear to capture ENSO events and subsequent reorganizations of the SPCZ. The Vanuatu speleothem $\delta^{18}\text{O}$ record also exhibits concentrations of variance on the decadal scale. The Guadalcanal record of $\delta^{18}\text{O}$ variations is also from a fast-growing speleothem (~1–4 mm/year), which yields a record of rainfall variability spanning ~1650–2010 CE, as dated by U–Th disequilibrium techniques. The $\delta^{18}\text{O}$ records from both of these stalagmites provide evidence for changes in convection in the equatorial WPWP region of the SPCZ: the rising limb of the Pacific Walker Circulation.

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