

# World-unique coral pyramids

Geoscience researchers prove Micronesia's coral pyramidal tombs are much older than previously thought

**M**onumental tombs within ancient civilizations worldwide hold precious clues for deciphering the architectural skill, acumen, and industry of prehistoric cultures. In a recent study, the world's only coral pyramidal tombs, which are located in Kosrae, Micronesia, were dated back to 700 years ago by Prof. Chuan-Chou Shen of the High-Precision Mass Spectrometry and Environment Change Laboratory (HISPEC) of the Department of Geosciences of National Taiwan University and his international collaborators. This date is at least three centuries earlier than previous estimates. The study findings, which were published in the journal *Science Advances*<sup>1</sup>, also reconstruct the fading prehistoric trans-oceanic culture.

Pyramidal structures dating back to 6,000 years ago provide an important archive of the architectural styles and cultural practices of ancient civilizations. These pyramids often served as tombs for royalty and were built using locally and/or regionally available abiotic materials, such as stone, soil, and clay. The ruins of the prehistoric capital city of Leluh (~AD 1250–1850) in Micronesia contain several royal tombs, which are world-unique pyramids constructed using biotic coral. However, these tombs' construction dates and the means by which the tombs were built had remained shrouded in myth since the discovery of

these pyramids.

In the study, Prof. Shen and his team utilized high-precision radiometric uranium-thorium techniques to date three selected sacred Leluh tombs. The team discovered that these tombs were created in the 14th century, approximately 600-700 years ago. The new estimate predates previous estimates by at least 300 to 500 years; in addition, the team found fossil corals with ages of 4,000 to 6,000 years in the tomb structure, refuting previous arguments that only live corals were used in these tombs.

According to oral history, locals built each tomb by form-

ing a chain between the tomb's location and a coastal reef to allow live coral material to be relayed to the construction site. As a result, the tombs were composed of tens of thousands of coral stones, each measuring up to hundreds of centimeters. In contrast to pyramidal tombs from other parts of the world, the Leluh tombs are open and accessible from a truncated top that features a crypt of up to 2 meters by 4 meters. Legends indicate that the reason for this design feature is that the tombs were used only as temporary burial sites, with the king's body placed inside the crypt for praying and worshipping purposes during his funeral. After several months, the royal bones would be relocated to a



Coral sampling atop a Leluh pyramidal tomb.

nearby reef and buried in a deep hole. However, these tales had never previously been validated by scientific evidence.

In a previous study, the remains of a 50-year-old male estimated to have lived during the 1800s were found in one of the tombs. Prior researchers had therefore concluded that the tombs were built approximately 200 years ago. Precise analysis of the coral has demonstrated that the tombs were built in the

14th century; thus, Prof. Shen's team deduced that the 19th-century body belonged to the last king to have participated in the ancient burial ceremony. Although the reason why this king's remains were not relocated is unknown, the study findings validate previous tales indicating that the tombs were repeatedly used as temporary burial sites.

#### Reference

Zoe T. Richards, Chuan-Chou Shen, Jean-Paul A. Hobbs, Chung-Che Wu, Xiuyang Jiang, Felicia Beardsley (2015) New precise dates for the ancient and sacred coral pyramidal tombs of Leluh (Kosrae, Micronesia). *Science Advances*, 1, e1400060, DOI: 10.1126/sciadv.1400060.

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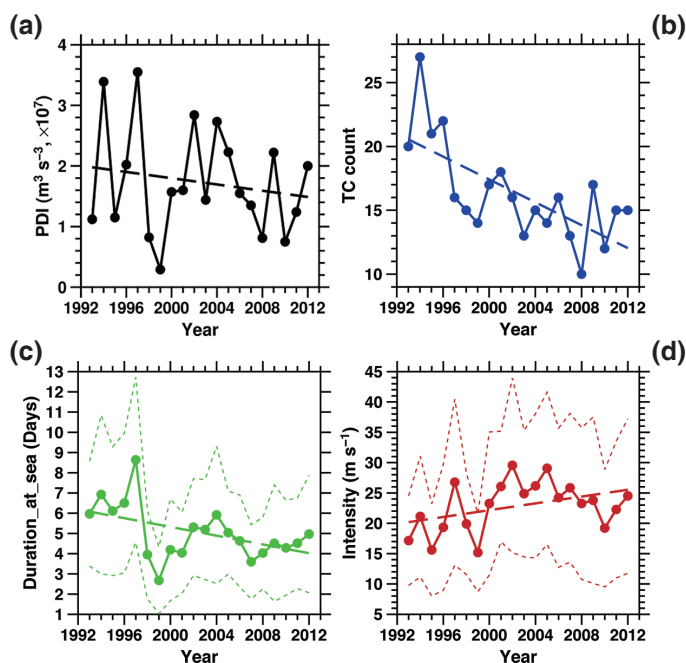
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## Does a warmer ocean guarantee stronger typhoons?

### A reinterpretation of tropical cyclone and ocean interaction

Taiwan is located in the northwestern Pacific Ocean and experiences destructive tropical cyclones (TCs; also called typhoons in Asia) every year. Typhoons can cause damage and they have become one of the most popular research topics in Taiwan. Dr. I-I Lin, a professor in the Department of Atmospheric Sciences at National Taiwan University (NTU), has published several important papers that describe new discoveries in the interaction between tropical cyclones and the ocean. These works demonstrate successful national and international co-operation including by researchers from the National Taiwan Normal University (NTNU) and Academia Sinica in Taiwan as well as groups from the USA, China, and Hong Kong.

The condition of the ocean has long been considered a key factor in TC research because of how it may affect TC development and intensification. However, there is still no complete theory that



**Fig. 1.** Time series of the observed PDI and other parameters over the western North Pacific over the past two decades. (a) PDI, (b) annual number of typhoons during the typhoon season (July to October), (c) the average typhoon duration, and (d) the typhoon intensity. <sup>[1]</sup>