

Sea-level change in Tongatapu, the Kingdom of Tonga for the last 3000 years based on local marine reservoir effect and geophysical modeling

*福與 直人^{1,2}、Anthony Purcell³、Geoffrey Clark⁴、Phillip Parton⁴、横山 祐典^{1,2}

*Naoto Fukuyo^{1,2}, Anthony Purcell³, Geoffrey Clark⁴, Phillip Parton⁴, Yusuke Yokoyama^{1,2}

1. 東京大学大気海洋研究所、2. 東京大学理学系研究科地球惑星科学専攻、3. オーストラリア国立大学地球科学研究所、4. オーストラリア国立大学アジア太平洋学部

1. Atmosphere and Ocean Research Institute, The University of Tokyo, 2. Department of Earth and Planetary Sciences, Faculty of Science, The University of Tokyo, 3. Research School of Earth Sciences, The Australian National University, 4. College of Asia and the Pacific, Australian National University

Reconstructing the history of Holocene relative sea levels around Tonga provides essential constraints on the recent geological evolution of this region and paleoenvironmental context for archaeological studies. However, there are few sea-level records currently available from the region, and no quantitative paleoenvironmental studies using geochemical/physical methods have been reported. In this study, we reconstruct sea-level histories for Tongatapu island using radiocarbon measurements and glacio-hydro-isostatic adjustment (GIA). Our analyses suggest that changes in the average size of bivalves (*Gafrarium tumidum*) are synchronous with corresponding changes in the paleoenvironment. These changes also correspond to the timing of the increase of local marine reservoir effects (ΔR) from 219 ± 78 to 376 ± 69 . Sea surface salinity (SSS) changes within Fanga ' Uta lagoon were also synchronous with these changes caused by a gradual decrease in the exchange of water in and out of the lagoon. Salinity seems to have been higher than present at approximately 2.6 cal kyr BP, suggesting an embayment that was relatively open to the ocean. Predicted mid-Holocene sea level height using GIA modeling indicates less than 1 m above sea level in Tongatapu, suggesting that previously reported observations of mid-Holocene high stand require additional factors other than GIA. Furthermore, present-day satellite-based observed (i.e., GPS) vertical uplift rate in Tongatapu is ten orders of magnitude higher than the long-term uplift rate obtained from Holocene sea-level data.

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