A 2500-YEAR SEA LEVEL RECORD FROM PHRA THONG ISLAND, THAILAND

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INTRODUCTION

Temporally changing coastline configurations and local sea-level changes pose a considerable threat to coastal communities and infrastructure. However, regional sea-level (RSL) histories spanning the last 3000 years have not been widely studied in Southeast Asia, even though the region shows significantly different RSL records from place to place (Horton et al., 2005). This period is crucial for understanding sea-level changes from pre-industrial time. Here, we investigate the record of past sea-level(s) preserved within the stratigraphy of the beach ridge system of Phra Thong Island (PTI), Thailand (Figure 1).

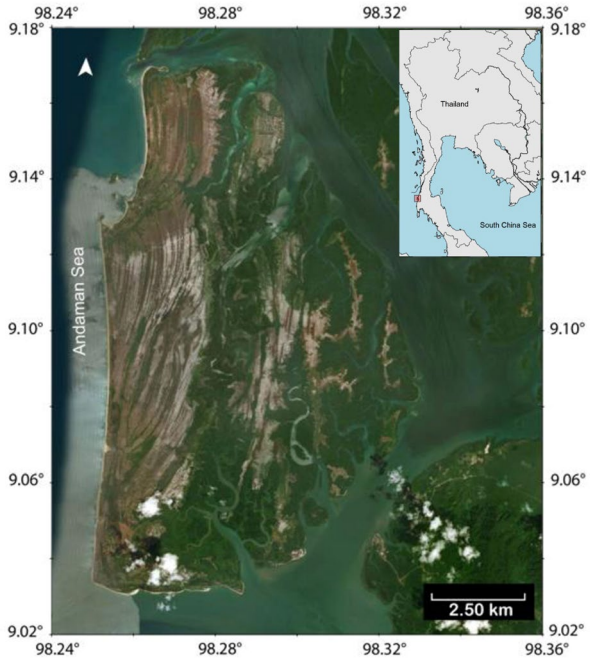

Figure 1 - Beach ridge system on the prograded coast of Phra Thong Island, Thailand.

Beach ridge systems are coastal landforms that develop on prograding coasts (i.e., with the shoreline shifting seaward with time). They are comprised of the alternating swale (depression) and ridge (slightly elevated) sequences. Commonly, a history of coastal evolution with the changing sea-level and sediment budget remains preserved within these ridge systems. Beach ridge system archives are relatively untapped for RSL records because this method is comparatively new compared to the established techniques (Dougherty et al., 2019).

METHODS

High-resolution images of beach ridge stratigraphy, chronology, and precise elevation data are essential for reconstructing accurate sea-level records and catastrophic events on prograded coasts (Gouramanis et al., 2015, 2017; Dougherty et al., 2019). Ground penetrating radar (GPR) is a tool for such investigations (Switzer et al., 2020), and here we used GPR to retrieve stratigraphic images of the prograded beach of PTI. Shore-normal and shore-parallel GPR reflection profiles were collected from PTI in 2014 using a 100 MHz GPR antenna of the pulseEKKO PRO GPR system developed by Sensors & Software. Optically Stimulated Luminescence (OSL) data have been transposed onto the shore-normal GPR transect to establish the chronology. A section of the shore-normal GPR image from Phra Thong Island is shown below in Figure 2.

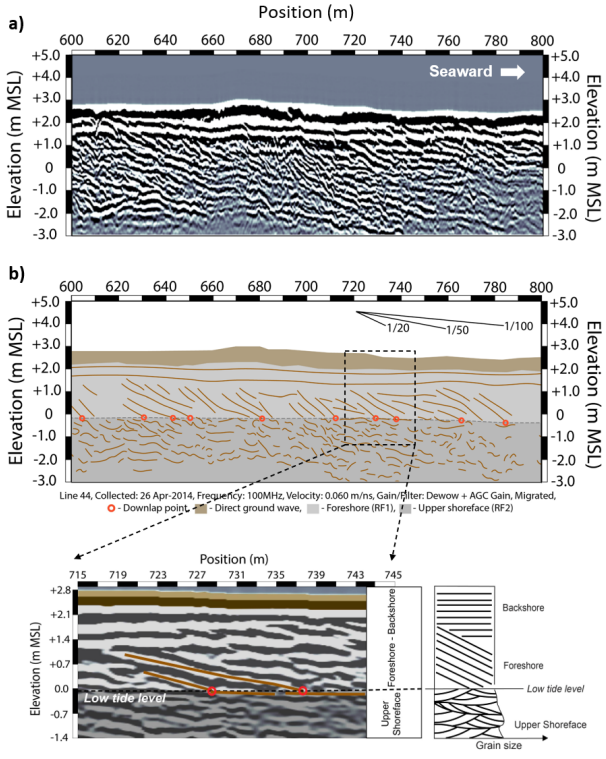

Figure 2 - a) A 200 m section of a processed and topographically corrected shore-normal GPR profile from Phra Thong Island, Thailand. b) Interpreted profile with different radar facies. A zoomed-in section (bottom) of the shore-normal profile illustrates the criteria for the demarcation of the boundary between Shoreface and Foreshore deposits. The overall trend of downlap points suggests an overall falling relative sea-level (RSL) trend in the area.

DISCUSSION

The shore-normal GPR profile shows a prominent downlap point marking the boundary between the foreshore and shoreface that is considered a sea-level index point (SLIP) which indicates the low-tide level during sediment deposition (Tamura et al., 2008). A total of 52 SLIPs are interpreted along the 800 m GPR profile to approximate past sea-level(s). OSL dates collected at slightly offset locations are incorporated to create the temporal sea-level record. The result shows a net sea-level fall of ~1 m between 2659±139 and 367±27 years BP based on OSL dating from Brill et al., 2015.

CONCLUSION

This study confirms that beach ridge systems investigated with GPR and OSL techniques can be highly effective for reconstructing prehistoric regional sea-level trends. More precise chronological and elevational data may further improve the accuracy of the reconstructed record. This study covers only a part of the entire beach ridge system in the PTI area. Applying a similar approach to older beach ridges further inland may provide a record of sea-level change that extends further back in the past.

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