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Bachelor's Thesis "*Characterisation of modern tropical cyclone deposits at Chaung Thar by applying sedimentological and luminescence dating approaches – Towards using sedimentary evidence for long-term hazard assessment in Myanmar "*

Tropical coastal areas are prone to extreme wave events (EWEs) like tropical cyclones (TCs) and tsunamis. Along with monsoonal precipitation and river floods, tropical storms are a compound of hazards whose consequences cannot be completely estimated yet as TC activity is related to climatic changes in El Niño-Southern Oscillation (ENSO) and monsoon circulation. Together with their residential and touristic importance, the question arises whether and to what extent a particular area is (i) capable for those EWEs, and (ii) resilient to cope with experienced damages. Especially towards climate change, associated with possible changing frequency-magnitude patterns, long-term information is indispensable to assess the regional hazard adequately and finally to establish a risk management plan.

Though the Bay of Bengal was affected by severe floodings in the past (e.g., the Indian Ocean tsunami (IOT) 2004, TC Mala 2006, TC Nargis 2008 and TC Giri 2010), there is little known about their impact on the western coast of Myanmar. Besides the Bay of Bengal earthquake triggered at the Rakhine segment of the Sunda Arc in AD 1762, which is associated with a tsunami, long-term history of EWEs has not been taken into account so far. This may partly be due to the fact that historic information is scarce and previous approaches primarily focus on climatic analyses, tectonic and remote sensing measurements, so their information might be restricted to short time scales only (e.g., HALSTEAD 1843: 433-435, MALLET 1878: 188-191, ALAM et al. 2003: 1119-1125, SWE & TUN 2008: 267-277, HTWAY & MATSUMOTO 2011: 382-393, WANG et al. 2013: 4373-4384, BRAKENRIDGE et al. 2017: 81-109).

Investigating sedimentary archives by combined analyses of granulometry, geochemistry and optically stimulated luminescence (OSL) dating has not been applied in coastal Myanmar yet but could serve as a valuable approach to characterise past events on a local scale and thus might extend the historical record (e.g., BRILL et al. 2011: 146, BRILL et al. 2012: 2177-2192, PRENDERGAST et al. 2012: 20-27). Events are identified and characterised by sedimentological analyses while their chronology allows for estimations of potential recurrence intervals (e.g., NANAYAMA et al. 2000: 255-264, KORTEKAAS & DAWSON 2007: 208-221, HORTON et al. 2009: 15-30, BAHLBURG & SPISKE 2012: 1063-1086, CHAUMILLON et al. 2017: 151-184).

Situated at the westward oriented Rakhine coast of Myanmar, the settlement of Chaung Thar is particularly prone to flooding as it lacks any offshore islands that may serve as a buffer for probable EWEs. Being a growing touristic destination, the potential of devastating damage is higher compared to its neighbouring, less developed regions.

Besides TCs, tsunamis triggered at the Rakhine segment and floods of the Chaung River are major natural hazards, whereby fluvial dynamics are influenced by monsoonal and storm related rainfalls.
Within the sedimentary record, the uppermost of two allochthonous sand sheets is known to be deposited by TC Mala 2006. This event may serve as a reference for the historic one when sedimentological and luminescence dating approaches are applied to gain insights into. This study therefore focuses on the characterisation of both event layers and their appropriateness for luminescence dating.

1. Identification and characterisation of modern tropical cyclone deposits by applying sedimentological analyses

2. Assessing the datability of extreme wave events by applying optically stimulated luminescence dating

3. Assessing the preservation potential of storm related sediments in different depositional environments

4. Evaluation of the potential of sedimentary evidence for long-term hazard assessment at the Rakhine coast

Both layers reflect typical sedimentary characteristics of EWEs and originate from the same sources out of the foreshore beach while their internal structure is slightly different. Luminescence dating of quartz grains from the TC Mala deposit reveals satisfying results with remnant ages of 10-40 years, if appropriate statistical approaches are used, and allows for inferences about bleaching characteristics. The historic event dates to AD 1929-1953 by applying OSL, indicating a TC that hit the Rakhine coast in AD 1982 as the most probable one. However, the preservation potential of these sediments is very low as carbonate weathering and soil formation already started to overprint them, whereby swale areas and local depressions at the back side of the beach ridge turn out as the most promising archives.
Due to the limit of preservation and together with the lack of knowledge of further former events, the potential of the sedimentary record at Chaung Thar may be very low to provide useful input for local hazard assessment and more differentiated, systematic information are still required, as these findings are only part of first investigations. But though the local conditions at Chaung Thar do not allow for conservation over longer time periods, this holds true for other coastal areas at the Rakhine coast (e.g., ~ 30 km further south, near Ngwe Saung (BRILL et al. 2017: 7-11)). The characteristics of the Mala deposit worked out in this thesis (OSL residuals, changes in sedimentology through weathering, sediment sources etc.) can thus be transferred to those sites to interpret EWE deposits of so far unknown age. Furthermore, this thesis shows the potential of insights derived from sedimentological and luminescence dating analyses. They should be included as additional input into already existing hazard assessments at the Rakhine coast as they contribute to a better understanding of EWEs at a local and regional scale.

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