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What coastal sediments in northern Halland reveal about storm-surges and their effects on carbon storage

Storm-surges, described as temporary rises in sea level caused by strong winds and low atmospheric pressure, represent an important hazard in many coastal areas. With the current climatic change, these extreme events are expected to become more frequent and require additional research to understand their effects on coastal environments.

Today, storm events are recorded through modern instruments with short-term records that only cover the last century. In this context, geology is considered an important tool to study and understand long-term patterns. Coastal sediments act as natural archives, preserving traces of past storms in sedimentary deposits, which allow the reconstruction of past storm events.

This project focuses on the northern Halland coast, Sweden, with three different study sites: Rosendal, Sallebacka and Träslöv. In these locations, both sedimentological observations (fieldwork) and geochemical analyses (X-Ray Fluorescence, Loss On Ignition and elemental analysis of Carbon & Nitrogen) were used to identify storm-surge events and to assess their influence on carbon storage. This "multi-proxy" approach allows for cross-validation of results, for better interpretations.

The results show clear sedimentological signs of past storm activity across the three sites. These include sharp erosional boundaries, laterally discontinuous layers and the inland transport of coarser material, such as shell fragments and cobbles. Additionally, the alternation of coarse- and fine-grained layers was associated with fluctuations in depositional energy, with the coarse-grained layers linked to high depositional energy, and fine-grained ones linked to lower depositional energy.

While LOI results showed an overall low organic matter content, the XRF analysis proved how various elemental proxies behave differently based on the location, due to different mineral composition of origin and hydraulic sorting responses, highlighting the lack of universal geochemical signals. Additionally, the elemental analysis of C & N showed an overall decrease of organic carbon in beds associated with storm activity. High values of C/N ratio were also observed and are linked to a high terrestrial input and possibly to the influence of seagrass, which also presents organic matter more resistant to degradation.

Furthermore, considering the increased accumulation rates of sediments during storm events, a possible short-term carbon response is believed to be an increased carbon burial. With more frequent storm events, however, the long-term response would be a decrease in carbon storage potential due to higher erosion of the coastal sediments.

Overall, the results demonstrate that storm-surges can leave variable evidence depending on local conditions and therefore highlight the importance of combining different types of data rather than relying

on a single method. Finally, improving the identification and interpretation of past storm events is considered fundamental to understanding environmental changes and possible future coastal hazards, for appropriate coastal management and protection.

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