EGU25-11445, updated on 15 May 2025
https://doi.org/10.5194/egusphere-egu25-11445
EGU General Assembly 2025

Holocene stratigraphy of the shallow offshore zones of the Shetland Islands: Insights into paleotsunami and paleoenvironment reconstructions

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Understanding the evolution of coastal environments requires integrating evidence from both onshore coastal regions and shallow marine environments. The Shetland Islands offer a unique natural laboratory to investigate episodic impacts on the coastal environment through abundant well-preserved tsunami deposits. While numerous studies have identified tsunami deposits onshore in the Shetland Islands, offshore tsunami deposits remain underexplored. This study aims to reconstruct the stratigraphic history of these offshore environments by utilizing shallow seismic surveys, geomorphological analyses, and sediment core investigations.
Bathymetric data and sub-bottom profiles reveal a complex geomorphology characterized by bedrock exposures and isolated depressions that form sub-basins. Initial sedimentation filled these preexisting basins, and this was then overlain by shallow marine sediments that typically accumulated in mounded depocenters, suggesting a strong influence of bottom currents. Stratigraphic reconstruction across three study areas (Dury Voe, Basta Voe, and Sullom Voe) reveals a consistent pattern: moraine deposits associated with glacial till at the base, overlain by postglacial lacustrine or fluvial deposits near the shoreline, and transitioning into shallow marine deposits indicative of transgressive phases in deeper areas.
Within this sedimentary sequence, anomalous layers were identified in all three voes, marked by high-amplitude reflectors and contrasting characteristics, including coarser grain sizes and erosional boundaries, suggesting deposition by extreme wave events. Preliminary dating of these layers aligns with the Storegga tsunami (~8150 cal yr BP) and a Holocene tsunami event around 1500 cal yr BP.
These findings underscore the influence of local bathymetric conditions, sediment supply, and depositional configurations in shaping the distribution of offshore tsunami deposits in the shallow

waters surrounding the Shetland Islands. This study contributes to a deeper understanding of Holocene coastal evolution and the geological record of extreme wave events. For instance, we reconstruct connectivity between onshore and offshore deposits and try to establish a model of how the offshore deposit changes with distance to the coast, and how the environmental factors influence this model.