Tracing ancient DNA of foraminifera in tsunami deposits

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Tsunami deposits add to our understanding of the tsunami long-term frequency-magnitude patterns, which are rarely covered by the historical and instrumental record. Such information is crucial for the assessment of coastal hazards and efforts to mitigate against the loss of life and assets. Microfossils (e.g. foraminifera, ostracods, diatoms) are often used to identify tsunami deposits, and to differentiate them from results of other coastal processes. However, the dissolution and bacterial degradation of their remnants (e.g. tests) often prevent microfossil identification. To address this issue, the pioneering GEN-EX project aims to use high-throughput metagenomic sequencing techniques to identify marine organisms in both onshore and offshore sand layers, using their DNA remains to unravel cryptic diversities. We focus on foraminifera, single-celled protists that show depth-related zonation in subtidal environments and that have already been traced successfully in palaeo-tsunami deposits by their ancient DNA (Szczuciński et al., 2016).

GEN-EX will apply the eDNA approach in two climatically different study areas: (i) the Shetland Islands and (ii) south-central Chile, both of which are known for their well-studied and well-dated tsunami deposits. The Shetland Islands have a temperate oceanic climate, near-shore lakes and coastal peat lowlands which exhibit sand sheets deposited by the submarine Storegga landslide c. 8 ka ago, along with two younger tsunamis dated to c. 5.5 and 1.5 ka (Bondevik et al., 2005). Whereas in the temperate-humid Chaihuin (south central Chile), deposits of the 1960 Chile tsunami and also older historical events have been documented (Garrett et al., 2018) and sampled for a foraminiferal study and DNA extraction.

The main objectives include: (i) quantifying the relationship between water depth and the distribution of different species of foraminifera, using a comparative classic assemblage and metagenomic approach (ii) assessing the potential (based on both approaches), for identifying key indicator species in extreme-wave deposits in different coastal settings and (iii) establishing how metagenomic approaches can contribute to the consistent and reliable differentiation between the sedimentary evidence for storms and tsunamis in coastal settings.

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