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GEN-EX – Metagenomics of Extreme-Wave Events

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Onshore deposits of tsunamis and storm surges enhance our understanding of their long-term frequency-magnitude patterns, which are usually not entirely covered by the historical and instrumental record. Such information is pivotal for a successful coastal hazard assessment and consequential efforts to mitigate against the loss of life and assets. Ambiguities remain in the differentiation between the sedimentary evidence for tsunamis and storms as deposits from both processes share a number of sedimentary criteria. Microfossil approaches (foraminifera, ostracods, diatoms) have yielded promising progress towards conclusive identification, even though dissolution and bacterial degradation of carbonate tests often prevent microfossil identification. To address this issue in a pioneering project, which started in late 2017, we aim at using high-throughput, metagenomic sequencing techniques to identify marine organisms in onshore sand layers from their DNA remains and to unravel cryptic diversities. We focus on foraminifera, single-celled protists, which show depth-related zonation in subtidal environments and have already been traced successfully in palaeo-tsunami deposits by their ancient DNA (Szczuciński et al., 2016), and compare classic and molecular methods for their identification. The main objectives include: (i) Quantify the relationship between water depth and the distribution of different species of foraminifera using both classic assemblage methods and metagenomic approaches; (ii) assess the potential for identifying key indicator species in extreme-wave deposits in different coastal settings based on both assemblage approaches and metagenomic high-throughput sequencing techniques; (iii) establish how metagenomic approaches contribute to consistent and reliable differentiation between the sedimentary evidence for storms and tsunamis in coastal settings.
The field areas chosen for this project – the Shetland Islands and southern Chile – share an abundance of published, well-dated evidence for tsunamis. The Shetland Islands have a temperate oceanic climate, and near-shore lakes and coastal peat lowlands exhibit sand sheets deposited by the submarine Storegga landslide around 8 ka years ago and two younger tsunamis dated to c. 5.5 and 1.5 ka (Bondevik et al., 2005). At temperate-humid Chaihuin, southern Chile, deposits of the 1960 Chile tsunami and also older events have been documented (Garrett et al., 2018) and sampled for the identification of foraminiferal assemblages based on DNA remains.

Bondevik, S., Mangerud, J., Dawson, S., Dawson, A., and Lohne, Ø.: Evidence for three North Sea tsunamis at the Shetland Islands between 8000 and 1500 years ago, Quat. Sci. Rev., 24, 1757–1775, 2005.
Garrett, E., Hocking, E., Melnick, D. and Aedo, D.: Did a tsunami accompany the 1737 Chilean earthquake? Contrasting evidence from historical records and coastal sediment, Geophys. Res. Abstr., 20, EGU2018-611, 2018.
Szczuciński, W., Pawłowska, J., Lejzerowicz, F., Nishimura, Y., Kokociński, M., Majewski, W., Nakamura, Y., and Pawlowski, J.: Ancient sedimentary DNA reveals past tsunami deposits, Mar. Geol., 381, 29–33, 2016.