Towards a paleotsunami chronology in the southern Aegean and Levantine seas, Eastern Mediterranean

Reporting

Project Information

EASTMED-PALEOTSUNAMI

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Project website

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Closed project

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MIDDLE EAST TECHNICAL UNIVERSITY
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Periodic Reporting for period 1 - EASTMED-PALEOTSUNAMI (Towards a paleotsunami chronology in the southern Aegean and Levantine seas, Eastern Mediterranean)

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Summary of the context and overall objectives of the project

In 2004 and 2011, the World witnessed the devastating consequences of Sumatra (Indonesia) and Tohoku (Japan) tsunamis. We realized once again how seriously tsunamis can threaten our lives and infrastructures, and how vital tsunami hazard assessment studies are to reveal especially the recurrence of tsunamis by means of paleotsunami investigations. In the Aegean and the Levantine

seas (Eastern Mediterranean), although the historical records report 17 damaging tsunamis during the last 2500 years, the geological records of the paleotsunamis revealed so far in the region are far from providing information useful for reliable tsunami hazard assessments. The project aims to take a significant step forward towards constructing paleotsunami chronologies in the eastern Mediterranean, and hence to contribute to tsunami hazard assessments in the region. At this point of view, the sedimentary sequences of six lagoonal sites located along the south-western and southern coasts of Turkey have been investigated to reveal geological fingerprints of past tsunamis. The methods applied comprise piston coring the sequences, high-resolution micro-XRF core scanning, u-channel X-ray radiography, and AMS 14C dating. In this way, for the last ca. 2000 years, geochemical and physical sedimentary traces of past eastern Mediterranean tsunamis were revealed.

Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far

The coring campaign within the scope of the project took 63 days in total, and 34 piston cores each having length of ca 3.5 meters were collected from the lagoonal systems. Since lagoons are shallow and highly dynamic depositional environments, multi-core interpretations are crucial to check

basinwide extent of sedimentary events so that local and micro sedimentary processes like sediment focusing and post-depositional diagenesis as well as coring disturbances can be ruled out. Along the cores, total of 80 meters of ITRAX micro-XRF scanning was done at 1 mm resolution. The U-channel radiography method, which uses thin sediment slabs rather than half core sections like in conventional radiography, was used to better reveal mm-scale sedimentary structures. Total of 31 radiocarbon dating were done to understand the chronology of the sedimentary sequences recovered during the project.

Normalization of element profiles like Ti, Fe, K and Zn by Ca is used to evaluate the changes in the balance between terrestrial clastic deposition and deposition of bio/chemical $CaCO_3$ from water column. In all of the target sites of the project, Ca-normalized profiles show anomalies temporally correlating with the historical tsunamis in the eastern Mediterranean. This kind of geochemical trace is attributed to sudden increase in the amount of terrigenous sediment into the lagoons, which is swept from the sand spits of the lagoons due to marine overwash during tsunamis. During relatively sudden deposition of these clastics, there would be no time for bio/chemical $CaCO_3$ precipitation from the water column that would result in a Ca-depleted intercalation within the background sedimentation. Above-mentioned geochemical fingerprints of tsunamis are relatively distinct compared to the physical sedimentary traces observed along u-channel radiographs. Catastrophic tsunamis are expected to transport significant amounts of coarse sediment and macro fossils from near-shore environment and sand barriers of the lagoon. However, this is not the case for the lagoons investigated within the scope of the project, because no obvious physical changes that are distinctly different from the background sedimentation were observed along the radiographs. It is probably because coarse-grained tsunami deposits could not reach to the coring locations, which are approximately 500 meters away from the sand barriers of the lagoons. Instead, only fine-grained sediment cloud could be transported to the coring locations, which can still be geochemically detected.

Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal

implications of the project so far)

In contrast to the extensive historical tsunami records, the geological records of the paleotsunamis that had been revealed so far in the eastern Mediterranean were far from providing paleotsunami chronologies that can contribute to tsunami hazard assessment analyses. Significant part of the related literature for the region presents geological records of only single tsunamis, i.e. not useful to evaluate tsunami recurrence. Currently, at only four locations around the eastern Mediterranean multiple tsunami records (3-4 events) have been detected. The paleotsunami records obtained by the EASTMED-PALEOTSUNAMI project seem more complete compared to the other studies in the literature; e.g. especially the record obtained from Ölüdeniz Lagoon revealed eight tsunami deposits for the last 2000 years. Accordingly, it seems that the results of the project will highly improve geological tsunami catalogues.

The coring platform constructed during EASTMED-PALEOTSUNAMI project is working in one of the lagoons

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