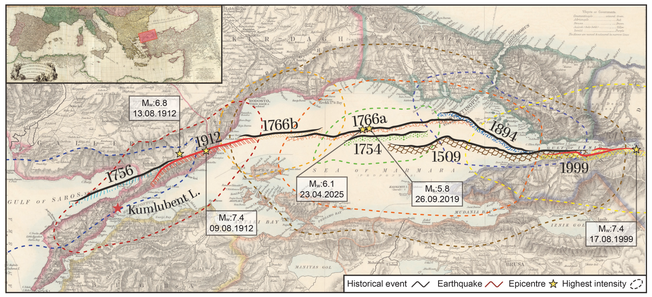
Tracking the 1912 Tsunamigenic Earthquake: A Multi-Proxy Study of Rapid Coastal Evolution and Event Stratigraphy in Kumlubent Lagoon, NW Türkiye

(ECS)Emin Berke Tülümen[1,2,3*], Ufuk Tarı[1,3], Nazlı Olgun Kıyak[2], Ulaş Avşar[4], Sevinç Kapan Ürün[5]

[1]Department of Geological Engineering, Faculty of Mines, Istanbul Technical University, 34469, Istanbul, Türkiye
[2]Climate and Marine Sciences Division, Eurasia Institute of Earth Sciences, Istanbul Technical University, 34469, Istanbul, Türkiye
[3]MATAM (ITU Türkiye İş Bankası Marmara Active Fault Hazard and Risk Application and Research Center), Istanbul Technical University, Istanbul, Türkiye
[4]Department of Geological Engineering, Middle East Technical University, 06800 Ankara, Türkiye
[5]Department of Geological Engineering, Faculty of Engineering, Canakkale Onsekiz Mart University, 17000, Canakkale, Türkiye

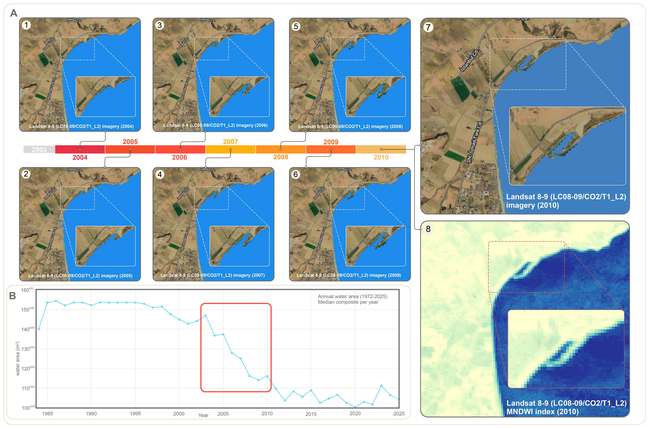
Study Area & Motivation



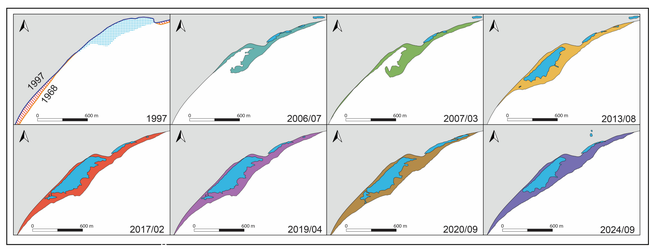
The Marmara Sea is a tectonically active pull-apart basin controlled by the North Anatolian Fault (NAF) system. Historical catalogues document several high-magnitude, tsunamigenic earthquakes associated with ruptures along the Ganos Fault, including the notable AD 1509, 1766, and 1912 (Ms 7.4) events. Despite the well-documented seismic hazard in the region, geological evidence linking historical earthquakes to coastal tsunami inundation remains remarkably sparse along the western Marmara margin.

Panoramic view of the Kumlubent Lagoon (Gallipoli Peninsula). The back-barrier lagoon environment and surrounding geomorphology, where core samples were retrieved for multi-proxy analyses.

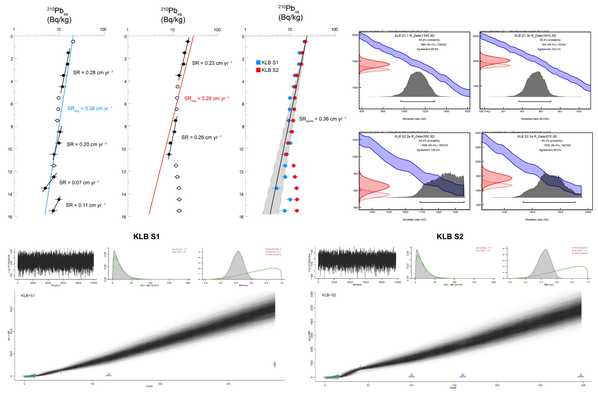
Rapid Formation of Kumlubent Lagoon



Landsat imagery and MNDWI analysis (1984–2025) reveal Kumlubent as a highly dynamic coastal system with rapid lagoon-generating capacity. Furthermore, the system exhibits high sensitivity and rapid response to external impacts such as drainage shifts, seismic shaking, and tsunamis.

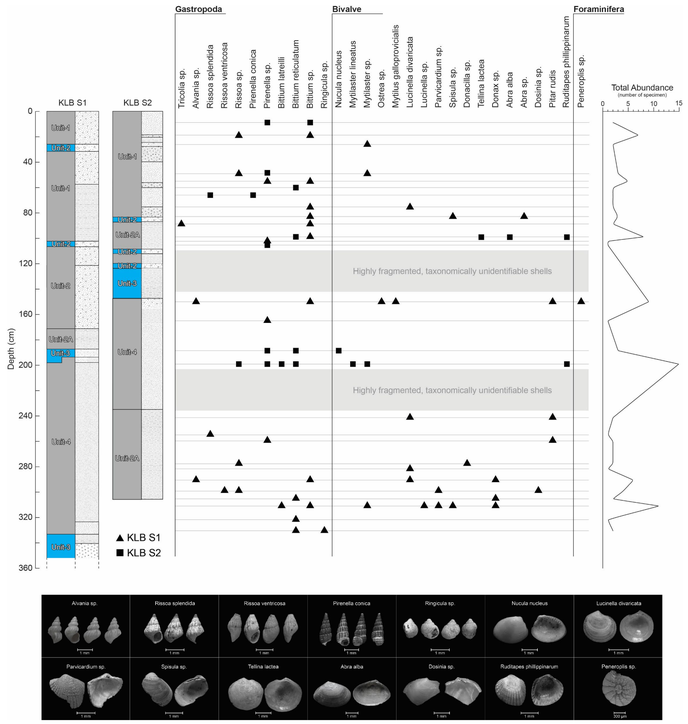


Construction of Age-Depth Model

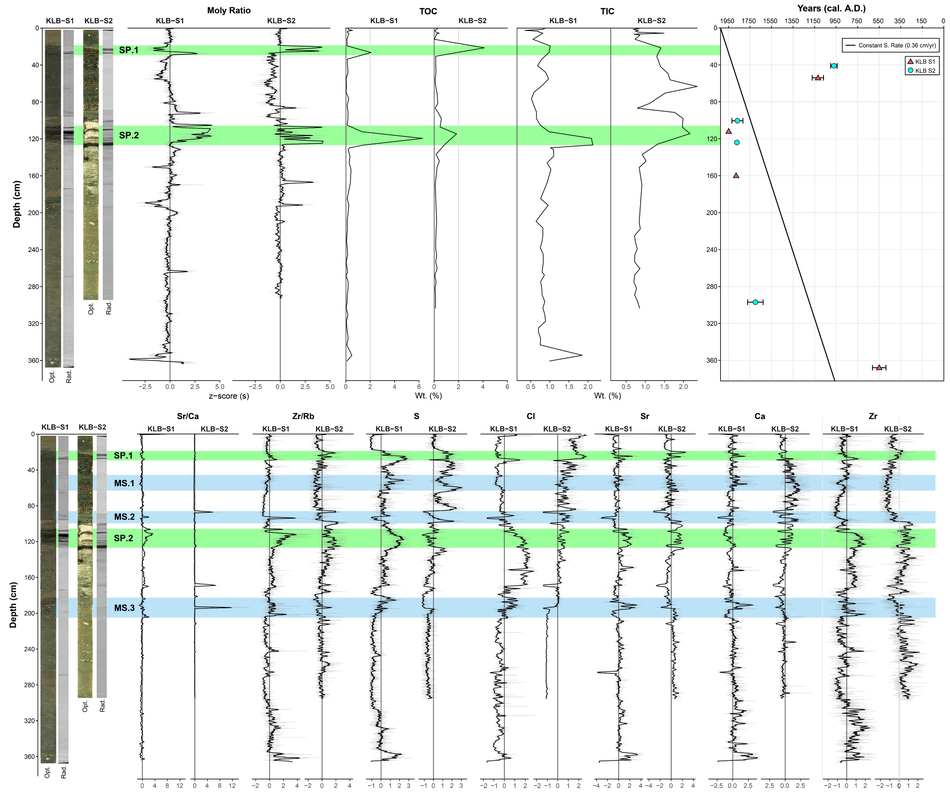


To establish a robust chronostratigraphic framework, we integrated high-resolution (1 cm) 210Pb profiling of the uppermost sediment with AMS 14C dating of marine mollusc shells from deeper intervals. The 210Pbxs activity profiles indicated a stable modern background sedimentation rate of 0.36 cm/yr. Conventional radiocarbon dates were calibrated via OxCal using the Marine20 curve, applying a regional reservoir correction of ΔR=−100±50 years specific to the Marmara Sea. Finally, both geochronological datasets were synthesized using a Bayesian age-depth modeling approach (Bacon) to reconstruct a continuous depositional history spanning approximately 1500 years. This integrated model successfully bridges short-term modern sedimentation with long-term baseline rates, enabling the precise chronostratigraphic identification of event-driven rapid accumulation phases.

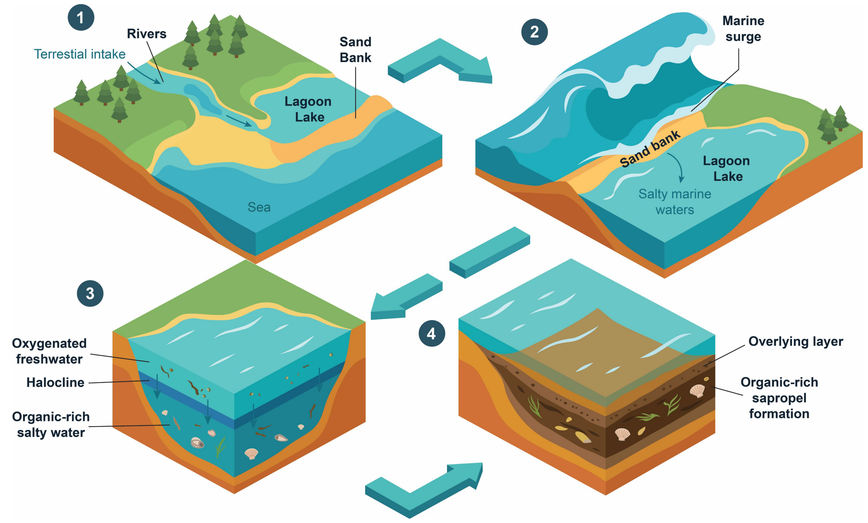
Macro-paleontology



Identifying Sapropels & Marine Surge Events (ITRAX – XRF)



Sapropelic Lag Cycle



Abstract

References

Sharing is encouraged