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# Historic and pre-historic tsunamis in the Mediterranean and its connected seas: a review on documentation, geological signatures, generation mechanisms and coastal impacts

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The origin of tsunamis in the Mediterranean region and its connected seas is reviewed. A variety of historical documentary sources combined with evidence from on-shore and off-shore geological signatures, geomorphological imprints, observations from selected coastal archaeological sites, as well as from instrumental records, clearly indicate that seismic and non-seismic (e.g. volcanism, landslides) tsunami sources can be found in all the seas of the region. Local, regional and basin-wide tsunamis have been documented. An improved map of 22 tsunamigenic zones and their relative potential for tsunami generation is presented. From west to east, the most tsunamigenic zones are situated offshore SW Iberia, in North Algeria, in the Tyrrhenian Calabria and Messina Straits, in the western and eastern segments of the Hellenic Arc, in Corinth Gulf (Central Greece), in the Levantine Sea off-shore the Dead Sea Transform Fault and in the eastern Marmara Sea. The mean recurrence of large (intensity$\geq$8) tsunamis in the entire region is $\sim$90 yrs and in the Mediterranean basin $\sim$102 yrs. However, for most of the historical events it is still doubtful which one was the causative seismic fault and if the tsunami was caused by co-seismic fault dislocation or by earthquake-triggered submarine landslides or by a combined source mechanism (e.g. Lisbon 1755). Instrumentally recorded seismic tsunamis (e.g. Messina 1908, S. Aegean 1956) are still with debatable sources. Calculation of seismic slip slowness factor does not indicate that the 1908 and 1956 events were "tsunami earthquakes". In pre-historical times large tsunamis were caused by volcanic processes in Thera and Etna. A tsunami was supposedly generated in the Holocene by the so-called BIG'95 large submarine landslide in W. Mediterranean. The AD 1650 eruption of the submarine Columbo volcano, off-shore Thera, caused an important tsunami but very little is known about its source mechanism. We concluded that investigating further the tsunami generation mechanisms is of primary importance. Inputs from tsunami numerical modeling and from empirical discrimination criteria for characterizing tsunami sources have been proved particularly effective for recent, well-documented, aseismic landslide tsunamis (1963 Corinth Gulf, 1979 Côte d' Azur, 1999 Izmit Bay, 2002 Stromboli volcano). Since the tsunami generation mechanisms are controlled by a variety of factors, and given that the knowledge of past tsunami activity is the cornerstone for undertaking tsunami risk mitigation actions, future interdisciplinary research efforts on past tsunamis is needed to include: (i) investigation and identification of palaeotsunamis through geological methods in both on-shore and off-shore environments and correlation with the historical record, (ii) better constraints on earthquake and other source parameters and mechanisms, (iii) further development and testing of diagnostic criteria for the source characterization, (iv) drastic improvement of high-resolution bathymetry particularly in the near-shore domain mainly through marine geophysics, as well as of DEM's for coastal topography, and (v) advancement and systematic testing of numerical modeling techniques.