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Seismic Shaking, Tsunami Wave Erosion And Generation of Seismo-Turbidites in the Ionian Sea

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We are investigating the effects of earthquakes and tsunamis on the sedimentary record in the Ionian Sea through the analysis of turbidite deposits. A comparison between radiometric dating and historical earthquake catalogs suggests that recent turbidite generation is triggered by great earthquakes in the Calabrian and hellenic Arcs such as the AD 1908 Messina, AD 1693 Catania, AD 1169 Eastern Sicily and AD 365 Crete earthquakes.
Textural, micropaleontological, geochemical and mineralogical signatures of the youngest three seismo-turbidites reveal cyclic patterns of sedimentary units. The basal stacked turbidites result from multiple slope failure sources as shown by different sedimentary structures as well as mineralogic, geochemical and micropaleontological compositions. The homogenite units, are graded muds deposited from the waning flows of the multiple turbidity currents that are trapped in the Ionian Sea confined basin. The uppermost unit is divided into two parts. The lower marine sourced laminated part without textural gradation, we interpret to result from seiching of the confined water mass that appears to be generated by earthquake ruptures combined with tsunami waves. The uppermost part we interpret as the tsunamite cap that is deposited by the slow settling suspension cloud created by tsunami wave backwash erosion of the shoreline and continental shelf. This tsunami process interpretation is based on the final textural gradation of the upper unit and a more continental source of the tsunami cap which includes C/N >10, the lack of abyssal foraminifera species wirth the local occurrence of inner shelf foraminifera.
Seismic reflection images show that some deeper turbidite beds are very thick and marked by acoustic transparent homogenite mud layers at their top. Based on a high resolution study of the most recent of such megabeds (Homogenite/Augias turbidite, i.e. HAT), we show that it was triggered by the AD 365 Crete earthquake. Radiometric dating support a scenario of synchronous deposition of the HAT in an area as wide as 150.000 km2, which suggests basin-scale sediment remobilization processes. The HAT in our cores is made up of a base to top sequence of stacked and graded sand/silt units with different compositions related to the Malta, Calabria and Sicilian margin locations. This composition suggests multiple synchronous slope failures typical of seismo-turbidites; however, the Crete earthquake source is too distant from the Italian margins to cause sediment failures by earthquake shaking. Consequently, because our present evidence suggests shallow-water sediment sources, we reinforce previous interpretations that the HAT is a deep-sea "tsunamite" deposit.
Utilizing the expanded stratigraphy of the HAT, together with the heterogeneity of the sediment sources of the Ionian margins, we are trying to unravel the relative contribution of seismic shaking (sediment failures, MTDs, turbidity currents) and of tsunami wave processes (overwash surges, backwash flows, turbidity currents) for seismo-turbidite generation.