Geophysical Research Abstracts
Vol. 12, EGU2010-756, 2010
EGU General Assembly 2010

Geological record of the 365 A.D. Crete tsunami in south-eastern Sicily

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Five years ago we started a coring campaign with the purpose to identify evidence for tsunami inundations along the coastal areas of eastern Sicily, that were affected in historical times by devastating tsunamis, generated both by local earthquakes, such as the 1169, 1693 and 1908 events, and by distant seismic sources, such as those belonging to the Aegean subduction zone (e.g. the A.D. 365 Crete earthquake). Following a multi-theme approach, we used the available historical information to address geomorphological study of the coastal landscape: aerial-photographs analysis, satellite images interpretation and field surveys allowed us to select areas likely invaded by tsunami waves in the past, representing potential trap-site for high energy deposits sedimentation and preservation.

Given the variability in the nature of tsunami deposit characteristics, they are not uniquely identifiable, and other kinds of high energy deposits may share some of their features. Despite the abundant literature regarding diagnostic criteria for tsunami deposits, their distinction from storm and hurricane deposits remains a debated issue. We present the geological evidence of a tsunami inundation that left continuous onshore sandy deposit inside the Pantano Morghella along the south-eastern Sicilian coast.

Pantano Morghella an almost flat area, about 1.3 km long and 0.8 km wide, surrounded by Upper Cretaceous lavas and volcanoclastic deposits, Late Cretaceous limestone calciruditi, calcarenites and marls. To the east Quaternary deposits, beach sands and 3 m high, partially cemented, dunal system (Holocene and Late Pleistocene) separate the Pantano from the sea forming the intertidal pond with a little channel from which sea water can rush into. The site was partially used as salt-pans in the recent past. In this site, we dug 33 cores down to a maximum depth of 5.80 m, from 200 m up to 1200 m from the coastline. The sedimentological core analysis reveals a fine stratigraphic sequence mainly composed by clay and silty clay, interrupt by a yellow sandy layer (about 8-10 cm thick) at about one meter of depth. Paleontological analyses show that the sandy samples have different macro and microfauna composition with respect to those samples collected above and below characterized by a lagoonal assemblage. The sandy layer, mainly composed by well-rounded yellowish carbonatic clasts, is made of several reworked foraminifera (both planktonic and benthonic), few well preserved littoral benthic foraminifera, marine macro fossil fragments and few lagoonal specimens. The deposit shows similarity with the local beach sand and it also presents a landward thinning. X-Ray analysis performed on some selected cores shows that the sandy layer is characterized by a fining upward granulometry and a sharp basal contact, possibly erosional.

Summarizing, we investigated spatial distribution and lithofacies of this peculiar deposit and observed the following properties as typical of high energy deposition event: (1) the deposit covers the surface almost continuously on gentle topography and extend inland for about 1200 meters; (2) its thickness varies across local surface undulation; (3) the foraminiferal assemblage contains several reworked marine planktonic and benthonic specimens with some lagoonal species; (4) the deposit is characterized by erosive basal contact. Moreover, its composition consisting of a single structureless bed of normally graded sand, its thickness decreasing with distance from the sea and its landward limit represent attributes that strongly suggest a tsunami origin.

Radiocarbon dating, performed on three samples collected just above, within and below the sandy anomalous layer, gives ages close in time, confirming a sudden deposition due to a high energy event occurred in the interval 270-650 A.D. Comparing this age with the historical tsunami catalogue, we can hypothesize that the sandy layer represents the geological record of the 365 A.D. Crete tsunami.