Re: New archaeological evidence casts doubt on mega−tsunami theory of Minoan collapse

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From: Eric Stevens (*eric.stevens_at_sum.co.nz*)
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On Fri, 07 Jan 2005 08:06:45 +1300, Eric Stevens
<eric.stevens@sum.co.nz> wrote:
>"The re−analysis of
>the original tsunami hypothesis indicates that there is insufficient
>evidence to demonstrate that a large tsunami propagated throughout the
>eastern Mediterranean circa 3,500 years BP."

A subjective answer to the question of what it is that constitutes 'a large tsunami' may be indicated from the following:

Bryant in his 'Tsunami: The underrated Hazard' writes of the Santorin eruption on page 225:

"The eruption around 1470 B.C. had four distinct phases. The first was a Plinian phase with massive pumice falls. This was followed by a series of basal surges producing profuse quantities of pumice up to 30 m thick on Santorini. The third phase was associated with the collapse of the caldera and production of pyroclastic flows. About 4.5 km3 of dense magma was ejected from the volcano, producing 10 km3 of ash. The volume of ejecta is similar in magnitude to that produced by the Krakatau eruption in 1883. The ash drifted to the east−southeast, but did not exceed 5 mm thickness in deposits on any of the adjacent islands, including Crete. The largest thickness of ash measured in marine cores appears to originate from pumice that floated into the Eastern Mediterranean. It is possible at this stage that ocean water made contact with the magma chamber and produced large explosions, which generated tsunami in the same way that the eruption of Krakatau did. The final phase of the eruption was associated with the collapse of the caldera in its southwest corner. The volcano sunk over an area of 83 km2 and to a depth of between 600 and 800 m. According to the Krakatau model, this final event produced the largest tsunami, directing most of its energy westwards (Figure 7.4). It is estimated that the original height of the tsunami was 46—68 m in height, and maybe as high as 90 m. The average period between the dozen or more peaks in the wave train was 15 minutes.

Evidence of the tsunami is found in deposits close to Santorini. On the island of Anapi to the east, sea−borne pumice was deposited to an altitude of 40—50 m above present sea level. Considering that sea levels at the time of the eruption may have been 10 m lower, this represents run−up heights greater than those produced by Krakatau in the Sunda Strait. On the Island of Crete, the wave arrived within 30 minutes, with a height of approximately 11 m. Refraction focussed wave energy on the northeast corner of Crete, where run−up heights reached 40 m above sea level. In the region of Knossos, the tsunami swept across a 3−km−wide coastal plain, reaching the mountains behind. The backwash concentrated in valleys and watercourses, and was highly erosive. Evidence for the tsunami is also found in the Eastern Mediterranean on the western side of Cyprus, and further away at Jaffa—Tel Aviv in Israel. At the latter location, pumice has been found on a terrace lying 7 m above sea level at the time of the eruption. However, the tsunami wave here had already undergone substantial defocussing because of wave refraction as it passed between the islands of Crete and Rhodes. The greatest tsunami wave heights occurred west of Santoririi. Based upon linear wave theory, the wave in the central Mediterranean Sea was 17 m high, while closer to Italy over the submarine Calabrian Ridge, it was 7 m high. Bottom current velocities under the wave crest in these regions ranged between 20 and 50 cm s~ — great enough to entrain clay to gravel sized particles. The maximum pressure pulse produced on the seabed by the passage of the wave ranged between 350 and 850 kdyne cm2. Spontaneous liquefaction and flow of water−saturated muds is known to occur under pressure pulses of 280.

Some of the evidence for a large tsunami comes from the discovery of unusual deposits on the seabed of the central Mediterranean Sea, where wave heights were highest. These deposits — labelled homogenites — formed in the deep ocean as the result of settling from suspension of densely concentrated, fine−grained sediment. This process produced homogeneous units up to 25 m thick with a sharp basal contact. Homogenites can be linked hydrodynamically to the passage of a tsunami wave. As sediment fails via liquefaction due to the pressure pulse, oscillatory flow under the wave suspends finer particles, creating turbulent clouds of sediment. It is estimated that the slurries exceeded concentrations of 16,000 rng H. In comparison, the highest measured sediment concentrations on the ocean seabed and in muddy tidal estuaries rarely exceed 12 rng l~ and 300 mg H respectively. Gravity sorting occurred under this extreme concentration. Sand−sized particles settled first to the bottom and were deposited at the erosional contact with the seabed as a fining upward unit whose thickness ranged from a few centimetres to several metres. Finer clay−sized sediment was deposited over the next few days as a massive undifferentiated clay deposit that was up to 20 rn or more thick. Hormgenites differ from turbidites described in Chapter 3 by their greater thickness, lack of laminations, and undifferentiated particle size. Homogenites differ from debris flows by the absence of large clasts or rock pieces derived from continental sediments.

Four types of homogenites can be differentiated. In the Western Mediterranean, on the lonian Abyssal Plain, a 10− to 20−rn−thick deposit, with an estimated volume of 11 km3, was laid down on the seabed over an area of 1,100 km2. It appears that the tsunami wave slammed into the continental shelf of North Africa and either directly or indirectly triggered a mega−turbidity current. This current carried terrigenous and shelf sediment into the deep Mediterranean Sea, eroding flanks of undersea ridges and depositing homogenites with an erosional base on upsiopes. In one location this turbidity current rode up a ridge 223 m above the abyssal plain and deposited sediment. In the eastern part of the Mediterranean, bottom velocities and the related powerful pressure pulse liquefied sand into depressions, forming uniform deposits several metres thick with a sandy base overlying an erosional contact. These deposits form in cobblestone−shaped basins with a vertical relief of 200 m. Finally, in the Bannock Basin, the passage of the wave destabilised evaporites. The resulting deposits are 12 m thick and consist of 3 m of sand overlain by 9 m of graded mud deposited from suspension in highdensity brines trapped at the bottom of 100−m−deep depressions in the seabed. All of the homogenites found in the Mediterranean are derived from a single event and date around the time of the Santorini eruption. Homogenites are not found in the Eastern Mediterranean Sea, where tsunami wave heights were insufficient to cause resuspension or liquefaction of bottom sediment."

I was familiar with this text as the discussions of the last few days had caused me to reread it. I particularly noted the depths of the turbidity deposits etc desceiped in the last two paragraphs. What caused me to post it on this occasion was an interview on the local TV yesterday evening with an Indian naval officer. He said the Indian navy has discovered that Aceh earthquake and tsunami have made drastic changes in the shape of the sea bed over very large areas. He mentioned on area where the depth was previously 4000' and now is only 100'! Such a change is very unlikely to have been caused by crustal movement and can only be ascribed to turbidities etc. Clearly the volume of water displaced in the Aceh tsunami vastly exceeds that displaced by Santorini, yet the Santorini 'run ups' seem to vastly exceed those of Aceh.

This then raises the question of what is a 'large tsunami'. Dominey−Howes may well be correct when he says that there is insufficient evidence to demonstrate that a large tsunami (in the Aceh sense) propagated throughout the eastern Mediterranean circa 3,500 years BP, yet the evidence of tsunami deposits on land cited by Bryant suggest that there was a very considerable wave series, nevertheless.

Eric Stevens