



## Puglia 2003 - Final Conference Project IGCP 437

Coastal Environmental Change  
During Sea-Level Highstands:  
A Global Synthesis with implications  
for management of future coastal change

Otranto / Taranto - Puglia (Italy) 22-28 September 2003  
Quaternary coastal morphology and sea level changes



Project 437

Anzidei M.<sup>1</sup>, Lambeck K.<sup>2</sup>, Antonioli F.<sup>3</sup>, Baldi P.<sup>1</sup>, Benini A.<sup>5</sup>, Esposito A.<sup>1</sup>,  
Nobili A.<sup>4</sup>, Surace L.<sup>4</sup>

## Sea-level change from Roman time up to the present in Central Mediterranean

<sup>1</sup>Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy, E-mail: [anzidei@ingv.it](mailto:anzidei@ingv.it);

<sup>2</sup>Australian National University, Canberra, Australia;

<sup>3</sup>ENEA, Casaccia, Roma, Italy, E-mail: [fabrizio.antonioli@casaccia.enea.it](mailto:fabrizio.antonioli@casaccia.enea.it);

<sup>4</sup>Università della Tuscia, Viterbo, Italy;

<sup>5</sup>Istituto Idrografico della Marina, Genova, Italy, E-mail: [alessandrabenini@libero.it](mailto:alessandrabenini@libero.it);

**Keywords:** late Holocene sea level rise, Roman fisheries, tide gauge

### Abstract

Sea level change exhibits a complex pattern of temporal and spatial variability. Geological indicators provide clear records for this variability during glacial cycles (Lambeck et al., submitted 2003) but, because the change for the past

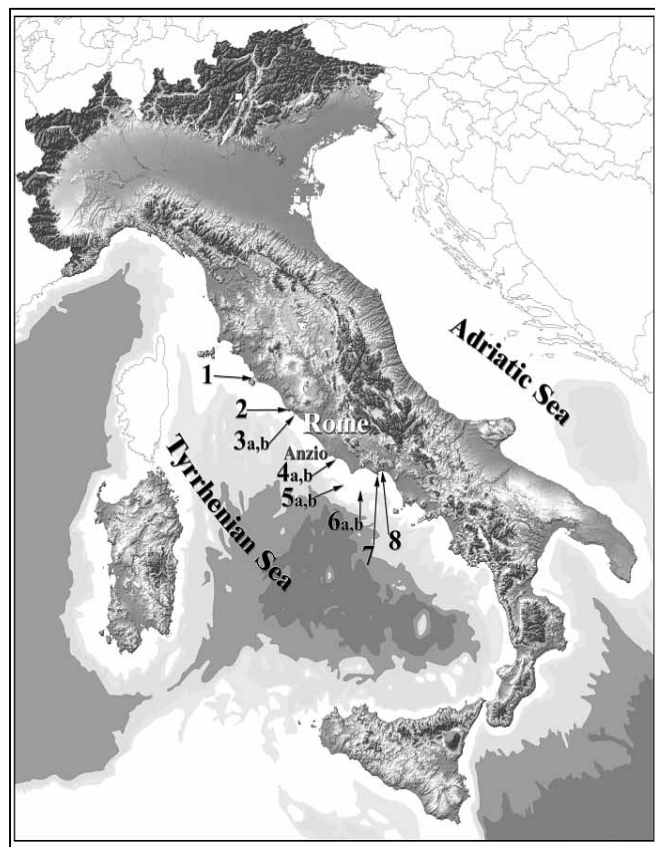
few millennia has been mostly small, the record for this period is not well defined.

The instrumented record in contrast provides a relatively precise measure of sea level change for the past 50-100 years. The aim of this research is to reconstruct the vertical deformations of the earth's crust and the relative sea level oscillations during late Holocene by means of multidisciplinary investigations of archaeological sites located along the central Tyrrhenian coastlines (Italy). The sites (fish tanks (*piscinae*) and harbours) of Roman Age (2.1-1.9 ka BP), play a fundamental role for the evaluation of the sea level rise during the last 2 ka. Early studies using this technique were performed by Flemming (1969), Schmiedt (1972), Pirazzoli (1976) and more recently by Flemming and Webb (1986) and Leoni and Dai Pra (1997).

We have used the original latin sources written by the historical Roman authors Varrone and Columella to understand the detailed technical rules for the construction of the *piscinae* (depth of ponds and channels, operating range of the sluice gates, etc.). On the basis of these publications we re-interpret some significant sites to estimate the difference between their ancient depths and some recent interpretations.

We studied the remains located at Punta della Vipera, Santa Marinella, Torre Astura, Ponza, Serapo, Sarinola and Ventotene island. Our data show an increase in sea level at these sites of between  $145 \pm 20$  and  $100 \pm 20$  cm since roman age.

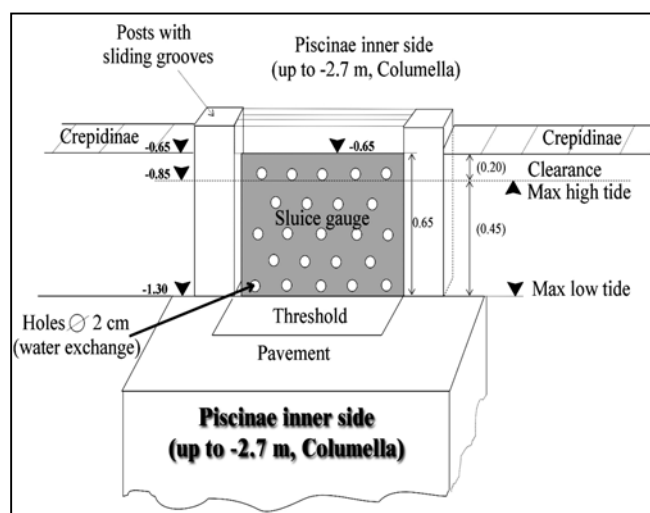
All sites are located along about 300 km coastline of the Tyrrhenian sea, in Latium, that exhibits areas of both tectonic stability and instability and we use the elevation of the MIS 5.5 transgression (inner margin sediments) to estimate the rates of uplift or subsidence. At Punta della Vipera this elevation reaches 35 m (Nisi et al., submitted) and we consider that this area has been tectonically active with an uplift rate of  $0.23 \pm 0.05$  mm yr<sup>-1</sup>.



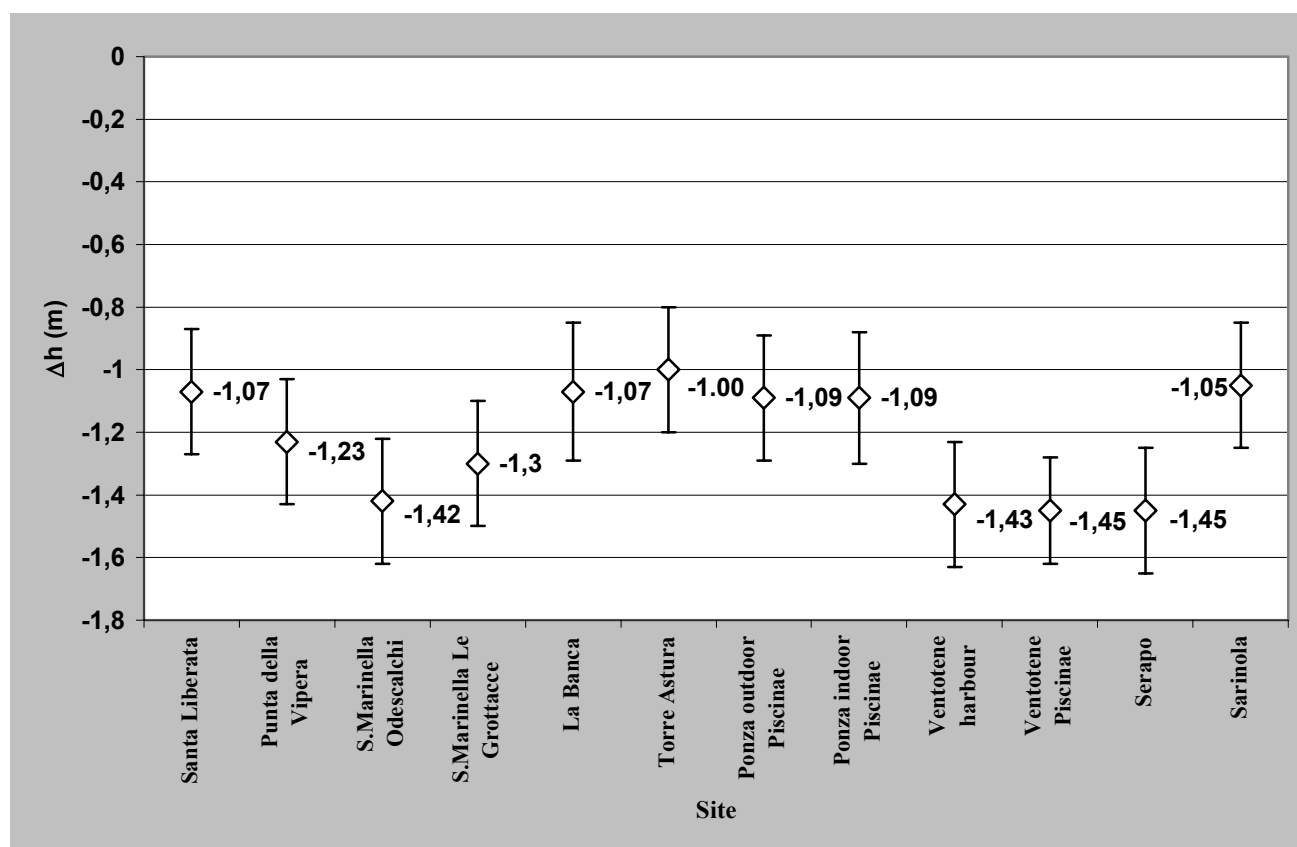
**Figure 1.** Italian sites on which were made the new measurements.



**Figure 2.** The sludge gauge discovered at the Roman fishery "La Banca" near Torre Astura. The new measurement indicate for this site a sea level of  $-100 \pm 20$  cm. Previous measurement was  $-65$  cm by Smiedt, 1972,  $-50$  cm by Pirazzoli 1976,  $-50$  cm by Leoni & dai Pra 1997.



**Figure 3.** Sketch of the Sludge gauge, Sliding Grooves and Crepidinae.



**Table 1.** All sites with the new measurements of Roman age (2.1-1.9 ka BP) architectural markers connected with sea level.

High resolution numerical models of sea-level change have been used and tested against other Italian sea level data to provide a realistic representation of the spatial variability of the sea-level change and shoreline evolution during last 2ka BP.

These predicted values are in good agreement with our revised interpretations of the archaeological observations. These data provide a precise measure of local sea level for 2000 years ago as well as a constraint on the change in ocean volume for the past 2000 years.

Comparison of this evidence with tide-gauge data from the same region establishes that the onset of the modern (PMSL, 2003) sea-level rise is a comparatively recent phenomenon.

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