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Adapting coastal structures to a moving relative sea level: Roman Time geoarchaeological evidence from Posillipo promontory (Naples, Italy).

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The Posillipo promontory belongs to the southern periphery the active volcanic complex called Campi Flegrei. Especially the central caldera of CF is well known for offering a rich geoarchaeological record of the vertical ground movements it has been suffering since Roman times; which includes the ruins of Portus Julius (built in 37 BC) presently found between 10 and 5 m bsl and the Middle Ages Lithophaga perforations at about 7m asl on the marble columns of the Serapeo building (Morhange, 2006 and references therein).
In order to better constraint the vertical movements suffered by the Posillipo promontory during the last two millennia, we selected three geoarcaeolgical coastal sites (Nisida Roman port, Marechiaro Roman port and Villa Robery) and we studied them by means of both geomorphological observations and geophysical surveys (Side Scan Sonar and Single Beam echo-sounder).
Within the submerged Roman port of Nisida, built in the 1st AD, we found two pilae of the ancient pier. The submersion measuring of the well-preserved one provided a palaeo-sea level at 3.1±0.30 m bsl.
In the submerged Roman port of Marechiaro, we recognized a still preserved breakwater connected to the tuffaceous sea cliff, and submerged foundations of a 1st century small sea-side villa. Nearby there is also a two-storeyed Roman building (Palazzo degli Spiriti), built in the 1st cent. BC and later restructured to adapt to a phase of subsidence (Gunther 1908). From our submersion measurements, two different paleo-sea levels can be deduced: one for the 1st cent. BC at -4.4 + -0.50 m and another for the 1st cent. AD at -3 + - 0.30 m.
Finally, in front of the modern Villa Rosebery the sea bottom shows a sub-horizontal element at -3m to -3.5m bsl, emerged during the 1st BC century. In fact, at least three houses were erected there during said century (Gunther, 1908). As the area was very little elevated, an alignment of pilae was also constructed to protect those houses from the breakers. By precisely measuring the present submersion of all remains, two paleo-sea levels has been detected: one for the 1st century BC at -4 / -5 m and another for the 1st century AD at -3 + -0.50 m.
In conclusion, by comparing the relative palaeo-sea level we have found with the eustatic curve (Lambeck et al 2011), it appears that Posillipo area suffered 2 +/- 0.3m of subsidence after the 1st century AD. Moreover, the new interpretations we present here, strongly suggest that Posillipo area was also affected by subsidence between the 1st century BC and the 1st century AD, when the landmass sank about 1.5/2.5 m. Eventhough these movements appear less strong than those recognized in the Campi Flegrei central caldera, our results prove that volcano-tectonic movements of at least metrical magnitude have occurred also outside the caldera.
In terms of human adaptation to the subsidence-induced rise of sea level during Roman times, the archaeological remains of Marechiaro e Rosbery indicate that the villas were restructured closing the rooms submerged by the sea.