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A GEODATABASE OF LATE PLEISTOCENE - HOLOCENE PALAEO SEA-LEVEL MARKERS IN THE GULF OF NAPLES

Vincenzo Amato [1], Pietro P.C. Aucelli [2], Gaia Mattei [2], Micla Pennetta [3], Angela Rizzo [2], Carmen M. Rosskopf [1], Marcello Schiattarella [4]

1 GeoGisLab, Dipartimento Bioscienze e Territorio, Università degli Studi del Molise, Isernia, Italy
2 Dipartimento di Scienze e Tecnologie (DiST), Università degli Studi di Napoli Parthenope, Napoli, Italy
3 Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse (DiSTAR) Università degli Studi di Napoli Federico II, Napoli, Italy
4 Dipartimento delle Culture Europee e del Mediterraneo (DiCEM), Università degli Studi della Basilicata, Matera, Italy
Corresponding author: M. Pennetta <pennetta@unina.it>

ABSTRACT: During the Late Pleistocene and Holocene periods, the Italian coasts have undergone a very articulated geological and geomorphological evolution, due to the complex and differentiated interaction of endogenous and exogenous dynamics. Aim of this study is to implement a geodatabase concerning the geomorphological, stratigraphic, biological and archaeological palaeo sea-level proxies located in the Gulf of Naples, in order to provide a catalogue of the most representative markers and an overall picture of ancient shorelines positions since the Late Pleistocene.

KEYWORDS: Relative sea level changes, palaeo sea-level markers, Gulf of Naples, southern Italy

1. INTRODUCTION

The sea level variations that have occurred during the Late-Pleistocene and the Holocene along the Italian coasts obviously have deeply controlled coastal dynamics and morphology, causing cliff erosion, barrier beach and lagoon system migration, marine ingression, etc. In order to determinate past sea-levels, the identification of a number of sea-level indicators is required. Archaeological proxies are largely used for the Holocene, especially for the historical period (Auriemma & Solinas, 2009; Morhange & Marriner, 2015; Pennetta et al., 2016; Vacchi et al., 2016), while depositional and erosional proxies, such as speleothems, beach and lagoonal/marshy sediments, notches, abrasion platforms and marine terraces, along with associated biological indicators such as *Lithophaga* perforations are in general useful proxies for ancient Pleistocene shorelines (Benjamin et al., 2017).

In this study, we present preliminary results of a wider research project aimed to inventory the palaeo-sea level markers along Campania (southern Italy) coasts. In detail, a geodatabase of the geomorphological, sedimentary, biological and archaeological palaeo sea-level proxies recorded in the Gulf of Naples (Campania Region, southern Italy) has been implemented by collecting via literature and proper studies the main palaeo sea-level markers. The main aim of this study is to provide a free application of the collected proxies by releasing a Google xml file available for different stakeholders interested in the management, scientific data analysis and/or preservation of the proxies.

2. MATERIALS AND METHODS

The geodatabase has been implemented in a GIS environment by compiling two main attribute tables connected by a joint tool. The first table identifies the sites and the position where the palaeo sea-level proxies are located, specifying an ID number and the geographic coordinates. In the second table, the proxies are classified as archaeological, biological, depositional and erosional, and the height of each proxy, below or above the present sea-level, is indicated. The geodatabase furthermore provides information about the state of conservation and site conditions of the proxies, and its illustration by a representative photo.

3. RESULTS

The Gulf of Naples coastline is characterised by different coastal types, including high rocky, low sandy and volcanic coasts. The locations of detected palaeo-sea level proxies are indicated in Figure 1.

Each proxy is indicated by a number and an asterisk. The colour of the asterisk identifies the proxy type, the colour of the square that surrounds the asterisk, instead, the period: Late Pleistocene (green square) and Holocene (yellow square). Table 1 summarizes the data of collected proxies: ID number, proxy type, proxy age, and the ancient sea level height evaluated for each marker. Furthermore, for proxies reported by previous studies references are added. The proxies referring to the Holocene period are mainly represented by coastal archaeological ruins, while tidal notches are the main markers of Late Pleistocene sea level positions.

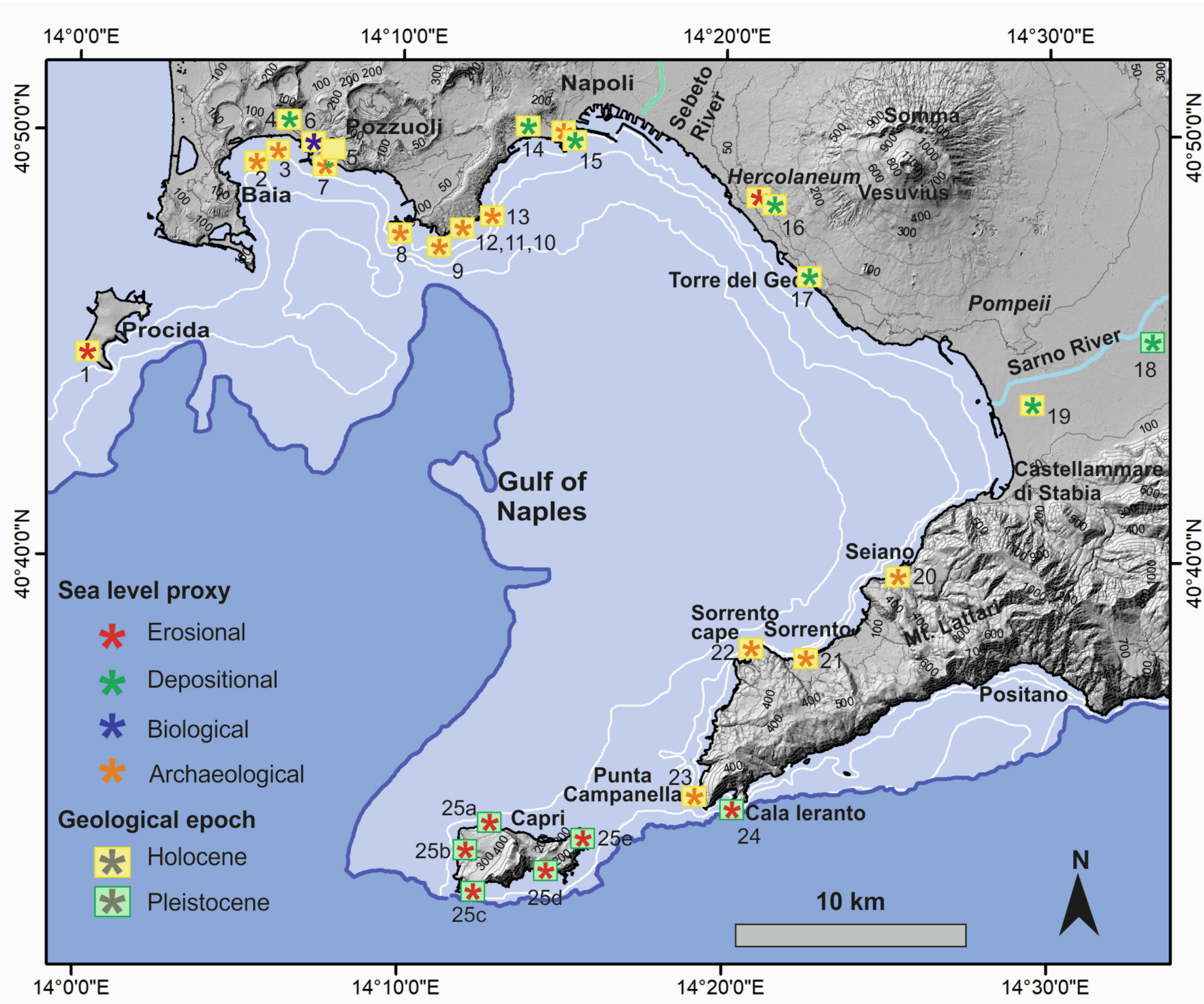

Fig. 1 - Location and type of main collected palaeo sea - level proxies in the Gulf of Naples.

4. DISCUSSION AND CONCLUSION

The comparative analysis of the main palaeo-sea level proxies has resulted in a homogeneous framework of the Gulf of Naples coasts, for a time lapse ranging from the Late Pleistocene to the present-day. At this time, the database contains only the markers referred to highstand phases, even if it is not excluded in the future to implement the database also with lowstand markers that, in the Gulf, are almost always below the present sea level. Totally, the database contains 47 sea level proxies, of which 7 related to the Pleistocene and 40 related to the Holocene.

The analysis of the Late Pleistocene-Holocene sea level markers included in the geodatabase has given evidence on the stability or non-stability of the investigated coastal sectors and, thus, on the entity of local vertical ground movements. These local movements are particularly significant in this sector, as it is located in a region of the Italian Tyrrhenian side where the volcano-tectonics significantly influenced the local sea level variations since the Late Pleistocene.

The Late Pleistocene proxies recognizable along the coasts of Naples Gulf are exclusively positioned in the eastern sector. The erosional proxies located along the Sorrento Peninsula and Capri coasts testifies a tectonic stability, though Ferranti & Antonioli (2007) use a change in elevation of the tidal notch to evaluate a minor tectonic slips along the Capri main faults. On the contrary, the depositional proxy located in the Sarno plain is a witness of a subsiding trend, that has characterised this sector since the Last Interglacial.

Considering the Holocene sea level markers, it is

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Tab. 1 - Table of main collected palaeo sea-level proxies in the Gulf of Naples containing: progressive ID; position of each site; typology and specific type of proxy; age in years before present; H, height above/below the present sea level; references.

ID	Site position	Typology	Type of RSL proxies	Age (y BP)	H (m)	Reference
1	Procida	Erosional	Abrasion platform	3700-3350	0.8	Putignano et al., (2009) Putignano et al., (2014)
2	Baia	Archaeological	Portus Julius entry channel	2037	-5.5	Passaro et al., (2013)
3	Baia	Archaeological	Pilae - Pisoni villa breakwater	2000	-6.3	Passaro et al., (2013)
4	Pozzuoli	Depositional	La Starza terrace - upper shoreface deposits	5000	26	Di Vito et al., (1999)
5	Pozzuoli	Depositional	La Starza terrace - beach deposits	9.100-9.600	20	Di Vito et al., (1999)
6	Pozzuoli	Archaeological Biological	Serapeo - Lithophaga perforations	334-527; 698-884; 1336-1454	7	Morhange et al., (2006)
7	Pozzuoli Puteoli port	Archaeological	Pilae	2000	-1	Unpubblished data
8	Napoli Nisida port	Archaeological	Pilae	1900	-2	Aucelli et al., (2017a)
9	Napoli - Pausylipon villa	Archaeological	Fishpond	1900		Simeone and Masucci, (2009)
10a	Napoli - Palazzo degli Spiriti	Archaeological	Floor	2100	-2.4	Aucelli et al., (2017a and b)
10b	Napoli - Palazzo degli Spiriti	Archaeological	Window	1900	-0.4	Aucelli et al., (2017a and b)
11	Napoli - Marechiaro port	Archaeological	Breakwater	1900	-2	Aucelli et al., (2017a and b)
12	Napoli -Pollio villa	Archaeological	Basal Floor	2100	-2.4	Aucelli et al., (2017a and b)
13a	Napoli - Posillipo cape	Archaeological	Pilae	1900	-1.5	Aucelli et al., (2017a)
13b	Napoli - Posillipo cape villa	Archaeological	Basal Floor	2100	-2.4	Aucelli et al., (2017a)
14a	Napoli - Chiaia	Depositional	Drill - Beach deposits	500	-0.4/-0.9	Romano et al., ((2013))
14b	Napoli - Chiaia	Depositional	Drill - Beach deposits	800-700	-0.5/-1.5	Romano et al., (2013)
14c	Napoli - Chiaia	Depositional	Drill - Beach deposits	1500	-3.5/-4.7	Romano et al., (2013)
14d	Napoli - Chiaia	Depositional	Drill - Beach deposits	1700	-4.1/-4.6	Romano et al., (2013)
14e	Napoli - Chiaia	Depositional	Drill - Beach deposits	1900	-3.7/-3.8	Romano et al., (2013)
14e	Napoli - Chiaia	Depositional	Drill - Shoreface deposits	2600-2400	-1.0/-3.5	Romano et al., (2013)
14e	Napoli - Chiaia	Depositional	Drill - Shoreface deposits	3900-2600	-4.3	Romano et al., (2013)
14e	Napoli - Chiaia	Erosional	Wave-cut platform	4550-3900	-4.7/-5.2	Romano et al., (2013)
14e	Napoli - Chiaia	Depositional	Drill - Beach deposits	4550	-4.9/-5.4	Romano et al., (2013)
15a	Napoli - Municipio	Depositional	Drill - Shoreface deposits	2500-2400	-5.5/-7.5	Amato et al., 2009
15b	Napoli - Municipio	Depositional	Drill - Beach deposits	2400-2200	-5.6/7.5	Amato et al., 2009
15c	Napoli - Municipio	Archaeological	Pier	2000	-2	Amato et al., 2009
15d	Napoli - Municipio	Archaeological - biological	Wooden structures with biocorrosion	1800	-2/-2.5	Amato et al., 2009
16a	Herculaneum	Erosional-Archaeological	Abrasion platform	2000	-7	Cinque and Irollo (2008)
16b	Herculaneum	Depositional - Archaeological	Shoreface deposits	1980-1970	-2.5 / -3	Cinque and Irollo (2008)
16c	Herculaneum	Depositional - Archaeological	Beach deposits	1970-1950	-5	Cinque and Irollo (2008)
16d	Herculaneum	Depositional - Archaeological	Beach deposits	1930	-2.5/-3	Cinque and Irollo (2008)
16e	Herculaneum	Depositional - Archaeological	Beach deposits	1921	-3.5/-4	Cinque and Irollo (2008)
17	Torre del Greco	Archaeological	Breakwater	1900	0	Aucelli et al., (2017c)
18	Sarno plain	Depositional	Drill - Beach deposits	122.000	-23	Barra et al., (1991)
19	Sarno plain	Depositional	Drill - Beach deposits	1900	-4	Cinque, (1990)
20	Sorrento Peninsula - Seiano	Archaeological	Pier	1900	-1	Aucelli et al., (2016a)
21	Sorrento Peninsula - Marina Grande	Archaeological	Fishpond	1900	-0.8	Aucelli et al., (2016b)
22	Sorrento Peninsula - Capo Sorrento	Archaeological	Pier	1900	-0.9	Aucelli et al., (2016b)
23	Sorrento Peninsula - Punta Campanella	Archaeological	Quay	1900	-0.5	Aucelli et al., (2016b)
24	Sorrento Peninsula - Cala Ieranto	Erosional	Tidal Notch	129000	8	Brancaccio et al., (1978)
25a	Capri	Erosional	Tidal Notch	124000	+5.2	Ferranti & Antonioli, (2007)
25b	Capri	Erosional	Tidal Notch	124000	+6.2	Ferranti & Antonioli, (2007)
25c	Capri	Erosional	Tidal Notch	124000	7	Ferranti & Antonioli, (2007)
25d	Capri	Erosional	Tidal Notch	124000	7	Ferranti & Antonioli, (2007)
25e	Capri	Erosional	Tidal Notch	124000	+7.7	Ferranti & Antonioli, (2007)

possible to state that along the high rocky coasts of Sorrento peninsula and Posillipo (Naples) the Late Holocene sea level rise led to the submersion of archaeological sites located at the base of the active sea cliffs. Anyway, in Sorrento peninsula the submersion has to be ascribed to eustatic effect, in Naples the eustatic effect is coupled with local subsidence of volcano-tectonic origin (Aucelli et al., 2017a; b).

In the Sorrento peninsula, the deposition of volcaniclastic products of the 79 AD Vesuvius eruption enhanced local and short-term shoreline progradation. Along the sandy low coasts (Sarno), although slightly subsiding or stable, the increase of fluvial inputs, due to Late Holocene climatic oscillations and land use changes, caused the progradation of the shorelines and the aggradation of the ground level, while the progradation of the barrier-lagoonal system was favoured by the 79AD Vesuvius volcaniclastic deposits. In the cases of the volcanic coasts (from Pozzuoli Bay to Naples), the vertical ground movements due to volcano-tectonic factors are the main responsible for their submersion. In the Pozzuoli sector, archaeological sites were affected by short-term uplift. Finally, in the case of Naples, strongly anthropised since Greek-Roman times, coastal progradation was enhanced by several coastline modifications due to human coastal reclamation.

In conclusion, the database here implemented represents a useful tool to manage geospatial coastal geomorphological, archeological, biological and stratigraphical data, providing useful information for the scientific investigation of ancient regional sea levels, and possible interventions aimed at their preservation.

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