SUPPLEMENTARY ONLINE MATERIAL 1

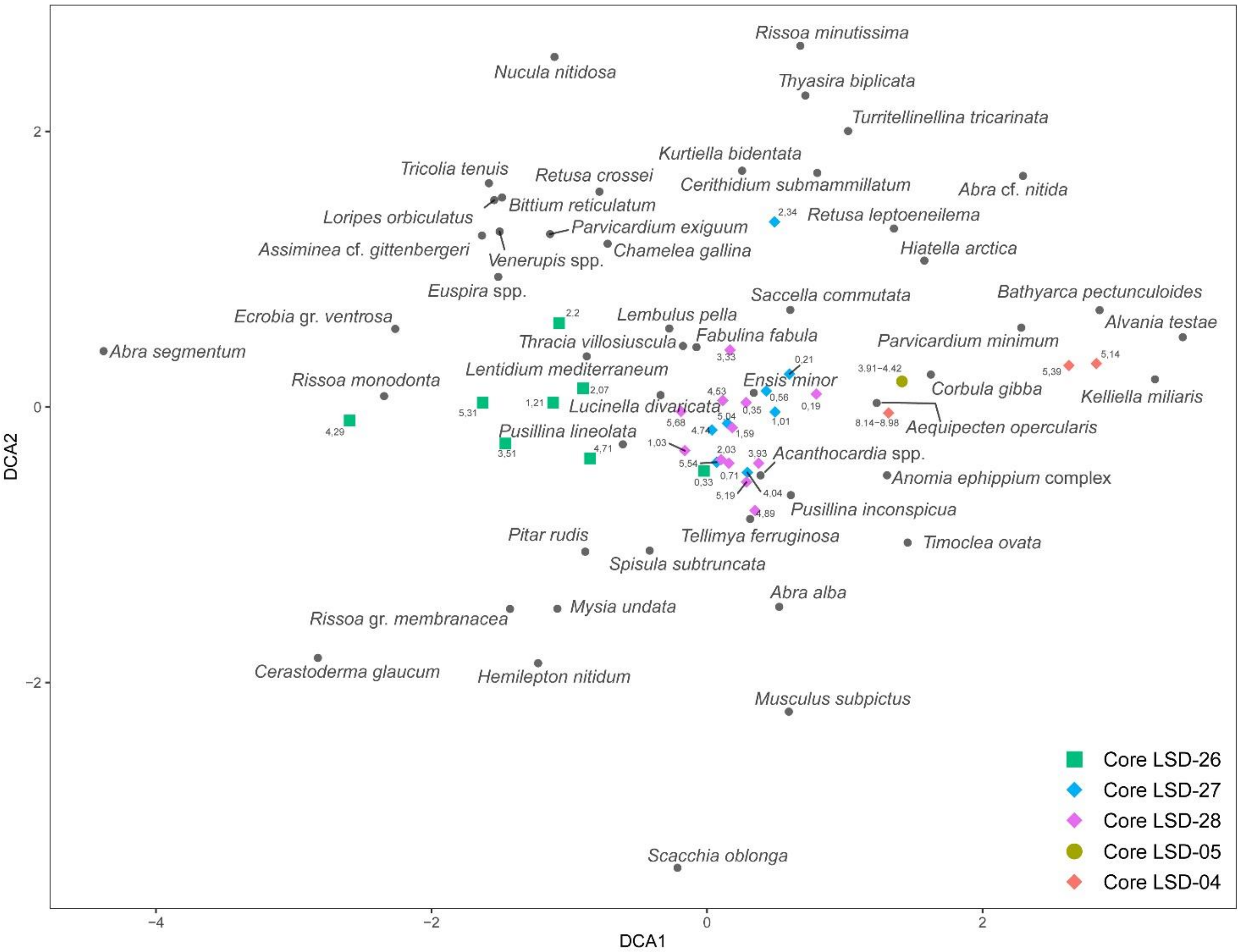


Fig. S1 - Detrended Correspondence Analysis (DCA) was applied to investigate the main environmental gradients associated to the distribution of samples along main axes of variation (i.e., DCA1 and DCA2). Samples with a sample size ≥ 20 specimens and species present in at least in two samples were included in the analysis. The plot reports all taxa used to run the DCA. The output reveals a gradient in the distribution of the samples along the DCA axis 1, mainly controlled by bathymetry and salinity.

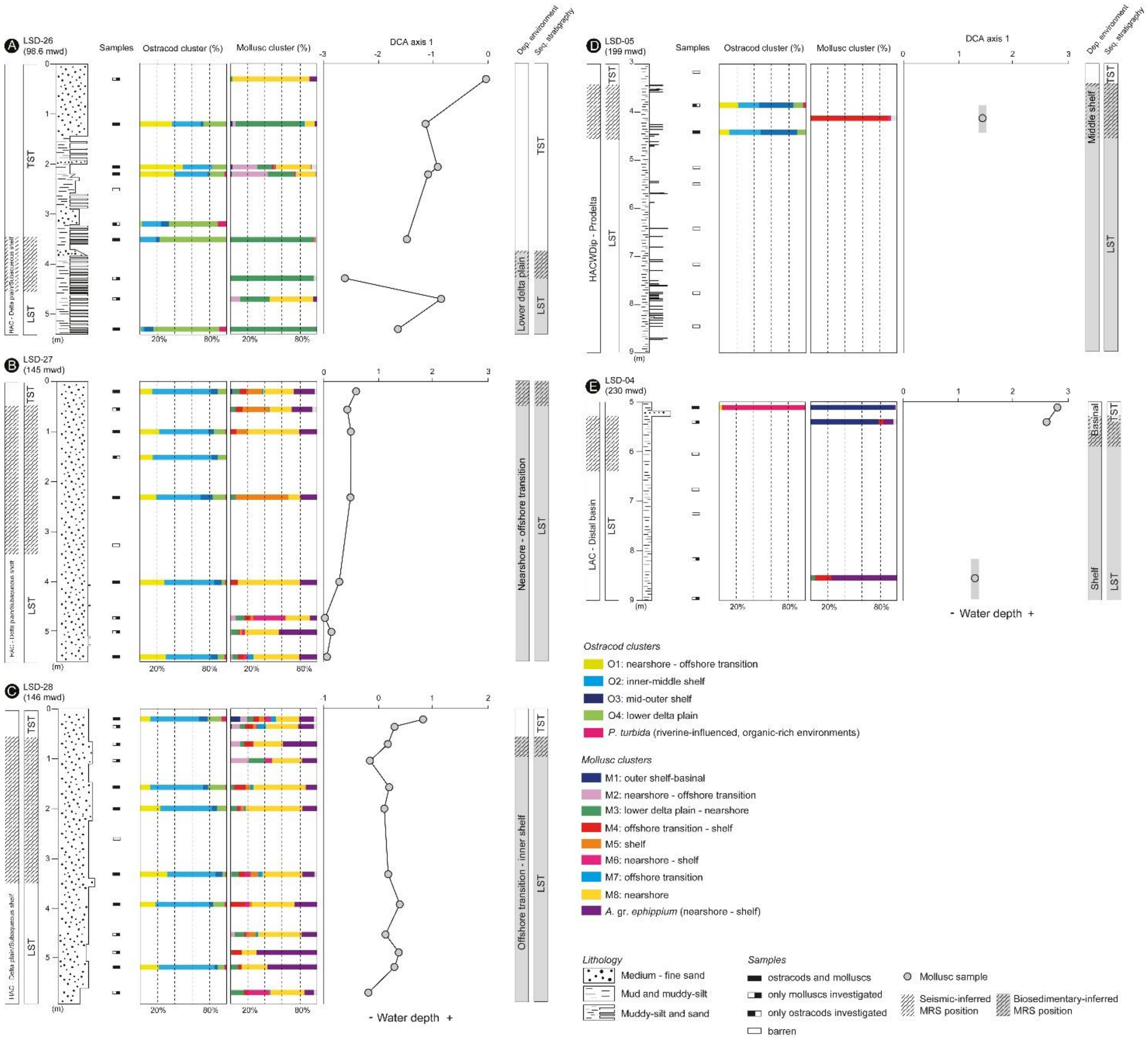
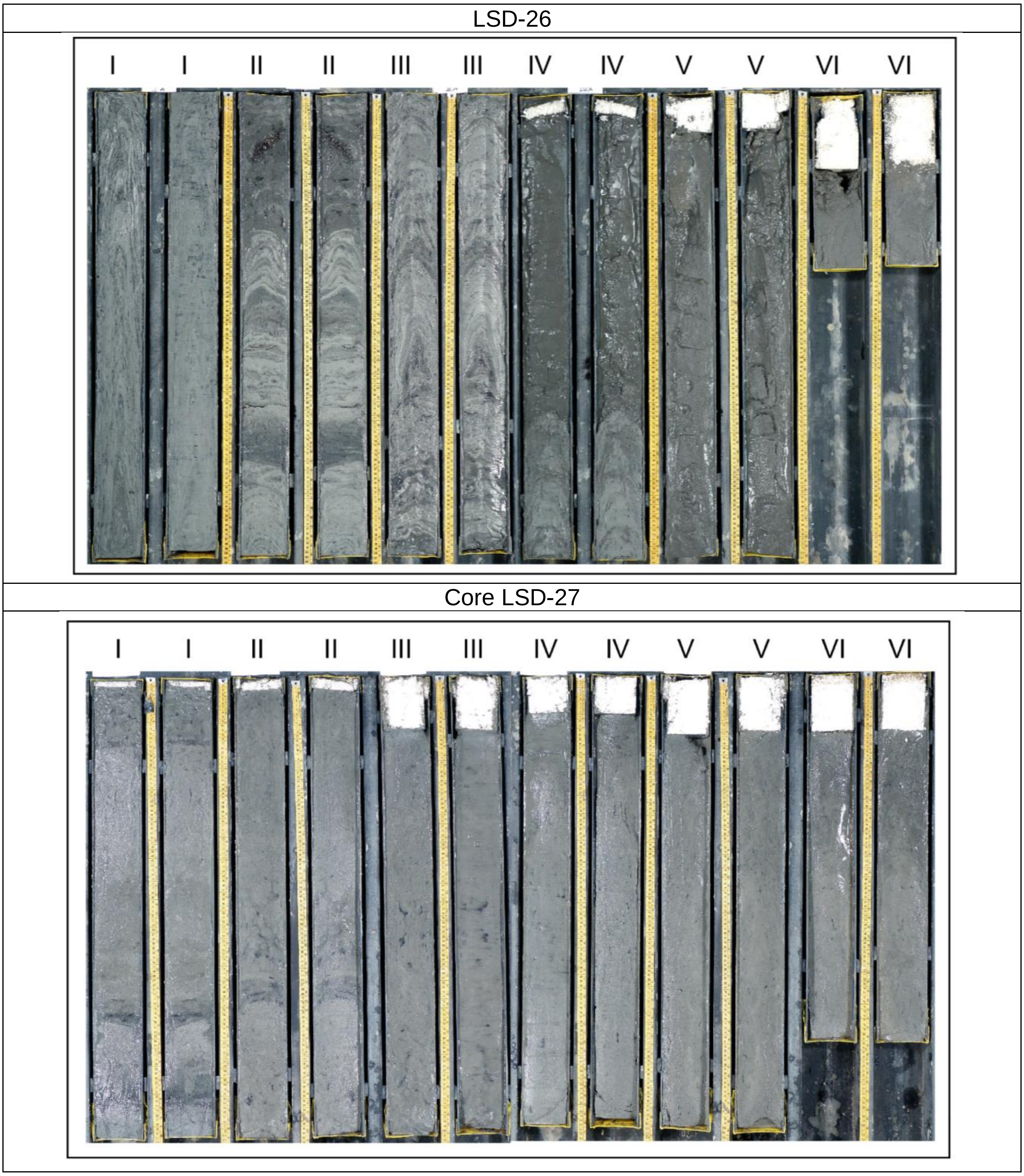


Fig. S2 - From left to right: Seismic-derived depositional facies and sequence stratigraphic reconstruction of clinothem C_2 normal regressive cored succession (after Pellegrini et al., 2018). The shadowed area on the first two columns represent the zone where, considering the resolution of the seismic profile, the Maximum Regressive Surface (MRS) should lie. The lithology of each investigated core is also reported. The two central panels reconstruct environmental dynamics through investigated cored deposits by means of cluster analyses: ostracods (left panel) and molluscs (right panel). Ordination derived bathymetric trends (DCA axis 1) of mollusc samples are also reported. Finally, the two rightmost columns show integrated bio-sedimentary inferences allowing to refine position of the MRS and to detail seismic-derived environmental facies.


LSD-26
I
I
II
II
III
III
IV
IV
V
V
VI
VI
Core LSD-27
I
I
II
II
III
III
IV
IV
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V
VI
VI

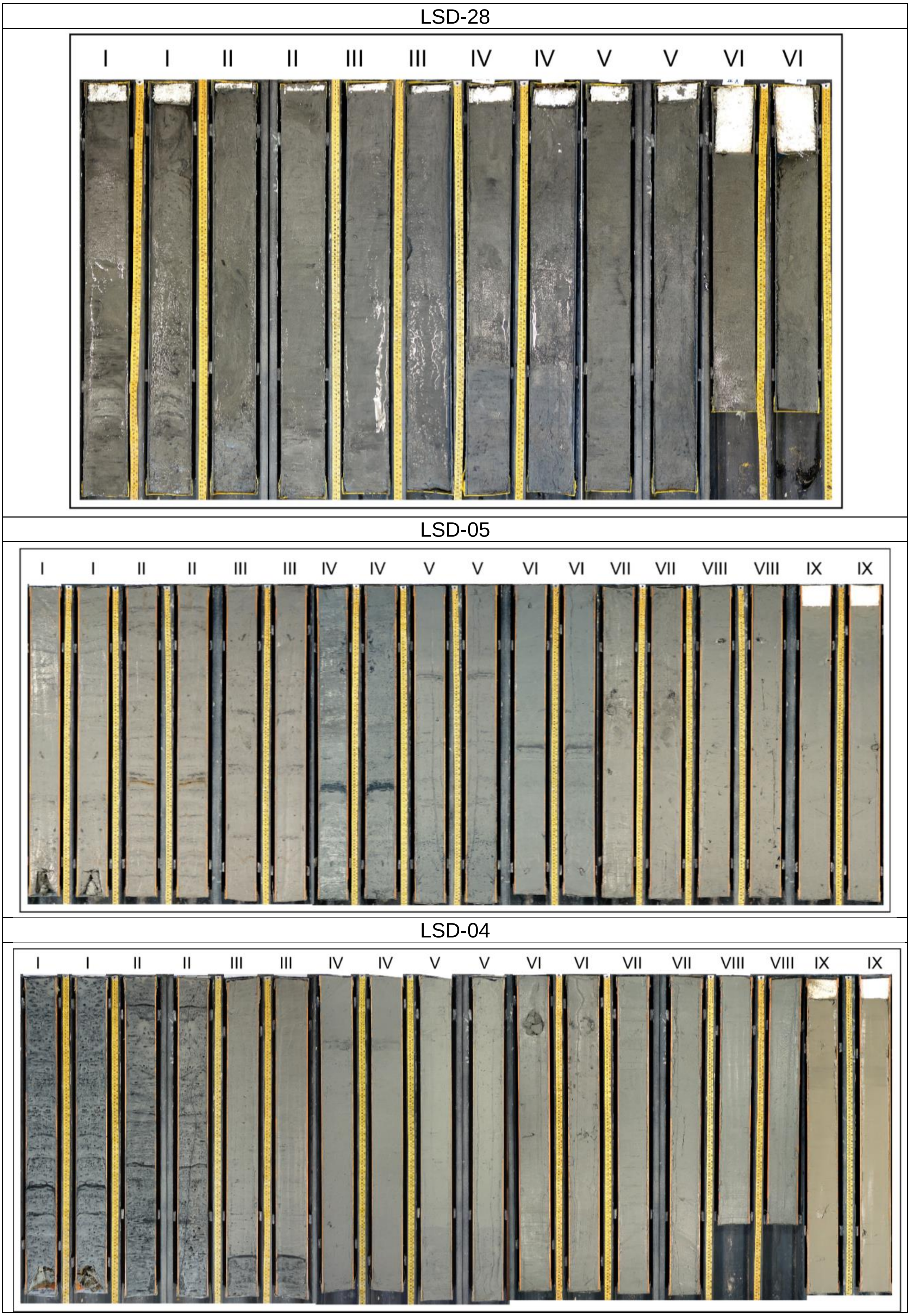


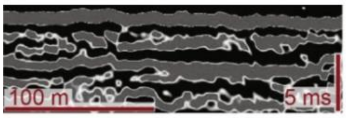
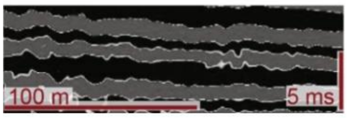
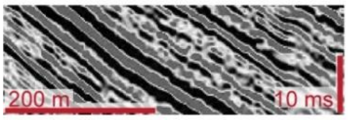
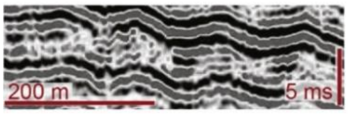
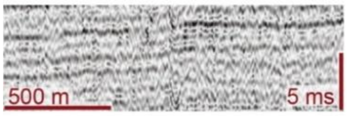
Fig. S3 - Pictures of the five investigated cores along the downdip transect LSD-22. Each core is subdivided in 1 m-long sections. Cores are housed at the Consiglio Nazionale delle Ricerche – Istituto delle Scienze Marine in Bologna (Italy).

Core name	Latitude	Longitude	Device	Water depth (m)	Recovery (m)
LSD-04	42.856494°N	14.626905°E	PC 10 m	230	8.97
LSD-05	42.883066°N	14.602752°E	PC 10 m	199	8.33
LSD-26	43.081668°N	14.440637°E	VC 6 m	98.6	5.21
LSD-27	42.895910°N	14.592332°E	VC 6 m	146	5.40
LSD-28	42.896907°N	14.591559°E	VC 6 m	145	5.60

Tab. S1 - Core data of the five investigated cores in this work. PC = piston corer, VC = vibrocorer.

Core LSD-27 (analysed core thickness 5.50 m; Fig. S2)

The core LSD-27 is adjacent to the core LSD-28 and records a comparable lithology, mainly composed by sand together with a similar pattern in faunal turnover. Specifically, this core records environmental dynamics of the Clinothem C_2 in fully marine settings. Similarly to the nearby core LSD-28 the seismic resolution does not allow to resolve the position of the Maximum Regressive Surface (MRS). Indeed, from the investigation of the multichannel profile (Fig. 2) the position of this important sequence stratigraphic surface cannot be resolved within the stratigraphic interval spanning from ca. 3.4 m to 0.50 m core depth. The 8 samples investigated for molluscs are overall dominated by the nearshore cluster M8 (15-75%) along with not negligible abundances of mollusc clusters indicative of deeper environments (e.g, M4 and M6). As interpreted for the core LSD-28 the presence of mollusc clusters indicative of ecological mixing suggests a possible increase in the bioturbation rate on the shelf and/or a sustained discharge of reworked material from storm-aided hyperpycnal flows as also suggested in Gamberi et al. (2020). As for the molluscs, the ostracod-defined clusters suggest a mixing of different faunas across the core. Indeed, clusters O1 and O2 that record suites of species indicative of nearshore to inner-middle shelf settings are associated with a non-negligible presence (ca. 5-15%) of the brackish cluster O4 across the entire portion of investigated core. Finally, the DCA1 sample scores trend is indicative of aggradation on the shelf. Respect to the core LSD-28 the bathymetric trend records only a slight deepening within the topmost portion of the core. The coupling of the DCA-derived bathymetric trend and the environmental inferences tentatively suggest the position of the MRS on the topmost 0.50 m of the core.

Seismic facies	Acronyms and colours	Internal reflections	Depositional environment
	HAD	High Amplitude Discontinuous	Lagoon
	HAC	High Amplitude Continuous	Delta plain/ subaqueous shelf
	HACDip	High Amplitude Continuous Dipping	Prodelta
	HACWDip	High Amplitude Continuous Wavy Dipping	Prodelta
	LAC	Low Amplitude Continuous	Distal Basin

Tab. S2 - Summary of the five seismic facies recognised in the study area during emplacement of Clinothem C_2. For each facies is also reported the acronym and the colour used in the text and in the figures (modified after Pellegrini et al., 2018).

Description of the seismic facies recovered in the study area

HAD: this seismic facies is associated with clinothem topset and consists of High Amplitude Discontinuous reflections (Table S2), typical of deposits with irregular spatial distribution. *Inferred depositional environment:* the HAD facies has been interpreted as representative of lagoon deposits.

HAC: this seismic facies is associated with clinothem topsets and bottomsetof the PRWL and consists of High Amplitude Continuous reflections (Table S2). However, in the C_2 the *HAC* is found only on the topset portion of the clinothem. *Inferred depositional environment*: HAC seismic facies in the topset has been interpreted to represent delta plain and subaqueous shelf deposits, whereas, in the bottomset the HAC has been interpreted to represent fine-grained basinal deposits (Trincardi et al., 1996).

HACDip: this facies characterises the clinothem foreset, and consists of High Amplitude Continuous Dipping reflections (Table S2). *Inferred depositional environment*: the *HACDip* seismic facies has been interpreted as representative of heterolithic foreset deposits related to the delta front and prodelta-slope zone.

HACWDip: this seismic facies characterises the foreset of the C_2 clinothem and consists of High Amplitude Continuous Wavy Dipping reflections (Table S2). *Inferred depositional environment*: the HACWDip seismic facies represents the complex foreset stratigraphy of the upper prodelta-slope, due to the presence of 10-m-scale wavy irregularities associated with the presence of heterolithic bedsets (e.g., Urgeles et al., 2011).

LAC: this is associated with clinothems developed in the late phase of the PRLW progradation. *Inferred depositional environment*: the LAC seismic facies has been interpreted to represent fine-grained deposits in basinal settings under continuous background sediment accumulation.

References

Pellegrini C., Asioli A., Bohacs M.K., Drexler T.M., Feldman H.R., Sweet M.L., Maselli V., Rovere M., Gamberi F., Dalla Valle G. & Trincardi F. The late Pleistocene Po River lowstand wedge in the Adriatic Sea: Controls on architecture variability and sediment partitioning. *Marine and Petroleum Geology*, 93: 16-50.

Trincardi, F., Cattaneo, A., Asioli, A., Correggiari, A. & Langone, L. (1996). Stratigraphy of the late-Quaternary deposits in the central Adriatic basin and the record of short-term climatic events. *Memorie Istituto Italiano di Idrobiologia*, 55: 39-70.

Urgeles, R., Cattaneo, A., Puig, P., Liquete, C., De Mol, B., Sultan, N. & Trincardi, F. (2011). A review of undulated sediment features on Mediterranean prodeltas: distinguishing sediment transport structures from sediment deformation. *Marine Geophysical Research*, 32: 49-69.