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Quantitative Estimates of Temporal Mixing across a 4th-order Depositional Sequence: Variation in Time-averaging along the Holocene Marine Succession of the Po Plain, Italy

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Single fossiliferous beds contain biotic remnants that commonly vary in age over a time span of hundreds to thousands of years. Multiple recent studies suggest that such temporal mixing is a widespread phenomenon in marine depositional systems. This research focuses on quantitative estimates of temporal mixing obtained by direct dating of individual corbulid bivalve shells (*Lentidium mediterraneum* and *Corbula gibba*) from Po plain marine units of the Holocene 4th-order depositional sequence, including Transgressive Systems Tract [TST] and Highstand Systems Tract [HST]. These units displays a distinctive succession of facies consisting of brackish to marginal marine retrogradational deposits, (early TST), overlain by fully marine fine to coarse gray sands (late TST), and capped with progradational deltaic clays and sands (HST). More than 300 corbulid specimens, representing 19 shell-rich horizons evenly distributed along the depositional sequence and sampled from 9 cores, have been dated by means of aspartic acid racemization calibrated using 23 AMS-radiocarbon dates (14 dates for *Lentidium mediterraneum* and 9 dates for *Corbula gibba*, respectively).

The results indicate that the scale of time-averaging is comparable when similar depositional environments from the same systems tract are compared across cores. However, time averaging is notably different when similar depositional environments from TST and HST segments of the sequence are compared. Specifically, late HST horizons (n=8) display relatively low levels of time-averaging: the mean within-horizon range of shell ages is 537 years and standard deviation averages 165 years. In contrast, late TST horizons (n=7) are dramatically more time-averaged: mean range of 5104 years and mean standard deviations of 1420 years. Thus, late TST horizons experience a 1 order of magnitude higher time-averaging than environmentally comparable late HST horizons.

In conclusion the HST and TST systems tracts of the Po Plain display dramatically different levels of time-averaging, and therefore, are also likely to differ notably in their taphonomic overprint. The observed patterns are also consistent with the sequence stratigraphic paradigm, which predicts differences in rate of sedimentation and severity of reworking between HST and TST. The results provide a compelling case for applicability of amino acid racemization methods as a tool for evaluating changes in depositional dynamics, sedimentation rates, time-averaging, temporal resolution of the fossil record, and taphonomic overprints across sequence stratigraphic cycles.