QUANTITATIVE ESTIMATES OF TIME-AVERAGING IN MOLLUSK DEATH ASSEMBLAGES ON THE SOUTHERN BRAZILIAN SHELF

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INTRODUCTION

Fossil assemblages are expected to be time-averaged due to temporal (and spatial) mixing of skeletal remains. Our quantitative understanding of time-averaging derives primarily from actualistic studies, in which direct numerical dating of individual specimens is used to assess the scale and structure of age mixing in surficial death assemblages (incipient fossil assemblages).

MATERIAL AND METHODS

Here, we examine time-averaging in shells collected from surficial sediments at three sites on a passive-margin subtropical shelf (the Southern Brazilian Shelf; 33°S, **Figure 1**). Specimens of *Mactra* (Bivalvia: Mollusca) (**Figure 2**) were individually dated using amino acid racemization (AAR) (n = 60) calibrated against AMS radiocarbon ages (n = 15) (**Figure 3**).
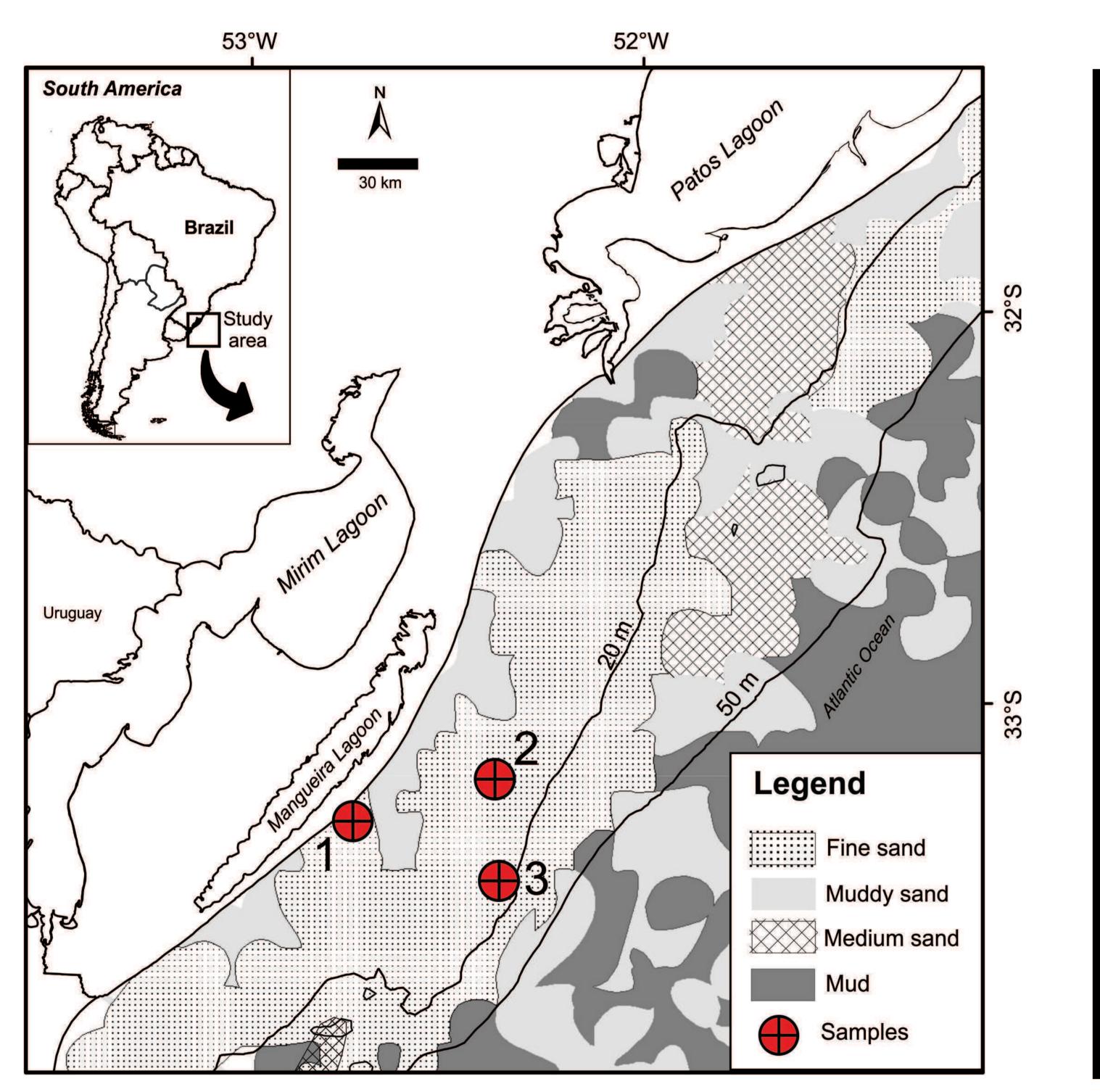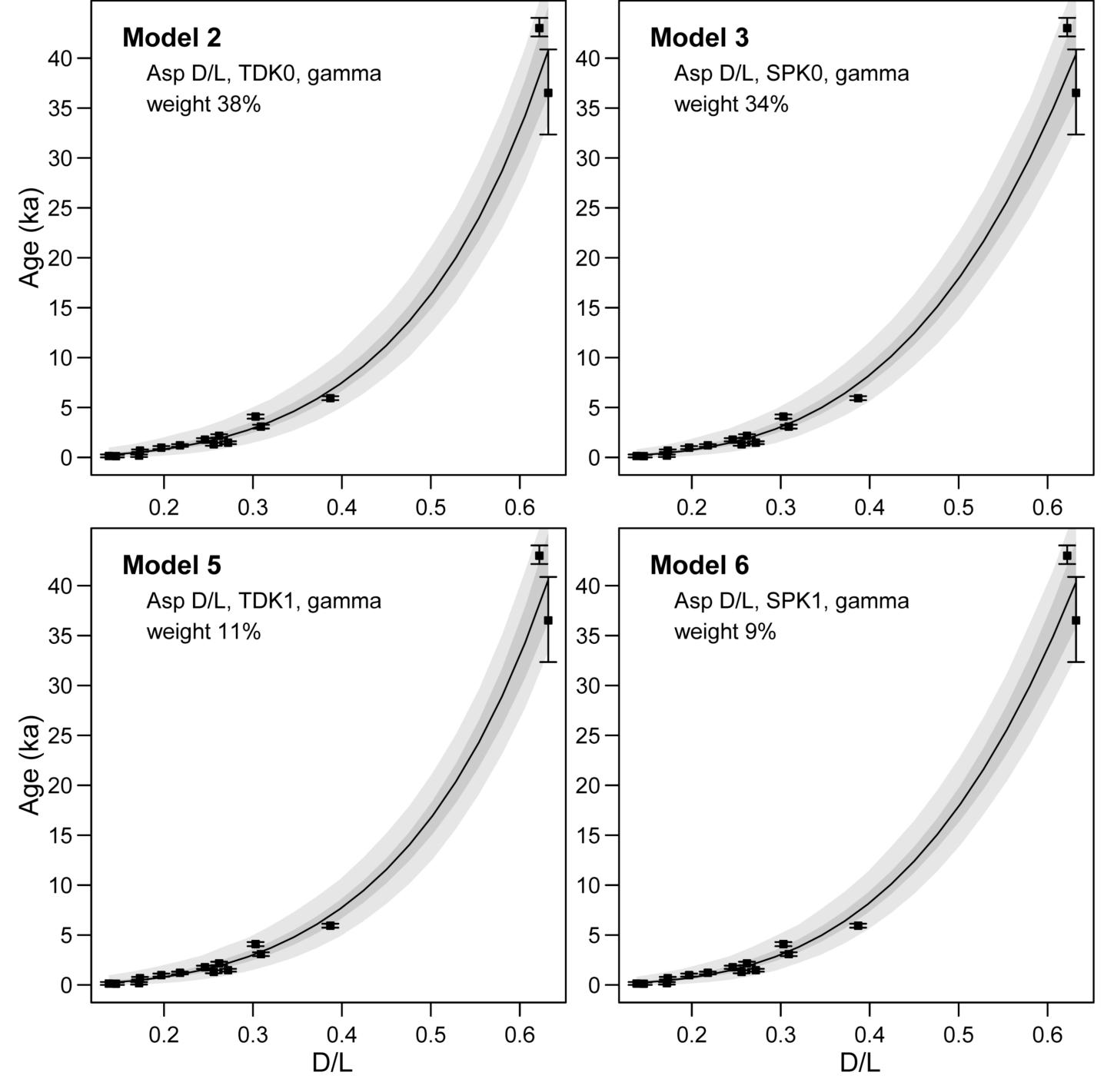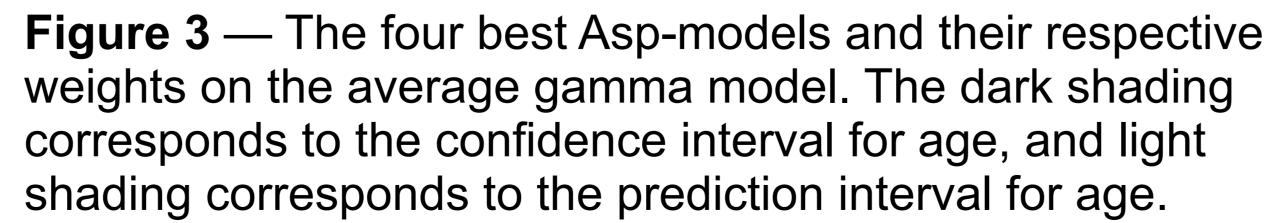

Figure 1 — Study area and sample sites on the inner Southernmost Brazilian Shelf. Site 1: 7 m; Site 2: 19 m; Site 3: 21 m.

Figure 2 — A right valve of *Mactra* sp. Scale bar: 10 mm.

Figure 3 — The four best Asp-models and their respective weights on the average gamma model. The dark shading corresponds to the confidence interval for age, and light shading corresponds to the prediction interval for age.

The amount of time-averaging exceeding the expectation due to uncertainties in dating was determined by subtracting the age-estimation error from the total age-estimate variability, based on 10,000 Bayesian Markov-chain Monte-Carlo replicates.

RESULTS

The ^{14}C-calibrated AAR ages, pooled across all three sites, indicate that individual mollusk shells vary in age from 0 to ~56 cal kyr BP. The age distribution is right skewed (i.e., dominated by young specimens) (**Figure 4**) suggesting that the sampled death assemblages is time averaged over multi-millennial time scales.

The magnitude of time-averaging varied inversely with the water depth, from <15 yr in the deepest site (21 meters) up to 1020-1250 yr in the shallowest site (7 meters) (**Table 1**).
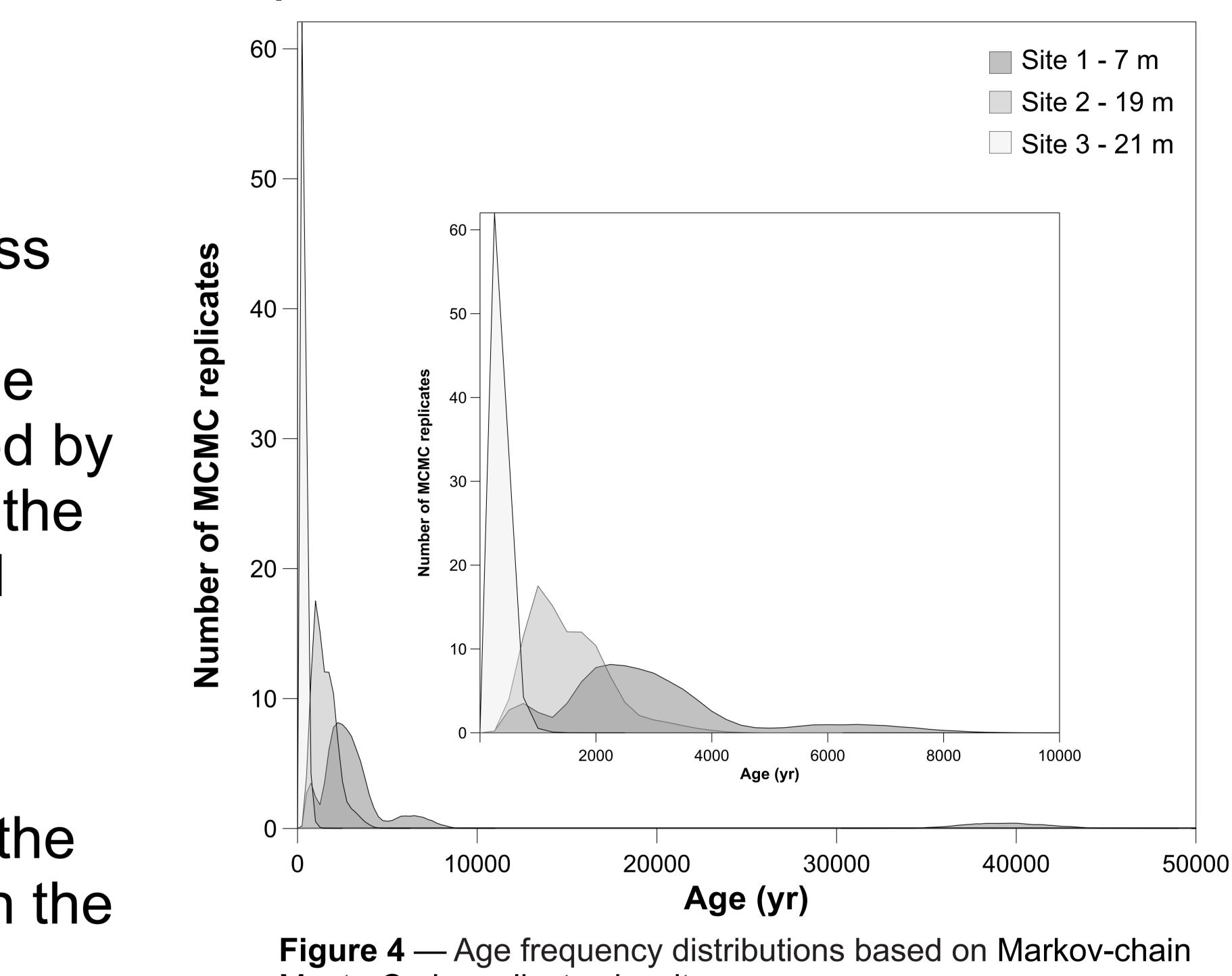

Figure 4 — Age frequency distributions based on Markov-chain Monte-Carlo replicates by site.

Table 1 — Age-estimate variability, age-estimation error, and residual time-averaging estimates from the mcmc replicates for all the age estimates by site.

Site	Depth (m)	Age-estimate variability (yrs.)							Age-estimation error (yrs.)				Time-averaging (yrs.)		
		0%	25%	**50%**	75%	100%	**oIQR**		mean	**median**	95%	mean	**median**	95%
1	7	70	1892	**2658**	3806	56231	**1914**		896	**663**	2999	1018	**1251**	0
2	19	93	912	**1318**	1833	7085	**921**		472	**431**	590	449	**490**	331
3	21	2	146	**230**	346	3095	**200**		189	**186**	216	11	**14**	0

DISCUSSION AND CONCLUSIONS

The multi-millennial scale of time-averaging observed for pooled data and strongly right-skewed nature of age distributions are consistent with other studies of time-averaging in sediment-starved shelf settings. The substantial temporal span of dated specimens points to their potential value as archives of the paleoenvironmental history of the Southern Brazilian shelf over the most recent millennia.