

**Supplementary Material**

**Table S1.** Table displaying sedimentological facies that were identified in both littoral and profundal cores from Laguna Salada de Chiprana (see [31]). Mineralogical and sedimentological descriptions and values of LOI (loss on ignition) are also presented alongside an interpretation of the likely depositional environment that each facies formed in.

Facies	Characteristics
	<p><b>Grey-yellow sandy mudstones</b></p> <p><b>a.1</b> Grey weakly bedded to massive heterolithic sandy siltstones, typically with heightened amounts of quartz and detrital aragonite and calcite. Low abundances of gypsum, halite and hexahydrite. Basal loading structures are present in some intervals.</p> <p><b>a.2</b> Massive sandy siltstones, typically illustrating a range of continuous and lenticular bed morphologies and, in some cases, displaying basal loading structures. Low abundances of gypsum and hexahydrite, high abundances of detrital calcite, phyllosilicates and quartz.</p>
b	<p><b>Massive muds with gypsum</b> Massive and poorly laminated dark-coloured mudstones with abundant intergrowths of coarse gypsum as the primary mineralogical phase. Intercalated or interbedded with minor lenses of siliciclastic layers of various grain sizes or microbialite laminae. Magnesium sulphates and halite form secondary phases, carbonate and quartz absent.</p>
c	<p><b>Gypsum laminae</b> White-coloured beds and fine laminae of endogenic gypsum crystals and precipitates of highly variable grain sizes. The beds are often closely associated with Facies 1, typically overlying the upper surface of the latter facies. Minor amounts of hexahydrite and thenardite, absence of carbonates and quartz.</p>
d	<p><b>Cemented charophytes</b> Crystalline cemented masses of charophytes typically confined to littoral depositional environments. Predominantly composed of gypsum, with some minor amounts of aragonite, calcite and hexahydrite. Cemented charophytic and macrophytic intervals, typically massive and highly consolidated. Gypsum rich, with minor amounts of aragonite and thenardite throughout.</p>
e	<p><b>Laminated Microbial Mats with Mudstones</b> Finely laminated (&lt;1mm) cyanobacterial/microbial mats with strong red, green, and dark black staining of the sediment, attributed to the presence of microbial pigments. Cyanobacterial sheaths can typically be found occurring alongside EPS, micrite matrices and densely packed microcrystalline carbonate and gypsum. Interstitial layers occurring between microbially stained laminae consist primarily of aragonite/high-Mg calcite and gypsum/thenardite.</p>
f	<p><b>Microbial mats with gypsum</b> Very finely laminated dark-brown and orange laminae (organic matter, diatoms) and white-yellow laminae (carbonate precipitates) interbedded with white crystalline phases (gypsum). Gypsum intergrowths form both as laminated/bedded intervals and as lenticular deposits between microbial laminae. Carbonates are primarily composed of aragonite and calcite and other minor phases are constituted by hexahydrite and halite. Microbially induced layering is strongly displaced by large (&gt;0.5mm) gypsum crystals.</p>
g	<p><b>Charophytic muds</b> Charophytic and macrophytic mudstones, typically massive, with an abundance of fragmented charophytes and macrophytes. These facies display predominantly clayey-silty grain sizes and contain moderate amounts of gypsum, hexahydrite and very small amounts of calcite, aragonite and halite. Organic content is typically high (4%-6%) and is composed of organic-rich biofilms, diatoms and charophytic remains.</p>
h	<p><b>Black-grey laminated and organic-rich muds</b> Very finely laminated black clayey muds with high amounts of organic carbon, moderate amounts of gypsum and halite and varying but relatively low amounts of quartz, calcite and aragonite. They are typically distinctive from adjacent facies due to their very dark black colour and strong degree of lamination.</p>

**Table S2.** Table displaying the output of the principal component analyses for the profundal and littoral settings.

		Profundal										Littoral							
		1	2	3	4	1	2	3	4	1	2	3	4						
Eigenvalue		6.18	1.92	1.69	1.37	43.13	13.38	11.81	9.58	42.61	22.69	11.89	6.70						
Variance (%)		43.13	13.38	11.81	9.58	42.61	22.69	11.89	6.70	42.61	22.69	11.89	6.70						
Cumul. (%)		43.13	56.51	68.31	77.89	42.61	65.31	77.20	83.90	42.61	65.31	77.20	83.90						
		Al	Si	S	Cl	K	Ca	Ti	Cr	Mn	Fe	Ni	Cu	Br	Rb	Sr	Zr	Mo	Inc/Coh
Profundal	Eigenvector 1	0.14	0.26	-0.18	-0.17	0.17	0.09	0.63	0.03	0.20	0.27	-0.16	-0.20	-0.22	0.27	-0.21	-0.18	-0.18	-0.11
	Eigenvector 2	-0.40	-0.13	0.00	0.04	0.02	-0.09	-0.05	-0.20	-0.05	0.02	0.08	0.12	0.12	0.85	-0.01	0.05	0.02	0.12
	Eigenvector 3	0.85	0.12	-0.01	-0.01	-0.04	-0.07	-0.33	-0.06	-0.07	-0.08	0.01	0.04	0.02	0.36	-0.05	0.00	-0.04	0.03
	Eigenvector 4	-0.06	-0.02	0.02	0.04	0.00	0.00	-0.12	0.97	-0.01	-0.02	-0.03	0.02	-0.01	0.19	-0.03	-0.02	-0.03	-0.02
Littoral	Eigenvector 1	-0.11	-0.03	-0.15	-0.03	0.17	-0.10	0.84	-0.07	0.06	0.24	-0.02	0.03	0.09	0.36	-0.04	-0.02	-0.09	0.10
	Eigenvector 2	0.08	0.01	-0.02	-0.03	-0.09	-0.01	-0.34	-0.06	-0.03	-0.10	-0.02	-0.02	-0.04	0.92	-0.01	0.01	-0.01	0.00
	Eigenvector 3	0.97	0.13	-0.03	-0.04	-0.01	-0.01	0.14	-0.06	0.07	0.01	-0.03	-0.05	-0.06	-0.05	-0.05	-0.06	-0.01	-0.02
	Eigenvector 4	0.14	-0.15	-0.15	0.17	0.31	-0.17	-0.23	-0.04	-0.16	0.16	0.22	0.46	0.46	-0.02	0.09	0.19	-0.07	0.40

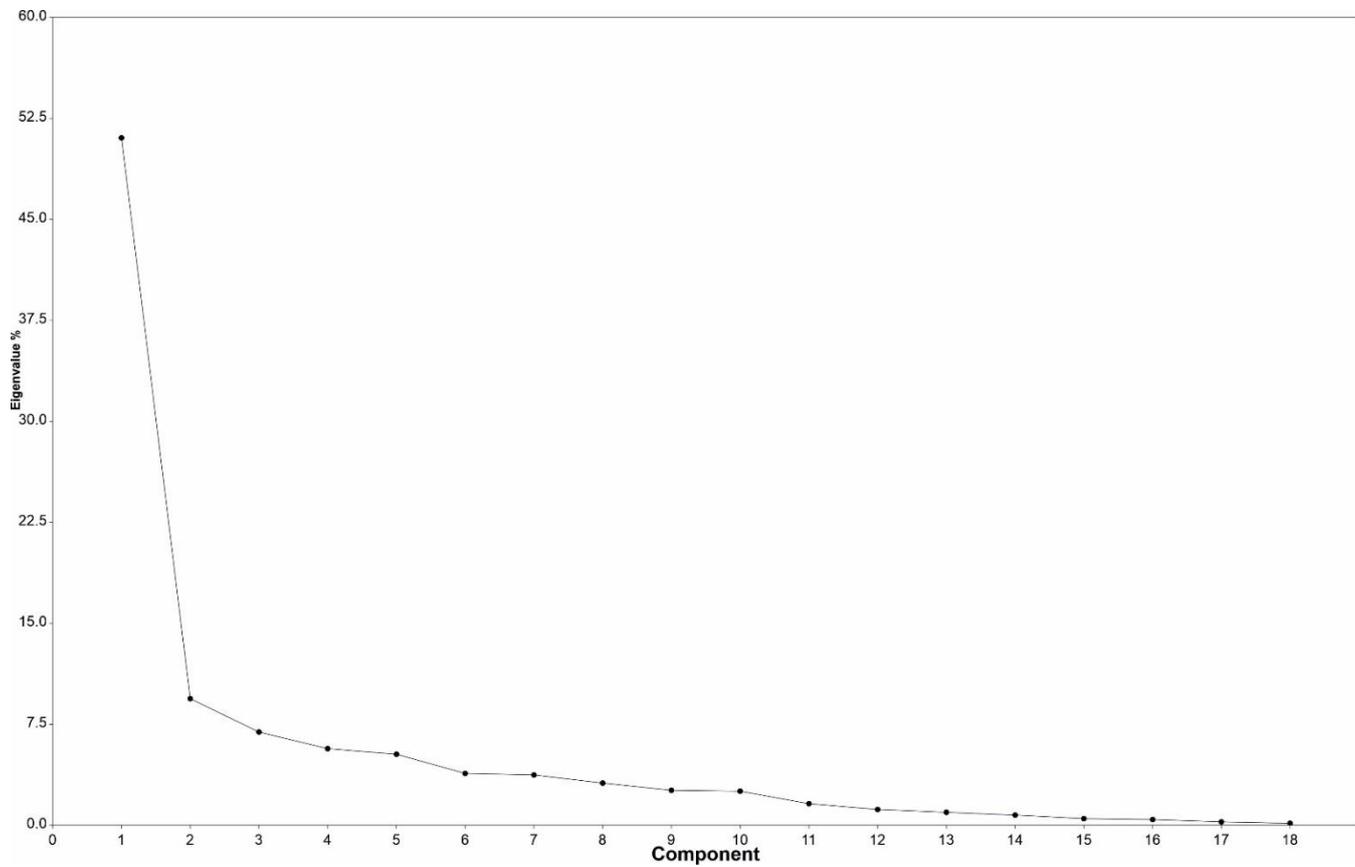


Figure S1. Scree plot from elements from core CHI19-1A (profundal setting).

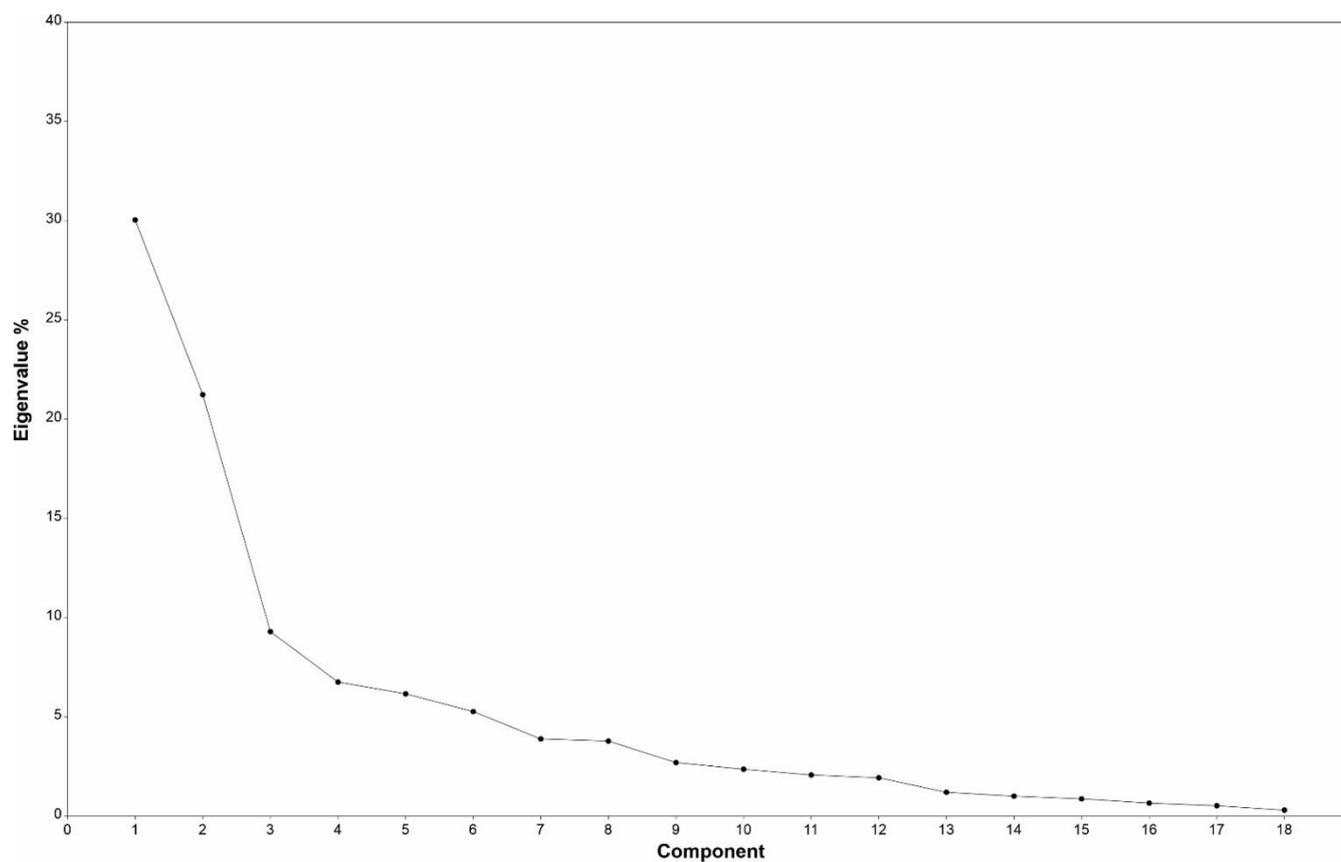


Figure S2. Scree plot from elements from core CHI19-4A (littoral setting).

### Chronological Acceptance

Dates for the chronological model were assessed based on their agreement with the clam-generated model. The output of the model determined that the majority of the  $^{210}\text{Pb}$  dates was in disagreement with the model and the dates were within significant error margins such that they could not be considered viable for the model.