Supplementary Material

A total of 119 bivalves, 50 belemnites, seven brachiopods, and three aptychi were collected in the Neuquén Basin and analysed within the present study. Some typical fossils are illustrated in Figure S1. The specimens were collected at seven localities which belong to two groups, the northern sections near Chos Malal and the southern sections near Zapala. Their geographic coordinates and used abbreviations are listed in Table S1. All localities will be described in detail in the following paragraphs. Most of the collected specimens could be attributed to a particular sample horizon in already published sections (cited below).

Northern sections near Chos Malal

Vega de la Veranada (VV). The locality of Vega de la Veranada is situated west of the Ruta Nacional 40 and east of the Tromen volcano. Outcrops at this locality comprise 90 m of Upper Bajocian to Oxfordian marine, sedimentary rocks belonging to the Cuyo and Lotena groups. The succession includes the Los Molles (Bajocian), the Lajas (uppermost Bajocian-Lower Callovian), Lotena (Middle-Upper Callovian), and La Manga (Upper Callovian-Oxfordian) formations (Stipanicic, 1965; Parent and Garrido, 2015; Parent et al., 2020; new unpublished data). Fossils are not very abundant, but occur at several levels within these units (mostly oysters, belemnites are comparatively rare). Ammonites allow precise age assignments, particularly in the La Manga Formation (Stipanicic et

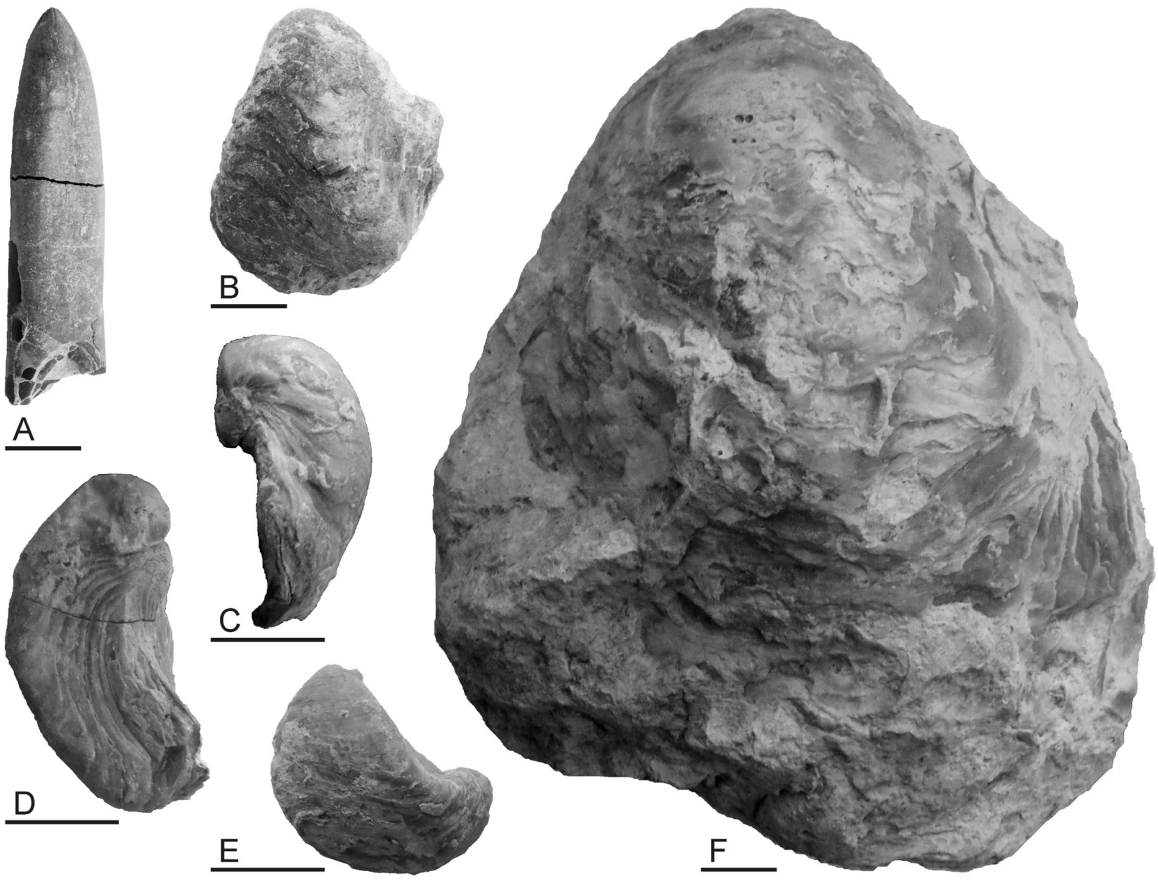

Fig. S1 Examples of well-preserved fossils from the Jurassic succession of the Neuquén Basin used for geochemical analyses within the present study. **A.** *Brevibelus* sp., Lower Bajocian, PL-1 (MOZ-PI 11832/1). **B.** *Gryphaea* sp., Lower Oxfordian, VV (MOZ-PI 11847/7). **C.** *Gryphaea* sp., Upper Tithonian, CC (MOZ-PI 8612/2). **D.** *Gryphaea* sp., Upper Tithonian, PC (MOZ-PI 8817/12). **E.** *Gryphaea* sp., Upper Tithonian, CC (MOZ-PI 8597/3). **F.** *Aetostreon*? sp., Upper Tithonian, PC (MOZ-PI 8823). Scale bars = 10 mm.

Table S1 Geographic coordinates of the sampled sections in the Neuquén Basin.

Locality	Abbreviation	Latitude	Longitude
Northern sections near Chos Malal			
Vega de la Veranada	VV	−37.213139°	−69.868389°
Pampa Tril	PT	−37.251056°	−69.830333°
Southern sections near Zapala			
Portada Covunco	PC	−38.792639°	−70.179250°
Cerrito Caracoles	CC	−38.822500°	−70.148583°
Cerro Granito	CG	−39.110556°	−69.590000°
Picún Leufú 1	PL-1	−39.200083°	−70.053556°
Picún Leufú 2	PL-2	−39.195556°	−70.063667°
Picún Leufú (Campamento Vialidad)	PL-CV	−39.168083°	−70.451722°
Charahuilla	CH	−39.383056°	−70.430000°

al., 1975; Parent and Garrido, 2015). While most of the succession is dominated by siliciclastic rocks (occasionally showing signs of higher water energy, such as reworking and trough cross-bedding), the La Manga Formation is dominated by carbonates proposed to represent a distal platform setting (Gulisano, 1992; Parent and Garrido, 2015). The section continues into the overlying Auquilco Formation (Oxfordian), which covers a wide area but is unfossiliferous due to its evaporitic (gypsiferous) nature. Fossils of Vega de la Veranada used in the present study have Bathonian to Oxfordian ages.

Pampa Tril (PT). The locality of Pampa Tril is situated southwest of Vega de la Veranada and closer to the Ruta Nacional 40. The Kimmeridgian to lower Cretaceous sedimentary rocks belong to the Mendoza Group and form a northeast-southwest-oriented ridge. The succession starts with the evaporitic Auquilco Formation and includes the Tordillo (Kimmeridgian), Vaca Muerta (Tithonian-Lower Valanginian), Mulichinco (Lower Valanginian), and Agrio (Valanginian-Lower Barremian) formations (Leanza and Hugo, 1977; Parent et al., 2015). The Tordillo Formation consists of continental/volcaniclastic rocks, but the Vaca Muerta Formation (with a thickness of 421.6 m) is marine and contains abundant fossils. Particularly common are ammonites (including aptychi) and belemnites, while oysters are comparatively rare. The ammonites allow precise age assignments as described in detail by Parent et al. (2015). The lithology is dominated by very fine-grained siliciclastics with occasionally intercalated black shales and calcareous shales interpreted as basinal to outer ramp deposits (e.g., Spalletti et al., 1999; Parent et al., 2015). The basal levels of the Mulichinco Formation consist of Lower Valanginian marine, calcareous, fine- to medium-grained sandstones with oysters (Schwarz and Howell, 2005). Most of the used samples of Pampa Tril have Tithonian ages and their exact stratigraphic level can be found in the section published by Parent et al. (2015: fig. 2). Two samples of Pampa Tril have a Valanginian age and were collected from a basal level of the Mulichinco Formation (see Parent et al., 2015: figs 2 and 3F).

Southern sections near Zapala

Portada Covunco (PC). The locality of Portada Covunco is one of the oldest studied in the Neuquén Basin situated approximately 15 km northwest of Zapala along the Ruta Nacional 40. It exposes mainly Upper Jurassic rocks of the Tordillo, Vaca Muerta, and Picún Leufú formations. Compared to the localities in the vicinity of Chos Malal, the depositional environment near Zapala has been described as shallower due to the presence of the Huincul Arch behaving as a positive topographic feature (Leanza and Zeiss, 1990; Parent et al., 2013). The ammonite biostratigraphy has been studied in detail by Parent et al. (2013), who also included detailed sections for the Vaca Muerta Formation with a thickness of more than 550 m and the Picún Leufú Formation with a thickness of more than 240 m.

Cerrito Caracoles (CC). The locality of Cerrito Caracoles is situated approximately 10 km northwest of Zapala along the Ruta Nacional 40. Due to their proximity, the exposed sedimentary rocks are similar to those of Portada Covunco. The Vaca Muerta Formation gradually changes into the Picún

Leufú Formation from north to south. At Cerrito Caracoles, the Picún Leufú Formation is more than 100 m in thickness and consists of bioclastic limestones in addition to calcareous siltstones. The fossil content is very high with bivalves, ammonites, brachiopods, gastropods, echinoderms, hermatypic corals, and serpulids (compare Parent et al., 2013). According to Armella et al. (2007, 2008), the rocks represent a shallow subtidal environment (inner shelf margin) associated with patch reefs. The Upper Jurassic biostratigraphy of Cerrito Caracoles is described in detail by Parent et al. (2013). Used samples of Portada Covunco and Cerrito Caracoles have Tithonian ages and their exact stratigraphic level can be found in the section published by Parent et al. (2013: fig. 4).

Cerro Granito (CG). The geology and stratigraphy of Cerro Granito, about 9 km northeast of Cerro Lotena, has been described by Suero (1951). The oldest marine rocks exposed (Sierra Chacaico Formation; time-equivalent to the basal Los Molles Formation) are Pliensbachian in age and contain bivalves and brachiopods. The succession is followed by the Middle Jurassic Los Molles, Lajas, Challacó, Mutrucó (conglomeratic unit), and the Tithonian Vaca Muerta formations, which contain ammonites, belemnites, bivalves (including oysters), and corals among other fossils (compare Westermann and Riccardi, 1979; Garrido and Parent, 2013). Five samples with a Pliensbachian age and one sample with a Tithonian age were analysed from Cerro Granito.

Picún Leufú (PL-1&2). The localities of Picún Leufú 1 and 2 are situated approximately 30 km south of Zapala along the Ruta Nacional 40. The studied Los Molles Formation consists of siltstones with occasionally intercalated sandstone beds and concretions. Fossils are common, but mostly restricted to ammonites and belemnites, with bivalves being much rarer. The biostratigraphy has been studied in detail by Westermann and Riccardi (1979), who also describe the section with a thickness of more than 500 m. Samples of Picún Leufú 1 have a Bajocian age and were collected at six evenly spaced levels in a 50-m-thick unit corresponding to beds 11a to 11c of Westermann and Riccardi (1979: p. 95). In addition, seven samples of Picún Leufú 2 have an Aalenian age.

Picún Leufú (Campamento Vialidad; PL-CV) and Charahuilla (CH). These localities are situated in the region of Cerro Chachil where Triassic and Jurassic deposits include the Ñirecó, Lapa, Sierra Chacaico, Los Molles, Lajas, Challacó, Lotena, Fortín Primero de Mayo, Quebrada del Sapo, and Vaca Muerta formations (see Leanza, 1990, 1993; Leanza et al., 2013; Garrido and Parent, 2013 and references therein). Abundant bivalves and ammonites, and less frequently belemnites, nautiloids, and brachiopods can be collected from the Sierra Chacaico, Los Molles, Lajas, Lotena, and Vaca Muerta formations. Recently, ammonites, bivalves, brachiopods, and belemnites have been gathered, which allowed biostratigraphic assignments (yet unpublished) and the analyses in this study. The six samples of Charahuilla have a Pliensbachian age. Finally, one sample was analysed from Picún Leufú (Campamento Vialidad) with a Bathonian age.

Analytical results

Fossil specimens were sampled for their stable isotope ($\delta^{13}C$, $\delta^{18}O$) and elemental (Mg/Ca, Sr/Ca, Fe, Mn) content. All samples with an iron content above 300 µg/g and a manganese content above 100 µg/g were considered unreliable and removed from environmental reconstructions. In addition, all specimens for which the analysis of elemental concentrations was not possible were also considered unreliable. The data were consequently subdivided into seemingly pristine data (Table S2) and potentially altered data (Table S3). Finally, one oyster (*Gryphaea* sp.) from the Lower Oxfordian of Vega de la Veranada was used for a high-resolution stable isotope ($\delta^{13}C$, $\delta^{18}O$) analysis in order to examine seasonal changes during the life time of the individual bivalve (Table S4). The acquired datasets are presented on the following pages.

Table S2 Results of stable isotope ($\delta^{13}C$, $\delta^{18}O$) and element (Mg/Ca, Sr/Ca, Fe, Mn) analyses of seemingly well-preserved fossils of the Neuquén Basin ([1]The relative stratigraphy represents an approximate age of the sample based on its stratigraphic position and ammonite biostratigraphy in combination with the time scale of Ogg et al. (2016). Please note that this approximate age is theoretical and used only for plotting the samples; [2]Temperatures are calculated with the equation of Anderson and Arthur (1983) and a $\delta^{18}O_{sea}$ value of −1 ‰ VSMOW during shell formation (Shackleton and Kennett, 1975); [3]Temperatures are calculated with the equation of Nunn and Price (2010) for belemnites and the equation of Mouchi et al. (2013) for oysters and brachiopods).

sample no.	taxonomy	level	age	ammonite zone	rel. strat.[1]	$\delta^{13}C$ (‰ VPDB)	δ18O (‰ VPDB)	T[2] (°C)	Mg/Ca (mmol/mol)	T[3] (°C)	Sr/Ca (mmol/mol)	Fe (µg/g)	Mn (µg/g)
Northern sections near Chos Malal													
MOZ-PI 10362/1	*Aetostreon* sp.	PT (33)	E. Valang.	Riveroi	138.53	0.80	−2.53	22.6	1.942	9.2	0.930	< 90	< 30
MOZ-PI 10362/2	*Aetostreon* sp.	PT (33)	E. Valang.	Riveroi	138.53	1.41	−2.80	23.9	3.087	13.5	0.792	< 90	43
MOZ-PI 11834/1	oyster	PT (42-44)	L. Tith.	Alternans	146.60	−0.33	−5.11	35.2	8.156	32.6	0.733	113	80
MOZ-PI 11854/1	*Actinostreon*? sp.	PT (36-38)	L. Tith.	Alternans	147.38	0.53	−5.79	38.8	1.549	7.7	0.743	173	39
MOZ-PI 11854/2-AB	*Actinostreon*? sp.	PT (36-38)	L. Tith.	Alternans	147.38	0.70	−5.54	37.4	1.519	7.6	0.823	< 90	< 30
MOZ-PI 11854/3	oyster	PT (36-38)	L. Tith.	Alternans	147.38	0.95	−5.19	35.6	1.815	8.7	0.811	< 90	< 30
MOZ-PI 11835/5	oyster	PT (19-31)	M. Tith.	Internispinosum	147.90	0.93	−6.14	40.7	2.557	11.5	0.977	209	35
MOZ-PI 11835/6	oyster	PT (19-31)	M. Tith.	Internispinosum	147.90	1.21	−5.23	35.9	3.242	14.1	0.951	< 90	< 30
MOZ-PI 11836/1	oyster	PT (14)	M. Tith.	Zitteli/Mendozanus	149.87	2.34	−6.18	40.9	2.044	9.6	0.861	< 90	41
MOZ-PI 11836/2	oyster	PT (14)	M. Tith.	Zitteli/Mendozanus	149.87	1.65	−5.51	37.3	2.021	9.5	0.977	< 90	< 30
MOZ-PI 11836/4	oyster	PT (14)	M. Tith.	Zitteli/Mendozanus	149.87	1.78	−6.76	44.2	1.958	9.3	1.032	< 90	43
MOZ-PI 11836/5	oyster	PT (14)	M. Tith.	Zitteli/Mendozanus	149.87	2.16	−6.29	41.5	2.306	10.6	1.044	< 90	32
MOZ-PI 11836/6	*Actinostreon*? sp.	PT (14)	M. Tith.	Zitteli/Mendozanus	149.87	0.77	−6.16	40.8	2.310	10.6	1.410	< 90	85
MOZ-PI 11850/1	oyster	PT (2-6)	E. Tith.	Picunleufuense	151.51	1.15	−6.34	41.8	2.670	11.9	0.764	260	81
MOZ-PI 11851/2	oyster	PT (2-6)	E. Tith.	Picunleufuense	151.51	0.66	−6.56	43.0	3.027	13.3	0.731	< 90	79
MOZ-PI 11847/1	*Gryphaea* sp.	VV (20)	E. Oxf.	Pressulus	160.91	3.38	−7.27	47.0	2.643	11.8	0.444	287	65
MOZ-PI 11847/3	*Gryphaea* sp.	VV (20)	E. Oxf.	Pressulus	160.91	3.33	−7.69	49.5	1.741	8.4	0.504	95	42
MOZ-PI 11847/4	*Gryphaea* sp.	VV (20)	E. Oxf.	Pressulus	160.91	3.50	−8.12	52.1	2.210	10.2	0.454	101	40
MOZ-PI 11847/7	*Gryphaea* sp.	VV (20)	E. Oxf.	Pressulus	160.91	3.02	−8.24	52.8	1.933	9.2	0.457	111	< 30
MOZ-PI 11847/11-B	*Gryphaea* sp.	VV (20)	E. Oxf.	Pressulus	160.91	3.19	−7.59	48.9	2.359	10.8	0.427	268	84
MOZ-PI 11847/12	*Gryphaea* sp.	VV (20)	E. Oxf.	Pressulus	160.91	3.24	−7.03	45.7	1.978	9.3	0.437	< 90	< 30
MOZ-PI 11847/13	*Gryphaea* sp.	VV (20)	E. Oxf.	Pressulus	160.91	3.63	−7.33	47.4	2.815	12.5	0.497	< 90	< 30
MOZ-PI 11847/14	*Gryphaea* sp.	VV (20)	E. Oxf.	Pressulus	160.91	3.19	−7.01	45.6	3.195	13.9	0.457	< 90	< 30
MOZ-PI 11846/2	*Gryphaea* sp.	VV (12)	L. Call.	Dimorphosus	163.46	3.90	−7.35	47.5	2.153	10.0	0.528	< 90	< 30
MOZ-PI 11846/4	*Gryphaea* sp.	VV (12)	L. Call.	Dimorphosus	163.46	4.09	−7.70	49.6	2.518	11.4	0.486	< 90	< 30
MOZ-PI 11846/5	*Gryphaea* sp.	VV (12)	L. Call.	Dimorphosus	163.46	3.18	−8.24	52.8	2.741	12.2	0.503	< 90	50
MOZ-PI 11846/9-B	*Gryphaea* sp.	VV (12)	L. Call.	Dimorphosus	163.46	3.78	−7.32	47.3	3.232	14.1	0.497	240	56
MOZ-PI 11846/10	*Gryphaea* sp.	VV (12)	L. Call.	Dimorphosus	163.46	4.01	−7.74	49.8	3.497	15.1	0.483	129	68
MOZ-PI 11846/11	*Gryphaea* sp.	VV (12)	L. Call.	Dimorphosus	163.46	4.10	−7.95	51.1	1.980	9.3	0.531	155	43
MOZ-PI 11846/12	*Gryphaea* sp.	VV (12)	L. Call.	Dimorphosus	163.46	3.76	−7.63	49.2	3.350	14.5	0.596	185	73
MOZ-PI 11849/1	*Gryphaea* sp.	VV (2)	L. Call.	Primus (Schilleri Hz)	163.90	3.54	−7.43	48.0	1.511	7.6	0.585	229	66
MOZ-PI 11849/2	oyster	VV (2)	L. Call.	Primus (Schilleri Hz)	163.90	3.58	−7.61	49.0	2.020	9.5	0.630	146	88
MOZ-PI 11849/3	*Gryphaea* sp.	VV (2)	L. Call.	Primus (Schilleri Hz)	163.90	3.72	−7.51	48.5	2.682	12.0	0.544	103	60
MOZ-PI 11849/5	*Gryphaea* sp.	VV (2)	L. Call.	Primus (Schilleri Hz)	163.90	3.79	−8.12	52.1	2.409	11.0	0.611	< 90	60
MOZ-PI 11849/7	oyster	VV (2)	L. Call.	Primus (Schilleri Hz)	163.90	3.14	−7.18	46.6	2.850	12.6	0.615	144	63
MOZ-PI 11839/1-B	oyster	VV (>1° gran)	L. Bath.	-	166.28	2.50	−8.69	55.5	2.570	11.6	0.637	166	73
MOZ-PI 11839/3	oyster	VV (>1° gran)	L. Bath.	-	166.28	2.03	−7.85	50.4	2.325	10.6	0.656	111	91
MOZ-PI 11839/4-A	oyster	VV (>1° gran)	L. Bath.	-	166.28	1.75	−8.62	55.1	2.776	12.3	0.599	178	96
MOZ-PI 11839/6	oyster	VV (>1° gran)	L. Bath.	-	166.28	1.91	−8.08	51.8	2.603	11.7	0.564	112	88

Table S2 (continued) Results of stable isotope ($\delta^{13}C$, $\delta^{18}O$) and element (Mg/Ca, Sr/Ca, Fe, Mn) analyses of seemingly well-preserved fossils of the Neuquén Basin ([1]The relative stratigraphy represents an approximate age of the sample based on its stratigraphic position and ammonite biostratigraphy in combination with the time scale of Ogg et al. (2016). Please note that this approximate age is theoretical and used only for plotting the samples; [2]Temperatures are calculated with the equation of Anderson and Arthur (1983) and a $\delta^{18}O_{sea}$ value of −1 ‰ VSMOW during shell formation (Shackleton and Kennett, 1975); [3]Temperatures are calculated with the equation of Nunn and Price (2010) for belemnites and the equation of Mouchi et al. (2013) for oysters and brachiopods).

sample no.	taxonomy	level	age	ammonite zone	rel. strat.[1]	$\delta^{13}C$ (‰ VPDB)	δ18O (‰ VPDB)	T[2] (°C)	Mg/Ca (mmol/mol)	T[3] (°C)	Sr/Ca (mmol/mol)	Fe (µg/g)	Mn (µg/g)
MOZ-PI 11839/11	oyster	VV (>1° gran)	L. Bath.	-	166.28	2.87	−8.83	56.4	3.108	13.6	0.667	124	66
MOZ-PI 11838/1-A	oyster	VV (near base)	E.-M. Bath.	-	167.40	2.07	−9.03	57.6	2.726	12.2	0.592	< 90	41
MOZ-PI 11838/2-B	oyster	VV (near base)	E.-M. Bath.	-	167.40	2.28	−9.45	60.2	2.670	11.9	0.585	< 90	61
MOZ-PI 11838/3	*Gryphaea* sp.	VV (near base)	E.-M. Bath.	-	167.40	2.24	−8.39	53.7	2.131	9.9	0.659	134	90
MOZ-PI 11838/4	*Gryphaea* sp.	VV (near base)	E.-M. Bath.	-	167.40	1.38	−8.43	53.9	2.383	10.9	0.557	164	71
MOZ-PI 11838/7	oyster	VV (near base)	E.-M. Bath.	-	167.40	2.25	−7.78	50.1	2.071	9.7	0.577	< 90	44
MOZ-PI 11838/8	*Gryphaea* sp.	VV (near base)	E.-M. Bath.	-	167.40	2.34	−8.47	54.2	2.555	11.5	0.596	< 90	61
MOZ-PI 11834/2	*Hibolithes* sp.	PT (42-44)	L. Tith.	Alternans	146.60	−0.98	−1.82	19.5	14.422	22.6	1.823	< 90	< 30
MOZ-PI 11854/4	*Hibolithes* sp.	PT (36-38)	L. Tith.	Alternans	147.38	−1.30	−0.82	15.3	9.763	19.1	2.145	< 90	< 30
MOZ-PI 11854/6	*Hibolithes* sp.	PT (36-38)	L. Tith.	Alternans	147.38	−1.20	−0.56	14.2	8.106	17.4	1.892	< 90	< 30
MOZ-PI 11854/7	*Hibolithes* sp.	PT (36-38)	L. Tith.	Alternans	147.38	−0.49	−0.40	13.6	7.919	17.2	2.174	< 90	< 30
MOZ-PI 11835/1	*Hibolithes* sp.	PT (19-31)	M. Tith.	Internispinosum	147.90	−0.34	−4.20	30.6	13.601	22.1	1.330	206	< 30
MOZ-PI 11835/3	*Hibolithes* sp.	PT (19-31)	M. Tith.	Internispinosum	147.90	−1.92	−2.06	20.5	10.059	19.3	1.469	147	58
MOZ-PI 11835/4	*Hibolithes* sp.	PT (19-31)	M. Tith.	Internispinosum	147.90	−1.57	−1.26	17.1	15.583	23.3	1.631	< 90	< 30
MOZ-PI 11841	*Belemnopsis* sp.	VV (22)	E. Oxf.	Pressulus	160.73	0.57	−0.28	13.1	8.940	18.3	1.301	< 90	< 30
MOZ-PI 11843-AB	*Belemnopsis* sp.	VV (17)	E. Oxf.	Pressulus (Pressulus Hz)	161.10	0.58	−1.05	16.2	8.098	17.4	1.472	< 90	< 30
Southern sections near Zapala													
MOZ-PI 8597/1	*Aetostreon*? sp.	CC (18)	L. Tith.	Alternans	146.37	0.62	−1.67	18.8	3.492	15.0	0.689	177	47
MOZ-PI 8597/3	*Gryphaea* sp.	CC (18)	L. Tith.	Alternans	146.37	0.13	−1.28	17.2	4.274	18.0	0.680	146	39
MOZ-PI 8823	*Aetostreon*? sp.	PC (151)	L. Tith.	Alternans	146.47	1.11	−1.17	16.7	2.061	9.6	0.880	132	45
MOZ-PI 8824	*Gryphaea* sp.	PC (151)	L. Tith.	Alternans	146.47	0.43	−1.15	16.6	1.698	8.3	0.890	103	35
MOZ-PI 8611/1	*Gryphaea* sp.	CC (16)	L. Tith.	Alternans	146.99	0.82	−1.23	17.0	1.684	8.2	0.791	140	< 30
MOZ-PI 8807/2	*Gryphaea* sp.	PC (141, base)	L. Tith.	Alternans	146.99	0.21	−1.24	17.0	3.437	14.8	0.643	131	41
MOZ-PI 8631/2	*Gryphaea* sp.	CC (10)	L. Tith.	Alternans	147.30	0.77	−1.74	19.1	1.190	6.4	0.762	238	< 30
MOZ-PI 8817/10	*Gryphaea* sp.	PC (136)	L. Tith.	Alternans	147.51	0.43	−1.75	19.2	3.604	15.5	0.588	201	< 30
MOZ-PI 8817/11	*Gryphaea* sp.	PC (136)	L. Tith.	Alternans	147.51	0.28	−1.49	18.0	3.293	14.3	0.585	187	< 30
MOZ-PI 8817/12	*Gryphaea* sp.	PC (136)	L. Tith.	Alternans	147.51	0.54	−1.53	18.2	3.442	14.9	0.610	287	50
MOZ-PI 8612/2	*Gryphaea* sp.	CC (6)	L. Tith.	Alternans	147.61	1.56	−1.58	18.4	3.476	15.0	0.778	143	< 30
MOZ-PI 8612/3	*Gryphaea* sp.	CC (6)	L. Tith.	Alternans	147.61	0.38	−1.87	19.7	3.290	14.3	0.643	259	63
MOZ-PI 11254	*Gryphaea* sp.	PL-CV	?Bath.	-	167.19	3.35	−3.08	25.2	2.405	10.9	0.716	164	36
MOZ-PI 11830/1-AB	*Gryphaea* sp.	PL-1 (27-04)	E. Bajoc.	Giebeli	169.88	3.70	−1.44	17.8	2.102	9.8	0.721	< 90	< 30
MOZ-PI 4420/2	*R. lamberti*	CG (4)	Pliensb.	-	187.53	4.06	−3.01	24.9	4.182	17.6	1.148	100	68
MOZ-PI 4421	rhynchonellid	CG (4)	Pliensb.	-	187.53	3.87	−3.47	27.0	5.469	22.5	1.010	240	48
MOZ-PI 11827/1	*Brevibelus* sp.	PL-1 (27-01)	E. Bajoc.	Giebeli	169.73	1.65	−0.82	15.3	13.383	21.9	1.525	254	< 30
MOZ-PI 11827/2	*Brevibelus* sp.	PL-1 (27-01)	E. Bajoc.	Giebeli	169.73	0.55	−0.63	14.5	13.646	22.1	1.490	< 90	< 30
MOZ-PI 11827/3	*Brevibelus* sp.	PL-1 (27-01)	E. Bajoc.	Giebeli	169.73	1.78	−0.88	15.5	14.244	22.5	1.447	< 90	< 30
MOZ-PI 11827/4	*Brevibelus* sp.	PL-1 (27-01)	E. Bajoc.	Giebeli	169.73	2.54	−0.77	15.0	13.165	21.8	1.414	< 90	< 30

Table S2 (continued) Results of stable isotope ($\delta^{13}C$, $\delta^{18}O$) and element (Mg/Ca, Sr/Ca, Fe, Mn) analyses of seemingly well-preserved fossils of the Neuquén Basin ([1]The relative stratigraphy represents an approximate age of the sample based on its stratigraphic position and ammonite biostratigraphy in combination with the time scale of Ogg et al. (2016). Please note that this approximate age is theoretical and used only for plotting the samples; [2]Temperatures are calculated with the equation of Anderson and Arthur (1983) and a $\delta^{18}O_{sea}$ value of −1 ‰ VSMOW during shell formation (Shackleton and Kennett, 1975); [3]Temperatures are calculated with the equation of Nunn and Price (2010) for belemnites and the equation of Mouchi et al. (2013) for oysters and brachiopods).

sample no.	taxonomy	level	age	ammonite zone	rel. strat.[1]	$\delta^{13}C$ (‰ VPDB)	δ18O (‰ VPDB)	T[2] (°C)	Mg/Ca (mmol/mol)	T[3] (°C)	Sr/Ca (mmol/mol)	Fe (µg/g)	Mn (µg/g)
MOZ-PI 11827/5	*Brevibelus* sp.	PL-1 (27-01)	E. Bajoc.	Giebeli	169.73	1.53	−0.57	14.3	13.164	21.8	1.492	< 90	< 30
MOZ-PI 11827/6	*Brevibelus* sp.	PL-1 (27-01)	E. Bajoc.	Giebeli	169.73	0.92	−0.16	12.6	13.533	22.0	1.513	< 90	< 30
MOZ-PI 11827/7	*Brevibelus* sp.	PL-1 (27-01)	E. Bajoc.	Giebeli	169.73	1.68	−0.73	14.9	14.472	22.6	1.599	< 90	< 30
MOZ-PI 11827/8	*Brevibelus* sp.	PL-1 (27-01)	E. Bajoc.	Giebeli	169.73	1.92	−1.02	16.1	13.970	22.3	1.611	< 90	< 30
MOZ-PI 11828/1	*Brevibelus* sp.	PL-1 (27-02)	E. Bajoc.	Giebeli	169.78	2.11	−0.62	14.4	9.904	19.2	1.493	< 90	< 30
MOZ-PI 11828/2	*Brevibelus* sp.	PL-1 (27-02)	E. Bajoc.	Giebeli	169.78	1.73	−0.80	15.2	12.814	21.5	1.710	< 90	< 30
MOZ-PI 11828/3	*Brevibelus* sp.	PL-1 (27-02)	E. Bajoc.	Giebeli	169.78	1.41	−1.06	16.2	15.255	23.1	1.509	< 90	< 30
MOZ-PI 11828/4	*Brevibelus* sp.	PL-1 (27-02)	E. Bajoc.	Giebeli	169.78	1.10	−0.41	13.6	17.103	24.2	1.616	< 90	< 30
MOZ-PI 11828/5	*Brevibelus* sp.	PL-1 (27-02)	E. Bajoc.	Giebeli	169.78	2.10	−1.04	16.1	16.556	23.9	1.728	< 90	< 30
MOZ-PI 11828/6	*Brevibelus* sp.	PL-1 (27-02)	E. Bajoc.	Giebeli	169.78	1.61	−0.78	15.1	9.878	19.2	1.492	< 90	< 30
MOZ-PI 11829/1	*Brevibelus* sp.	PL-1 (27-03)	E. Bajoc.	Giebeli	169.83	1.69	−0.89	15.6	13.744	22.2	1.671	< 90	< 30
MOZ-PI 11829/2	*Brevibelus* sp.	PL-1 (27-03)	E. Bajoc.	Giebeli	169.83	1.30	−1.41	17.7	14.463	22.6	1.641	< 90	< 30
MOZ-PI 11829/3	*Brevibelus* sp.	PL-1 (27-03)	E. Bajoc.	Giebeli	169.83	2.10	−0.47	13.8	11.980	20.9	1.560	< 90	< 30
MOZ-PI 11829/4	*Brevibelus* sp.	PL-1 (27-03)	E. Bajoc.	Giebeli	169.83	1.59	−0.76	15.0	13.162	21.8	1.620	< 90	< 30
MOZ-PI 11829/5	*Brevibelus* sp.	PL-1 (27-03)	E. Bajoc.	Giebeli	169.83	2.21	−0.88	15.5	10.980	20.1	1.564	< 90	< 30
MOZ-PI 11829/6	*Brevibelus* sp.	PL-1 (27-03)	E. Bajoc.	Giebeli	169.83	3.04	−1.52	18.2	12.911	21.6	1.639	< 90	< 30
MOZ-PI 11829/7	*Brevibelus* sp.	PL-1 (27-03)	E. Bajoc.	Giebeli	169.83	1.42	−0.44	13.7	11.074	20.2	1.561	< 90	< 30
MOZ-PI 11829/8	*Brevibelus* sp.	PL-1 (27-03)	E. Bajoc.	Giebeli	169.83	1.18	−0.89	15.5	14.496	22.7	1.800	< 90	< 30
MOZ-PI 11830/2	*Brevibelus* sp.	PL-1 (27-04)	E. Bajoc.	Giebeli	169.88	1.86	−1.00	16.0	12.135	21.0	1.769	< 90	< 30
MOZ-PI 11830/3	*Brevibelus* sp.	PL-1 (27-04)	E. Bajoc.	Giebeli	169.88	2.33	−1.04	16.2	11.153	20.3	1.460	< 90	< 30
MOZ-PI 11830/4	*Brevibelus* sp.	PL-1 (27-04)	E. Bajoc.	Giebeli	169.88	1.93	−0.42	13.7	13.557	22.0	1.691	< 90	< 30
MOZ-PI 11830/5	*Brevibelus* sp.	PL-1 (27-04)	E. Bajoc.	Giebeli	169.88	1.30	−0.30	13.2	10.231	19.5	1.584	< 90	< 30
MOZ-PI 11831/1	*Brevibelus* sp.	PL-1 (27-05)	E. Bajoc.	Giebeli	169.93	1.59	−0.77	15.0	12.681	21.4	1.601	< 90	< 30
MOZ-PI 11831/2	*Brevibelus* sp.	PL-1 (27-05)	E. Bajoc.	Giebeli	169.93	1.84	−0.52	14.0	11.510	20.6	1.675	< 90	< 30
MOZ-PI 11831/3	belemnite	PL-1 (27-05)	E. Bajoc.	Giebeli	169.93	2.07	−0.62	14.5	13.504	22.0	1.610	< 90	< 30
MOZ-PI 11831/4	*Brevibelus* sp.	PL-1 (27-05)	E. Bajoc.	Giebeli	169.93	1.33	−3.19	25.7	13.809	22.2	1.517	< 90	< 30
MOZ-PI 11831/5	belemnite	PL-1 (27-05)	E. Bajoc.	Giebeli	169.93	1.20	−0.31	13.2	13.726	22.2	1.669	< 90	< 30
MOZ-PI 11832/1	*Brevibelus* sp.	PL-1 (27-06)	E. Bajoc.	Giebeli	169.98	1.10	−0.62	14.4	7.800	17.0	1.388	< 90	< 30
MOZ-PI 11832/2	*Brevibelus* sp.	PL-1 (27-06)	E. Bajoc.	Giebeli	169.98	1.70	−0.35	13.4	9.039	18.4	1.375	< 90	< 30
MOZ-PI 11832/3	belemnite	PL-1 (27-06)	E. Bajoc.	Giebeli	169.98	1.96	−0.80	15.2	11.987	20.9	1.719	< 90	< 30

Table S3 Results of stable isotope ($\delta^{13}C$, $\delta^{18}O$) and element (Mg/Ca, Sr/Ca, Fe, Mn) analyses of unreliable, potentially poorly preserved fossils and sediment samples of the Neuquén Basin ([1]The relative stratigraphy represents an approximate age of the sample based on its stratigraphic position and ammonite biostratigraphy in combination with the time scale of Ogg et al. (2016). Please note that this approximate age is theoretical and used only for plotting the samples).

sample no.	taxonomy	level	age	ammonite zone	rel. strat.[1]	δ13C (‰ VPDB)	δ18O (‰ VPDB)	Mg/Ca (mmol/mol)	Sr/Ca (mmol/mol)	Fe (µg/g)	Mn (µg/g)
Northern sections near Chos Malal											
MOZ-PI 11854/10-AB	*Trichites* sp.	PT (36-38)	L. Tith.	Alternans	147.38	−1.95	−8.49	5.756	0.646	213	399
MOZ-PI 11836/3	oyster	PT (14)	M. Tith.	Zitteli/Mendozanus	149.87	0.71	−6.51	3.876	1.181	540	148
MOZ-PI 11840	oyster	PT (2)	E. Tith.	Picunleufuense	151.51	1.05	−6.68	2.957	0.833	266	195
MOZ-PI 11844	oyster	PT (2)	E. Tith.	Picunleufuense	151.51	1.09	−6.31	2.397	0.783	159	175
MOZ-PI 11849/9	oyster	PT (4)	E. Tith.	Picunleufuense	151.51	0.98	−6.29	2.261	0.738	326	304
MOZ-PI 11849/10	oyster	PT (4)	E. Tith.	Picunleufuense	151.51	1.26	−6.32	1.928	0.844	938	155
MOZ-PI 11850/2	oyster	PT (2-6)	E. Tith.	Picunleufuense	151.51	1.66	−6.48	4.124	0.817	278	219
MOZ-PI 11850/3	oyster	PT (2-6)	E. Tith.	Picunleufuense	151.51	0.83	−6.18	-	-	-	-
MOZ-PI 11850/4	*Actinostreon*? sp.	PT (2-6)	E. Tith.	Picunleufuense	151.51	0.54	−6.28	4.072	0.723	487	265
MOZ-PI 11850/5	oyster	PT (2-6)	E. Tith.	Picunleufuense	151.51	0.42	−6.40	2.752	0.736	< 90	172
MOZ-PI 11850/6	*Actinostreon*? sp.	PT (2-6)	E. Tith.	Picunleufuense	151.51	−1.29	−6.00	7.305	0.690	1037	670
MOZ-PI 11851/1	oyster	PT (2-6)	E. Tith.	Picunleufuense	151.51	−0.93	−6.96	8.530	0.687	1524	1839
MOZ-PI 11853/1	oyster	PT (2-6)	E. Tith.	Picunleufuense	151.51	0.19	−6.79	-	-	-	-
MOZ-PI 11853/2-AB	oyster	PT (2-6)	E. Tith.	Picunleufuense	151.51	−0.33	−6.77	-	-	-	-
MOZ-PI 11847/2	*Gryphaea* sp.	VV (20)	E. Oxf.	Pressulus	160.91	3.34	−8.53	1.122	0.519	325	88
MOZ-PI 11847/5	*Gryphaea* sp.	VV (20)	E. Oxf.	Pressulus	160.91	3.32	−8.26	2.432	0.534	325	49
MOZ-PI 11847/6	*Gryphaea* sp.	VV (20)	E. Oxf.	Pressulus	160.91	3.56	−7.90	1.184	0.480	11857	737
MOZ-PI 11847/8	*Gryphaea* sp.	VV (20)	E. Oxf.	Pressulus	160.91	3.55	−7.99	2.311	0.501	6378	150
MOZ-PI 11847/9	*Gryphaea* sp.	VV (20)	E. Oxf.	Pressulus	160.91	3.08	−8.29	1.785	0.478	710	98
MOZ-PI 11847/10	*Gryphaea* sp.	VV (20)	E. Oxf.	Pressulus	160.91	3.62	−7.98	1.613	0.519	178	155
MOZ-PI 11847/11-A	*Gryphaea* sp.	VV (20)	E. Oxf.	Pressulus	160.91	3.39	−7.91	1.569	0.554	313	144
MOZ-PI 11846/1	*Gryphaea* sp.	VV (12)	L. Call.	Dimorphosus	163.46	2.85	−9.02	2.346	0.494	1235	95
MOZ-PI 11846/3	*Gryphaea* sp.	VV (12)	L. Call.	Dimorphosus	163.46	3.96	−7.25	2.880	0.486	422	58
MOZ-PI 11846/6	*Gryphaea* sp.	VV (12)	L. Call.	Dimorphosus	163.46	2.57	−8.46	3.934	0.457	899	335
MOZ-PI 11846/7	*Gryphaea* sp.	VV (12)	L. Call.	Dimorphosus	163.46	2.78	−8.26	3.551	0.598	1130	159
MOZ-PI 11846/8	*Gryphaea* sp.	VV (12)	L. Call.	Dimorphosus	163.46	3.92	−7.62	3.570	0.494	435	112
MOZ-PI 11846/9-A	*Gryphaea* sp.	VV (12)	L. Call.	Dimorphosus	163.46	3.53	−8.13	2.593	0.545	3634	81
MOZ-PI 11849/4	*Gryphaea* sp.	VV (2)	L. Call.	Primus (Schilleri Hz)	163.90	0.97	−8.34	-	-	-	-
MOZ-PI 11849/6	oyster	VV (2)	L. Call.	Primus (Schilleri Hz)	163.90	3.66	−7.98	1.369	0.542	293	128
MOZ-PI 11849/8	oyster	VV (2)	L. Call.	Primus (Schilleri Hz)	163.90	3.11	−7.63	2.252	0.604	521	138
MOZ-PI 11837	*Actinostreon*? sp.	VV (<2° gran)	E. Call.	-	165.36	−12.00	−7.63	3.663	0.250	382	1267
MOZ-PI 11839/1-A	oyster	VV (>1° gran)	L. Bath.	-	166.28	2.01	−8.38	5.754	0.700	1630	92
MOZ-PI 11839/2	oyster	VV (>1° gran)	L. Bath.	-	166.28	−0.31	−8.20	7.514	0.426	3055	490
MOZ-PI 11839/4-B	oyster	VV (>1° gran)	L. Bath.	-	166.28	1.74	−8.70	4.343	0.540	560	270
MOZ-PI 11839/5	oyster	VV (>1° gran)	L. Bath.	-	166.28	2.11	−8.78	2.262	0.584	108	192
MOZ-PI 11839/7	oyster	VV (>1° gran)	L. Bath.	-	166.28	−0.36	−5.79	-	0.323	6688	770
MOZ-PI 11839/8	oyster	VV (>1° gran)	L. Bath.	-	166.28	1.47	−8.35	3.901	0.605	400	201
MOZ-PI 11839/9	oyster	VV (>1° gran)	L. Bath.	-	166.28	1.73	−8.82	3.146	0.532	166	202
MOZ-PI 11839/10	oyster	VV (>1° gran)	L. Bath.	-	166.28	1.55	−4.49	8.948	0.794	2711	167
MOZ-PI 11845	oyster	VV (base of 1°)	M.-L. Bath.	-	166.41	0.09	−8.67	7.694	0.609	421	400
MOZ-PI 11842	oyster	VV (<1° gran)	M.-L. Bath.	-	167.06	2.42	−7.90	1.729	0.679	501	140

Table S3 (continued) Results of stable isotope ($\delta^{13}C$, $\delta^{18}O$) and element (Mg/Ca, Sr/Ca, Fe, Mn) analyses of unreliable, potentially poorly preserved fossils and sediment samples of the Neuquén Basin ([1]The relative stratigraphy represents an approximate age of the sample based on its stratigraphic position and ammonite biostratigraphy in combination with the time scale of Ogg et al. (2016). Please note that this approximate age is theoretical and used only for plotting the samples).

sample no.	taxonomy	level	age	ammonite zone	rel. strat.[1]	δ13C (‰ VPDB)	δ18O (‰ VPDB)	Mg/Ca (mmol/mol)	Sr/Ca (mmol/mol)	Fe (µg/g)	Mn (µg/g)
MOZ-PI 11838/1-B	oyster	VV (near base)	E.-M. Bath.	-	167.40	2.10	−9.56	3.001	0.626	176	111
MOZ-PI 11838/2-A	oyster	VV (near base)	E.-M. Bath.	-	167.40	1.75	−9.87	2.693	0.591	159	170
MOZ-PI 11838/5	oyster	VV (near base)	E.-M. Bath.	-	167.40	1.61	−8.39	2.511	0.583	482	99
MOZ-PI 11838/6	oyster	VV (near base)	E.-M. Bath.	-	167.40	1.46	−9.21	3.240	0.552	253	117
MOZ-PI 11838/9	oyster	VV (near base)	E.-M. Bath.	-	167.40	0.52	−8.59	3.269	0.543	249	210
MOZ-PI 11838/10	oyster	VV (near base)	E.-M. Bath.	-	167.40	1.45	−8.27	2.977	0.552	649	123
MOZ-PI 11854/5	*Hibolithes* sp.	PT (36-38)	L. Tith.	Alternans	147.38	−1.89	−1.26	12.162	2.247	1368	< 30
MOZ-PI 11854/8	*Hibolithes* sp.	PT (36-38)	L. Tith.	Alternans	147.38	−1.82	−0.65	8.722	1.896	345	< 30
MOZ-PI 11854/9	*Hibolithes* sp.	PT (36-38)	L. Tith.	Alternans	147.38	−0.10	−1.08	-	-	-	-
MOZ-PI 11835/2	*Hibolithes* sp.	PT (19-31)	M. Tith.	Internispinosum	147.90	−0.74	−9.40	14.120	1.071	1074	121
MOZ-PI 11836/7	*Hibolithes* sp.	PT (14)	M. Tith.	Zitteli/Mendozanus	149.87	3.43	−10.48	-	-	-	-
MOZ-PI 11846/13	*Belemnopsis* sp.	VV (12)	L. Call.	Dimorphosus	163.46	0.86	−5.43	12.933	1.480	486	128
MOZ-PI 11856	aptychus	PT (15-18)	M. Tith.	Proximus	148.54	−3.96	−5.16	13.413	0.892	3343	1180
MOZ-PI 11836/8	aptychus	PT (14)	M. Tith.	Zitteli/Mendozanus	149.87	−6.54	−8.00	17.176	1.352	303	435
MOZ-PI 11836/9	aptychus	PT (14)	M. Tith.	Zitteli/Mendozanus	149.87	0.25	−8.73	11.819	-	476	391
MOZ-PI 11851-Sed	sediment	PT (2-6)	E. Tith.	Picunleufuense	151.51	−4.44	−8.61	26.580	0.431	1479	646
MOZ-PI 11847-Sed	sediment	VV (20)	E. Oxf.	Pressulus	160.91	0.00	−11.56	18.660	0.550	2624	439
MOZ-PI 11849-Sed	sediment	VV (2)	L. Call.	Primus (Schilleri Hz)	163.90	−1.87	−6.66	39.579	0.358	1329	670
Southern sections near Zapala											
MOZ-PI 8636	*Gryphaea* sp.	CC (17)	L. Tith.	Alternans	146.68	1.40	−1.79	1.408	0.839	491	< 30
MOZ-PI 8611/2	*Gryphaea* sp.	CC (16)	L. Tith.	Alternans	146.99	0.90	−1.87	1.614	0.798	997	< 30
MOZ-PI 8807/1	*Gryphaea* sp.	PC (141, base)	L. Tith.	Alternans	146.99	−0.35	−1.72	8.802	0.556	1693	270
MOZ-PI 8631/3	*Gryphaea* sp.	CC (10)	L. Tith.	Alternans	147.30	0.28	−1.01	-	-	-	-
MOZ-PI 8817/2	*Gryphaea* sp.	PC (136)	L. Tith.	Alternans	147.51	0.56	−1.54	3.405	0.580	503	64
MOZ-PI 8607/1	rhynchonellid	CC (6)	L. Tith.	Alternans	147.61	0.00	−2.41	-	-	-	-
MOZ-PI 8607/2	rhynchonellid	CC (6)	L. Tith.	Alternans	147.61	−0.58	−1.41	-	-	-	-
MOZ-PI 8612/1	*Gryphaea* sp.	CC (6)	L. Tith.	Alternans	147.61	0.21	−2.26	-	-	-	-
MOZ-PI 8380	oyster	CG (4)	E. Tith.	Picunleufuense	151.51	0.74	−2.67	-	-	-	-
MOZ-PI 6627/1	oyster	PL-2	E. Aalenian	Manflaensis	172.88	2.62	−2.52	-	-	-	-
MOZ-PI 6627/2	oyster	PL-2	E. Aalenian	Manflaensis	172.88	0.67	−4.09	3.465	0.818	1885	251
MOZ-PI 6627/3	oyster	PL-2	E. Aalenian	Manflaensis	172.88	1.62	−3.43	3.644	0.906	2481	285
MOZ-PI 6627/4	oyster	PL-2	E. Aalenian	Manflaensis	172.88	2.25	−3.89	-	-	-	-
MOZ-PI 6627/5	oyster	PL-2	E. Aalenian	Manflaensis	172.88	1.44	−2.85	-	-	-	-
MOZ-PI 6627/6	oyster	PL-2	E. Aalenian	Manflaensis	172.88	3.24	−3.05	-	-	-	-
MOZ-PI 4419	*Piarorhynchia keideli*	CG (4)	Pliensb.	-	187.53	3.34	−4.26	-	-	-	-
MOZ-PI 4420/1	*Rhynchonelloides lamberti*	CG (4)	Pliensb.	-	187.53	4.08	−3.53	-	-	-	-
MOZ-PI 4423	*Rhynchonella variabilis*	CG (4)	Pliensb.	-	187.53	3.58	−4.01	-	-	-	-
MOZ-PI 2416/1-AB	*Placunopsis*? sp.	CH (11)	E. Pliensb.	Behr.-Merid.	188.59	1.80	−2.31	1.542	0.654	330	1106

Table S3 (continued) Results of stable isotope ($\delta^{13}C$, $\delta^{18}O$) and element (Mg/Ca, Sr/Ca, Fe, Mn) analyses of unreliable, potentially poorly preserved fossils and sediment samples of the Neuquén Basin ([1]The relative stratigraphy represents an approximate age of the sample based on its stratigraphic position and ammonite biostratigraphy in combination with the time scale of Ogg et al. (2016). Please note that this approximate age is theoretical and used only for plotting the samples).

sample no.	taxonomy	level	age	ammonite zone	rel. strat.[1]	δ13C (‰ VPDB)	δ18O (‰ VPDB)	Mg/Ca (mmol/mol)	Sr/Ca (mmol/mol)	Fe (µg/g)	Mn (µg/g)
MOZ-PI 2416/2	oyster	CH (11)	E. Pliensb.	Behr.-Merid.	188.59	1.34	−1.85	2.744	0.639	522	3245
MOZ-PI 2447/1	oyster	CH (8)	E. Pliensb.	Behr.-Merid.	188.93	3.73	−2.16	1.893	0.964	333	1049
MOZ-PI 2447/2	oyster	CH (8)	E. Pliensb.	Behr.-Merid.	188.93	3.19	−1.79	-	-	-	-
MOZ-PI 4524	oyster	CH (3)	E. Pliensb.	Behr.-Merid.	189.26	1.51	−2.62	4.709	0.603	743	993
MOZ-PI 11830/6	*Brevibelus* sp.	PL-1 (27-04)	E. Bajoc.	Giebeli	169.88	1.97	−0.70	13.311	1.549	419	< 30
MOZ-PI 11831-Sed	sediment	PL-1 (27-05)	E. Bajoc.	Giebeli	169.93	−7.67	−10.10	41.078	0.857	4593	620
MOZ-PI 11831-Cem	cement	PL-1 (27-05)	E. Bajoc.	Giebeli	169.93	0.78	−3.33	69.844	4.110	< 90	< 30
MOZ-PI 6627-Sed	sediment	PL-2	E. Aalenian	Manflaensis	172.88	−6.74	−7.73	61.231	1.057	2754	737

Table S4 Results of high-resolution stable isotope ($\delta^{13}C$, $\delta^{18}O$) analyses of a shell of *Gryphaea* sp. (MOZ-PI 11847/13) from the Lower Oxfordian of the Vega de la Veranada near Chos Malal in the northern Neuquén Basin ([1]Temperatures are calculated with the equation of Anderson and Arthur (1983) and a $\delta^{18}O_{sea}$ values of −1 ‰; [2]Temperatures are calculated with the equation of Anderson and Arthur (1983) and a $\delta^{18}O_{sea}$ values of −6.5 ‰).

sample no.	$\delta^{13}C$ (‰ VPDB)	$\delta^{18}O$ (‰ VPDB)	T[1] (°C)	T[2] (°C)
MOZ-PI 11847/13-1	3.55	−7.52	48.5	20.3
MOZ-PI 11847/13-2	3.40	−6.90	44.9	17.7
MOZ-PI 11847/13-3	3.33	−7.02	45.6	18.2
MOZ-PI 11847/13-4	3.41	−7.27	47.1	19.3
MOZ-PI 11847/13-5	3.44	−7.42	47.9	19.9
MOZ-PI 11847/13-6	3.26	−7.07	45.9	18.4
MOZ-PI 11847/13-7	3.16	−7.05	45.8	18.3
MOZ-PI 11847/13-8	3.10	−7.26	47.0	19.2
MOZ-PI 11847/13-9	3.27	−6.99	45.5	18.1
MOZ-PI 11847/13-10	3.25	−6.83	44.6	17.4
MOZ-PI 11847/13-11	3.39	−6.78	44.2	17.2
MOZ-PI 11847/13-12	3.50	−6.41	42.2	15.6
MOZ-PI 11847/13-13	3.59	−6.73	44.0	17.0
MOZ-PI 11847/13-14	3.54	−7.03	45.7	18.2
MOZ-PI 11847/13-15	3.48	−7.15	46.4	18.7
MOZ-PI 11847/13-16	3.50	−7.56	48.7	20.5
MOZ-PI 11847/13-17	3.74	−6.85	44.6	17.4
MOZ-PI 11847/13-18	3.79	−6.59	43.2	16.4
MOZ-PI 11847/13-19	3.72	−5.77	38.7	13.0
MOZ-PI 11847/13-20	3.75	−6.07	40.3	14.2
MOZ-PI 11847/13-21	3.69	−6.58	43.2	16.3
MOZ-PI 11847/13-22	3.53	−7.15	46.3	18.7
MOZ-PI 11847/13-23	3.61	−7.39	47.8	19.8
MOZ-PI 11847/13-24	3.49	−7.62	49.1	20.8
MOZ-PI 11847/13-25	3.38	−7.58	48.9	20.6
MOZ-PI 11847/13-26	3.09	−8.33	53.4	24.0
MOZ-PI 11847/13-27	3.30	−7.81	50.2	21.6

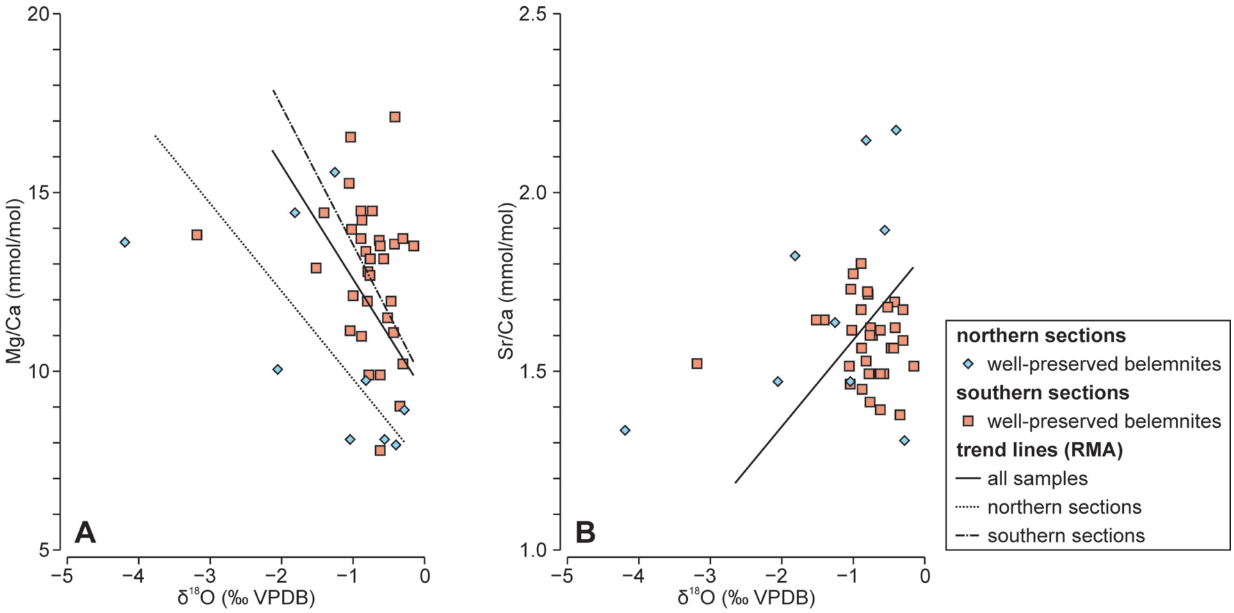

Fig. S2 A. $\delta^{18}O$ values and Mg/Ca ratios of well-preserved belemnites from the Neuquén Basin show a weak negative correlation, whether examined for the entire collection (rs = −0.35, p = 0.02) or separately for northern (rs = −0.68, p = 0.05) and southern sections (rs = −0.32, p = 0.07). **B.** $\delta^{18}O$ values and Sr/Ca ratios of well-preserved belemnites from the Neuquén Basin do not show a significant correlation. The Spearman correlation coefficient is just below zero (rs = −0.04, p = 0.82), while a linear trend line based on reduced major axis (RMA) regression shows a positive slope (linear correlation r = 0.17, p = 0.27).

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