

Supplement of *Clim. Past Discuss.*, 11, 2121–2157, 2015
<http://www.clim-past-discuss.net/11/2121/2015/>
doi:10.5194/cpd-11-2121-2015-supplement
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Supplement of

Eastern Andean environmental and climate synthesis for the last 2000 years BP from terrestrial pollen and charcoal records of Patagonia

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Supplementary material

S1. Peninsula Avellaneda Alto (PAA) analysis

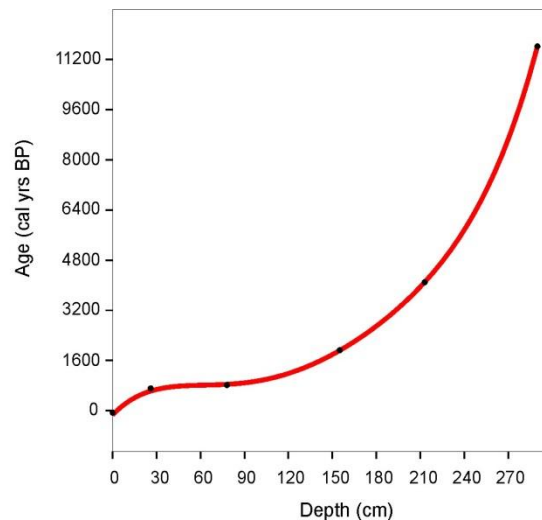
S1.1. Radiocarbon dates from PAA.

Radiocarbon dates were calibrated using the CALIB Rev 7.0.1 software (Stuiver et al., 2005). All radiocarbon dates were calibrated with the Southern Hemisphere curve (SHCal13) (Hogg et al., 2013). Material analyzed: bulk organic matter.

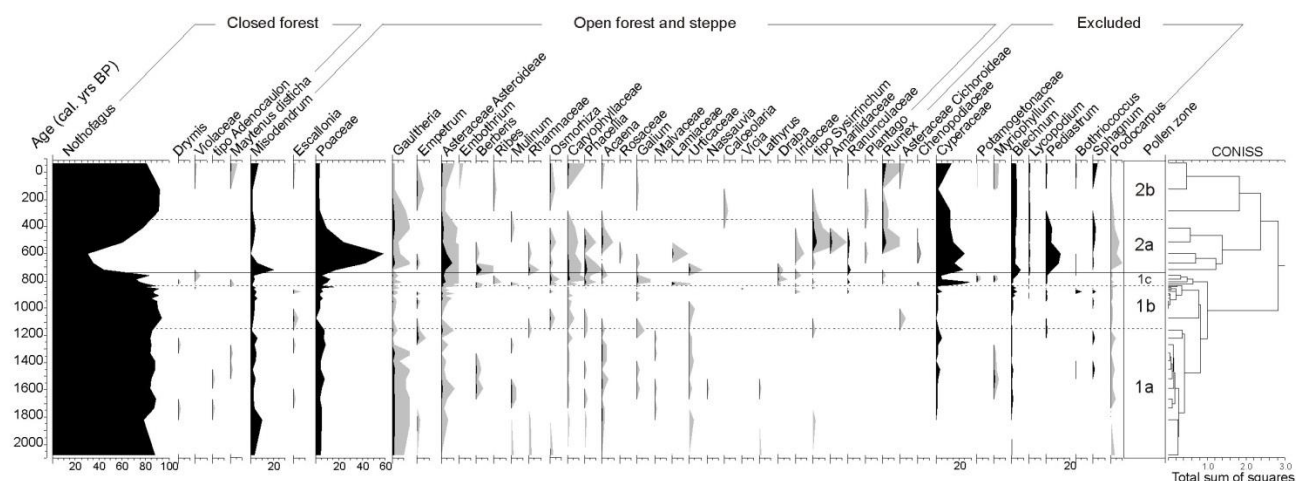
Sample depth (cm)	Age ¹⁴ C yr BP	Age cal yrs BP	Lab. Cod.
0-1	-	-60	n/a
26-27	835±44	711	AA99350
78-79	948±35	819	AA96517
155-156	2013±37	1928	AA96516
218-219	3782±40	4094	AA89352
291-292	10112±69	11613	UBA23299

S1.2. Age-depth Model of PAA

An age-depth model based on five AMS radiocarbon dates and the assignment of a modern age (AD 2010) to the surface of the sequence was performed using PAST software (Hammer et al., 2001) applying a five degree polynomial function $(4.307 \times 10^{-08}(\text{depth})^5 - 2.994 \times 10^{-05}(\text{depth})^4 + 0.008215(\text{depth})^3 - 0.9424(\text{depth})^2 + 48.58(\text{depth}) - 60)$.



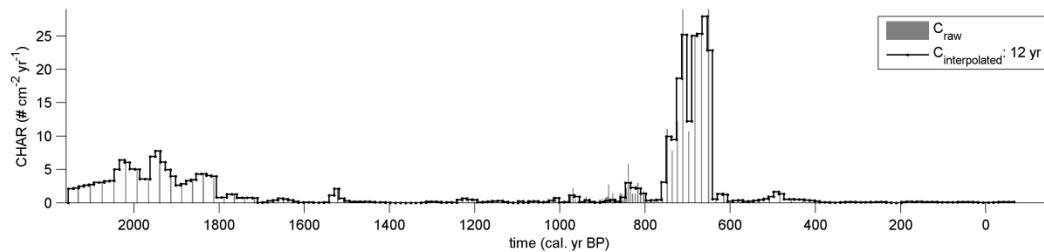
S1.3. *Península Avellaneda pollen diagram (in percentages) and pollen zones obtained by cluster analysis.*



Pollen Zone	Age (cal yrs BP)	Pollen characteristics
2b	Present-350	Re-establishment of <i>Nothofagus</i> , accompanied by a decrease in palynological richness, low presence of herbs and shrubs. Inferred vegetation: Closed forest with poorly developed understory vegetation.
2a	350-730	The <i>Nothofagus</i> values drops abruptly to 30-40%, with an increase of herbs and shrubs values. Poaceae reaches the highest values of the record (60%). Inferred vegetation: Open forests and grass steppe mosaic.
1c	730-830	<i>Nothofagus</i> slightly decrease favoring the development of some herbs and shrubs, such as: Asteraceae subf. Asteroidea, Caryophyllaceae, <i>Phacellia</i> and <i>Galium</i> . The major pick in Cyperaceae values took place in this zone. Inferred vegetation: Mixed of closed forest and forest gaps.
1b	830-1150	Rise of the <i>Nothofagus</i> values and a decrease of pollen richness. Inferred vegetation: Closed forest with poorly developed understory vegetation.
1a	1150-2150	Dominance of <i>Nothofagus</i> (up to 80%). Low values (<10%) of of Poaceae, Gaultheria, Asteraceae subf. Asteroidea and other herbs. Inferred vegetation: Mixed of closed forest and forest gaps.

S1.4. Charcoal accumulation rates of PAA

Charcoal particles > 250 μm and between 250 and 125 μm were summed together as they show the same patterns. Charcoal concentrations (number of particles/ cm^3) were multiplied by sedimentation rate (cm/yr) to obtain the charcoal accumulation rate (CHAR; particles/ cm^2/yr) of each sample. Charcoal data were interpolated to constant 12 years, corresponding approximately to the median temporal resolution of the record. All statistical treatments were done using the program CharAnalysis, written by Philip E. Higuera (<http://CharAnalysis.googlepages.com>).



S2. Bajo de la Quinta (BQ) and La tercera (LT) analysis

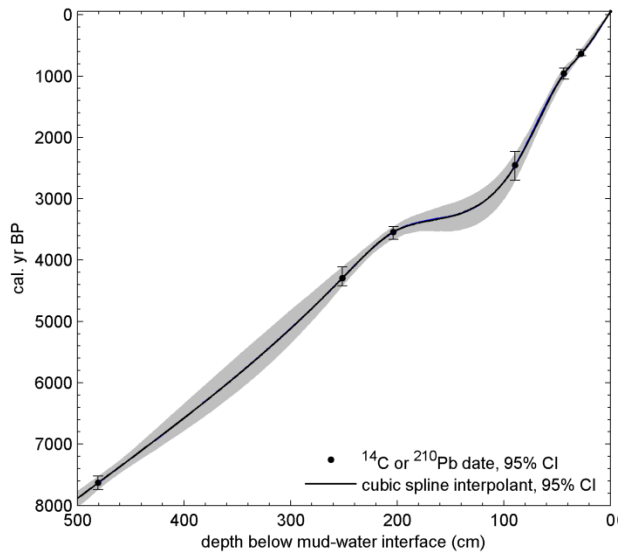
S2.1. Radiocarbon dates from BQ and LT

Radiocarbon dates were calibrated using the CALIB Rev 7.0.1 software (Stuiver et al., 2005). All radiocarbon dates were calibrated with the Southern Hemisphere curve (SHCal13) (Hogg et al., 2013). Material analyzed bulk organic matter.

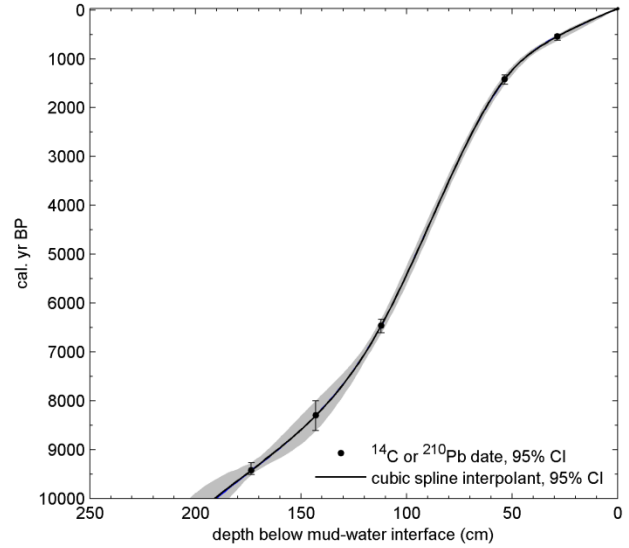
	Sample depth (cm)	Age ^{14}C yr BP	Age cal yr BP	Lab. Cod.
BQ	0-1	-	-59	n/a
	27-28	721±24	637	D-AMS 008818
	43-44	1097±35	956	AA96518
	89-90	2422±68	2452	AA92539
	203-204	3358±37	3540	AA92540
	251-252	3909±50	4292	AA93730
	480-181	6821±58	7629	AA88053
LT	0-1	-	-35	n/a
	28-29	565±37	536	D-AMS 008819
	53-54	1570±37	1412	AA87093
	111-113	5717±45	6459	AA76035
	142-144	7540±160	8298	A4335
	173-174	8439±52	9424	AA87094

S2.2. Age-depth Models of BQ and LT

Age-depth models based on AMS radiocarbon dates were performed using MCAge software (Higuera et al., 2009).



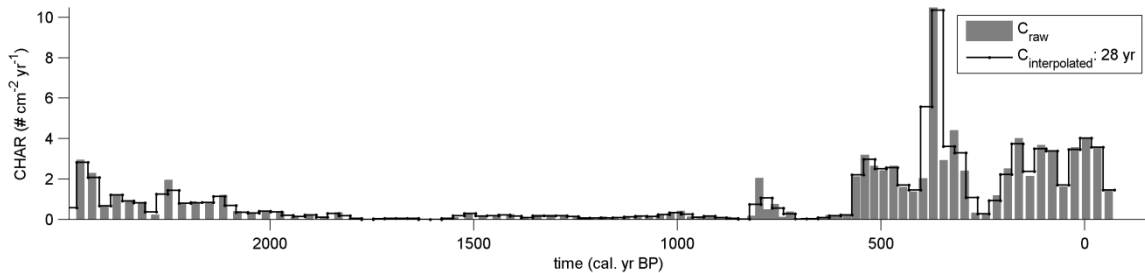
BQ Age-Depth Model



LT Age-Depth Model

S2.3. Charcoal accumulation rates of BQ

Charcoal particles $> 250 \mu\text{m}$ and between 250 and $125 \mu\text{m}$ were summed together as they show the same patterns. Charcoal concentrations (number of particles/ cm^3) were multiplied by sedimentation rate (cm/yr) to obtain the charcoal accumulation rate (CHAR; particles/ cm^2/yr) of each sample. Charcoal data were interpolated to constant 28 years, corresponding approximately to the median temporal resolution of the record.



S3. Table of sites included in this work and PAGES LOTRED-2k South American and Global fulfilled criteria

Site	LOTRED-2K South American Criteria				LOTRED-2K Global Criteria		
	CONTROL2	AGE500	RES200	MIN1500	DUR500	TOP_END	1000_MID
L.Trébol	X		X	X	X	Partially	
L. Theobald	X		X	X	X	Partially	X
L. Mosquito	X	X	X	X	X	Partially	X
M. Pollux	X		X	X	X	Partially	X
Bajo de la Quinta	X		X	X	X	Partially	X
M. PAA	X		X	X	X	Partially	X
M. PAB	X	X	X	X	X	X	X
M. Cerro Frías	X		X	X	X		
Río Rubens bog	X	X	X	X	X	X	X
M. Paisano Desconocido	X		X	X	X	Partially	X
Mallín La Tercera	X		X	X	X	Partially	X
M. Cabo Vírgenes	X	X	X	X	X	Partially	X

CONTROL2: > 1 chronological control in 2K

AGE500: 1 numerical age < 500 yr

RES200: 200yr minimum average sample interval.

MIN1500: Minimal age less than 1500 yr BP

DUR500: a minimum length of 500 yr

TOP_END: The timeline must be constrained by at least one chronological control point near the end (most recent) part of the record and another near the oldest part of the record. Sites which partially fulfil this criteria, lack of recent chronological control (<200 cal yrs BP).

1000_MID: When older than 1000 years, records must include at least one additional age nearly midway between the other two

S4. *Paleohydric pollen index construction of each record*

Lake Trébol above/below hydric availability ratio=

(*Drimys*+*Escallonia*+*Hydrangea*+*Myrtaceae*+*Nothofagus*+*Saxegothea*) /

(*Acaea*+*Apiaceae*+*Amaranthaceae*+*Asteraceae* subf. *Asteroideae*+*Asteraceae* subf. *Cichoroideae*+
Asteraceae tribe *Mutisiae*+*Caryophyllaceae*+*Cupressaceae*+*Misodendrum*+*Euphorbiaceae*+
Gallium+*Gaultheria*+*Lomatia*+*Maytenus*+*Plantago*+*Poaceae*+*Rhamnaceae*+*Ribes*+*Rosaceae*+
Schinus+*Solanaceae*)

Lake Theobald above/below hydric availability ratio=

(Aristotelia+Drimys+Bromeliaceae+Escallonia+Fuchsia+Nothofagus+Saxegothaea) /
(Acaena+Adesmia+Amaranthaceae+Apiaceae+Arjona+Asteraceae subf. Asteroideae+ Asteraceae
tribe Mutisiae+ Azorella+Berberis+Calceolaria+Caryophyllaceae+Colletia+Cupressaceae+Discaria
+Embothrium+Empetrum+Galium+Geraniaceae+Lomatia+Malvaceae+Misodendrum+Phacelia+
Plantago+Poaceae+Portulacaceae+Ribes+Sisyrinchium+Solanaceae+Specularia+Urticaceae)

Lake Mosquito above/below hydric availability ratio=

(Drimys+Escallonia+Lomatia+Misodendrum+Nothofagus+Myrtaceae+Saxegothaea+Cupressaceae+
Maytenus) / (Acaena+Amaranthaceae+Asteraceae subf. Asteroideae+ Asteraceae subf.
Cichoroideae+ Asteraceae tribe Mutisiae+ Caryophyllaceae+Poaceae+Rhamnaceae+Solanaceae)

Mallín Pollux above/below hydric availability ratio=

(Drimys+Escallonia+Hydrangea+Myrtaceae+Nothofagus+Pilgerodendron+Pseudopanax) /
(Acaena+Adesmia+Amaranthaceae+Apiaceae+Misodendrum+Asteraceae subf. Asteroideae+
Asteraceae tribe Mutisiae+Berberis+Brassicaceae+Caryophyllaceae+Embothrium+Ericaceae+
Lamiaceae+Phacelia+Plantago+Poaceae+Polygonaceae+Ranunculaceae+Rhamnaceae+Ribes+
Wahlenbergia)

Bajo de la Quinta above/below hydric availability ratio=

(Zygophyllaceae+Chuquiraga+Fabaceae subf. Cesalpinoideae+Bougainvillea+Monttea+Poaceae
+Rosaceae +Ranunculaceae+Malvaceae+ Plumbaginaceae+Boraginaceae+Cyperaceae) /
(Cactaceae+Ephedra+Hyalis+Calyceae +Chenopodiaceae)

Mallín PAA above/below hydric availability ratio=

(Adenocaulon type+Drimys+Maytenus disticha+Nothofagus+Viola) / (Acaena+Apiaceae+
Asteraceae subf. Asteroideae+ Asteraceae tribe Mutisiae+Berberis+Calceolaria+Caryophyllaceae
+Chenopodiaceae+Draba+Embotrium+Empetrum+Escallonia+Galium+Gaultheria+Iridaceae+
Lamiaceae+Lathyrus type+Malvaceae+Mulinum+Nassauvia type+Osmorhiza type+Phacelia
+Plantago+Rhamnaceae+Ribes+Rosaceae+Sysirinchium+Urticaceae)

Mallín PAB above/below hydric availability ratio=

(Drimys+Misodendrum+Nothofagus) / (Acaena+Amaranthaceae+ Asteraceae subf. Asteroideae+
Asteraceae tribe Mutisiae+Berberis+Calceolaria+Calyceae+Caryophyllaceae
+Chenopodiaceae+Embotrium+Empetrum+Euphorbiaceae+Fabaceae+Gaultheria+Iridaceae
+Lamiaceae+Liliaceae+Mulinum+Orchidaceae+Poaceae+Ranunculaceae+Solanaceae)

Mallín Cerro Frías above/below hydric availability ratio=

(Misodendrum+Nothofagus) / (Apiaceae+ Asteraceae subf. Asteroideae+ Asteraceae subf. Cichoroideae+Asteraceae tribe Mutisieae+Berberis+Caryophyllaceae+Empetrum+Euphorbiaceae+ Ephedra+Fabaceae+Lamiaceae+Liliaceae+Monocotyledoneae+Orchidaceae+Plantago+Poaceae +Ranunculaceae+Rosaceae+Rubiaceae+Scrophulariaceae+Solanaceae+Valeriana+Verbenaceae)

Río Rubens bog above/below hydric availability ratio=

(Drimys+Escallonia+Misodendrum+Nothofagus+Pseudopanax) / (Acaena+Adesmia+Amaranthaceae+Apiaceae+Armeria+ Asteraceae subf. Asteroideae+ Asteraceae tribe Mutisieae+Berberis+Brassicaceae+Caryophyllaceae+Cerastium type+Ephedra+Ericaceae+ Fabaceae+Nassauvia type+ Plantago+Poaceae+Ribes+Rubiaceae+Schinus+Srophulariaceae+ Urticaceae+Verbena)

Mallín Paisano Desconocido above/below hydric availability ratio=

(Acaena+Asteraceae tribe Mutisieae+Brassicaceae+Calceolaria+Caryophyllaceae+Empetrum+ Gaultheria+Geraniaceae+Hypochaeris+Monocotyledoneae+Onagraceae+Plumbaginaceae+Poaceae+Ranunculaceae) / (Adesmia+ Asteraceae subf. Asteroideae+Azorella+Chenopodiaceae+Lycium +Mulinum+Nassauvia type+ Schinus)

Mallín La Tercera above/below hydric availability ratio=

(Campanulaceae+Convolvulaceae+Empetrum+Euphorbiaceae+Gaultheria+Lamiaceae+Liliaceae +Malvaceae+Poaceae+Polemoniaceae+Ranunculaceae+Rubiaceae+Valeriana) / (Asteraceae subf. Asteroideae+Azorella+Fabaceae+Ephedra+Mulinum+Nassauvia type+Plantago+Solanaceae)

Mallín Cabo Vírgenes above/below hydric availability ratio=

(Asteraceae subf. Cichoroideae+Caryophyllaceae+Cyperaceae+Fabaceae+Juncaginaceae+ Lamiaceae +Monocotyledoneae+Osmorhiza+Perezia+Poaceae+Rubiaceae+Triglochin+Valeriana) / (Asteraceae subf. Asteroideae+Azorella+Berberis+Chenopodiaceae+Empetrum+Ephedra +Nassauvia+Rosaceae +Solanaceae)