

# Dendrochronological study of charred wood at the Cerro Pintado archaeological site (Patagonia, Argentina)

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**Summary:** In this work we present the dendrochronological analysis of charcoal from *Austrocedrus chilensis* – ciprés de la cordillera – found in a campfire at the archeological site Cerro Pintado in Patagonia, Argentina. Our goals, in the context of a series of studies in Patagonian archaeology, were to compare the charcoals from the campfire with the existing chronologies and to present, based on dendrochronological methods, precise dates for the studied charcoals. Our study represents the first attempt of dating archaeological charcoals using dendrochronological methods in Patagonia.

**Key words:** dendrochronology, charcoal, hunter-gatherers, Patagonia

## INTRODUCTION

In the Patagonian archeological records, the conservation of wood only occurs in exceptional cases. There have been no studies from dendrochronological perspective of the structure of combustion in the eaves or in the open air, where the environmental conditions do not facilitate the wood conservation.

Dendrochronology is the dating of growth rings from woody tree species (Schweingruber, 1996). The comparison between tree rings and climatic records permit the reconstruction of past variations in temperature and/or precipitation. The study of the growth rings in tree species permits us to detect the occurrence of past human activities such as the systematic pruning of branches, which belong to the field of dendroecology. The study of dendrochronology applied on specimens of charcoal found in archeological sites provides a wealth of information, which complements socioeconomic and paleoecological data obtained through conventional charcoal analysis (Carrión, 2003).

In this paper, we present the results of a dendrochronological analysis of charcoal collected in a stove found in a hunter-gatherer archeological site, Cerro Pintado. The objective of the investigation was to initiate studies in the context of Patagonian archeology to date charred wood against master chronologies previously developed for the region. Dating of charcoal will allow inferring past climatic conditions, which existed at the time that the hunter-gather tribes occupied this zone.

## DATA AND RESULTS

The archeological site “Cerro Pintado” -42°25'07'' S and 71°30'34'' W-, located in the Province of Chubut,

Patagonia, Argentina, is situated in an area covered by a mixed forest of *Austrocedrus chilensis* – ciprés de la Cordillera – and *Nothofagus antarctica* – ñire- (Fig. 1). Due to the low rate of deposition of sediments as shown by the low power and low stratigraphic gap between the dated samples (28 cm in approximately 1500 years), and lack of clear stratigraphic levels, the deposit of Cerro Pintado site represents a palimpsest with very low resolution within a time range between 680±60 BP and 1870±80 BP (Bellelli *et al.*, 2003).

The state of the combustion structure allowed the recuperation of three fragments of charcoal from the campfire base, radiocarbon dated to 1870±80 BP. The charcoals, identified as *Austrocedrus chilensis*, were dendrochronologically dated. *A. chilensis* is a conifer well-studied in the field of dendrochronology (Villalba and Veblen, 1997, amongst others). It has provided numerous chronologies, which may be used in the future for successive dating of archeological charcoal from this particular species.

Following the dating and measuring of the growth rings from the 3 specimens of charcoal, 4 series were generated, one from each fragment (CP001, CP002, CP003) and an additional series (CP002-03) as a result of the average of CP002 and CP003 time series. By applying the program COFECHA, it was noted that the series CP002 and CP003 cross-dated perfectly after an 8-year displacement in series CP002 in relation to the series CP003, was applied (Fig. 2, left). The correlation reported by COFECHA between these two series is  $r=0.714$  during the common period. In the case of series CP001, the synchronization was not as precise as that between CP002 and CP003. Due to the fact that series CP001 is very short, problems arose from the dating of this piece of charcoal. With the exception of series CP001, series CP002, CP003 and CP002-03 compared well with a regional chronology, given a correlation coefficient of the order of  $r=0.60$ , during the period 1730 – 1780 AD, which represents a considerably

significant value ( $p < 0.01$ ). This leads us to propose that the 2 charcoal fragments of the series CP002-03 cover the period 1733-1785 AD.



FIGURE 1. Left: Archeological site Cerro Pintado, Right: *Austrocedrus chilensis* tree.

## CONCLUSION

The dendrochronological dating of charred wood represents an innovative analysis of archeological sites in Patagonia.

The results are not consistent with the radiocarbon dating of the base of the fire ( $1870 \pm 80$  BP); this could be due to the formation processes of the archaeological record of Cerro Pintado. The natural and anthropogenic disturbances of the record, coupled with the low rate of sediment deposition, suggest the possibility that the analyzed coals do not belong directly to the campfire base.

Since there are tree-ring reconstructions of temperature and precipitation for the past centuries in the region, they will be used in the future to characterize the climate variability at times of human occupation in Cerro Pintado.

The dendrochronological study shows that the two coals studied cover the period 1733-1785 AD. Presently, logs of *Austrocedrus chilensis* containing rings from this interval have, on average diameters larger than 50 cm, ruling out the possibility that these charcoals belong to current campfires found on the surface of the archaeological site.

To solve the inconsistency between radiocarbon and dendrochronological dates we will conduct radiocarbon dates of the charcoals dated by dendrochronology. This information would corroborate the dendrochronological dates and provide additional information regarding the use of Cerro Pintado archeological site.

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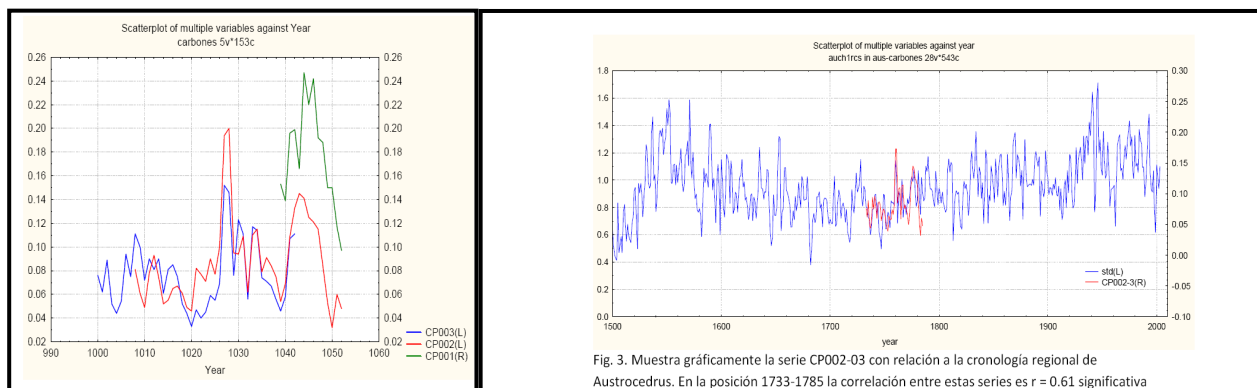


Fig. 3. Muestra gráficamente la serie CP002-03 con relación a la cronología regional de *Austrocedrus*. En la posición 1733-1785 la correlación entre estas series es  $r = 0.61$  significativa

FIGURE 2. Left: Comparison between the 3 series<sup>1</sup>. Right: Graph showing the series CP002-03 with relation to the regional chronology of *Austrocedrus chilensis* (<sup>1</sup>The year 1000 does not correspond to the actual test date, but was used simply as a random date by which to run the programs).