El paisaje de las montañas atlánticas: avances en el conocimiento geohistórico y ambiental

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(EDITOR)

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Palaeoecological review of the climatic, cultural and plant landscape dynamics of the Cantabrian region

Revisión paleoecológica de la dinámica climática, cultural y del paisaje vegetal de la región cantábrica

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Resumen: La región del noroeste peninsular Ibérico ha demostrado ser un excelente laboratorio a campo abierto para el estudio de las dinámicas del paisaje vegetal a lo largo del tiempo. El gran número de cuevas, lagos y turberas, entre otros yacimientos existentes en la región, ha permitido el análisis de múltiples registros sedimentarios y arqueológicos a partir de técnicas palinológicas, análisis de carbones sedimentarios y de otros indicadores paleoambientales. En este sentido, durante las últimas décadas se han aportado distintas evidencias sobre cómo han evolucionado las comunidades vegetales durante el Último Periodo Glacial y el Holoceno. Además, también se han estudiado factores clave implicados en la configuración del paisaje, tales como el clima, los incendios o las distintas fases culturales que han tenido lugar en la región. Con el fin de contextualizar en qué punto se encuentra el conocimiento paleoecológico del noroeste peninsular Ibérico y más en concreto el de la región de Cantabria, el presente trabajo revisa el estado de la cuestión de tres grandes temáticas paleoambientales: la evolución del clima, las etapas culturales del ser humano y el estudio de las dinámicas del paisaje vegetal a partir de registros paleoecológicos.

Palabras clave: Península Ibérica, Cantabria, Último Periodo Glacial, Holoceno, Dinámicas del paisaje vegetal, Paleoecología, Clima, Influencia antrópica, Geografía histórica ambiental.

Abstract: The northwestern Iberian Peninsula has proved to be an excellent open field laboratory for the study of plant landscape dynamics over time. The large number of caves, lakes and peat bogs, among other sites in the region, has allowed the analyses of multiple sedimentary and archaeological records using palynological techniques, sedimentary charcoal analyses and other palaeoenvironmental indicators. In this sense, over the last few decades, different evidence has been provided on how plant communities evolved during the Last Glacial Period and the Holocene. In addition, key factors involved in the configuration of the landscape have also been studied, such as climate, fires or the different cultural phases that have taken place in the region. In order to contextualise the current state of palaeoecological knowledge of the northwestern Iberian Peninsula and more specifically of the Cantabrian region, this work reviews the state of the art of three major palaeoenvironmental topics: the evolution of climate, the cultural stages of human beings and the study of the plant landscape dynamics based on palaeoecological records.

Key words: Iberian Peninsula, Cantabria, Last Glacial Period, Holocene, Plant landscape dynamics, Palaeoecology, Climate, Anthropogenic influence, Historical environmental geography.

PALAEOCLIMATOLOGY IN THE NORTH ATLANTIC REGION AND AN APPROACH TO THE CANTABRIAN RANGE

Glacial-Interglacial cycles and the Last Glacial Period

Climate during the Quaternary has been characterised by an alternation between cold and warm intervals. Such oscillations have been studied through several methods in fossil cores, and oxygen isotopes are one of the proxies most commonly used.

For ocean sediments, Lisiecki & Raymo (2005) presented a 5.3-Myr stack of 57 $\delta^{18}O$ records for all over the world (Fig. 1). The sequences were

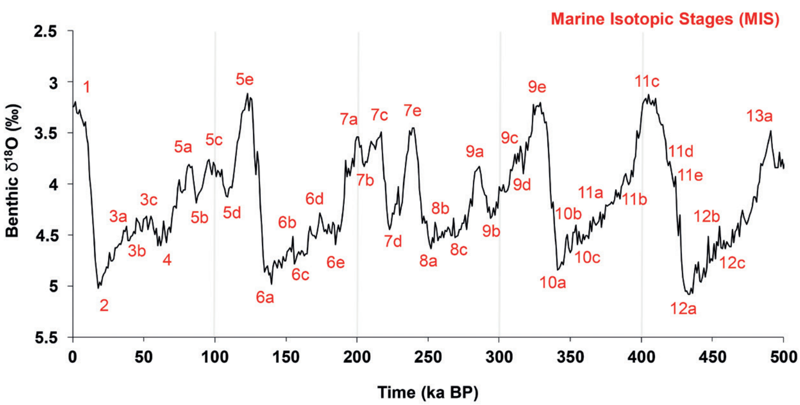

FIGURE 1. *Benthic δ¹⁸O from the LR 04 stack for the 500 ka BP. In red: the onset of Marine Isotopic Stages (MIS) and substages identified within them. Adapted from: Lisiecki & Raymo (2005) and Railsback et al. (2015).*

globally well-distributed and covered the entire Quaternary period (Holocene and Pleistocene epochs) and the Pliocene epoch. In total, 104 Marine Isotopic Stages (MIS) were identified along the Quaternary. Some MIS were also subdivided into lettered substages considering fluctuations from other environmental proxies (e.g., pollen and loess), from both oceanic and non-oceanic records (Railsback et al., 2015). According to that classification, the Holocene corresponds to MIS-1 (c. 0 – 11.7 ka BP) and the Last Glacial Period, also known as the Würm Glaciation, encompasses the MIS-2 (c. 11.7 – 28 ka BP), MIS-3 (c. 28 – 60 ka BP), MIS-4 (c. 60 – 75 ka BP) and MIS-5a-d (c. 75 – 117 ka BP). MIS-5e (c. 117 – 130 ka BP), which is the oldest substage of MIS-5, corresponds to the Eemian interglacial.

Ice records have also registered detailed climate variability from the present to the Eemian interglacial. A climate classification was established from the study of oxygen isotopes into different periods, known as the Dansgaard – Oeschger (DO) events (Fig. 2; Dansgaard et al., 1982; Johnsen et al., 1992). These episodes were divided into Stadials (cold conditions) and Interstadials (warm conditions), and as well as marine isotopic stages, some of them were also subdivided. More specifically, the DO events detected in Greenland ice cores are known as Greenland Stadials (GS) and Greenland Interstadials (GI). A common nomenclature was established by the synchronisation of the GRIP, GISP2 and NGRIP Greenland ice cores (Fig. 2; Rasmussen et al., 2014; Seierstad et al., 2014). In total, 26 GS and 25 GI, with their corresponding subdivisions, were identified along the Last Glacial Period. Additionally, occasional events of massive ice-rafted debris (IRD) occurred during some Stadials as the result of North Atlantic glaciers melting, which are known as Heinrich events or Heinrich layers (Fig. 2; Heinrich, 1988; Bond et al., 1992; Hemming, 2004).

Within the Last Glacial Period, most ice sheets reached their maximum extent between c. 26.5 and 19 ka BP, a cold period which is known as the Last Glacial Maximum (Clark et al., 2009). The harsh conditions led to the extension of the ice and permafrost cover in northern Europe (Clark et al., 2002; Vandenberghe et al., 2014; Lindgren et al., 2016). In the Cantabrian range a glacier advance has also been detected between c. 22.5 to 18 ka BP, even though the greatest extension of glaciers (Local Last Glacial Maximum) occurred during the initial phases of the Würm glaciation (Frochoso et al., 2013; Ruiz-Fernández et al., 2016). At all events, the sea level reached its maximum depth throughout the Last Glacial Maximum, approximately 120 – 135 m deeper than nowadays (Lambeck et al., 2014). At a global scale, a stack of the sea level variations from the last 798 ka was reconstructed considering 12 ocean records (Fig. 2; Spratt & Lisiecki, 2016).

Environmental conditions became warmer after the Last Glacial Maximum. The Bølling-Allerød chronozone, which corresponds to the DO-1, was a warm period between 14.6 – 12.9 ka BP (Iversen, 1953). Within this episode, seven subevents were established within the GI-1, indicating climate variability over a brief period of time (Rasmussen et al., 2014). Between the Bølling-Allerød chronozone and the onset of the Holocene lies the last Stadial of the Last Glacial Period, the Younger Dryas (Iversen, 1953). It was a cold period triggered by the discharge of meltwater into the oceans (Fairbanks, 1989; Teller & Leverington, 2004), affecting the North Atlantic thermohaline circulation and subsequently

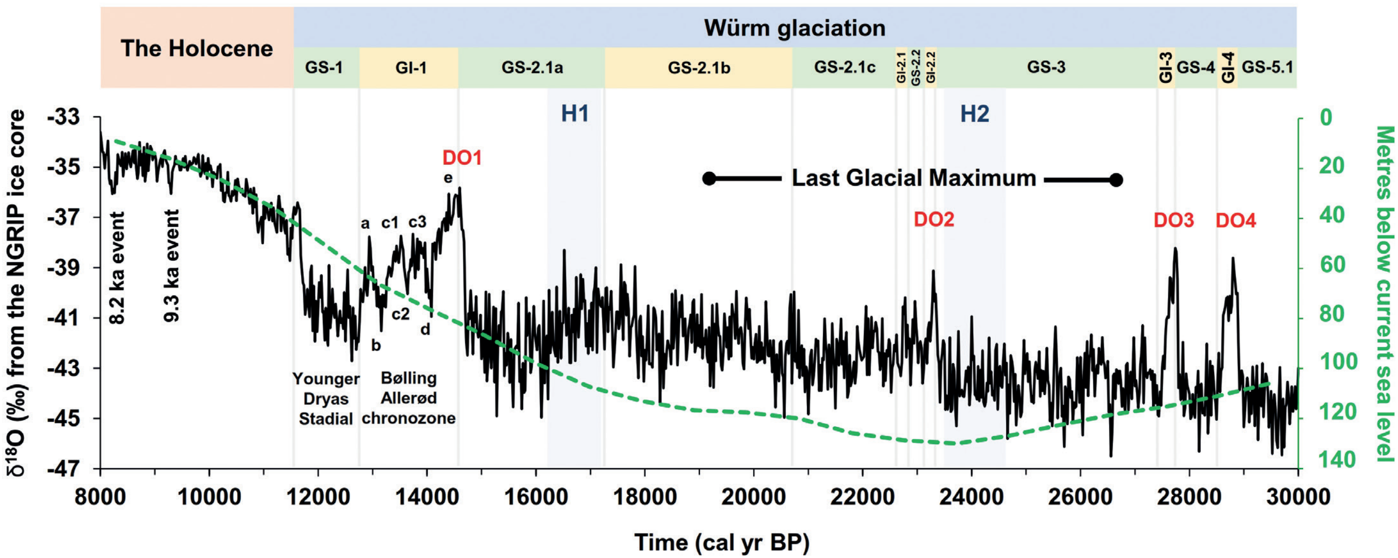

FIGURE 2. *Climate proxies from 30,000 to 8000 yr BP. In a black line: $\delta^{18}O$ from the NGRIP core, adapted from Rasmussen et al. (2014). Al the top of the figure, the chronology based on Greenland Stadials (GS) and Greemland Interstadials (GI) is shown, adapted from Rasmussen et al. (2014). In a green dashed line: metres below the current sea level, modified from the sea level stack obtained in Spratt & Lisiecki (2016). In blue rectangles: Heinrich events identified and discussed by Heinrich (1988); Bond et al. (1992) and Hemming (2004). In red: Dansgaard – Oeschger events (DO) identified by Dansgaard et al. (1982) and Johnsen et al. (1992).*

the atmospheric climate (Clark et al., 2001, 2002). Several studies have examined the impact that such climate variability had on the Cantabrian region through isotopic analyses of cave speleothems (Domínguez-Villar et al., 2008, 2009, 2017; Moreno et al., 2010a; Baldini et al., 2015, 2019; Smith et al., 2016; Rossi et al., 2018). The transition from the Bølling-Allerød chronozone to the Younger Dryas Stadial entailed a reduction in temperature ranging from 6 to 9 ºC on the Cantabrian littoral, a significant temperature relapse that was accompanied by winter aridity (Figs. 2 and 3; Baldini et al., 2015, 2019).

The Holocene

The Holocene is the Interstadial that runs until today. The onset of this epoch is dated to 11.7 ka BP (Walker et al., 2009), when a strong climate shift occurred in a brief period of time. Climatologically, this event brought about alterations in atmospheric circulation (Steffensen et al., 2008) and air temperature, which was estimated to increase by about 10 ± 4 ºC (Severinghaus et al., 1998; Grachev & Severinghaus, 2005) in less than 50 years (Taylor et al., 1997; Alley, 2000). As a result, several environmental proxies such as the $^{18}O/^{16}O$ ratio, ice chemistry and the dust accumulation rate registered sharp variations (Johnsen et al., 2001; Steffensen et al., 2008).

During the Holocene, glaciers have fluctuated in accordance with climate changes (Denton & Karlén, 1973; Thompson et al., 2009; Solomina et al., 2015). Similar to the Heinrich events, the coldest episodes were detected in North Atlantic sea records in the form of ice-rafted debris increases known as Bond events or Bond cycles (Fig. 3; Bond et al. 1997, 2001; Mayewski et al., 2004; Wanner & Bütikofer, 2008; Isono et al., 2009; Wanner et al., 2011). Two of these climate shifts, the 8.2 and the 4.2 ka events, were registered in a variety of fossil records from all over the world (Walker et al., 2018) and provided time boundaries for the establishment of a new Holocene division into three new stages / ages (Fig. 3): the Greenlandian (11.7 – 8.2 cal ka BP), the Northgrippian (8.2 – 4.2 cal ka BP) and the Meghalayan (4.2 cal ka BP – present; Walker et al., 2018, 2019). The first millennia of the Holocene were characterised by upward temperature (Marcott et al., 2013) and humidity (Morellón et al., 2018) trends until approximately 9500 cal yr BP, coinciding with the greater Holocene values of summer insolation in the Northern Hemisphere (Fig. 3; Berger & Loutre, 1991). During that period, meltwater pulsations continued triggering episodes of cold conditions (Teller & Leverington, 2004), which were shorter than the Younger Dryas Stadial. Due to their magnitude, the 11.4, 9.3 and 8.2 ka events stand out above other pulsations (Alley et al., 1997; Alley & Ágústsdóttir, 2005; Teller & Leverington, 2004; Fleitmann et al., 2008; Rasmussen et al., 2007, 2014). In the Cantabrian region, the period around the 9.3 ka event had especially dry summers, leading to conditions similar to the Mediterranean climate (Baldini et al., 2019), while the 8.2 ka event was also a dry inverval (Domínguez-Villar et al., 2009; Smith et al., 2016; Rossi et al., 2018) with the coldest winters of the Greenlandian stage (Baldini et al., 2019).

During the Northgrippian, temperature gradually decreased in southern Europe following the falling summer insolation trend in the Northern hemisphere (Berger & Loutre, 1991) and unlike the warm stable conditions exhibited at European high latitudes (Davis et al., 2003; Marcott et al., 2013). After that period, a series of cold pulsations occurred during the last millennia derived from multiple factors such as volcanic eruptions and solar irradiance fluctuations (Wanner & Buetikofer, 2008). The 4.2 ka event is well detected in North Iberian records, yielding the lowest temperature of the Holocene and summer aridity (Smith et al., 2016; Baldini et al., 2019). Thereafter temperatures fluctuated giving

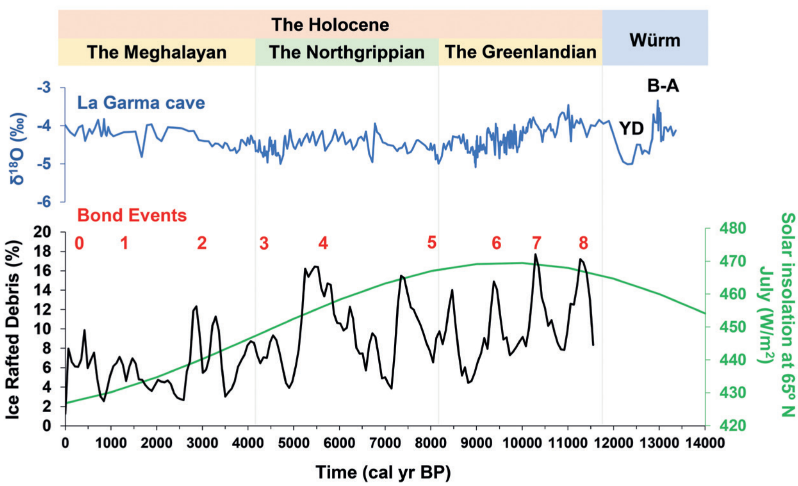

FIGURE 3. *At the top: Holocene chronology based on Walker et al. (2018, 2019). In blue: hand-drilled δ¹⁸O from La Garma cave speleothem (GAR-01), adapted from Baldini et al. (2019). "YD" and "B-A" refers to the Younger Dryas and to the Bølling-Allerød chronozone, respectively. Numbers in red: Bond events identified in Bond et al. (2001). Black line: Ice-Rafted Debris (IRD) index. IRD (%): Stack of MC52-V29191 + MC21-GGC22 (Adapted from Bond et al., 2001). Green line: Solar insolation of July at 65º N, adapted from Berger & Loutre (1991).*

rise to several climate episodes whose chronology is well-defined on both the southern (Martín-Chivelet et al., 2011) and northern slopes of the Cantabrian range (Baldini et al., 2019). A first warm stage from 4000 to 3000 cal yr BP, including short cold pulsations in 3950, 3550 and 3250 cal yr BP, was followed by the Iron Age cold period (c. 2850 – 2500 cal yr BP) and the Roman warm period (c. 2500 – 1650 cal yr BP), both recording significant summer precipitations between 2800 and 1800 cal yr BP (Baldini et al., 2019). Following that oscillating trend, climate shifted again from the Dark Ages cold period (c. 1650 – 1350 cal yr BP, with a cold peak around 1500 cal yr BP), to the Medieval warm period (c. 1350 – 750 cal yr BP, with cold pulsations at 1250 and 850 cal yr BP) and to the last cold relapse, the Little Ice Age (LIA, 750 – 100 cal yr BP) (Martín-Chivelet et al., 2011). The 20th century started with ten of the Holocene's coldest years in Northern hemisphere mid-latitudes (Marcott et al., 2013), but temperature suddenly reversed its decreasing trend as a consequence of the greenhouse gases released into the atmosphere (Joos & Spahni, 2008), inducing the present global warming (Wanner & Buetikofer, 2008; Marcott et al., 2013).

CULTURAL DYNAMICS IN THE CANTABRIAN REGION SINCE THE PALAEOLITHIC

Lower Palaeolithic

The oldest fossil evidence of human occupation in the Cantabrian range dates from the Lower Palaeolithic (Fig. 4). In the Sima del Elefante cave (Atapuerca cave-sites in the Atapuerca karst Mountains, southern

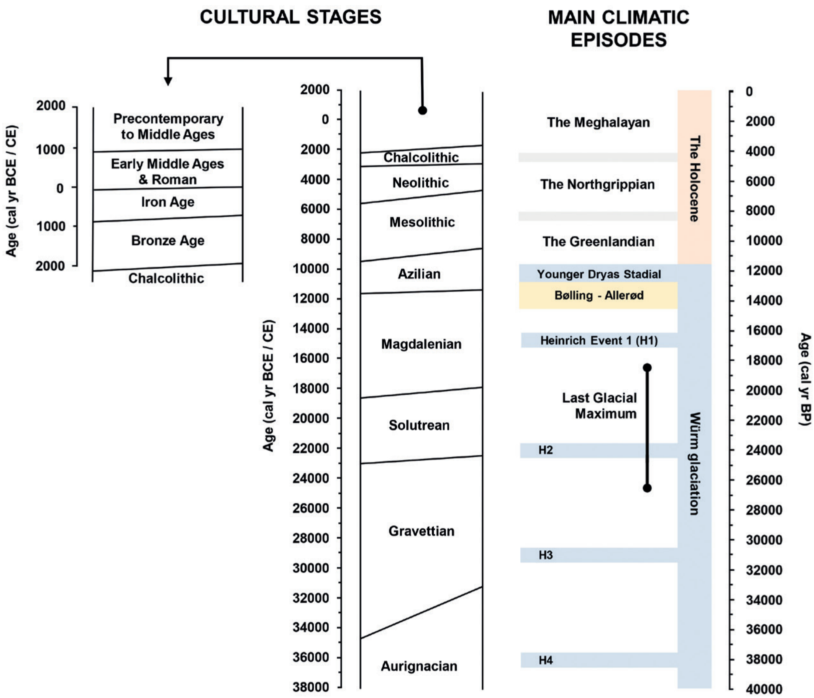

FIGURE 4. *Cultural stages in Cantabria from 40,000 cal yr BP to the present and the climate characterisation of the sequence. Boundaries for the cultural stages have been drawn according to González-Sainz (1994), Rasilla-Vives & Straus (2004), González-Sainz & González-Urquijo (2004), Marín-Arroyo et al. (2018a) and Straus (2018b) for the Palaeolithic; González-Sainz & González-Urquijo (2004), Alday-Ruiz (2009), Fano et al. (2015) and Straus (2018a) for the Azilian, Mesolithic and Neolithic; Arias (1995), Ontañón (2003) and González-Rabanal et al. (2020) for the Chalcolithic; Marín-Suárez (2011) for the Bronze and Iron Ages; and Costa-García (2018) for the onset of the Roman Period. Climate: Heinrich events identified and discussed by Heinrich (1988), Bond et al. (1992) and Hemming (2004).*

slope of the Cantabrian range, Burgos), some of the oldest Eurasian hominid remains are documented, dating back between 1.2 and 1.1 Myr BP (Carbonell et al., 2008). On the whole, the three main caves from the Atapuerca cave-sites, Sima del Elefante, Gran Dolina and Galería, contain hominid evidence within a range of at least 1 Myr (from 1.2 Myr to 200 ka BP; Falguères et al., 1999; Berger et al., 2008; Carbonell et al., 2008; Rodríguez et al., 2011), providing proof of the ancient presence of *Homo antecessor* and *Homo heidelbergensis* in the region. In the area equivalent to the modern Cantabrian province (hereinafter "Cantabria"), the archaeological sites from the Lower Palaeolithic date to a more recent time, most of them outdoor sites located close to the coastline (e.g., Cúlebre, Oyambre, Ubiarco, Suances, Cuchía, Hondal, Usgo, Somocuevas, Rostrío and La Verde; Fig. 5; Solórzano et al., 1999). Nonetheless, the sites with the oldest hominid remains are caves. For example, El Monte Castillo is a karst formation that hosts multiple cavities (El Castillo, La Pasiega, Las Monedas, Las Chimeneas and La Cantera caves). Up to now, El Castillo has been the site with the oldest human presence in Cantabria. A stratigraphic level, separating materials from the Acheulean and Mousterian industries, was dated at 89,000 yr BP (Bischoff et al., 1992). However, two new dates from Abrigo Rojo (close to El Mirón cave, Ramales de la Victoria, Cantabria) have recently been analysed with an estimated age of 230 – 240 ka BP, within a level that contains faunal and lithic industry remains (personal communication of Manuel R. González Morales, Universidad de Cantabria).

Middle Palaeolithic

The colder conditions of the Last Glacial Period coincided with greater occupation of caves and rocky shelters in the region by both hominids and wild animals (Solórzano et al., 1999). These cavities host multiple fossil evidence of Neanderthals and Mousterian and Châtelperronian industries (such as bones, lithic materials, phytoliths and faunal remains) as well as of their coexistence with anatomically modern humans (AMH) and Aurignacian industry. AMH arrived in Eurasia at c. 45,000 cal yr BP, their presence overlapping with Neanderthals in western Europe for a period of between 2600 and 5400 years (Higham et al., 2014). In the northern Cantabrian range, the end of the Châtelperronian is estimated at around 42.4 – 41.8 cal ka BP (Marín-Arroyo et al., 2018a). In parallel, the Aurignacian spanned from 43.3 – 40.5 to 34.6 – 33.1 cal ka BP, followed by the onset of Gravettian industry at about 36.8 – 35 cal ka BP (Marín-

Arroyo et al., 2018a). Several archaeological sites from Cantabria cover these transitional epochs (Fig. 5), although some of them are still poorly documented (Muñoz-Fernández & Llamosas, 1987; Solórzano et al., 1999). The principal stratigraphic sequences are found in caves (Table 1; Fig. 5) and in the outdoor site of El Habario (Solórzano et al., 1999).

TABLE 1. *Principal caves with stratigraphic sequences covering the Lower and the Middle Palaeolithic in Cantabria.*

Cave	**References**
Cobrante	Cáceres, 2009; Fernández & Santamaría, 2009.
Covalejos	Maroto et al., 2012; Cáceres, 2013; Yravedra, 2013; Yravedra et al., 2016; Marín-Arroyo et al., 2018a; Jones et al., 2019; Sánchez-Hernández et al., 2019.
El Castillo	Straus, 1975; Cabrera-Valdés, 1984, 1996; Cabrera-Valdés & Bischoff, 1989; Rink et al., 1996, 1997; Cabrera-Valdés et al., 2000, 2002; Bernaldo de Quirós et al., 2006, 2010, 2015; Sánchez-Fernández & Bernaldo de Quirós, 2008; Wood et al., 2018; Jones et al., 2019; Garralda et al., 2019; Luret et al., 2020; Martín-Perea et al., 2022.
El Cuco	Muñoz-Fernández et al., 2007; del Río et al., 2011; Gutiérrez-Zugasti et al., 2013, 2018.
El Esquilleu	Baena et al., 2005, 2012, 2019; Yravedra, 2006, 2013; Manzano-Espinosa et al., 2005; Jordá-Pardo et al., 2008; Cabanes et al. 2010; Maroto et al., 2012; Uzquiano et al. 2012; Yravedra & Castanedo, 2014; Yravedra et al., 2014; Cuartero et al., 2015.
El Mirón	Cuenca-Bescós et al., 2008, 2009; Straus & González-Morales, 2007, 2012a, 2012b, 2016; Marín-Arroyo et al., 2018b, 2020.
El Ruso	Muñoz-Fernández, 1991; Muñoz-Fernández & Serna, 1994, 1999; Yravedra et al., 2010.
El Pendo	Carballo, 1960; Echegaray, 1980; Hoyos-Gómez & Laville, 1982; Ortega-Mateos, 1982; Pike-Tay et al., 1999.
Hornos de la Peña	Ríos-Garaizar et al., 2020.
La Garma	Ontañón, 2003; Álvarez-Fernández, 2007.
Morín	Altuna, 1973; Echegaray et al., 1973; Freeman, 1978, 1983; Pike-Tay et al., 1999; Maíllo-Fernández, 2001; Maillo-Fernández et al., 2001, 2014; Yravedra & Gómez-Castanedo, 2010; Maroto et al., 2012; Yravedra, 2013; Bradtmöller, 2015; Bradtmöller et al., 2016.

Furthermore, many of these cavities presented various artistic paintings ranging from the Middle to Upper Palaeolithic (Bicho et al., 2007), such as the decorated bone discs in the caves of El Linar and Las Aguas (de las Heras et al., 2008) and varied rock art representations in Altamira (García-Diez et al., 2013; Cuenca-Solana et al., 2016), La Garma archaeological complex (Arias et al., 2000, 2011; Arias & Ontañón, 2014; Pettitt et al., 2014) and the caves of El Castillo, Las Monedas, Las Chimeneas and La Pasiega (Fig. 5; Alcalde del Rio, 1906; Alcalde del Rio

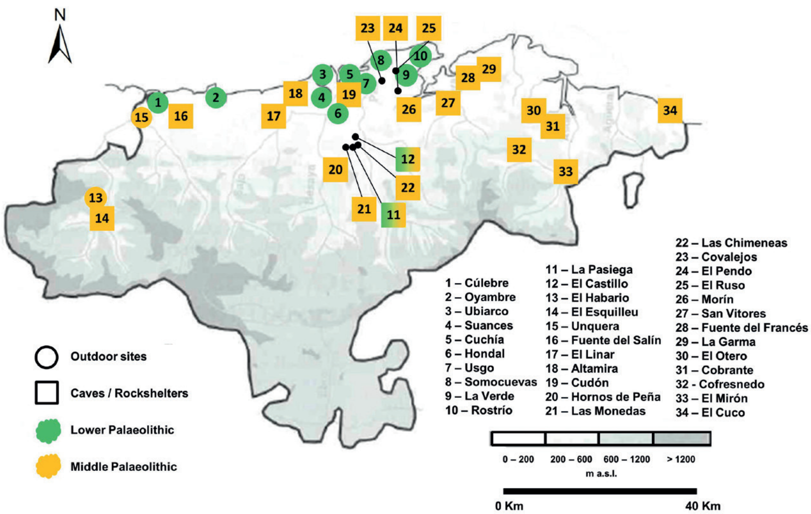

FIGURE 5. *Main archaeological sites covering the Lower and the Middle Palaeolithic in Cantabria. Adapted from Solórzano et al. (1999) and completed with the sites mentioned in the text.*

et al., 1912; Valladas et al., 1992; Pike et al., 2012; García-Diez et al., 2015; Pettitt et al., 2014; d'Errico et al., 2016). In particular, a U-Th dating from a carbonate crust overlying a cave painting at La Pasiega indicated a minimum age of 64.8 ka BP, which would attribute the origin of cave paintings to Neanderthals (Hoffman et al., 2018a). However, this statement has generated controversy among the scientific community and the discussion about the chronological data's reliability and their archaeological meaning is still ongoing nowadays (Slimak et al., 2018; Hoffman et al., 2018b, 2020; White et al., 2019).

The faunal remains documented in the caves suggest that Middle-Palaeolithic Cantabrian society was mainly hunter-gatherer. Broadly, no major differences have been detected between the diet of Neanderthals and the first *Homo sapiens* (Yravedra et al., 2016). In the case of the northern Cantabrian range, hunting bison, deer and horses seems to have been common between the Mousterian and the Gravettian, which was later joined by hunting smaller-sized ungulates such as caprids (Solórzano et al., 1999; Rasilla-Vives & Straus, 2004; Yravedra, 2013). Also, shellfish exploitation has been documented since Mousterian / Aurignacian times (Gutiérrez-Zugasti et al., 2013, 2018) and continued through the Gravettian (Álvarez-Fernández, 2007).

Upper Palaeolithic

During the Last Glacial Maximum (c. from 26.5 to 19 ka BP), the increment of the ice and permafrost cover in northern Europe (Clark et al., 2002; Vandenberghe et al., 2014; Lindgren et al., 2016) triggered massive human migrations towards southern regions (Banks et al., 2008). The Iberian Peninsula, for example, became a climate refuge (Banks et al., 2008) and Solutrean settlements increased, most of them located in coastal areas (Aura et al., 2012). More precisely, there is human evidence in regions rich in indoor sites such as caves and shelters, especially those close to watercourses to facilitate the collection of water and wood from riparian vegetation (Straus, 2015). Outdoor sites have been poorly documented (Solórzano et al., 1999), while most cavities occupied during the Gravettian continued to host human groups during Solutrean industry (Corchón-Rodríguez, 1999; Rasilla-Vives & Straus, 2004; Straus et al., 2012; Maíllo-Fernández et al., 2014; Straus, 2015; Ríos-Garaizar et al., 2020). Although the weather was cold, subsistence activities remained diversified with prey such as birds, shellfish and fish from rivers and estuaries (Rasilla-Vives & Straus, 2004; Álvarez-Fernández & Fernández-García, 2013).

During the Magdalenian, the development of lithic tools, such as harpoons in the Upper stages, was facilitated through the use of flint and derivatives which led to a further intensification of hunting (González-Sainz & González-Urquijo, 2004). In this respect, some large carnivores disappeared from the Cantabrian region due to hunting pressure (Castaños, 1992). The Red deer *(Cervus elaphus)* was the main prey during the first millennia (González-Sainz & González-Urquijo, 2004; Portero et al., 2019), especially documented in archaeological sites close to the current shoreline (<9 km) and below 200 m from the current sea level. By contrast, the Iberian ibex *(Capra pyrenaica)* was dominant at higher altitudes (Portero et al., 2019). Other food sources such as shellfish were also exploited

(Álvarez-Fernández, 2010). Additionally, important developments were made in terms of meat treatment and conservation, representing key factors in understanding the population growth (González-Sainz & González-Urquijo, 2004). Together with the warmer climate conditions, especially during the Bølling-Allerød chronozone (GI-1), communities grew up across the Cantabrian region and new cavities were occupied (Fig. 6; González-Sainz, 1989; González-Sainz & González-Urquijo, 2004; Chauvin, 2007; Chauvin et al., 2018; Fano et al., 2020). In particular, human groups expanded towards mid-mountain areas (0 – 700 m a. s. l.) along the Upper Magdalenian and the first stages of the Azilian, achieving increasing control of landscape with important migration rates among sites (Fernández-Tresguerres, 2004; González-Sainz & González-Urquijo, 2004). Economic activities between the Cantabrian region, the Pyrenees and south-western France became frequent, as evidenced by the exchange of art pieces, tools and several valuable objects (Sauvet et al., 2008; Straus & Langlais, 2020; Lefebvre et al., 2021). Cave art was also particularly relevant during the Magdalenian (González-Sainz, 2007, 2012), especially because the paintings with the most recent radiocarbon dates belong to that period (three radiocarbon dates of paintings between 14,000 and 13,600 cal yr BP in Las Monedas cave: González-Sainz, 2005).

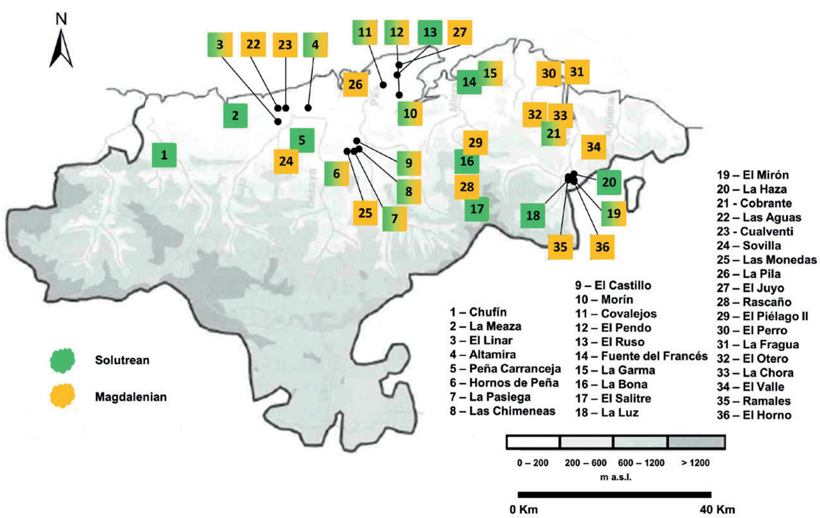

FIGURE 6. *Main archaeological sites covering the Solutrean and Magdalenian cultural stages in Cantabria. Adapted from Solórzano et al. (1999) and completed with sites described in Rasilla-Vives* & *Straus (2004) for the Solutrean and González-Sainz* & *González-Urquijo (2004) for the Magdalenian.*

Azilian and Mesolithic

The Azilian refers to the Epipalaeolithic culture developed in several eastern sites in the northern Cantabrian range among other European regions. It encompassed the second half of the Bølling-Allerød chronozone (≈ since the Greenland Interstadial 1c), the Younger Dryas Stadial (GS-1) and the first stages of The Holocene. Technologically, the decrease in tool size and variety represented an important shift with respect to the Magdalenian (Fernández-Tresguerres, 2006), and the reduction in artefacts made of bones is especially significant (Fernández-Tresguerres, 2004). However, small-size stone tools, also known as microliths, started to spread during that time. The diagnostic tool of the period was a flat harpoon instead of the circular harpoon characteristic of the Upper Magdalenian. Thus, human populations still based their economies on hunter-gatherer activities (Fernández-Tresguerres, 2004). Human presence was detected at high altitudes of the northern Cantabrian range, for example in the Portugain rock shelter (920 / 940 m a. s. l., Navarra) and the Urratxa III cave (1015 m a. s. l., Vizcaya; Barandiarán et al., 2006). However, there are no documented sites within this altitude range in Cantabria. Moreover, similar to the decrease in tool variety, artistic expression was also drastically reduced with only a limited number of art pieces in comparison to earlier ages (Fernández-Tresguerres, 2006). Altogether, however, all these changes seem to have come about progressively, while the Younger Dryas Stadial does not appear to have marked a clear boundary in cultural progression (Straus, 2011, 2018a).

The microlith industry continued to grow on the eastern side of the northern Cantabrian range during the Mesolithic (Alday-Ruíz & Cava, 2009; Soto et al., 2015), while a new cultural phase, the Asturian, was settled on the most westerly side (there are only a few Asturian sites on the most westerly side of Cantabria). In Cantabria, 256 non-Asturian sites have been documented, the largest concentration of which was found close to the coastline and along the littoral plain, although some interior valleys were also frequented. The maximum altitude was achieved by three sites at between 650 and 750 m a. s. l. (Pérez-Bartolomé, 2019).

In terms of climate, temperature followed an upward trend during these millennia (Marcott et al., 2013). Accordingly, the sea level continued rising as it had done since the Last Glacial Maximum (Spratt & Lisiecki, 2016), which would have progressively affected some ancient migratory routes between Cantabria, the Basque country and France (Straus, 2018b). Also, the 9.3 and 8.2 ka climate events occurred during the Mesolithic, both shorter than the Younger Dryas Stadial. The 9.3 ka event brought very dry summers in Cantabria while during the 8.2 ka event winters were especially harsh (Baldini et al., 2019). Considering the archaeological records, however, these events do not seem to have led to significant social changes in the region (Straus, 2018a), contrary to what happened in dryer areas in the Mediterranean basin (Berger & Guilaine, 2009). In the Iberian Peninsula, for example, human populations migrated from the Lower Aragón to more humid northern areas during the centuries after the 8.2 ka event, leaving an archaeological silence with no known human evidence until the Neolithic period (González-Sampériz et al., 2009).

Neolithic

One of the most striking aspects of the Neolithic period was the transition from hunter-gatherer to farmer societies (Arias, 1991) which took place along the Cantabrian range at between 7700 – 6800 cal yr BP (Fano et al., 2015). There seems to be evidence that these activities were introduced by foreign human groups, although it remains unclear whether the migrations came from the Pyrenees (Zapata, 2000; Zapata & Peña-Chocarro, 2005) or the Ebro Valley (Arias, 2007). In this respect, radiocarbon dates place the oldest cereal remains from the northern Cantabrian range at between c. 7000 and 6000 cal yr BP (Table 2), some centuries after the first documented evidence in Iberian Mediterranean sites (Alday-Ruiz, 2009; Pérez-Obiol et al., 2011). In particular, up to four different cereals have been identified in the region, namely einkorn, emmer, barley and wheat (Zapata et al., 2004), while their concentration was lower than in other Iberian sites (Straus, 2018a). Likewise, the domestication of animals for human consumption went hand in hand with the onset of agriculture. The oldest domesticated fauna remains date approximately from 6900 to 6500 cal yr BP (Cubas & Fano, 2011). Among other species, cows, pigs and ovicaprid fauna have been identified as part of the diet composition of Cantabrian Neolithic and Chalcolithic human groups (Arias, 2005; Aranburu-Mendizabal et al., 2018; Sarasketa-Gartzia et al., 2018; Jones et al., 2019; González-Rabanal et al., 2020). However, ancient activities such as animal hunting and gathering of marine resources and wild plants persisted significantly after the introduction of agricultural practices in many settlements (Cubas et al., 2016). Thus, it is believed that both traditional and farmer human groups lived together for at least 500 years in the Cantabrian region before the establishment of more developed agricultural societies (Fano et al., 2015). Additionally and also related to the latter developments, ceramic utensils spread during the Neolithic (Alday-Ruiz, 2009). Their origin is probably linked to farming activities as they may have been used as storage for surplus food or as containers to facilitate trading among human groups (Orton et al., 1997).

As a whole, the Neolithic archaeological record may seem limited in Cantabria with only a few documented sites, such as the caves of El Mirón (Straus & González-Morales, 2012a, b), Los Gitanos (Ontañón et al., 2013) and La Calvera Hut (Diez-Castillo, 1996). However, a funerary ritual introduced in the form of megaliths reveals intense anthropic occupation. In particular, approximately 1250 megaliths have been documented in the northern Cantabrian range, distributed from sea level to more than 1800 m a. s. l. (Arias et al., 2005). The propagation of these funerary monuments occurred rapidly after their introduction, which is dated at around 6550 – 6200 cal yr BP (Fano et al., 2015).

To conclude, all these socioeconomic breakthroughs triggered changes in food resource exploitation and yielded more cohesive human communities, resulting in the appearance of prominent settlements around Europe (Sherratt, 1995).

TABLE 2. *Documented cereal evidence from the modern provinces of the Northern Cantabrian range (Asturias, Cantabria and the Basque Country).*

Region	**Site**	**Type of evidence**	**Oldest documented age (cal yr BP)**	**Reference**
Basque Country	Lumentxa	Seed	6178 – 5747	Zapata (2002)
	Kobaederra	Seed	6658 – 6219	Zapata (2002)
		Seed	6308 – 5938	Zapata (2002)
	Pico Ramos	Seed	6280 – 6004	Zapata et al. (2004)
	Herriko Barra	Pollen	7156 – 6661	Iriarte-Chiapusso et al. (2005)
		Pollen	7153 – 6539	Iriarte-Chiapusso et al. (2005)
	Los Husos	Pollen - Seed	7172 – 6849	Iriarte-Chiapusso (2009)
Cantabria	El Mirón	Seed	6484 – 6016	Peña-Chocarro et al. (2005)
		Seed	6821 – 6357	Peña-Chocarro et al. (2005)
		Seed	6406 – 6287	Peña-Chocarro et al. (2005)
	La Molina	Pollen	6735 – 6495	Pérez-Obiol et al. (2016), Sánchez-Morales et al. (2022)
Asturias	Monte Areo	Pollen	6736 – 6495	López-Merino et al. (2010)

Chalcolithic, Bronze and Iron Ages

As noted by Blanco-González et al. (2018), later Prehistory has been less studied than the Palaeolithic period in the Cantabrian range, which also started after it did in the Mediterranean basin. However, several significant new factors are worth emphasising.

During the Chalcolithic, human presence spread over the entire Cantabrian region, with a geographical level of organisation comprising a similar extension to the modern Spanish comarcas (Ontañón, 2015). Economic activities continued to be based on agricultural and farming practices (Ontañón, 2015), thus solidifying the model introduced during the Neolithic with increasing anthropic pressure on the landscape. Evidence of domestic animals increased during this period (Ontañón, 2003; Altuna & Mariezkurrena, 2009), in particular cattle and pigs, as documented in sites such as El Mirón cave (Altuna & Mariezkurrena, 2012) and La Castañera rocky shelter (Vega-Maeso et al., 2016). Although hunting of wild animals decreased significantly (Ontañón, 2000), traditional activities did not disappear. Thus, Cantabrian Chalcolithic industry produced a great quantity of lithic projectile points. Their function varied since they could well be used to hunt, forming part of the arrows of the remaining hunter groups, or also employed as offerings in funerary rituals (Ontañón, 2002). These artefacts have been found around megaliths, which continued to be important funerary elements, but also in caves (Ontañón, 2002). This is due to the fact that caves and shelters started to be used as burial sites, which in turn went hand in hand with the progressive decrease in human occupation (Ontañón & Armendáriz, 2005). Along with many other sites, the Los Avellanos I and II caves (Cantabria) are examples of these funerary rituals (González-Rabanal et al., 2020).

As a whole, all changes mentioned above should be framed within the scenario of climate stability. The most relevant oscillation took place during the 4.2 ka event, which did not significantly affect anthropic activity (Balsera et al., 2015; Blanco-González et al., 2018).

By the end of the Chalcolithic, industry shifted as metal pieces started to be developed. Although copper (Cu) deposits were irregular and scarce in Cantabria (Mantecón, 2000), metal exploitation was particularly important on the westernmost side of the Cantabrian range. For example, the Aramo range (Asturias) provided great quantities of copper (Blas-Cortina, 2014). Thus, the first metal utensils consisted of this element, which was alloyed with arsenic (As) by the first half of the second millennium BCE (Early Bronze Age). After that, copper was alloyed with other materials in the Bronze Age, first with tin (Sn) to obtain Bronze, and thereafter with tin and lead (Pb), albeit ternary alloys seem to have been poorly developed in Cantabria (Arias et al., 2005). In parallel, the first fortified structures of the Iberian Peninsula, which are in some cases referred to as Castros, were built during the Chalcolithic. However, it was not until the Late Bronze Age when the first fortifications were erected in the Cantabrian region (e.g., Castro de la Garma dates from 1400 BCE: Obregón-Goyarrola, 2010).

Contrary to the case of copper, Cantabria hosted several iron mines, especially in its central and eastern sectors (Mantecón, 2000). The development of iron metallurgy led to a diversification of weapons and warlike equipment (Torres-Martínez, 2010). Also, fortified structures became more numerous during the Iron Age and the Roman period when wars and battles started to take place between peoples. In this respect, most fortifications were placed at high altitudes to have good visibility over and control of the surrounding territories. Thus, settlement distribution shifted until the Middle Ages, when they were again placed along interior valleys. The modern comarca of Campoo, with an average altitude above 1000 m a. s. l., is the Cantabrian area with more documented Castros (Obregón-Goyarrola, 2010).

From the Roman period to the present

In Cantabria, the end of the Iron Age is delimited by the invasion of the Roman Empire, which took place after a series of battles between 29 and 19 BCE known as the Cantabrian Wars (Costa-García, 2018). The Roman troops entered the Cantabrian region from the southern slope of the Cantabrian range divided into two main battlefronts with the aim of taking control of Noega (Gijón, Asturias) and Portus Victoriae (Santander, Cantabria). In both cases, mountain areas became the battlefield of the wars where a great number of roads were also built to facilitate the advance of troops (Peralta-Labrador et al., 2019).

The process of Romanisation was a culture shock in Cantabria as it brought a new hierarchical social system and gender inequality which has not been detected in previous ages (Marín-Suárez & González-Álvarez, 2011). Otherwise, traditional mining works continued to be important during that time, with a total of 10 Roman mines located along the central sector of the littoral plain (Fig. 7). The extractions were principally of iron (hematite and goethite ores), lead (galena and cerussite, also containing a

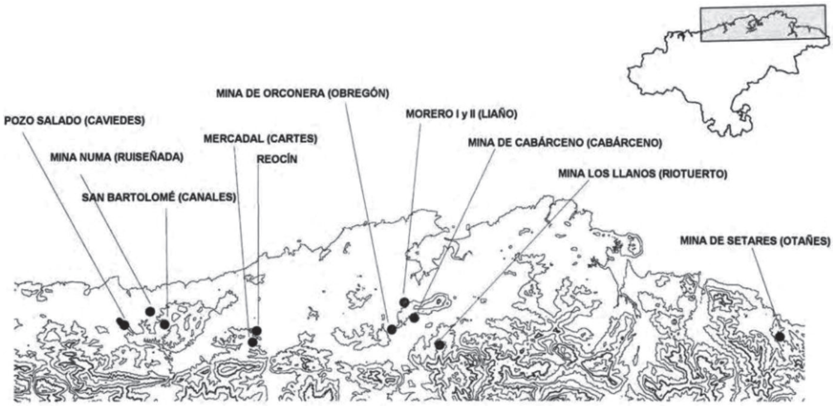

FIGURE 7. *Location of Cantabrian mines exploited during the Roman period. Retrieved from Mantecón (2000).*

variable proportion of silver which was difficult to separate), calamine and probably some salt mines which were exploited as well (Mantecón, 2000). Gold mines, by contrast, were more abundant in Asturias and Galicia (Lewis & Jones, 1970; Spiering et al., 2000).

The Roman Empire began to lose its power in the early 400s CE. Two Germanic groups, the Sueves and the Vandals, together with the Alans, a people from further east (probably Iranian), crossed the Pyrenees in 409 CE and took control of some Iberian points. The Visigoths, a Germanic group allied to the Romans, regained territory after fierce battles during the 5th and 6th centuries and established the Visigoth Kingdom in the Iberian Peninsula (Collins, 2004). Afterwards, the Middle Ages brought a Christian monarchy to Cantabria for the first time, the Kingdom of Asturias, which encompassed the north-western part of the Iberian Peninsula. The most prominent buildings of the Middle Ages were castles that were deployed around various areas of Cantabrian territory depending on the period. The oldest were constructed on mid-mountain areas, while between the 8th and 11th centuries CE the fortifications returned to high altitudes, similar to the Iron Age distribution. Around the 14th and 15th centuries, however, castles were mostly sited in low valleys, close to villages or in them (Martínez & Mantecón, 2012).

In terms of economic activities, maritime industry gained importance in Cantabria during the Middle Ages, which led to a greater need for iron and wood. The importance of this industry was such that the Crown of Castile gave preferential treatment to operations in the Cantabrian Mountains in 1335 CE (Corbera, 1999). Here major breakthroughs were made by using charcoal as fuel instead of freshly-cut wood during the 12th-13th centuries CE, resulting in a calorific power increase (García-Alonso, 1999). In Europe, the first hydraulic finery forges date from the 12th century CE. Although it is estimated that they were introduced into the Iberian Peninsula during the 13th century CE it was not until the 14th century CE that they are documented in Cantabria closely linked to the shipbuilding industry, and increased significantly during the 15th century CE (Corbera, 1999; Cuerno, 2001). The time of maximum charcoal demand, however, is documented as from 1622 CE, when a cannon industry was constructed in the towns of Liérganes and La Cavada (García-Alonso, 1999). Charcoal kilns were widely scatted across the territory by that time, resulting in significant levels of deforestation (García-Alonso, 1999).

During the 17th century CE, a socioeconomic crisis hit Spain and also Europe on a larger scale. The iron industry withstood the crisis owing to its importance until 1850 – 1870 CE, when iron production decreased in Cantabria due to the depletion of forest resources and the boom in foreign sources of supply (Corbera, 1999). In accordance, the use of charcoal kilns progressively decreased during the middle of the 19th century CE (García-Alonso, 1999).

THE STUDY OF THE CANTABRIAN LANDSCAPE'S EVOLUTION BASED ON PALEOLIMNOLOGY

Due to the great variety of data, multiproxy paleolimnological studies have become more numerous in recent times, emerging as useful tools to better characterise past environmental dynamics (Birks & Birks, 2006; Michelutti & Smol, 2013). The number of studies in the north-western Iberian Peninsula has steadily increased over the last century, both in the Atlantic and Mediterranean biogeographical regions (Fig. 10; Table 3). This has been possible owing to the large number of glacial lakes (Jiménez & Farias, 2005) and peat deposits (Martínez-Cortizas et al., 2000, 2009; Ramil-Rego et al., 2018) in the area. The sequences with the longest chronology in the Iberian north-west, however, are the ones obtained from two marine records (MD03-2697 and MD99-2331) which were sampled in the Atlantic Ocean and have a bottom age of 340 ka BP (Gouzy et al., 2004; Sánchez-Goñi et al., 2005, 2008; Naughton et al., 2007; Desprat et al., 2009).

In the Cantabrian range, the reconstruction of plant dynamics has been enabled by the large number of palynological records studied (Fig. 10; Table 3). From west to east, the sequences of Laguna de Lucenza (Aira-Rodríguez, 1986; Santos-Fidalgo et al., 1997; Muñoz-Sobrino et al., 2001), Villaseca de Laciana (Jalut et al., 2010), La Mata (Jalut et al., 2010), Lago de Ajo (Allen et al., 1996), Puerto de Tarna (Ruíz-Zapata et al., 2000), Puertos de Ríofrio (Menéndez-Amor & Florschütz, 1963) revealed an open area with a large presence of xerophytes during some intervals of the Last Glacial Period above 1000 m a. s. l. The same landscape was inferred on the northern slope of the Cantabrian range from the record of La Molina peat bog (Cantabria, 484 m a. s. l., Sánchez-Morales et al., 2022). A few more records from Burgos (north-eastern Castile and León), such as La Piedra (Ramil-Rego et al., 1998) and San Mamés de Abar (Iriarte-Chiapusso et al., 2001), documented a higher presence of pines and birches, while the dominance of pines becomes more evident in the northern Iberian System as indicated by the papers on Hoyos de Iregua (Gil-García et al., 2002), Laguna del Hornillo (Gómez-Lobo et al., 1996), Laguna Negra (Von EngerIbrechten, 1998), Lago Las Pardillas (Sánchez-Goñi & Hannon, 1999), Quintanar de la Sierra (Peñalba, 1994; Peñalba et al., 1997) and Laguna Grande (Ruiz-Zapata et al., 2002a).

On the northern slope of the Cantabrian range, plant dynamics studies have revealed a generalised dominance of mixed deciduous formations over the Holocene epoch composed of deciduous *Quercus, Corylus* and *Betula* at some stages. In Asturias, the papers on El Alto de la Espina (López-Merino, 2009), Las Dueñas (López-Merino et al., 2006), El Monte Areo peat bogs (López-Merino, 2009; López-Merino et al., 2010) and Lake Enol (López-Merino, 2009) are the most relevant. In Cantabria, located in the eastern sector of the mountain system, the main sequences are those obtained from the peat bogs of Culazón (González-Pellejero et al., 2014), Pico Sertal (Mariscal, 1986; Carracedo et al., 2018), El Cueto de la Avellanosa (Mariscal, 1983; Núñez, 2018), Pico Ano (Salas, 1993), Alsa (Mariscal, 1993), Puerto del Escudo (Muñoz-Sobrino, 2001), Estacas de Trueba (Mariscal, 1987, 1989), Sotombo (Pérez-Díaz et al., 2016a), Los Tornos (Peñalba, 1994; Muñoz-Sobrino et al., 2005), La Nava (Menéndez-Amor, 1968) and La Molina (Pérez-Obiol et al., 2016; Sánchez-Morales et al., 2022). Some syntheses containing most of these paleobotanical records and also archaeological sites from the northern Iberian Peninsula were provided by Iriarte (2009) and Pérez-Obiol et al. (2011). Other paleobotanical syntheses have also been performed for the Western Pyrenees region (Pérez-Díaz et al., 2015) and for the Iberian Peninsula and Balearic Islands (Carrion, 2012).

Among all the mentioned sites, however, only a few studies considered the role of fire in the reconstruction of the Cantabrian landscape. This may lead to partial interpretations since fire is an important factor in the complex scenario between vegetation, climate and anthropic pressure (Harrison et al., 2010; Whitlock et al., 2010; Krawchuk & Moritz, 2011). The fire regime can be characterised by analysis of sedimentary charcoals. Charcoals are plant remains resulting from incomplete combustion (Whitlock & Larsen, 2001) that can be transported by wind over long distances (Radtke et al., 1991; Andreae, 1991). Some studies estimate that the smallest particles (<100 µm) can travel more than 100 km through the atmosphere (Conedera et al., 2009), while charcoal particles larger than 125 µm are mainly deposited within a 7-km radius (Whitlock & Millspaugh, 1996). Therefore, the study of sedimentary micro and macrocharcoals can provide insight into the fire regime on both a regional and local scale respectively. In Europe, analysis of multiple charcoal sequences allowed the determination of fire episodes that occurred simultaneously in different regions during some glacial and postglacial intervals and therefore might have been strongly influenced by climate conditions (Power et al., 2008; Daniau et al., 2010, 2012; Marlon et al., 2016). In the Cantabrian range, the oldest charcoal record is the obtained from La Molina peat bog, that covers the last c. 17,500 cal years (Sánchez-Morales et al., 2022). The lack of woody species during the Palaeolithic section of the record went hand in hand with the absence of significant fire events at a local scale, in accordance with other Iberian paleosites (Portugal: Connor et al., 2012; Central Pyrenees: Gil-Romera et al., 2014; Andalucía: Carrión, 2002). The first significant fire episode occurred during the early Holocene coinciding with the 9.3 and the 8.2 ka events (Sánchez-Morales et al., 2022). "It has been shown that climate changes of this magnitude can cause major fires in a brief period of time (Daniau et al., 2019) since both temperature and humidity are acknowledged to be important factors in controlling biomass burning on a regional scale (Daniau et al., 2012). Power et al. (2008) also point out that increased seasonality during the early Holocene could have regulated the fire regime in the Northern Hemisphere" (Sánchez-Morales et al., 2022: 107373). Thus, the dry conditions of the 9.3 and the 8.2 ka events in the Cantabrian range (Domínguez-Villar et al., 2009; Smith et al., 2016; Rossi et al., 2018; Baldini et al., 2019) together with the fuel accumulation that took place during the early Holocene (Sánchez-Morales et al., 2022) were most likely responsible of the two fire episodes.

For the last 7000 years, the sequences obtained from El Sertal, El Cueto de la Avellanosa (Carracedo et al., 2018) and La Molina (Pérez-Obiol et al., 2016; Sánchez-Morales et al., 2022), all located in the eastern sector of the Cantabrian range, indicated intense use of fire from the Neolithic onwards coinciding with the onset of agricultural practices and the need to create forest openings, thus revealing an anthropic origin (Figs. 8 and 9). In La Molina, which is the study site located at the lowest altitude (484 m a. s. l.), important fire events were detected from 5800 to 3500 cal yr BP (Late Neolithic, Chalcolithic and Bronze Age) in the form of intense and frequent charcoal peaks and increases in charcoal content. The beginning of these fire events was accompanied by the appearance of *Calluna* and other Ericaceae (Pérez-Obiol et al., 2016) whose germination is stimulated by high temperatures (Reyes & Casal, 2000). Fire intensity was lower at a higher altitude range, especially in El Sertal (940 m a. s. l.) where sedimentary macrocharcoals were not continuously recorded until the Middle Ages, increasing sharply during the last 400 years. By contrast, in El Cueto de la Avellanosa (1320 m a. s. l.) the fire signals were constant from the beginning of the sequence, registering a rise at around 3600 cal yr BP.

Paleolimnology has also been applied in the Cantabrian region to determine the beginning and the main phases of former mining activities. This has been possible since the atmospheric pollution resulting from mining or metallurgy, as well as from other anthropic sources such as the combustion of coal or petrol and waste incineration, can result in trace metal (e.g., Pb, Hg, Fe, Zn) release and subsequent dumping in sedimentary deposits (Boyle, 2001). However, some caution is needed in the interpretation of trace metals since they may also come from other sources such as erosional processes and can be remobilised within the sedimentary layers due to redox conditions (Boyle, 2001). In this respect, it is interesting to look at

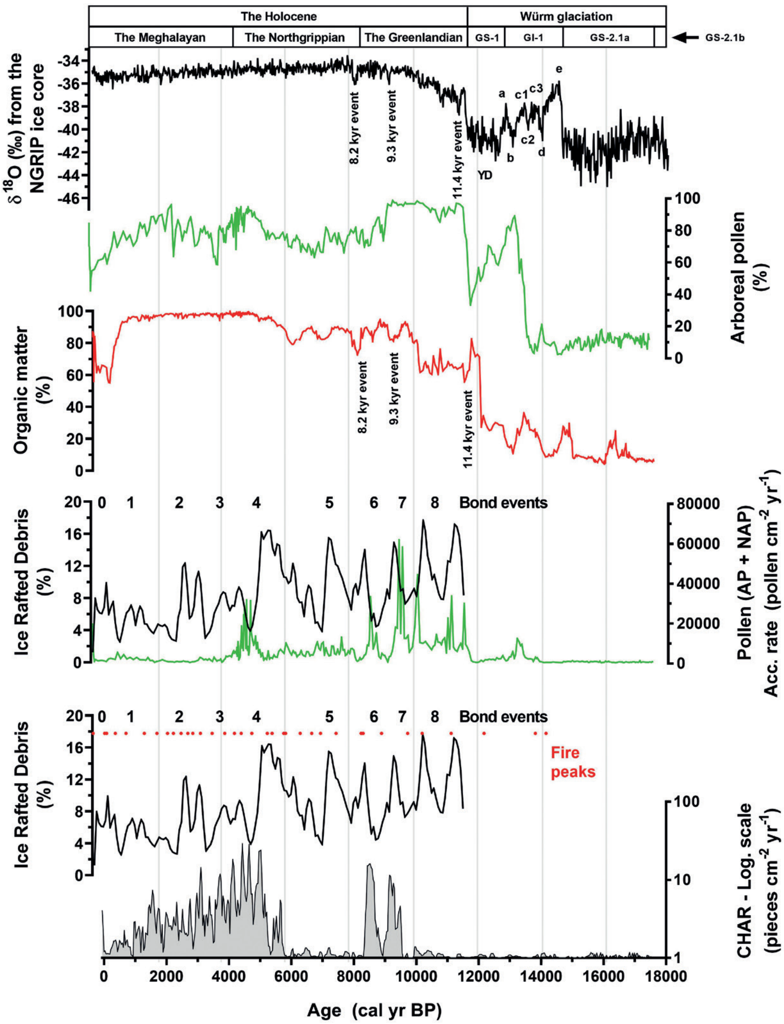

FIGURE 8. *Comparison of CHAR, Ice Rafted Debris (IRD) index: Stack of MC52-V29191 + MC21-GGC22 (Bond et al., 2001), pollen accumulation rate (arboreal: AP + non arboreal: NAP) and organic matter of La Molina peat bog (Sánchez-Morales et al., 2022) and* $\delta^{18}O$ *from the NGRIP ice core, adapted from Rasmussen et al. (2014). At the top of the figure, the chronology for the Würm glaciation based on Greenland Stadials (GS) and Greenland Interstadials (GI) is shown (Rasmussen et al., 2014), and also the stages for the Holocene based on Walker et al. (2018, 2019). The Younger Dryas Stadial (YD), Heinrich event 1 (H1; Heinrich, 1988; Bond et al., 1992; Hemming, 2004) and the substages of the Greenland Interstadial 1 (a-e) are indicated. Retrieved from Sánchez-Morales et al. (2022).*

the isotopic composition of Pb. This is a toxic element found in multiple anthropic emissions whose composition of stable isotopes varies depending on the primordial Pb, U and Th concentrations of the source and the lengths of the decay processes (Komárek et al., 2008). ^{204}Pb is a primordial lead isotope whose concentration on Earth does not vary over time, whereas ^{206}Pb, ^{207}Pb and ^{208}Pb isotopes are products of the radioactive decay of ^{238}U, ^{235}U and ^{232}Th respectively (Long, 1999). Therefore, each material containing Pb has a different isotopic signature and thus its exploration in sediments can provide a fine-tuned view of the sources of metal inputs.

In Asturias (north-western Cantabrian range), the study of a sedimentary sequence from La Molina mire detected evidence of mining activities from the beginning of the Chalcolithic (c. 4980 cal yr BP) in the form of important concentrations of trace metals and changes in lead isotopic composition (Martínez-Cortizas et al., 2013, 2016). In Cantabria former exploitations of iron and zinc ore deposits have also been documented, but to date there are no paleolimnological studies that have explored the sources and scale of the mining phases.

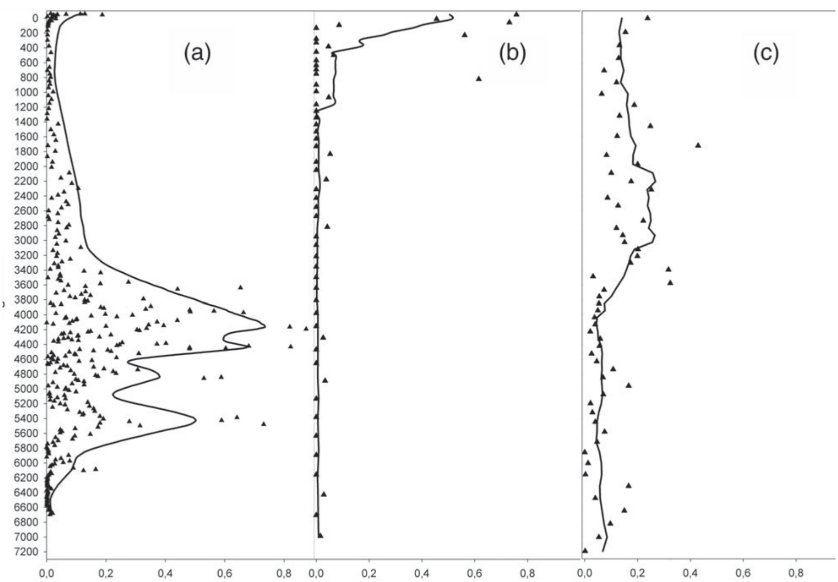

FIGURE 9. *Comparison of the charcoal accumulation rate (CHAR) with rescaled and smoothed values from La Molina (a), El Sertal (b) and El Cueto de la Avellanosa (c). Over the past 7000 years, the intensity and chronology of fire events were unequal at the three sites studied, which can be interpreted as the result of asynchronous human activity in the high versus low mountain areas and also of the type of fuel involved in each zone. Retrieved from Carracedo et al. (2018).*

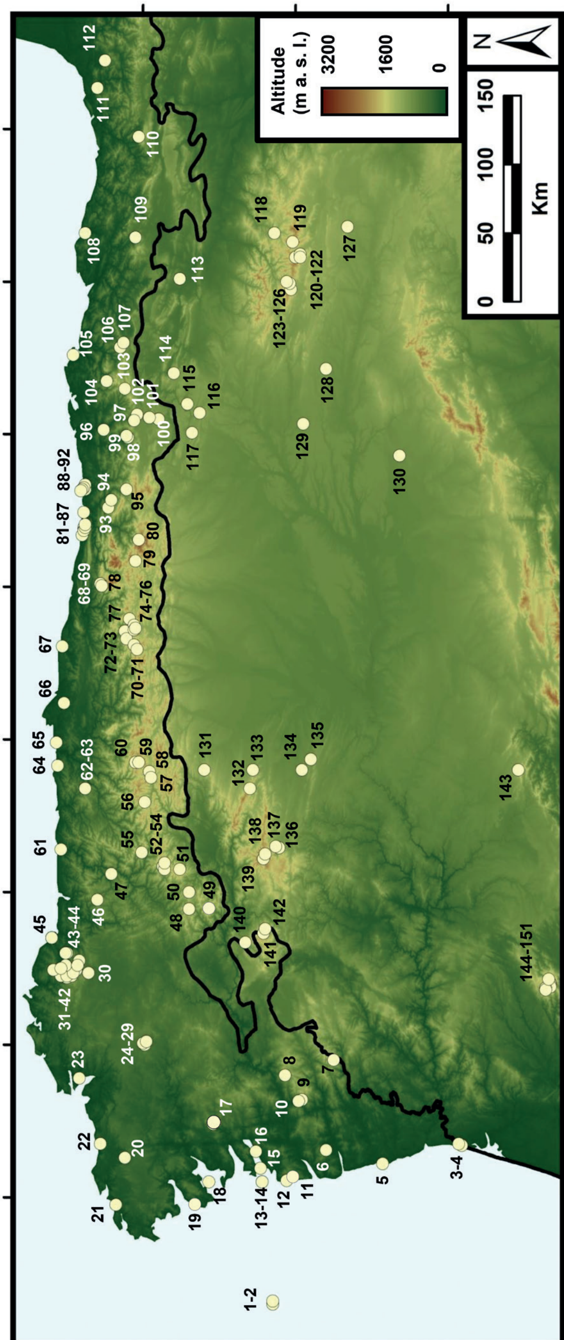

FIGURE 10. *Map of the sedimentary sites studied in the north-western Iberian Peninsula. The black line indicates the border between the Eurosiberian and Mediterranean biogeographical regions (northern and southern sides, respectively).*

Table 3. Sedimentary sites from the north-western Iberian Peninsula.

Code	Site	Region	Lat.	Long.	Altitude (m a. s. l.)	Estimated chronology of palynological data (ka BP)	Palynology	Plant macroremains	Sedimentary macrocharcoals	Sedimentary microcharcoals	Organic matter	Metal content / Pb isotopes	Other paleodata	References
1	Marine record: MD03-2697	Atlantic ocean	42.15	-9.70	0	c. 340 to 270 // 12.5 to present	X						X	Naughton et al. (2007), Desprat et al. (2009), redrawn in Carrión et al. (2012)
2	Marine record: MD99-2331	Atlantic ocean	42.15	-9.68	0	c. 135 to 13.2	X						X	Gouzy et al. (2004), Sánchez-Goñi et al. (2005, 2008), Naughton et al. (2007), redrawn in Carrión et al. (2012)
3	Maceda	Portugal	40.91	-8.66	0	c. 25 to 15	X							Gómez-Orellana et al. (2001)
4	Cortegaça	Portugal	40.93	-8.65	0	c. 6.8 to 5.5	X							Gómez-Orellana et al. (2001)
5	Aguçadoura	Portugal	41.43	-8.78	0	c. 4.4 to 0.3	X							Gómez-Orellana et al. (2001)
6	Serra de Arga	Portugal	41.80	-8.69	780	c. >7.1 to present	X							Gómez-Orellana et al. (2010)
7	Lagoa do Marinho	Portugal	41.75	-8.1	1150	c. >11.2 to present	X							Ramil-Rego et al. (1998)
8	Ribo Moadiora: PUS V	Portugal	42.07	-8.20	970	^{14}C data at 3.4	X							Ruíz-Zapata et al. (1995)
9	Lorderlo-Cha do Couço: PUT V	Portugal	41.96	-8.36	500	^{14}C data at 3	X							Ruíz-Zapata et al. (1995)
10	Portela de Alvito: PUT III	Portugal	41.98	-8.37	480	Ages not provided	X							Ruíz-Zapata et al. (1995)
11	Santa María de Oia	Pontevedra	42	-8.87	3	^{14}C dates at 34.2 and 29.3	X							Gómez-Orellana et al. (2013)
12	Mougás lagoon	Pontevedra	42.06	-8.89	0	c. 18.8 to present	X							Saa-Otero & Víaz-Fierros (1988), Gómez-Orellana et al. (1998), Ramil-Rego et al. (1998)
13	Islas Cíes: CS5	Pontevedra	42.22	-8.90	0	c. >5.2 to <3.7	X							Costas et al. (2009)
14	Islas Cíes: CS9	Pontevedra	42.22	-8.90	0	^{14}C data at 3.4	X							Costas et al. (2009)
15	Ría de Vigo: MVR-3	Pontevedra	42.23	-8.81	30	MIS 3 // c. 10.4 to present	X						X	Muñoz-Sobrino et al. (2018), García-Moreiras et al. (2019a)
16	Ría de Vigo: B5	Pontevedra	42.26	-8.70	18	MIS 3 // c. 8.5 to present	X						X	Muñoz-Sobrino et al. (2018), García-Moreiras et al. (2019a)
17	Campo Lameiro area - Monte Paradela	Pontevedra	42.53	-8.51	310-260	c. 9.8 to present	X	X					X	Kaal et al. (2011, 2013), López-Merino et al. (2012)
18	Ría de Arousa: A14-VC15	Pontevedra - A Coruña	42.57	-8.9	0	c. 12.5 to 8.7	X						X	García-Moreiras et al. (2019b)
19	Caamaño A and B	A Coruña	42.6	-9.02	3	c. 36 to <28.7 // ^{14}C data at 20.2	X							Gómez-Orellana et al. (2001, 2013)
20	Braña Rubia	A Coruña	43.12	-8.74	390	c. >2.5 to present	X							Törnqvist et al. (1989)
21	Traba	A Coruña	43.18	-9.05	4	No palynological data							X	Bao et al. (2007)
22	Baldayo	A Coruña	43.28	-8.65	0	No palynological data		X						Garcia-Amorena et al. (2008)
23	Seselle	A Coruña	43.42	-8.22	0	c. 4.3 to present	X						X	Santos-Fidalgo et al. (1993)
24	Cruz de Bocelo	A Coruña	42.99	-8.00	745	c. 2.1 to present	X							Castro et al. (1993)
25	Insua	A Coruña	43.00	-7.99	750	c. 5.0 to present	X							Castro et al. (1993)
26	Muiño	A Coruña	42.99	-7.99	705	c. 2.6 to present	X							Castro et al. (1993)
27	Ameneiros	A Coruña	42.99	-7.99	700	c. 6.5 to present	X							Aira-Rodríguez et al. (1994), Castro et al. (1993)
28	A Lagoa	A Coruña	42.98	-7.98	710	c. 3.1 to present	X							Castro et al. (1993)
29	A Pena	A Coruña	42.98	-7.98	660	c. 0.16 to present	X							Castro et al. (1993)
30	Sever	Lugo	43.36	-7.53	620	c. 5.1 to present	X							Ramil-Rego & Aira-Rodríguez (1993c)

Table 3. Continued.

Code	Site	Region	Lat.	Long.	Altitude (m a. s. l.)	Estimated chronology of palynological data (ka BP)	Palynology	Plant macroremains	Sedimentary macrocharcoals	Sedimentary microcharcoals	Organic matter	Metal content / Pb isotopes	Other paleodata	References
31	Pena Veira	Lugo	43.42	-7.45	585	c. 5.5 to present	X							Ramil-Rego & Aira-Rodríguez (1993b)
32	Tremoal de Schwejk	Lugo	43.43	-7.48	600-650	Ages not provided	X							Ramil-Rego & Aira-Rodríguez (1994)
33	Pena Vella	Lugo	43.44	-7.51	700	c. >9.6 to present	X							Ramil-Rego et al. (1994, 1998)
34	Tremoal do Pedrido	Lugo	43.45	-7.53	695	No palynological data						X	X	Olid et al. (2010), Pérez-Rodríguez & Martínez-Cortizas (2014)
35	Charca do Chan da Cruz	Lugo	43.46	-7.53	800	c. 5.9 to present	X							Ramil-Rego & Aira-Rodríguez (1993a)
36	Tremoal do Rio das Furnas II	Lugo	43.47	-7.55	800	^{14}C data at 7.4	X							Ramil-Rego et al. (1996), redrawn in Muñoz-Sobrino (2001)
37	Turbera Pena da Cadela	Lugo	43.50	-7.55	970	c. >4.6 to present	X	X				X	X	Martínez-Cortizas et al. (2002, 2007), Mighall et al. (2006), Olid et al. (2010), Castro et al. (2015), Souto et al. (2016)
38	Turbera de Chan do Lamoso	Lugo	43.50	-7.56	1150	c. >8.8 to present	X					X		Ramil-Rego et al. (1998), Muñoz-Sobrino et al. (2005), Olid et al. (2010)
39	Turbera de Penido Vello	Lugo	43.54	-7.55	700	c. >3.4 to present	X					X	X	Martínez-Cortizas et al. (1997, 1999, 2002), Muñoz-Sobrino et al. (2005), Kylander et al. (2005), Olid et al. (2010), Rauch et al. (2010), Schellekens et al. (2011, 2015), Pontevedra-Pombal et al. (2012)
40	Borralleiras de Cal Grande	Lugo	43.59	-7.51	600	c. >4.6 to present	X	X						Mighall et al. (2006), Souto et al. (2016), Souto (2018)
41	Chao de Veiga Mol	Lugo	43.54	-7.50	700	No palynological data		X					X	Souto et al. (2016), Pontevedra-Pombal et al. (2019), Castro et al. (2020)
42	Gañidoira	Lugo	43.51	-7.48	720	^{14}C data at 6.9	X							Ramil-Rego et al. (1993)
43	Finca Galea	Lugo	43.51	-7.4	65			X						García-Amorena et al. (2008)
44	Montes del Buyo	Lugo	43.5	-7.4	500-600	^{14}C data at 7.8	X							Menéndez-Amor & Florschütz (1961), redrawn in López-García (1978)
45	Area Longa (Level I, II and III)	Lugo	43.60	-7.30	0	Oxygen isotope stages 5c, 4 and 3	X							Mary et al. (1977), Gómez-Orellana et al. (2007)
46	San Ciprián	Lugo	43.3	-7.05	802	Ages not provided	X							Muñoz-Sobrino (2001)
47	Castro Chao de Samartín	Asturias	43.21	-6.88	675	Ages not provided	X							Ruiz-Zapata et al. (2003, 2005), redrawn in López-Merino (2009)
48	Pozo do Carballal	Lugo	42.70	-7.11	1330	c. >10.3 to present	X							Muñoz-Sobrino et al. (1997)
49	Laguna de Lucenza	Lugo	42.58	-7.13	1375	c. 17.4 to present	X			X				Aira-Rodríguez (1986), Santos-Fidalgo et al. (1997), Muñoz-Sobrino et al. (2001)
50	A Golada	Lugo	42.70	-7.00	1225	^{14}C data at 3.4	X							Muñoz-Sobrino et al. (1997)
51	Brañas de Lamela	León	42.76	-6.85	1280	^{14}C data at 3.1	X							Muñoz-Sobrino et al. (1997)
52	A Cespedosa I and II	Lugo	42.87	-6.83	1415	^{14}C data at 2	X							Muñoz-Sobrino et al. (1997)
53	Suárbol	León	42.86	-6.85	1080	^{14}C data at 1.25	X							Muñoz-Sobrino et al. (1997)
54	Porto Ancares	León	42.86	-6.81	1580	Ages not provided	X							Muñoz-Sobrino et al. (1997)
55	Pena Velosa	Asturias	43.01	-6.74	1350	c. 12 to present	X							Muñoz-Sobrino et al. (2012)

Table 3. Continued.

Code	Site	Region	Lat.	Long.	Altitude (m a. s. l.)	Estimated chronology of palynological data (ka BP)	Palynology	Plant macroremains	Sedimentary macrocharcoals	Sedimentary microcharcoals	Organic matter	Metal content / Pb isotopes	Other paleodata	References
56	Puerto de Leitariegos	León	42.99	-6.41	1700	^{14}C dates at 11.8 and 8.9	X							García-Rovés et al. (2001), García-Rovés (2007), described in López-Merino (2009)
57	Villaseca de Laciana (Laguna del Castro)	León	42.95	-6.25	1317	c. 39.5 to 31 // 11.4 to 9 // 1 to present	X							Jalut et al. (2010)
58	La Mata (Laguna del Miro)	León	42.96	-6.21	1500	^{14}C data at >35 // 12.9 to present	X							Jalut et al. (2010)
59	Laguna de la Mata	Asturias	43.03	-6.15	1500	Ages not provided, probably c. 30 to present	X							Belet (1993), described in López-Merino (2009)
60	Lago de Ajo	Asturias	43.05	-6.15	1570	c. >14.3 to present	X							Allen et al. (1996)
61	Navia	Asturias	43.54	-6.72	10	No palynological data		X						García-Amorena et al. (2008)
62	Turbera Alto de la Espina	Asturias	43.38	-6.32	650	c. 10.7 to present	X						X	López-Merino (2009)
63	La Molina Mire	Asturias	43.38	-6.32	650	c. 2.7 to present	X					X		López-Merino et al. (2011, 2014), Martínez-Cortizas et al. (2013, 2016)
64	Turbera de Las Dueñas	Asturias	43.56	-6.17	127	c. 9.9 to present	X						X	López-Merino et al. (2006), López-Días et al. (2010, 2013a)
65	Turbera Huelga de Bayas	Asturias	43.57	-6.02	115	No palynological data							X	López-Días et al. (2013a)
66	Turbera Monte Areo	Asturias	43.52	-5.76	200	c. >9.8 to present	X				X		X	López-Merino et al. (2010)
67	Estuario de Villaviciosa	Asturias	43.53	-5.39	15	c. >6.1 to present	X	X						García-Antón et al. (2006), García-Amorena et al. (2008)
68	Lago Enol	Asturias	43.27	-4.99	1070	c. 10.6 to 2.5	X					X	X	Menéndez-Amor (1975), López-Merino (2009), Moreno et al. (2010b, 2011)
69	Lago de la Ercina	Asturias	43.27	-4.98	1200	Ages not provided	X							Menéndez-Amor (1975)
70	Curueño	León	43.04	-5.41	1650	No palynological data		X						Sánchez-Hernando et al. (1999)
71	Turbera de Puerto de San Isidro	León	43.06	-5.38	1700	c. 8.3 to present	X							Fombella-Blanco et al. (2001), redrawn in Carrión et al. (2012)
72	Corteguero - S3	Asturias	43.11	-5.34	1530	^{14}C data at 5.7	X							Jiménez-Sánchez et al. (2003)
73	Brañagallones - S1	Asturias	43.12	-5.29	1230	^{14}C data at 29	X							Ruíz-Zapata et al. (2000, 2002b), redrawn in Carrión et al. (2012)
74	Mire in Pinar de Lillo	León	43.06	-5.25	1360	c. 1.7 to present	X							García-Antón et al. (1997), Muñoz-Sobrino (2001)
75	Lillo II	León	43.06	-5.28	1500	c. >4 to present	X							Muñoz-Sobrino (2001), Muñoz-Sobrino et al. (2003)
76	Porma	León	43.05	-5.27	1300	No palynological data		X						Sánchez-Hernando et al. (1999)
77	Puerto de Tarna - S2	Asturias	43.09	-5.21	1415	^{14}C data at 20.6	X							Ruíz-Zapata et al. (2000), redrawn in López-Merino (2009); Jiménez-Sánchez et al. (2003)
78	Turbera de Comella / Comeya	Asturias	43.28	-4.98	834	^{14}C data at 40.5 // ^{14}C data at 8.3 // c. >3.8 to <3.1	X							Ruiz-Zapata et al. (2002c), redrawn in López-Merino (2009), Jiménez-Sánchez et al. (2003)
79	Esla	León	43.05	-4.83	1450	No palynological data		X						Sánchez-Hernando et al. (1999)
80	Turbera de Puertos de Ríofrio	Cantabria	43.03	-4.69	1700	c. >10.2 to <2.2	X							Menéndez-Amor & Florschütz (1963), redrawn in López-García (1978)

Table 3. Continued.

Code	Site	Region	Lat.	Long.	Altitude (m a. s. l.)	Estimated chronology of palynological data (ka BP)	Palynology	Plant macroremains	Sedimentary macrocharcoals	Sedimentary microcharcoals	Organic matter	Metal content / Pb isotopes	Other paleodata	References
81	Turbera de Vidiago	Asturias	43.4	-4.66		Ages not provided	X							Menéndez-Amor (1950a, 1950b), redrawn in López-Merino (2009)
82	Turbera de Llano de la Mesa	Asturias	43.39	-4.63		Ages not provided	X							Menéndez-Amor (1950a, 1950b), redrawn in López-Merino (2009)
83	Turbera de Pendueles	Asturias	43.39	-4.63		Ages not provided	X						X	Menéndez-Amor (1950a, 1950b), redrawn in López-Merino (2009), López-Días et al. (2013a)
84	Turbera de Buelna	Asturias	43.39	-4.61	230	^{14}C dates at 2.2 and 1.7	X						X	Menéndez-Amor (1950a, 1950b), Menéndez-Amor & Florschütz (1961), redrawn in López-Merino (2009), López-Días et al. (2013a)
85	Turbera de la Borbolla	Asturias	43.38	-4.61	50	No palynological data		X					X	García-Amorena et al. (2008), López-Días et al. (2013a)
86	Turbera de Llano Roñanzas	Asturias	43.38	-4.59	220	^{14}C dates at 3.2 and 1.4	X					X	X	Menéndez-Amor (1950a, 1950b), Mary & De Beaulieu (1973) redrawn in López-García (1978) and López-Merino (2009); Ortiz et al. (2008, 2010), Moreno et al., (2009), Gallego et al. (2013), López-Días et al. (2013a, 2013b)
87	Las Arenas - Tina Mayor	Cantabria	43.39	-4.51	0	^{14}C data at 10	X							Mary et al. (1975)
88	Río Bederna	Cantabria	43.41	-4.37	0	^{14}C data at 4.7	X							Mary et al. (1975)
89	Jerra I	Cantabria	43.39	-4.35	0	^{14}C data at 5.8	X							Mary et al. (1975)
90	Jerra II	Cantabria	43.40	-4.36	0	^{14}C data at 5.3	X							Mary et al. (1975)
91	Turbera Merón	Cantabria	43.38	-4.36	0	No palynological data		X						Mary (1990), García-Amorena et al. (2008)
92	Turbera de Oyambre	Cantabria	43.38	-4.33	0	No palynological data		X						Mary (1990), García-Amorena et al. (2008)
93	Turbera de Culazón	Cantabria	43.23	-4.48	592	c. 3.6 to present	X							González-Pellejero et al. (2014)
94	Turbera del Pico Sertal	Cantabria	43.21	-4.43	940	c. >4.5 to present	X		X		X			Mariscal (1986), Carracedo et al. (2018)
95	Turbera de El Cueto de la Avellanosa	Cantabria	43.11	-4.36	1320	c. >6.1 to present	X		X		X			Mariscal (1983), Núñez (2018), Carracedo et al. (2018)
96	Turbera de La Molina	Cantabria	43.26	-3.97	484	c. 14.4 to present	X		X		X		X	Pérez-Obiol et al. (2016), Carracedo et al. (2018), Sánchez-Morales et al. (2022)
97	Turbera de El Cueto de la Espina	Cantabria	43.06	-3.91	1120	c. 5 to present	X		X	X	X			Rodríguez-Coterón (unpublished PhD),
98	Turbera de Pico Ano	Cantabria	43.1	-4.02	1288	4.1 to present	X							Salas (1993)
99	Turbera de Alsa	Cantabria	43.11	-4.01	560	c. 4.3 to 0.3	X							Mariscal (1993)
100	Santa Gadea	Burgos	42.9	-3.9	837	Ages not provided, probably c. 9-8.5 to present	X							Iriarte-Chiapusso et al. (2003)
101	Valle de La Nava I, II and III	Burgos	42.96	-3.89	870	c. >10 to <8.2	X							Menéndez-Amor (1968), redrawn in López-García (1978) and Muñoz-Sobrino (2001)
102	Puerto del Escudo	Cantabria	43.04	-3.87	940	^{14}C data at 7.8	X							Muñoz-Sobrino (2001)
103	Turbera de Estacas de Trueba	Cantabria	43.12	-3.70	1160	c. >5 to present	X							Mariscal (1987, 1989)
104	Turbera de Sotombo	Cantabria	43.24	-3.65	1290	c. 5.2 to present	X							Pérez-Díaz et al. (2016a)

Table 3. Continued.

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105	Noja	Cantabria	43.46	-3.48	0	No palynological data		X						García-Amorena et al. (2008)
106	Turbera de Los Tornos I and II	Cantabria	43.15	-3.43	920	c. 7.8 to present	X							Peñalba (1994), Muñoz-Sobrino (2001), Muñoz-Sobrino et al. (2005)
107	Turbera de Zalama	Bizkaia	43.13	-3.40	1330	c. 7.2 to present	X	X			X		X	Pérez-Díaz et al. (2016b), Souto et al. (2016), Souto (2018)
108	Urdaibai	Bizkaia	43.38	-2.68	5	c. 11.2 to >2.6	X							Iriarte-Chiapusso et al. (2006, 2016)
109	Turbera de Saldropo I and II	Bizkaia	43.05	-2.71	625	c. 5.6 to present	X							García-Antón et al. (1989), Peñalba (1994)
110	Turbera de Belate	Navarra	43.03	-2.05	825	c. > 6.6 to present	X							Peñalba (1994), redrawn in Muñoz-Sobrino (2001)
111	Estuary of Bidasoa	Gipuzkoa	43.3	-1.73	<200	^{14}C dates at 6.6 and 6.5	X						X	Sánchez-Goñi (1996)
112	Turbera de Atxuri	Navarra	43.25	-1.55	500	c. > 2.7 to present	X							Peñalba (1994), redrawn in Muñoz-Sobrino (2001)
113	Lago de Arreo (ARRO4-1A-1K and ARRO4-2A-1K)	Araba	42.76	-2.98	655	c. 2.5 to present	X			X			X	Corella et al. (2013)
114	Huidobro	Burgos	42.8	-3.6	835	^{14}C data at 0.45	X							Iriarte-Chiapusso et al. (2003)
115	Tubilla del Agua	Burgos	42.71	-3.80	765	No palynological data		X						Moreno-Amat & Igesias-González (2009), García-Amorena et al. (2011)
116	Turbera de La Piedra	Burgos	42.63	-3.86	950	c. >12.3 to present	X							Ramil-Rego et al. (1998)
117	Turbera de San Mamés de Abar	Burgos	42.68	-3.99	920	c. >10.7 to <3.7	X							Iriarte-Chiapusso et al. (2001, 2016), Muñoz-Sobrino (2001)
118	Laguna Ciega	La Rioja	42.14	-2.68	1470	Ages not provided, probably c. 1.9 to present	X							Gil-García et al. (1995)
119	Hoyos de Iregua	La Rioja	42.02	-2.74	1780	c. 13.7 to present	X							Gil-García et al. (2002)
120	Laguna Masegosa	Soria	41.97	-2.82	1600	c. >9.5 to present	X			X	X			Von Engerlbrechten (1998)
121	Laguna del Hornillo	Soria	41.97	-2.84	1820	c.15.5 to present	X							Gómez-Lobo Rodríguez (1993), Gómez-Lobo Rodríguez et al. (1996), redrawn in Muñoz-Sobrino (2001)
122	Laguna Negra	Soria	42.00	-2.84	1760	c. >9.6 to present	X	X		X	X			Von Engerlbrechten (1998)
123	Lago Las Pardillas	Burgos	42.06	-3.00	1850	c. 9.3 to present	X	X	X	X	X		X	Sánchez-Goñi & Hannon (1999)
124	Neila hollow	Burgos	42.04	-3.01	1480	c. >5.2 to present	X			X				Von Engerlbrechten (1998)
125	Quintanar de la Sierra	Burgos	42.03	-3.01	1470	c. >13.5 to present	X							Peñalba (1994), Peñalba et al. (1997)
126	Laguna grande (QS4)	Burgos	42.03	-3.05	1500	c. >17.15 to present	X							Ruiz-Zapata et al. (2002a)
127	Turbera Quintana Redonda	Soria	41.66	-2.64	1000	c. 9.3 to 6.7	X							García-Antón et al. (1994)
128	Tubilla del Lago	Burgos	41.80	-3.57	900	c. 6.5 to present	X	X	X	X				Moreno-Amat et al. (2009), García-Amorena et al. (2011), Morales-Molino et al. (2017)
129	Espinosa de Cerrato	Palencia	41.95	-3.93	885	c. 9.7 to present	X			X	X			Franco-Múgica et al. (2001), Morales-Molino et al. (2017)
130	El Carrizal	Segovia	41.32	-4.14	860	c. >8.7 to present	X			X				Franco-Múgica et al. (2005)

Table 3. Continued.

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131	Turbera de Brañuelas	León	42.6	-6.2	1000	^{14}C data at 8	X							Muñoz-Sobrino (2001)
132	Xan de Llamas	León	42.30	-6.32	1500	c. >3.2 to present	X	X		X				Morales-Molino et al. (2011)
133	Arroyo de Vallefondo	León	42.28	-6.20	1000	c. >0.84 to present	X			X				Morales-Molino et al. (2011)
134	Arroyo de Ciervas	Zamora	41.96	-6.2	790	Ages not provided	X							Muñoz-Sobrino (2001)
135	El Portillo I, II	Zamora	41.90	-6.13	870	Ages not provided	X							Muñoz-Sobrino (2001)
136	Laguna de las Sanguijuelas[1] / Sanabria Marsh[2] / Lleguna[3]	Zamora	42.11	-6.71	1050	c. >14 to present	X	X		X				Menéndez-Amor & Florschütz (1961)[1], Hannon (1985)[2], Turner & Hannon (1988)[2], Allen (1996)[2], Muñoz-Sobrino (2001)[3]
137	Laguna de las Sanguijuelas	Zamora	42.13	-6.70	1080	c. 14.8 to present	X							Muñoz-Sobrino (2001), Muñoz-Sobrino et al. (2004)
138	Laguna Cárdenas	Zamora	42.20	-6.75	1560	Ages not provided	X							Menéndez-Amor & Florschütz (1961)
139	Laguna Arroyas[1] / de la Roya[2]	Zamora	42.21	-6.78	1608	c. >12.9 to present	X	X			X			Menéndez-Amor & Florschütz (1961)[1], Allen et al. (1996)[2], Muñoz-Sobrino et al. (2013, 2018)[2]
140	Lagoa de As Lamas	Ourense	42.33	-7.33	1360	c. 12.8 to present	X							Maldonado-Ruiz (1994), Muñoz-Sobrino (2001)
141	Fraga	Ourense	42.21	-7.27	1360	^{14}C data at 8	X			X				Santos-Fidalgo et al. (1997, 2000)
142	Serra de Queixa - H profile	Ourense	42.20	-7.24	1310	Ages not provided	X							Menéndez-Amor (1971), Sangos-Fidalgo (1992), Vidal-Romaní & Santos-Fidalgo (1994)
143	El Maíllo mire	Salamanca	40.54	-6.20	1100	c. 9.3 to present	X	X		X				Morales-Molino et al. (2013)
144	Lagoa Comprida 1	Portugal	40.36	-7.64	1600	^{14}C data at 9	X							Van der Knaap & Van Leeuwen (1997)
145	Lagoa Comprida 2	Portugal	40.36	-7.63	1645	Ages not provided	X							Van der Knaap & Van Leeuwen (1997)
146	Charco da Candiera	Portugal	40.34	-7.57	1409	c. >11.9 to present	X	X						Van der Knaap & Van Leeuwen (1995, 1997), redrawn in Muñoz-Sobrino (2001)
147	Lagoa Clareza	Portugal	40.33	-7.60	1845	^{14}C data at 9.0	X							Van der Knaap & Van Leeuwen (1997)
148	Lagoa das Salgadeiras	Portugal	40.33	-7.60	1835	^{14}C data at 8.2	X							Van der Knaap & Van Leeuwen (1997)
149	Charca dos Cões	Portugal	40.33	-7.61	1795	^{14}C data at 6.4	X							Van der Knaap & Van Leeuwen (1997)
150	Chafariz do Rei	Portugal	40.33	-7.61	1770	Ages not provided	X							Van der Knaap & Van Leeuwen (1997)
151	Covão do Boieiro	Portugal	40.33	-7.62	1730	^{14}C dates at 9.9 and 9.6	X							Van der Knaap & Van Leeuwen (1997)

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BIBLIOGRAPHY

Aira-Rodríguez, M. J. (1986). Contribución al estudio de los suelos fósiles de montaña y antropógenos de Galicia. *Facultade de Bioloxía. Santiago de Compostela, Universidade de Santiago de Compostela*.

Aira-Rodríguez, N. J., Losada, E. D., & Otero, N. P. S. (1994). Estudio palinológico de la turbera de Ameneiros (Galicia, N.O. de España). *Botánica Complutensis, 19,* 59-73.

Alcalde del Río, H. (1906). Las pinturas y grabados de las cavernas prehistóricas de la provincia de Santander: Altamira, Covalanas, Hornos de la Peña, Castillo. Imprenta de Blanchard y Arce. Santander.

Alcalde del Río, H., Breuil, H., & Sierra, L. (1912). Les cavernes de la Région cantabrique. Imprimerie Vve. A. Chêne. Mónaco.

Alday-Ruiz, A. (2009). El final del Mesolítico y los inicios del Neolítico en la Península Ibérica: cronología y fases. *Munibe Antropologia-Arkeologia*, 60, 157-173.

Alday-Ruiz, A., & Cava, A. (2009). El mesolítico geométrico en Vasconia. In *El Mesolítico Geométrico en la Península Ibérica* (pp. 93-130). Departamento de Ciencias de la Antigüedad.

Allen, J. R., Huntley, B., & Watts, W. A. (1996). The vegetation and climate of northwest Iberia over the last 14,000 years. *Journal of Quaternary Science: Published for the Quaternary Research Association, 11*(2), 125-147. https://doi.org/10.1002/(SICI)1099-1417(199603/04)11:2<125::AID-JQS232>3.0.CO;2-U.

Alley, R. B., Mayewski, P. A., Sowers, T., Stuiver, M., Taylor, K. C., & Clark, P. U. (1997). Holocene climatic instability: A prominent, widespread event 8200 yr ago. *Geology*, 25(6), 483-486. https://doi.org/10.1130/0091-7613(1997)025<0483:HCIAPW>2.3.CO;2.

Alley, R. B. (2000). The Younger Dryas cold interval as viewed from central Greenland. *Quaternary science reviews*, 19(1-5), 213-226. https://doi.org/10.1016/S0277-3791(99)00062-1.

Alley, R. B., & Ágústsdóttir, A. M. (2005). The 8k event: cause and consequences of a major Holocene abrupt climate change. *Quaternary Science Reviews*, 24(10-11), 1123-1149. https://doi.org/10.1016/j.quascirev.2004.12.004.

Altuna, J. (1973). Fauna de mamiferos de la cueva de Morin (Santander) in Cueva Morin II, Excavaciones 1969, Santander. *tabl*, *27*, 3-12.

Altuna, J., & Mariezkurrena, K. (2009). Tipos de cabañas ganaderas durante el Neolítico en el País Vasco y zonas próximas. *Archaeofauna*, *18*, 137-157.

Altuna, J., & Mariezkurrena, K. (2012). Macromammalian remains from the Holocene levels of El Mirón cave. *El Mirón cave, Cantabrian SpaIn The site and its Holocene archaeological record*, 288-318.

Álvarez-Fernández, E. (2007). La explotación de los moluscos marinos en la Cornisa Cantábrica durante el Gravetiense: primeros datos de los niveles E y F de La Garma A (Omoño, Cantabria).

Álvarez-Fernández, E. (2010). Investigaciones arqueomalacológicas en La Garma A (Omoño, Cantabria): los moluscos marinos de los niveles N y O. In *El Paleolítico Superior Cantábrico: actas de la Primera Mesa Redonda, San Román de Candamo (Asturias), 26-28 de abril de 2007* (pp. 145-156). Universidad de Cantabria.

Álvarez-Fernández, E., & Fernández-García, R. (2013). Marine resource exploitation in Cantabrian Spain during the Solutrean/L'exploitation des ressources marines pendant le Solutréen dans la corniche cantabrique. *Supplément à la Revue archéologique du centre de la France*, *47*(1), 397-407.

Andreae, M. O. (1991). Biomass burning-Its history, use, and distribution and its impact on environmental quality and global climate, in: *Global biomass burning-Atmospheric, climatic, and biospheric implications*.

Aranburu-Mendizabal, A., Sarasketa-Gartzia, I., Arrizabalaga, A., Salazar García, D. C., Taldea, J., & José, I. C. M. (2018). El yacimiento calcolítico de Karea (Aia) en el contexto de las cuevas sepulcrales de Guipuzkoa (País Vasco). *Munibe Antropologia-Arkeologia, 2018,* 69, 1-14.

Arias, P. (1991). De cazadores a campesinos: la transición al neolítico en la región cantábrica (Vol. 6). Ed. Universidad de Cantabria.

Arias, P. (1995). La cronología absoluta del Neolítico y el Calcolítico de la región cantábrica: estado de la cuestión. In *Primeros agricultores y ganaderos en el Cantábrico y Alto Ebro* (pp. 15-40). Sociedad de Estudios Vascos= Eusko Ikaskuntza.

Arias, P. (2005). Determinaciones de isótopos estables en restos humanos de la región Cantábrica. Aportación al estudio de la dieta de las poblaciones del Mesolítico y el Neolítico. *Munibe. Antropologia-arkeologia*, *57*, 359-374.

Arias, P. (2007). Neighbours but diverse: social change in north-west Iberia during the transition from the Mesolithic to the Neolithic (5500-4000 cal BC). In *Proceedings-british academy* (Vol. 144, p. 53). Oxford university press inc.

Arias, P., González Sainz, C., Moure Romanillo, A., & Ontañón Peredo, R. (2000). La Zona Arqueológica de La Garma (Cantabria): investigación, conservación y uso social.

Arias, P., Gutierrez, A. A., & Mayolini, L. C. T. (2005). El fenómeno megalítico en la región Cantábrica. Estado de la cuestión. In *Actas del III Congreso del Neolítico en la Península Ibérica, Santander 5-8 octubre de 2003* (pp. 751-759). Servicio de Publicaciones de la Universidad de Cantabria.

Arias, P., Laval, E., Menu, M., Sainz, C. G., & Ontañón, R. (2011). Les colorants dans l'art pariétal et mobilier paléolithique de La Garma (Cantabrie, Espagne). *l'Anthropologie*, *115*(3-4), 425-445. https://doi.org/10.1016/j.anthro.2011.05.005.

Arias, P., & Ontańón, R. (2014). La Garma: un proyecto orientado al estudio del arte paleolítico, su contexto y su conservación. In Corchón, M. S., Menéndez, M. (Eds.), *Cien años de arte rupestre paleolítico* (pp. 173-194). Ediciones Universidad Salamanca, Salamanca.

Aura, J. E., Tiffagom, M., Pardo, J. F. J., Duarte, E., de la Vega, J. F., Santamaria, D., de la Rasilla, M., Vadillo, M., & Ripoll, M. P. (2012). The Solutrean–Magdalenian transition: a view from Iberia. *Quaternary International*, *272*, 75-87. https://doi.org/10.1016/j.quaint.2012.05.020.

Baena, J., Carrión, E., Ruiz Zapata, B., Ellwood, B., Sesé, C., Yravedra, J., Jordà, J., Uzquiano, P., Velázquez, R., Manzano, I., Sánchez-Marco, A., & Hernández, F. (2005). Paleoecología y comportamiento humano durante el Pleistoceno Superior en la comarca de Liébana: La secuencia de la Cueva de El Esquilleu (Occidente de Cantabria, España). *Monografías del Museo Nacional y Centro de Investigación de Altamira, 20,* 461-487.

Baena, J., Carrión, E., Cuartero, F., & Fluck, H. (2012). A chronicle of crisis: the Late Mousterian in north Iberia (Cueva del Esquilleu, Cantabria, Spain). *Quaternary International*, *247*, 199-211. https://doi.org/10.1016/j.quaint.2011.07.031.

Baena, J., Santafé, E. C., Navas, C. T., & Rodríguez, M. V. (2019). Mousterian inside the upper Paleolithic? The last interval of El Esquilleu (Cantabria, Spain) sequence. *Quaternary International*, *508*, 153-163. https://doi.org/10.1016/j.quaint.2018.11.015.

Baldini, L. M., McDermott, F., Baldini, J. U., Arias, P., Cueto, M., Fairchild, I. J., Hoffmann, D. L., Mattey, D. P., Müller, W., Nita, D. C., Ontañon, R., Garciá-Moncó, C., & Richards, D. A. (2015). Regional temperature, atmospheric circulation, and sea-ice variability within the Younger Dryas Event constrained using a speleothem from northern Iberia. *Earth and Planetary Science Letters*, 419, 101-110. https://doi.org/10.1016/j.quascirev.2019.105998.

Baldini, L. M., Baldini, J. U., McDermott, F., Arias, P., Cueto, M., Fairchild, I. J., Hoffmann, D. L., Mattey, D. P., Müller, W., Nita, D. C., Ontañon, R., Garciá-Moncó, C., & Richards, D. A. (2019). North Iberian temperature and rainfall seasonality over the Younger Dryas and Holocene. *Quaternary Science Reviews*, 226, 105-998. https://doi.org/10.1016/j.quascirev.2019.105998.

Balsera, V., Díaz-del-Río, P., Gilman, A., Uriarte, A., & Vicent, J. M. (2015). Approaching the demography of late prehistoric Iberia through summed calibrated date probability distributions (7000–2000 cal BC). *Quaternary International*, *386*, 208-211. https://doi.org/10.1016/j.quaint.2015.06.022.

Banks, W. E., d'Errico, F., Peterson, A. T., Vanhaeren, M., Kageyama, M., Sepulchre, P., Ramstein, G., Jost, A., & Lunt, D. (2008). Human ecological niches and ranges during the LGM in Europe derived from an application of eco-cultural niche modeling. *Journal of Archaeological Science*, *35*(2), 481-491. https://doi.org/10.1016/j.jas.2007.05.011.

Bao, R., Alonso, A., Delgado, C., & Pagés, J. L. (2007). Identification of the main driving mechanisms in the evolution of a small coastal wetland (Traba, Galicia, NW Spain) since its origin 5700 cal yr BP. *Palaeogeography, Palaeoclimatology, Palaeoecology*, *247*(3-4), 296-312. https://doi.org/10.1016/j.palaeo.2006.10.019.

Barandiaran, I., Almuzara, A. C., & Ruiz, A. A. (2006). Ocupaciones en altura e interior durante el Tardiglaciar: la Llanada alavesa y sus estribaciones montañosas. *Zona arqueológica*, (7), 535-550.

Belet, J. M. (1993). Etude palynologique de la tourbière de La Mata (Monts Cantabriques, Nord-Ouest de l'Espagne). *DEA «Géographie et Aménagement» option Milieux Naturels, Université Toulouse le Mirail.*

Berger, A., & Loutre, M. F. (1991). Insolation values for the climate of the last 10 million years. *Quaternary Science Reviews,* 10(4), 297-317. https://doi.org/10.1016/0277-3791(91)90033-Q.

Berger, G. W., Pérez-González, A., Carbonell, E., Arsuaga, J. L., de Castro, J. M. B., & Ku, T. L. (2008). Luminescence chronology of cave sediments at the Atapuerca paleoanthropological site, Spain. *Journal of Human Evolution*, 55(2), 300-311. https://doi.org/10.1016/j.jhevol.2008.02.012.

Berger, J. F., & Guilaine, J. (2009). The 8200 cal BP abrupt environmental change and the Neolithic transition: A Mediterranean perspective. *Quaternary international*, *200*(1-2), 31-49. https://doi.org/10.1016/j.quaint.2008.05.013.

Bernaldo de Quirós, F., Valdés, V. C., & Stuart, A. J. (2006). Nuevas dataciones para el musteriense y el magdaleniense de la cueva de El Castillo. In *En el centenario de la cueva de El Castillo: El Ocaso de los Neandertales*, 453-458.

Bernaldo de Quirós, F., Maillo, J. M., & Neira, A. (2010). La cueva de El Castillo: perspectivas desde el siglo XXI. In *El Paleolítico Superior Peninsular,* 291-310.

Bernaldo de Quirós, F., Maíllo-Fernández, J. M., Castaños, P., & Neira, A. (2015). The Gravettian of El Castillo revisited (Cantabria, Spain). *Quaternary International*, *359*, 462-478. https://doi.org/10.1016/j.quaint.2014.07.060.

Bicho, N., Carvalho, A. F., González-Sainz, C., Sanchidrián, J. L., Villaverde, V., & Straus, L. G. (2007). The upper paleolithic rock art of Iberia. *Journal of Archaeological Method and Theory*, *14*(1), 81-151. https://doi.org/10.1007/s10816-007-9025-5.

Birks, H. H., & Birks, H. J. B. (2006). Multi-proxy studies in palaeolimnology. *Vegetation history and Archaeobotany*, *15*(4), 235-251. https://doi.org/10.1007/s00334-006-0066-6.

Bischoff, J. L., Garcia, J. F., & Straus, L. G. (1992). Uranium-series isochron dating at El Castillo cave (Cantabria, Spain): the "Acheulean"/"Mousterian" question. *Journal of Archaeological Science*, *19*(1), 49-62. https://doi.org/10.1016/0305-4403(92)90006-O.

Blanco-González, A., Lillios, K. T., López-Sáez, J. A., & Drake, B. L. (2018). Cultural, demographic and environmental dynamics of the Copper and Early Bronze Age in Iberia (3300–1500 BC): towards an interregional multiproxy comparison at the time of the 4.2 ky BP event. *Journal of World Prehistory*, *31*(1), 1-79. https://doi.org/10.1007/s10963-018-9113-3.

Blas-Cortina, M. Á. D. (2014). El laboreo del cobre en la Sierra del Aramo (Asturias) como referente cardinal de la minería prehistórica en la región cantábrica. *Cuadernos de Prehistoria y Arqueología de la Universidad de Granada*. https://doi.org/10.30827/cpag.v24i0.4088.

Bond, G., Heinrich, H., Broecker, W., Labeyrie, L., McManus, J., Andrews, J., Huon, S., Jantschik, R., Clasen, S., Simet, C., Tedesco, K., Klas, M., Boani, G., & Ivy, S. (1992). Evidence for massive discharges of icebergs into the North Atlantic ocean during the last glacial period. *Nature*, 360(6401), 245-249. https://doi.org/10.1038/360245a0.

Bond, G., Showers, W., Cheseby, M., Lotti, R., Almasi, P., DeMenocal, P., Priore, P., Cullen, H., Hajdas, I., & Bonani, G. (1997). A pervasive millennial-scale cycle in North Atlantic Holocene and glacial climates. *Science*, 278(5341), 1257-1266. https://doi.org/10.1126/science.278.5341.1257.

Bond, G., Kromer, B., Beer, J., Muscheler, R., Evans, M. N., Showers, W., Hoffmann, S., Lotti-Bond, R., Hajdas, I., & Bonani, G. (2001). Persistent solar influence on North Atlantic climate during the Holocene. *Science*, 294(5549), 2130-2136. https://doi.org/10.1126/science.1065680.

Boyle, J. (2001). Inorganic geochemical methods in palaeolimnology, in: Last, W.M., & Smol, J. P. (Eds.), Tracking Environmental Change Using Lake Sediments. Vol. 2, pp. 83–141.

Bradtmöller, M. (2015). The Gravettian occupation of Level 4 at Cueva Morín (Cantabrian Region) and its regional context. *Munibe*, *66*, 23-52. https://doi.org/10.21630/maa.2015.66.02.

Bradtmöller, M., Sarmiento, A., Perales, U., & Zuluaga, M. C. (2016). Investigation of upper palaeolithic adhesive residues from cueva Morín, northern Spain. *Journal of Archaeological Science: Reports*, *7*, 1-13. https://doi.org/10.1016/j.jasrep.2016.03.051.

Cabanes, D., Mallol, C., Expósito, I., & Baena, J. (2010). Phytolith evidence for hearths and beds in the late Mousterian occupations of Esquilleu cave

(Cantabria, Spain). *Journal of Archaeological Science*, *37*(11), 2947-2957. https://doi.org/10.1016/j.jas.2010.07.010.

Cabrera-Valdés, V. (1984). El yacimiento de la cueva de "El Castillo" (Puente Viesgo, Santander) (Vol. 22). Editorial CSIC-CSIC Press.

Cabrera-Valdés, V. (1996). Del musteriense al paleolítico superior. *Gallaecia: revista de arqueoloxía e antigüidade*, (14), 123-130.

Cabrera-Valdes, V., & Bischoff, J. L. (1989). Accelerator 14 C dates for early upper paleolithic (basal Aurignacian) at El Castillo Cave (Spain). *Journal of Archaeological Science*, *16*(6), 577-584.

Cabrera-Valdés, V., Bernaldo de Quirós, F., & Maíllo Fernández, J. M. (2000). Esquemas operativos laminares en el Musteriense final de la Cueva de El Castillo (Puente Viesgo, Cantabria).

Cabrera-Valdés, V., Bernaldo de Quirós, F., Maíllo Fernández, J. M., Valladas, H., & Lloret Martínez de la Riva, M. (2002). El Auriñaciense arcaico en El Castillo (Cantabria): descripción tecnológica y objetivos de la producción.

Cáceres, J. M. T. (2009). Industria en materias duras animales de los niveles auriñacienses (5, 6, 7) del yacimiento de Cobrante. *Sautuola: Revista del Instituto de Prehistoria y Arqueología Sautuola*, (15), 199-205.

Cáceres, J. M. T. (2013). La explotación de las materias óseas en el Auriñaciense.

Carballo, J. (1960). Excavaciones en la caverna de «El Pendo» (Santander). *Investigaciones Prehistóricas II*, 15-124.

Carbonell, E., De Castro, J. M. B., Parés, J. M., Pérez-González, A., Cuenca-Bescós, G., Ollé, A., Mosquera, M., Huguet, R., Van der Made, J., Rosas, A., Sala, R., Vallverdú, J., García, N., Granger, D. E., Martinón-Torres, M., Rodríguez, X. P., Stock, G. M., Vergès, J. M., Allué, E., ..., & Arsuaga, J. L. (2008). The first hominin of Europe. *Nature*, 452(7186), 465-469. https://doi.org/10.1038/nature06815.

Carracedo, V., Cunill, R., García-Codron, J. C., Pèlachs, A., Pérez-Obiol, R., & Soriano, J. M. (2018). History of fires and vegetation since the Neolithic in the Cantabrian Mountains (Spain). *Land degradation* & *development, 29*(7), 2060-2072. https://doi.org/10.1002/ldr.2891.

Carrión, J. S. (2002). Patterns and processes of Late Quaternary environmental change in a montane region of southwestern Europe. *Quaternary Science Reviews, 21*(18-19), 2047-2066. https://doi.org/10.1016/S0277-3791(02)00010-0.

Carrión, J. S. (Eds.). (2012). *Paleoflora y paleovegetación de la Península Ibérica e Islas Baleares: Plioceno-Cuaternario*. Ministerio de Economía y Competitividad y la Universidad de Murcia, Madrid.

Castaños, P. (1992). Los mamíferos del Cuaternario de Eurasia. Paleontología de Vertebrados. Faunas y Filogenia, Aplicación y Sociedad. Universidad del País Vasco, Bilbao, 257-286.

Castro, D., Souto, M., Garcia-Rodeja, E., Pontevedra-Pombal, X., & Fraga, M. I. (2015). Climate change records between the mid-and late Holocene in a peat bog from Serra do Xistral (SW Europe) using plant macrofossils and peat humification analyses. *Palaeogeography, Palaeoclimatology, Palaeoecology*, *420*, 82-95. https://doi.org/10.1016/j.palaeo.2014.12.005.

Castro, D., Souto, M., Fraga, M. I., García-Rodeja, E., Pérez-Díaz, S., Sáez, J. A. L., & Pontevedra-Pombal, X. (2020). High-resolution patterns of palaeoenvironmental changes during the Little Ice Age and the Medieval Climate Anomaly in the northwestern Iberian Peninsula. *Geoscience Frontiers*, *11*(5), 1461-1475. https://doi.org/10.1016/j.gsf.2020.05.015.

Castro, M. T. T., Aira-Rodríguez, M. J., & Díaz-Fierros Viqueira, F. (1993). Formación de turberas en la Sierra de O Bocelo. Relación con las condiciones paleoambientales del holoceno. *Cuaderno do Laboratorio de Laxe, 18,* 365-377.

Chauvin, A. M. C. (2007). La evolución del uso de soportes líticos en la secuencia Tardiglaciar de la Cueva de El Rascaño (Mirones-Cantabria). *Trabajos de prehistoria*, *64*(1), 137-149. https://doi.org/10.3989/tp.2007.v64.i1.98.

Chauvin, A. M. C., Martínez, M. A. F., & Mayolini, L. C. T. (2018). Tecnología lítica de los niveles magdalenienses de la cueva de El Horno (Ramales de la Victoria, Cantabria). In *Septem!: Homenaje a Alberto Gómez Castanedo* (pp. 93-104). Federación ACANTO.

Clark, P. U., Marshall, S. J., Clarke, G. K., Hostetler, S. W., Licciardi, J. M., & Teller, J. T. (2001). Freshwater forcing of abrupt climate change during the last glaciation. *Science*, 293(5528), 283-287. https://doi.org/10.1126/science.1062517.

Clark, P. U., Pisias, N. G., Stocker, T. F., & Weaver, A. J. (2002). The role of the thermohaline circulation in abrupt climate change. *Nature*, 415(6874), 863-869. https://doi.org/10.1038/415863a.

Clark, P. U., Dyke, A. S., Shakun, J. D., Carlson, A. E., Clark, J., Wohlfarth, B., Mitrovica, J. X., Hostetler, S. W., & McCabe, A. M. (2009). The last glacial maximum. *Science*, 325(5941), 710-714. https://doi.org/10.1126/science.1172873.

Collins, R. (2004). *Visigothic Spain 409-711* (Vol. 2). John Wiley & Sons.

Conedera, M., Tinner, W., Neff, C., Meurer, M., Dickens, A. F., & Krebs, P. (2009). Reconstructing past fire regimes: methods, applications, and relevance to fire management and conservation. *Quaternary Science Reviews*, *28*(5-6), 555-576. https://doi.org/10.1016/j.quascirev.2008.11.005.

Connor, S. E., Araújo, J., van der Knaap, W. O., & van Leeuwen, J. F. (2012). A long-term perspective on biomass burning in the Serra da Estrela, Portugal. *Quaternary Science Reviews, 55*, 114-124. https://doi.org/10.1016/j.quascirev.2012.08.007.

Corbera, M. (1999). Ferrerías en Cantabria. In *Hierro al mar. Minas, bosques, ferrerías, astilleros y arsenales "litoral atlántico"* (pp. 45-51). Instituto de Estudios Cántabros, Asociación Tajamar.

Corchón-Rodríguez, M. S. (1999). Solutrense y Magdaleniense del Oeste de la Cornisa Cantábrica: dataciones C^{14} (calibradas) y marco cronológico.

Corella, J. P., Stefanova, V., El Anjoumi, A., Rico, E., Giralt, S., Moreno, A., Plata-Montero, A., & Valero-Garcés, B. L. (2013). A 2500-year multi-proxy reconstruction of climate change and human activities in northern Spain: the Lake Arreo record. *Palaeogeography, Palaeoclimatology, Palaeoecology*, *386*, 555-568. https://doi.org/10.1016/j.palaeo.2013.06.022.

Costa-García, J. (2018). Rediscovering the Roman Conquest of the North-western Iberian Peninsula. *Conflict Archaeology: Materialities of Collective Violence from Prehistory to Late Antiquity*, 141-151. https://doi.org/10.4324/9781315144771-13.

Costas, S., Muñoz-Sobrino, C., Alejo, I., & Pérez-Arlucea, M. (2009). Holocene evolution of a rock-bounded barrier-lagoon system, Cíes Islands, northwest Iberia. *Earth Surface Processes and Landforms*, *34*(11), 1575-1586. https://doi.org/10.1002/esp.1849.

Cuartero, F., Alcaraz-Castano, M., López-Recio, M., Carrión-Santafé, E., & Baena-Preysler, J. (2015). Recycling economy in the Mousterian of the Iberian Peninsula: The case study of El Esquilleu. *Quaternary International*, *361*, 113-130. https://doi.org/10.1016/j.quaint.2014.11.059.

Cubas, M., & Fano, M. (2011). Los primeros campesinos del Cantábrico: una revisión de la información disponible y de los modelos propuestos. *Férvedes 7*, 77-86.

Cubas, M., Altuna, J., Alvarez-Fernández, E., Armendariz, A., Fano, M. A., López-Dóriga, I. L., Mariezkurrena, K., Tapia, J., Teira, L. C., & Arias, P. (2016). Re-evaluating the Neolithic: the impact and the consolidation of farming practices in the Cantabrian region (northern Spain). *Journal of World Prehistory*, *29*(1), 79-116. https://doi.org/10.1007/s10963-016-9091-2.

Cuenca-Bescós, G., Straus, L. G., González Morales, M. R., & García Pimienta, J. C. (2008). Paleoclima y paisaje del final del Cuaternario en Cantabria: los pequeños mamíferos de la Cueva del Mirón (Ramales de la victoria). *Revista Española de Paleontología*, *23*(1), 91-126.

Cuenca-Bescós, G., Straus, L. G., Morales, M. R. G., & Pimienta, J. C. G. (2009). The reconstruction of past environments through small mammals: from the Mousterian to the Bronze Age in El Mirón Cave (Cantabria, Spain). *Journal of Archaeological Science*, *36*(4), 947-955. https://doi.org/10.1016/j.jas.2008.09.025.

Cuenca-Solana, D., Gutiérrez-Zugasti, I., Ruiz-Redondo, A., Gonzalez-Morales, M. R., Setién, J., Ruiz-Martínez, E., Palacio-Pérez, E., de las Heras, M., Prada-Freixedo, A., & Lasheras-Corruchaga, J. A. (2016). Painting Altamira Cave? Shell tools for ochre-processing in the Upper Palaeolithic in northern Iberia. *Journal of Archaeological Science*, *74*, 135-151. https://doi.org/10.1016/j.jas.2016.07.018.

Cuerno, C. C. (2001). Arozas y ferrones: las ferrerías de Cantabria en el Antiguo Régimen. Ed. Universidad de Cantabria.

Daniau, A. -L., Harrison, S. P., & Bartlein, P. J. (2010). Fire regimes during the last glacial. *Quaternary Science Reviews 29*, 2918–2930. https://doi.org/10.1016/j.quascirev.2009.11.008.

Daniau, A. -L., Bartlein, P. J., Harrison, S. P., Prentice, I. C., Brewer, S., Friedlingstein, P., Harrison-Prentice, T. I., Inoue, J., Izumi, K., Marlon, J. R., Mooney, S., Power, M. J., Stevenson, J., Tinner, W., Andrič, M., Atanassova, J., Behling, H., Black, M., Blarquez, O., Brown, K. J., Carcaillet, C., Colhoun, E.A., Colombaroli, D., Davis, B. A. S., D'Costa, D., Dodson, J., Dupont, L., Eshetu, Z., Gavin, D. G., Genries, A., Haberle, S., Hallett, D. J., Hope, G., Horn, S. P., Kassa, T. G., Katamura, F., Kennedy, L. M., Kershaw, P., Krivonogov, S., Long, C., Magri, D., Marinova, E., McKenzie, G. M., Moreno, P. I., Moss, P., Neumann, F. H., Norström, E., Paitre, C., Rius, D., Roberts, N., Robinson, G. S., Sasaki, N., Scott, L., Takahara, H., Terwilliger, V., Thevenon, F., Turner, R., Valsecchi, V. G., Vannière, B., Walsh, M., Williams, N., & Zhang, Y. (2012). Predictability of biomass burning in response to climate changes. *GlobalBiogeochemical Cycles 26*. https://doi.org/10.1029/2011GB004249.

Daniau, A. L., Desprat, S., Aleman, J. C., Bremond, L., Davis, B., Fletcher, W., Marlon, J. R., Marquer, L., Montade, V., Morales-Molino, C., Naughton, F., Rius, D., & Urrego, D. H. (2019). Terrestrial plant microfossils in palaeoenvironmental studies, pollen, microcharcoal and phytolith. Towards a comprehensive understanding of vegetation, fire and climate changes over the past one million years. *Revue de micropaléontologie, 63*, 1-35. https://doi.org/10.1016/j.revmic.2019.02.001.

Dansgaard, W., Clausen, H. B., Gundestrup, N., Hammer, C. U., Johnsen, S. F., Kristinsdottir, P. M., & Reeh, N. (1982). A new Greenland deep ice core. *Science,* 218(4579), 1273-1277. https://doi.org/10.1126/science.218.4579.1273.

Davis, B. A., Brewer, S., Stevenson, A. C., & Guiot, J. (2003). The temperature of Europe during the Holocene reconstructed from pollen data. *Quaternary science reviews*, 22(15-17), 1701-1716. https://doi.org/10.1016/S0277-3791(03)00173-2.

de las Heras, C., Barquín, R. M., Lasheras, J. A., Rasines, P., & Monforte, P. F. (2008). Dos rodetes paleolíticos procedentes de las cuevas del Linar y Las Aguas, Alfoz de Lloredo (Cantabria). *Veleia*, (24-25).

del Río, P. R., Fernández, E. M., Santamaría, S. S., Expósito, J. M. M., & Zugasti, F. I. G. (2011). Aproximación paleoambiental al nivel XIII

(Auriñaciense) del abrigo de El Cuco (Castro Urdiales. Cantabria). *Kobie. Paleoantropología*, (30), 31-42.

Denton, G. H., & Karlén, W. (1973). Holocene climatic variations—their pattern and possible cause. *Quaternary research,* 3(2), 155-205. https://doi.org/10.1016/0033-5894(73)90040-9.

Desprat, S., Sánchez Goñi, M. F., McManus, J. F., Duprat, J., & Cortijo, E. (2009). Millennial-scale climatic variability between 340 000 and 270 000 years ago in SW Europe: evidence from a NW Iberian margin pollen sequence. *Climate of the Past*, *5*(1), 53-72. https://doi.org/10.5194/cp-5-53-2009.

Diez-Castillo, A. (1996). Una cabaña neolítica en los Picos de Europa. In *I Congrés del Neolític a la Península Ibèrica* (Vol. I, pp. 349-356). Ed. Museu de Gavà.

Domínguez-Villar, D., Wang, X, Cheng, H., Martín-Chivelet, J. R., & Edwards, L. (2008). A high-resolution late Holocene speleothem record from Kaite Cave, northern SpaIn δ18O variability and possible causes. *Quaternary International,* 187(1), 40-51. https://doi.org/10.1016/j.quaint.2007.06.010.

Domínguez-Villar, D., Fairchild, I. J., Baker, A., Wang, X., Edwards, R. L., & Cheng, H. (2009). Oxygen isotope precipitation anomaly in the North Atlantic region during the 8.2 ka event. *Geology,* 37(12), 1095-1098. https://doi.org/10.1130/G30393A.1.

Domínguez-Villar, D., Wang, X., Krklec, K., Cheng, H., & Edwards, R. L. (2017). The control of the tropical North Atlantic on Holocene millennial climate oscillations. *Geology,* 45(4), 303-306. https://doi.org/10.1130/G38573.1.

d'Errico, F., Bouillot, L. D., García-Diez, M., Martí, A. P., Pimentel, D. G., & Zilhão, J. (2016). The technology of the earliest European cave paintings: El Castillo Cave, Spain. *Journal of Archaeological Science*, *70*, 48-65. https://doi.org/10.1016/j.jas.2016.03.007.

Echegaray, J. G., Freeman, L. G., de la Campa, B. M., Butzer, K. W., & Altuna, J. (1973). *Cueva Morín: excavaciones 1969*. Patronato de las Cuevas Prehistóricas, Museo de Prehistoria, Excma. Diputación de Santander.

Echegaray, J. G. (1980). El yacimiento de la cueva de "El Pendo": (excavaciones 1953-57). Editorial CSIC-CSIC Press.

Fairbanks, R. G. (1989). A 17,000-year glacio-eustatic sea level record: influence of glacial melting rates on the Younger Dryas event and deep-ocean circulation. *Nature*, 342(6250), 637-642. https://doi.org/10.1038/342637a0.

Falguères, C., Bahain, J. J., Yokoyama, Y., Arsuaga, J. L., de Castro, J. M. B., Carbonell, E., Bischoff, J. L., & Dolo, J. M. (1999). Earliest humans in Europe: the age of TD6 gran Dolina, Atapuerca, Spain. *Journal of Human Evolution*, 37(3-4), 343-352. https://doi.org/10.1006/jhev.1999.0326.

Fano, M. Á., Cubas, M., & Wood, R. (2015). The first farmers in Cantabrian SpaIn Contribution of numerical chronology to understand an historical process. *Quaternary International*, *364*, 153-161. https://doi.org/10.1016/j.quaint.2014.09.026.

Fano, M. Á., Grandela, A. C., Clemente-Conte, I., Tarriño, A., & Teira, L. C. (2020). Magdalenian knappers in the Asón Valley: Level 2 at El Horno Cave (Ramales de la Victoria, Cantabria, Spain). *Journal of Archaeological Science: Reports*, *30*, 102230. https://doi.org/10.1016/j.jasrep.2020.102230.

Fernández, E. M., & Santamaría, S. S. (2009). Análisis de la industria lítica de la cueva de Cobrante. *Sautuola: Revista del Instituto de Prehistoria y Arqueología Sautuola*, (15), 145-189.

Fernández-Tresguerres, J. A. (2004). El final del Paleolítico en los espacios cantábricos: el Aziliense. *Kobie*, *8*, 309-336.

Fernández-Tresguerres, J. A. (2006). El Aziliense de la región cantábrica. *Zephyrus LIX*, 163-179.

Fleitmann, D., Mudelsee, M., Burns, S. J., Bradley, R. S., Kramers, J., & Matter, A. (2008). Evidence for a widespread climatic anomaly at around 9.2 ka before present. *Paleoceanography,* 23(1). https://doi.org/10.1029/2007PA001519.

Fombella-Blanco, M. A., Olalla, A. A., García, E. P., Merino, Á. P., Herrero, E. A., Rodríguez, R. M., & Fernández, E. G. R. (2001). Primeros resultados sobre la dinámica de la vegetación en la turbera del Puerto de San Isidro (León, España). In *Palinología. Diversidad y aplicaciones: trabajos del XII Simposio de Palinología (APLE). León, 1998* (pp. 79-86). Servicio de Publicaciones.

Franco-Múgica, F., Antón, M. G., Ruiz, J. M., Juaristi, C. M., & Ollerol, H. S. (2001). The Holocene history of Pinnus forests in the Spanish Northern Meseta. *The Holocene*, *11*(3), 343-358. https://doi.org/10.1191/095968301669474913.

Franco-Múgica, F., García-Antón, M., Maldonado-Ruiz, J., Morla-Juaristi, C., & Sainz-Ollero, H. (2005). Ancient pine forest on inland dunes in the Spanish northern meseta. *Quaternary Research*, *63*(1), 1-14. https://doi.org/10.1016/j.yqres.2004.08.004.

Freeman, L. G. (1978). Mousterian Worked Bone from Cueva Morin (Santander, Spain): A Preliminary Description. *Views of the Past: Essays in Old World Prehistory and Paleanthropology*, 29-51.

Freeman, L. G. (1983). More on the Mousterian: flaked bone from Cueva Morín. *Current Anthropology*, *24*(3), 366-377.

Frochoso, M., González-Pellejero, R., & Allende, F. (2013). Pleistocene glacial morphology and timing of Last Glacial Cycle in Cantabrian Mountains (Northern Spain): new chronological data from the Asón Area. *Open Geosciences*, 5(1), 12-27. https://doi.org/10.2478/s13533-012-0117-8.

Gallego, J. L. R., Ortiz, J. E., Sierra, C., Torres, T., & Llamas, J. F. (2013). Multivariate study of trace element distribution in the geological record of Roñanzas Peat Bog (Asturias, N. Spain). Paleoenvironmental evolution and human activities over the last 8000 cal yr BP. *Science of the total Environment*, *454*, 16-29. https://doi.org/10.1016/j.scitotenv.2013.02.083.

García-Alonso, M. (1999). Los carboneros de los bosques de Cantabria. In *Hierro al mar. Minas, bosques, ferrerías, astilleros y arsenales "litoral atlántico"* (pp. 96-105). Instituto de Estudios Cántabros, Asociación Tajamar.

García-Amorena, I., Morla, C., Rubiales, J. M., & Gómez Manzaneque, F. (2008). Taxonomic composition of the Holocene forests of the northern coast of Spain, as determined from their macroremains. *The Holocene*, *18*(5), 819-829. https://doi.org/10.1177/0959683608089218.

García-Amorena, I., Rubiales, J. M., Amat, E. M., González, R. I., & Gómez-Manzaneque, F. (2011). New macrofossil evidence of Pinus nigra Arnold on the Northern Iberian Meseta during the Holocene. *Review of Palaeobotany and Palynology*, *163*(3-4), 281-288. https://doi.org/10.1016/j.revpalbo.2010.10.010.

García-Antón, M., Ruiz-Zapata, B., & Ugarte, F. M. (1989). Analisis geomorphologico y palinologico de la turbera de Saldropo, Barazar, Zeanuni, Bizkaia. *Lurralde (San Sebastián)*, (12), 25-44.

García-Antón, M., Múgica, F. F., Ollero, H. S., Juaristi, C. M., & Ruiz, J. M. (1994). Una secuencia polínica en Quintana Redonda (Soria). Evolución holocena del tapiz vegetal en el Sistema Ibérico septentrional. In *Anales del Jardín Botánico de Madrid* (Vol. 52, No. 2, pp. 187-195). Real Jardín Botánico.

García-Antón, M., Múgica, F. F., Maldonado, J., Juaristi, C. M., & Ollero, H. S. (1997). New data concerning the evolution of the vegetation in Lillo pinewood (León, Spain). *Journal of Biogeography*, 929-934. https://doi.org/10.1046/j.1365-2699.1997.00181.x.

García-Antón, M., Gil-Romera, G., Pagés, J. L., & Alonso-Millán, A. (2006). The Holocene pollen record in the Villaviciosa Estuary (Asturias, North Spain*). Palaeogeography, Palaeoclimatology, Palaeoecology, 237*(2-4), 280-292. https://doi.org/10.1016/j.palaeo.2005.12.004.

García-Diez, M., Hoffmann, D. L., Zilhão, J., de Las Heras, C., Lasheras, J. A., Montes, R., & Pike, A. W. (2013). Uranium series dating reveals a long sequence of rock art at Altamira Cave (Santillana del Mar, Cantabria). *Journal of Archaeological Science*, *40*(11), 4098-4106. https://doi.org/10.1016/j.jas.2013.05.011.

García-Diez, M., Garrido, D., Hoffmann, D., Pettitt, P., Pike, A., & Zilhão, J. (2015). The chronology of hand stencils in European Palaeolithic rock art: implications of new U-series results from El Castillo Cave (Cantabria, Spain). *Journal of Anthropological sciences*, *93*, 135-152. https://doi.org/10.4436/JASS.93004.

García-Moreiras, I., Delgado, C., Martínez-Carreño, N., García-Gil, S., & Muñoz-Sobrino, C. (2019a). Climate and vegetation changes in coastal ecosystems during the Middle Pleniglacial and the early Holocene: Two multi-proxy, high-resolution records from Ría de Vigo (NW Iberia). *Global and Planetary Change*, *176*, 100-122. https://doi.org/10.1016/j.gloplacha.2019.02.015.

García-Moreiras, I., Cartelle, V., García-Gil, S., Muñoz-Sobrino, C. (2019b). First high-resolution multi-proxy palaeoenvironmental record of the Late Glacial to Early Holocene transition in the Ría de Arousa (Atlantic margin of NW Iberia). *Quaternary Science Reviews, 215,* 308-321. https://doi.org/10.1016/j.quascirev.2019.05.016.

García-Rovés, E. (2007). *Dinámica de la Paleovegetación y cambios climáticos durante el Tardiglaciar y Holoceno en secuencias sedimentarías de la provincia de León*. Universidad de León.

García-Rovés, E., Puente-García, E., Fombella-Blanco, M. A., Ruiz-Zapata, M. B., & Marcos Varela, L. (2001). Primeros resultados palinológicos de la turbera del Puerto de Leitariegos, Provincia de León, in: Moreno-Grau, S., Elvira-Rendueles, B., & Moreno-Angosto, J. M. (Eds.), *XIII Simposio de la Asociación de Palinólogos en Lengua Española (A.P.L.E.)*. Universidad Politécnica de Cartagena, Cartagena, 283-290.

Garralda, M. D., Maíllo-Fernández, J. M., Higham, T., Neira, A., & Bernaldo de Quirós, F. (2019). The Gravettian child mandible from El Castillo Cave (Puente Viesgo, Cantabria, Spain). *American Journal of Physical Anthropology*, *170*(3), 331-350. https://doi.org/10.1002/ajpa.23906.

Gil-García, M. J., Las Heras, R. T., Olivera, E. N., & Abaigar, J. M. (1995). Análisis polínico de un depósito higroturboso de la Sierra de Cameros (La Rioja, España). *Zubía, (13),* 33-41.

Gil-García, M. J., Valiño, M. D., Rodríguez, A. V., & Zapata, M. B. R. (2002). Late-glacial and Holocene palaeoclimatic record from Sierra de Cebollera (northern Iberian Range, Spain). *Quaternary International*, *93*, 13-18. https://doi.org/10.1016/S1040-6182(02)00003-4.

Gil-Romera, G., González-Sampériz, P., Lasheras-Álvarez, L., Sevilla-Callejo, M., Moreno, A., Valero-Garcés, B., López-Merino, L., Carrión, J. S., Pérez-Sanz, A., Aranbarri, J., & Fronce, E. G. P. (2014). Biomass-modulated fire dynamics during the last glacial–interglacial transition at the Central Pyrenees (Spain). *Palaeogeography, Palaeoclimatology, Palaeoecology, 402*, 113-124. https://doi.org/10.1016/j.palaeo.2014.03.015.

Gómez-Lobo Rodríguez, A. (1993). *Historia de la vege tación durante los últimos 15.000 años en los Picos de Urbión (Soria) en base al análisis polínico*. Universidad de Alcalá de Henares: Alcalá de Henares.

Gómez-Lobo Rodríguez, A., García, M. J. G., Ballano, M. A., & Ruiz-Zapata, M. B. R. (1996). Evolución de la paleovegetación en el noroeste del Sistema

Ibérico (Soria), durante los últimos 7000 BP. *Botánica Macaronésica*, (23), 233-240.

Gómez-Orellana, L. R., Ramil-Rego, P., & Muñoz-Sobrino, C. (1998). Una nueva secuencia polínica y cronológica para el depósito pleistoceno de Mougás (NW de la Península Ibérica). *Revue de Paléobiologie, 17*, 35-47.

Gómez-Orellana, L. R., Ramil-Rego, P., & Sánchez, S. M. (2001). Modificaciones del paisaje durante el Pleistoceno Superior-Holoceno en los territorios litorales atlánticos del NW Ibérico. *Estudos do Quaternário/Quaternary Studies, (4)*, 79-96. https://doi.org/10.30893/eq.v0i4.43.

Gómez-Orellana, L. R., Ramil-Rego, P., & Muñoz-Sobrino, C. (2007). The Würm in NW Iberia, a pollen record from area Longa (Galicia). *Quaternary Research*, *67*(3), 438-452. https://doi.org/10.1016/j.yqres.2007.01.003.

Gómez-Orellana, L. R., Ramil Rego, P., Muñoz Sobrino, C., & Bettencourt, A. (2010). El paisaje Holoceno en la Serra de Arga (NW Portugal). In Bettencourt A. M. S., Alves M. I. C., Monteiro-Rodrigues S. (Eds.), Variações Paleoambientais e Evolução Antrópica no Quaternário do Ocidentente Peninsular/Palaeoenvironmental Changes and Anthropization in the Quaternary of Western Iberia, Braga, Associação Portuguesa para o Estudo do Quaternário-APEQ/Centro de Investigação Transdisciplinar (pp. 53-59). Cultura, Espaço e Memória-CITCEM.

Gómez-Orellana, L. R., Ramil-Rego, P., & Muñoz-Sobrino, C. (2013). The response of vegetation at the end of the last glacial period (MIS 3 and MIS 2) in littoral areas of NW I beria. *Boreas, 42*(3), 729-744. https://doi.org/10.1111/j.1502-3885.2012.00310.x.

González-Pellejero, R., Allende, F., López-Sáez, J. A., Frochoso-Sánchez, M., Alba-Sánchez, F., & Abel-Schaad, D. (2014). Dinámicas naturales y antrópicas en los paisajes vegetales de los valles internos de Cantabria occidental (Norte de España). *Boletín de la Asociación de Geógrafos Españoles, 65,* 139-165. https://doi.org/10.21138/bage.1747.

González-Rabanal, B., Marín-Arroyo, A. B., Jones, J. R., Pérez, L. A., Vega-Maeso, C., & González-Morales, M. R. (2020). Diet, mobility and death of Late Neolithic and Chalcolithic groups of the Cantabrian Region (northern Spain). A multidisciplinary approach towards studying the Los Avellanos I and II burial caves. *Journal of Archaeological Science: Reports*, *34*, 102644. https://doi.org/10.1016/j.jasrep.2020.102644.

González-Sainz, C. (1989). El Magdaleniense Superior-Final de la región cantábrica. Ed. Universidad de Cantabria.

González-Sainz, C. (1994). Sobre la cronoestratigrafía del Magdaleniense y Aziliense en la región cantábrica. *Munibe. Ciencias naturales*, *46*, 53-68.

González-Sainz, C. (2005). Actividad gráfica Magdaleniense en la región Cantábrica. Datación y modificaciones iconográficas. In *Actas do IV*

Congresso de Arqueología Peninsular (pp. 157-181). Universidade do Algarbe Faro.

González-Sainz, C. (2007). El tema del "ciervo herido" en el arte parietal paleolítico de la región Cantábrica: evaluación iconográfica. *Veleia,* 25-25, 305-327.

González-Sainz, C. (2012). Una introducción al arte parietal paleolítico de la región Cantábrica. In Arte sin artistas. Una mirada al Paleolítico:[exposición celebrada en el] Museo Arqueológico Regional, Alcalá de Henares, Madrid, de diciembre de 2012 a abril de 2013 (pp. 153-184).

González-Sainz, C., & González-Urquijo, J. E. (2004). El Magdaleniense reciente en la región cantábrica. *Las Sociedades del Paleolítico en la Región Cantábrica. Anejo de Kobie. Diputación Foral de Bizkaia. Bilbao*, 275-308.

González-Sampériz, P., Utrilla, P., Mazo, C., Valero-Garcés, B., Sopena, M. C., Morellón, M., Sebastián, M., Moreno, A., & Martínez-Bea, M. (2009). Patterns of human occupation during the early Holocene in the Central Ebro Basin (NE Spain) in response to the 8.2 ka climatic event. *Quaternary Research*, *71*(2), 121-132. https://doi.org/10.1016/j.yqres.2008.10.006.

Gouzy, A., Malaizé, B., Pujol, C., & Charlier, K. (2004). Climatic "pause" during Termination II identified in shallow and intermediate waters off the Iberian margin. *Quaternary Science Reviews*, *23*(14-15), 1523-1528. https://doi.org/10.1016/j.quascirev.2004.03.002.

Grachev, A. M., & Severinghaus, J. P. (2005). A revised + 10±4 ºC magnitude of the abrupt change in Greenland temperature at the Younger Dryas termination using published GISP2 gas isotope data and air thermal diffusion constants. *Quaternary Science Reviews,* 24(5-6), 513-519. https://doi.org/10.1016/j.quascirev.2004.10.016.

Gutiérrez-Zugasti, I., Cuenca-Solana, D., del Río, P. R., Muñoz, E., Santamaría, S., & Morlote, J. M. (2013). The role of shellfish in hunter–gatherer societies during the Early Upper Palaeolithic: A view from El Cuco rockshelter, northern Spain. *Journal of Anthropological Archaeology*, *32*(2), 242-256. https://doi.org/10.1016/j.jaa.2013.03.001.

Gutiérrez-Zugasti, I., Rios-Garaizar, J., Marín-Arroyo, A. B., del Río, P. R., Maroto, J., Jones, J. R., Bailey, G. N., & Richards, M. P. (2018). A chrono-cultural reassessment of the levels VI–XIV from El Cuco rock-shelter: A new sequence for the Late Middle Paleolithic in the Cantabrian region (northern Iberia). *Quaternary International*, *474*, 44-55. https://doi.org/10.1016/j.quaint.2017.06.059.

Hannon, G. E. (1985). *Late Quaternary Vegetation of Sanabria Marsh North West Spain*. Trinity College Dublin.

Harrison, S. P., Marlon, J. R., & Bartlein, P. J. (2010). Fire in the Earth system, in: *Changing climates, earth systems and society*. Springer, Dordrecht, pp. 21-48. https://doi.org/10.1007/978-90-481-8716-4_3.

Heinrich, H. (1988). Origin and consequences of cyclic ice rafting in the northeast Atlantic Ocean during the past 130,000 years. *Quaternary research*, 29(2), 142-152. https://doi.org/10.1016/0033-5894(88)90057-9.

Hemming, S. R. (2004). Heinrich events: Massive late Pleistocene detritus layers of the North Atlantic and their global climate imprint. *Reviews of Geophysics*, 42(1). https://doi.org/10.1029/2003RG000128.

Higham, T., Douka, K., Wood, R., Ramsey, C. B., Brock, F., Basell, L., Camps, M., Arrizabalaga, A., Baena, J., Barroso-Ruíz, C., Bergman, C., Boitard, C., Boscato, P., Caparrós, M., Conard, N. J., Draily, C., Froment, A., Galván, B., Gambassini, P., & Jacobi, R. (2014). The timing and spatiotemporal patterning of Neanderthal disappearance. *Nature*, *512*(7514), 306-309. https://doi.org/10.1038/nature13621.

Hoffmann, D. L., Standish, C. D., García-Diez, M., Pettitt, P. B., Milton, J. A., Zilhão, J., Alcolea-González, J. J., Cantalejo-Duarte, P., Collado, H., de Balbín, R., Lorblanchet, M., Ramos-Muñoz, J., Weniger, G. –Ch., & Pike, A. W. (2018a). U-Th dating of carbonate crusts reveals Neandertal origin of Iberian cave art. *Science*, *359*(6378), 912-915. https://doi.org/10.1126/science.aap7778.

Hoffmann, D. L., Standish, C. D., García-Díez, M., Pettitt, P. B., Milton, J. A., Zilhão, J., Alcolea-González, J. J., Cantalejo-Duarte, P., Collado, H., de Balbín, R., Lorblanchet, M., Ramos-Muñoz, J., Weniger, G. –Ch., & Pike, A. W. (2018b). Response to Comment on "U-Th dating of carbonate crusts reveals Neandertal origin of Iberian cave art". *Science*, *362*(6411). https://doi.org/10.1126/science.aau1736.

Hoffmann, D. L., Standish, C. D., García-Díez, M., Pettitt, P. B., Milton, J. A., Zilhão, J., Alcolea-González, J. J., Cantalejo-Duarte, P., Collado, H., de Balbín, R., Lorblanchet, M., Ramos-Muñoz, J., Weniger, G. –Ch., & Pike, A. W. (2020). Response to White et al.'s reply: 'Still no archaeological evidence that Neanderthals created Iberian cave art' [J. Hum. Evol. (2020) 102640]. *Journal of Human Evolution*, *144*, 102810. https://doi.org/10.1016/j.jhevol.2020.102810.

Hoyos-Gómez, M., & Laville, H. (1982). Nuevas aportaciones sobre la estratigrafía y sedimentología de los depósitos del Paleolítico Superior de la Cueva de El Pendo (Santander): sus implicaciones.

Iriarte-Chiapusso, M. J. (2009). Vegetation landscape and the anthropization of the environment in the central sector of the Northern Iberian Peninsula: Current status. *Quaternary International, 200*(1-2), 66-76. https://doi.org/10.1016/j.quaint.2008.10.008.

Iriarte-Chiapusso, M. J., Sobrino, C. M., Rego, P. R., & Guitián, M. R. (2001). Análisis palinológico de la turbera de San Mamés de Abar (Burgos). In *Palinología. Diversidad y aplicaciones: trabajos del XII Simposio de Palinología (APLE). León, 1998* (pp. 87-93). Servicio de Publicaciones.

Iriarte-Chiapusso, M. J., Ramil-Rego, P., & Muñoz-Sobrino, C. (2003). El registro postglaciar de dos turberas situadas en el norte de la provincia de Burgos. *Polen, 13,* 55-68.

Iriarte-Chiapusso, M. J., Mujika, J., & Tarriño, A. (2005). Herriko Barra (Zarautz Gipuzkoa): caractérisation industrielle et économique des premiers groupes de producteurs sur le littoral basque. Actas del Colloque Unite et diversité des processus de néolithisation sur la fac-ade atlantique de l'Europe. Bulletin de la Société Préhistorique Française XXXVI, 127–136.

Iriarte-Chiapusso, M. J., Muñoz-Sobrino, C., García-Orellana, L., & Ramil-Rego, P. (2006). Dinámica del paisaje en la Reserva de la Biosfera del Urdaibai durante el Holoceno. In *Comunicaciones/III Congreso Español de Biogeografía Universidad del País Vasco/Euskal Herriko Unibertsitatea*, pp. 113-117.

Iriarte-Chiapusso, M. J., Muñoz-Sobrino, C., Gómez-Orellana, L., Hernández-Beloqui, B., García-Moreiras, I., Fernández-Rodriguez, C., Heiri, O., Lotter, A. F., Ramil-Rego, P. (2016). Reviewing the Lateglacial–Holocene transition in NW Iberia: a palaeoecological approach based on the comparison between dissimilar regions. *Quaternary International, 403,* 211-236. https://doi.org/10.1016/j.quaint.2015.09.029.

Isono, D., Yamamoto, M., Irino, T., Oba, T., Murayama, M., Nakamura, T., & Kawahata, H. (2009). The 1500-year climate oscillation in the midlatitude North Pacific during the Holocene. *Geology,* 37(7), 591-594. https://doi.org/10.1130/G25667A.1.

Iversen, J. (1953). Radiocarbon dating of the Alleröd period. *Science*, 118(3053), 9-11. https://doi.org/10.1126/science.118.3053.9.

Jalut, G., Turu-Michels, V., Dedoubat, J. J., Otto, T., Ezquerra, J., Fontugne, M., Belet, J. M., Bonnet, L., García de Celis, A., Redondo-Vega, J. M., Vidal-Romaní, J. R., & Santos, L. (2010). Palaeoenvironmental studies in NW Iberia (Cantabrian range): vegetation history and synthetic approach of the last deglaciation phases in the western Mediterranean. *Palaeogeography, Palaeoclimatology, Palaeoecology, 297*(2), 330-350. https://doi.org/10.1016/j.palaeo.2010.08.012.

Jiménez, M., & Farias, P. (2005). Geomorfología glaciar en la Cordillera Cantábrica (noroeste de España: algunos ejemplos). *Enseñanza de las Ciencias de la Tierra*, *13*(3), 259-269.

Jiménez-Sánchez, M., Ruiz-Zapata, M., Arquer, P. F., Valiño, M. D., García, M. G., & Rodríguez, A. V. (2003). Palaeoenvironmental research in cantabrian mountains: redes natural, park and comella basin. In *Quaternary climatic changes and environmental crises in the Mediterranean Region. Universidad de Alcalá de Henares, Ministerio de Ciencia y Tecnología, INQUA, Alcalá de Henares* (pp. 229-240).

Johnsen, S. J., Clausen, H. B., Dansgaard, W., Fuhrer, K., Gundestrup, N., Hammer, C. U., Iversen, P., Jouzel, J., Stauffer, B., & Stauffer, B. (1992).

Irregular glacial interstadials recorded in a new Greenland ice core. *Nature*, 359(6393), 311-313. https://doi.org/10.1038/359311a0.

Johnsen, S. J., Dahl-Jensen, D., Gundestrup, N., Steffensen, J. P., Clausen, H. B., Miller, H., Masson-Delmotte, V., Sveinbjörnsdottir, A. E., & White, J. (2001). Oxygen isotope and palaeotemperature records from six Greenland ice-core stations: Camp Century, Dye-3, GRIP, GISP2, Renland and NorthGRIP. *Journal of Quaternary Science:* Published for the Quaternary Research Association, 16(4), 299-307. https://doi.org/10.1002/jqs.622.

Jones, J. R., Richards, M. P., Reade, H., Bernaldo de Quirós, F., & Marín-Arroyo, A. B. (2019). Multi-Isotope investigations of ungulate bones and teeth from El Castillo and Covalejos caves (Cantabria, Spain): Implications for paleoenvironment reconstructions across the Middle-Upper Palaeolithic transition. *Journal of Archaeological Science: Reports*, *23*, 1029-1042. https://doi.org/10.1016/j.jasrep.2018.04.014.

Joos, F., & Spahni, R. (2008). Rates of change in natural and anthropogenic radiative forcing over the past 20,000 years. *Proceedings of the National Academy of Sciences,* 105(5), 1425-1430. https://doi.org/10.1073/pnas.0707386105.

Jordá-Pardo, J. F., Baena, J., Carral-González, P., García-Guinea, J., Correcher-Delgado, V., & Yravedra J. (2008). Procesos sedimentarios y diagenéticos en el registro arqueológico del yacimiento Pleistoceno de la Cueva de El Esquilleu (Picos de Europa, Norte de España). *Cuaternario y geomorfología*.

Kaal, J., Marco, Y. C., Asouti, E., Seijo, M. M., Martínez-Cortizas, A., Casáis, M. C., & Boado, F. C. (2011). Long-term deforestation in NW Spain: linking the Holocene fire history to vegetation change and human activities. *Quaternary Science Reviews*, *30*(1-2), 161-175. https://doi.org/10.1016/j.quascirev.2010.10.006.

Kaal, J., Criado-Boado, F., Costa-Casais, M., López-Sáez, J. A., López-Merino, L., Mighall, T., Carrión, Y., Silva-Sánchez, N., & Martínez-Cortizas, A. (2013). Prehistoric land use at an archaeological hot-spot (the rock art park of Campo Lameiro, NW Spain) inferred from charcoal, synanthropic pollen and non-pollen palynomorph proxies. *Journal of Archaeological Science*, *40*(3), 1518-1527. https://doi.org/10.1016/j.jas.2012.09.024.

Komárek, M., Ettler, V., Chrastný, V., & Mihaljevič, M. (2008). Lead isotopes in environmental sciences: a review. *Environment international*, *34*(4), 562-577. https://doi.org/10.1016/j.envint.2007.10.005.

Krawchuk, M. A., & Moritz, M. A. (2011). Constraints on global fire activity vary across a resource gradient. *Ecology*, *92*(1), 121-132. https://doi.org/10.1890/09-1843.1.

Kylander, M. E., Weiss, D. J., Martínez-Cortizas, A., Spiro, B., Garcia-Sanchez, R., & Coles, B. J. (2005). Refining the pre-industrial atmospheric Pb isotope evolution curve in Europe using an 8000 year old peat core from

NW Spain. *Earth and Planetary Science Letters*, *240*(2), 467-485. https://doi.org/10.1016/j.epsl.2005.09.024.

Lambeck, K., Rouby, H., Purcell, A., Sun, Y., & Sambridge, M. (2014). Sea level and global ice volumes from the Last Glacial Maximum to the Holocene. *Proceedings of the National Academy of Sciences*, 111(43), 15296-15303. https://doi.org/10.1073/pnas.1411762111.

Lefebvre, A., Marín-Arroyo, A. B., Álvarez-Fernández, E., De la Rasilla Vives, M., Matías, E. D., Cueto, M., Tapia, J., Berganza, E., & Pétillon, J. M. (2021). Interconnected Magdalenian societies as revealed by the circulation of whale bone artefacts in the Pyreneo-Cantabrian region. *Quaternary Science Reviews*, *251*, 106692. https://doi.org/10.1016/j.quascirev.2020.106692.

Lewis, P. R., & Jones, G. D. B. (1970). Roman gold-mining in north-west Spain. *The Journal of Roman Studies*, *60*, 169-185. https://doi.org/10.1017/S0075435800043343.

Lindgren, A., Hugelius, G., Kuhry, P., Christensen, T. R., & Vandenberghe, J. (2016). Gis-based maps and area estimates of northern hemisphere permafrost extent during the last glacial maximum. *Permafrost and Periglacial Processes,* 27(1), 6-16. https://doi.org/10.1002/ppp.1851.

Lisiecki, L. E., & Raymo, M. E. (2005). A Pliocene-Pleistocene stack of 57 globally distributed benthic δ18O records. *Paleoceanography*, 20(1). https://doi.org/10.1029/2004PA001071.

Long, L. (1999). Lead isotopes, in: Marshall, C. P., & Fairbridge, R. W. (Eds.). Encyclopedia of Geochemistry, Kluwer Academic Publishers.

López-Días, V., Borrego, Á. G., & Blanco, C. G. (2010). Vertical evolution of petrographic and organic geochemical parameters in Las Dueñas mire (Cantabrian Coast, North Spain). *International journal of coal geology*, *84*(3-4), 179-189. https://doi.org/10.1016/j.coal.2010.08.004.

López-Dias, V., Urbanczyk, J., Blanco, C. G., & Borrego, A. G. (2013a). Biomarkers as paleoclimate proxies in peatlands in coastal high plains in Asturias, N Spain. *International journal of coal geology*, *116*, 270-280. https://doi.org/10.1016/j.coal.2013.04.006.

López-Días, V., Blanco, C. G., Bechtel, A., Püttmann, W., & Borrego, A. G. (2013b). Different source of n-alkanes and n-alkan-2-ones in a 6000 cal. yr BP Sphagnum-rich temperate peat bog (Roñanzas, N Spain). *Organic geochemistry*, *57*, 7-10. https://doi.org/10.1016/j.orggeochem.2013.01.006.

López-García, P. (1978). Resultados polínicos del Holoceno en la Península Ibérica. *Trabajos de prehistoria, 35,* 9-44.

López-Merino, L. (2009). *Paleoambiente y antropización en Asturias durante el Holoceno.* Universidad Autónoma de Madrid, Madrid.

López-Merino, L., López Sáez, J. A., & López García, P. (2006). Estudio palinológico de la turbera litoral holocena de Las Dueñas (Cudillero, Asturias, España). *Revista Española de Micropaleontología*, *38*(2-3), 299-308.

López-Merino, L., Martínez-Cortizas, A., & López-Sáez, J. A. (2010). Early agriculture and palaeoenvironmental history in the North of the Iberian Peninsula: a multiproxy analysis of the Monte Areo mire (Asturias, Spain). *Journal of Archaeological Science, 37*, 1978-1988. https://doi.org/10.1016/j.jas.2010.03.003.

López-Merino, L., Martínez-Cortizas, A., & López-Sáez, J. A. (2011). Human-induced changes on wetlands: a study case from NW Iberia. *Quaternary Science Reviews*, *30*(19-20), 2745-2754. https://doi.org/10.1016/j.quascirev.2011.06.004.

López-Merino, L., Sánchez, N. S., Kaal, J., López-Sáez, J. A., & Martínez-Cortizas, A. (2012). Post-disturbance vegetation dynamics during the Late Pleistocene and the Holocene: An example from NW Iberia. *Global and Planetary Change, 92,* 58-70. https://doi.org/10.1016/j.gloplacha.2012.04.003.

López-Merino, L., Martínez-Cortizas, A., Reher, G. S., López-Sáez, J. A., Mighall, T. M., & Bindler, R. (2014). Reconstructing the impact of human activities in a NW Iberian Roman mining landscape for the last 2500 years. *Journal of Archaeological Science*, *50*, 208-218. https://doi.org/10.1016/j.jas.2014.07.016.

Luret, M., Burke, A., Bernaldo de Quiros, F., & Besse, M. (2020). El Castillo cave (Cantabria, Spain): Archeozoological comparison between the Mousterian occupation level (unit 20) and the "Aurignacien de transition de type El Castillo" (unit 18). *Journal of Archaeological Science: Reports*, *31*, 102-339. https://doi.org/10.1016/j.jasrep.2020.102339.

Maíllo-Fernández, J. M. (2001). Aproximación al fenómeno laminar en el Paleolítico medio: El ejemplo de la Cueva Morín (Villanueva de Villaescusa, Cantabria). *Espacio Tiempo y Forma. Serie I, Prehistoria y Arqueología, 14.*

Maíllo-Fernández, J. M., Valladas, H., Cabrera Valdés, V., & Bernardo de Quirós, F. (2001). Nuevas dataciones para el Paleolítico superior de Cueva Morín (Villanueva de Villaescusa, Cantabria).

Maíllo-Fernández, J. M., Arteaga, C., Iriarte-Chiapusso, M. J., Fernández, A., Wood, R., Bernaldo de Quiros, F., & Sala Ramos, R. (2014). Cueva Morín (Villanueva de Villaescusa, Cantabria). In *Los Cazadores Recolectores Del Pleistoceno Y Del Holoceno En Iberia Y El Estrecho de Gibraltar* (pp. 72-78). Universidad de Burgos.

Maldonado-Ruiz, J. (1994) *Evolución Tardiglaciar y Holocena de los macizos del Noroeste Peninsular*. Escuela técnica superior de ingenieros de Montes. Universidad Politécnica de Madrid.

Mantecón, L. (2000). La minería romana en Cantabria. *Nivel cero: revista del grupo arqueológico Attica*, (8), 37-58.

Manzano-Espinosa, I., Baena, J., Lázaro, A. L., Martín-Puig, D., Albiach, L. D., & García, M. R. (2005). Análisis de los recursos líticos en la Cueva del Esquilleu: gestión y comportamiento durante el Musteriense (Comarca de la Liébana, Occidente de Cantabria). In *Neandertales cantábricos, estado de la cuestión: actas de la reunión científica: celebrada en el Museo de Altamira los días 20-22 de octubre de 2004* (pp. 285-300). Subdirección General de Publicaciones, Información y Documentación.

Marcott, S. A., Shakun, J. D., Clark, P. U., & Mix, A. C. (2013). A reconstruction of regional and global temperature for the past 11,300 years. *Science*, 339(6124), 1198-1201. https://doi.org/10.1126/science.1228026.

Marín-Arroyo, A. B., Rios-Garaizar, J., Straus, L. G., Jones, J. R., De la Rasilla, M., González-Morales, M. R., Richards, M., Altuna, J., & Ocio, D. (2018a). Chronological reassessment of the Middle to Upper Paleolithic transition and Early Upper paleolithic cultures in cantabrian Spain. *PloS one*, *13*(4), e0194708. https://doi.org/10.1371/journal.pone.0194708.

Marín-Arroyo, A. B., Geiling, J. M., Jones, J. R., Morales, M. R. G., Straus, L. G., & Richards, M. P. (2018b). The Middle to Upper Palaeolithic transition at El Mirón Cave (Cantabria, Spain). *Quaternary International*, *544,* 23-31. https://doi.org/10.1016/j.quaint.2018.06.036.

Marín-Arroyo, A. B., Geiling, J. M., Jones, J. R., Morales, M. R. G., Straus, L. G., & Richards, M. P. (2020). The middle to upper Palaeolithic transition at El Mirón cave (Cantabria, Spain). *Quaternary International*, *544*, 23-31. https://doi.org/10.1016/j.quaint.2018.06.036.

Marín-Suárez, C., & González-Álvarez, D. (2011). La romanización del Occidente Cantábrico: de la violencia física a la violencia simbólica. *Férvedes*, *7*, 197-206.

Mariscal, B. (1983). Estudio polínico de la turbera del Cueto de la Avellanosa, Polaciones (Cantabria*). Cadernos do Laboratorio Xeolóxico de Laxe, 5,* 205-226.

Mariscal, B. (1986). Análisis polínico de la turbera del Pico Sertal, de la Sierra de Peña Labra. Reconstrucción de la paleoflora y de la paleoclimatología durante el holoceno en la zona oriental de la Cordillera Cantábrica. In López-Vera, F. (Eds.), *Quaternary climate in western mediterranean: Proceeding of the Symposium on Climatic Fluctuations during the Quaternary in the Western Mediterranean Regions,* Madrid, Jun. 16-21, 205-220.

Mariscal, B. (1987). *Estudio Palinológico de la Flora Holocénica de Cantabria. Aspectos Paleoclimáticos.* Universidad Complutense.

Mariscal, B. (1989). Comparacion palinologica entre una turbera de la cordillera central y unas turberas de la cordillera cantabrica. In *European Paleobot. Conference.* Universidad Complutense, Madrid.

Mariscal, B. (1993). Variacion de la vegetacion Holocena (4300-280 BP) de Cantabria a traves del analisis polinico de la turbera del Alsa. *Estudios Geológicos, 49*(1-2), 63-68. https://doi.org/10.3989/egeol.93491-2338.

Marlon, J. R., Kelly, R., Daniau, A. L., Vannière, B., Power, M. J., Bartlein, P., Higuera, P., Blarquez, O., Brewer, S., Brücher, T., Feurdean, A., Romera, G. G., Iglesias, V., Maezumi, S. Y., Magi, B., Courtney-Mustaphi, C. J., & Zhihai, T. (2016). Reconstructions of biomass burning from sediment-charcoal records to improve data–model comparisons. *Biogeosciences 13*, 3225–3244. https://doi.org/10.5194/bg-13-3225-2016.

Maroto, J., Vaquero, M., Arrizabalaga, Á., Baena, J., Baquedano, E., Jordá, J., Julià, R., Montes, R., Van Der Plicht, J., Rasines, P., & Wood, R. (2012). Current issues in late Middle Palaeolithic chronology: New assessments from Northern Iberia. *Quaternary International*, *247*, 15-25. https://doi.org/10.1016/j.quaint.2011.07.007.

Martín-Chivelet, J., Muñoz-García, M. B., Edwards, R. L., Turrero, M. J., & Ortega, A. I. (2011). Land surface temperature changes in Northern Iberia since 4000 yr BP, based on δ13C of speleothems. *Global and Planetary Change,* 77(1-2), 1-12. https://doi.org/10.1016/j.gloplacha.2011.02.002.

Martín-Perea, D. M., Maíllo-Fernández, J. M., Marín, J., Arroyo, X., & Asiaín, R. (2022). A step back to move forward: a geological re-evaluation of the El Castillo Cave Middle Palaeolithic lithostratigraphic units (Cantabria, northern Iberia). *Journal of Quaternary Science,* 1-14. https://doi.org/10.1002/jqs.3473.

Martínez, M., & Mantecón L. (2012). Aproximación a las fortificaciones de cronología altomedieval en Cantabria. *Los castillos altomedievales en el noroeste de la Península Ibérica, Documentos de Arqueología Medieval*, *4*, 99-122.

Martínez-Cortizas, A., Pontevedra-Pombal, X., Munoz, J. N., & García-Rodeja, E. (1997). Four thousand years of atmospheric Pb, Cd and Zn deposition recorded by the ombrotrophic peat bog of Penido Vello (Northwestern Spain). *Water, air, and soil pollution*, *100*(3), 387-403. https://doi.org/10.1023/A:1018312223189.

Martínez-Cortizas, A., Pontevedra-Pombal, X., Garcıa-Rodeja, E., Novoa-Munoz, J. C., & Shotyk, W. (1999). Mercury in a Spanish peat bog: archive of climate change and atmospheric metal deposition. *Science*, *284*(5416), 939-942. https://doi.org/10.1126/science.284.5416.939.

Martínez-Cortizas, A., Pombal, X. P., Muñoz, J. N., García-Rodeja, E., & Estudiada, C. G. D. Á. (2000). Turberas de montaña del Noroeste de la Península Ibérica. *Edafología*, *7*, 1-29.

Martínez-Cortizas, A., Garcıa-Rodeja, E., Pombal, X. P., Muñoz, J. N., Weiss, D., & Cheburkin, A. (2002). Atmospheric Pb deposition in Spain during the last 4600 years recorded by two ombrotrophic peat bogs and implications for the use of peat as archive. *Science of the Total Environment*, *292*(1-2), 33-44. https://doi.org/10.1016/S0048-9697(02)00031-1.

Martínez-Cortizas, A., Biester, H., Mighall, T., & Bindler, R. (2007). Climate-driven enrichment of pollutants in peatlands. *Biogeosciences*, *4*(5), 905-911. https://doi.org/10.5194/bgd-4-2095-2007.

Martínez-Cortizas, A., Pombal, X. P., Muñoz, J. C. N., Fernández, R. R., & López-Sáez, J. A. (2009). Turberas ácidas de esfagnos, in: *Bases ecológicas preliminares para la conservación de los tipos de hábitat de interés comunitario en España*. Ministerio de Medio Ambiente, y Medio Rural y Marino.

Martínez-Cortizas, A., López-Merino, L., Bindler, R., Mighall, T., & Kylander, M. (2013). Atmospheric Pb pollution in N Iberia during the late Iron Age/Roman times reconstructed using the high-resolution record of La Molina mire (Asturias, Spain). *Journal of Paleolimnology*, *50*(1), 71-86. https://doi.org/10.1007/s10933-013-9705-y.

Martínez-Cortizas, A., López-Merino, L., Bindler, R., Mighall, T., & Kylander, M. E. (2016). Early atmospheric metal pollution provides evidence for Chalcolithic/Bronze Age mining and metallurgy in Southwestern Europe. *Science of the Total Environment*, *545*, 398-406. https://doi.org/10.1016/j.scitotenv.2015.12.078.

Mary, G. (1977). Documents sur l'evolution de la flore du Littoral Nord Espagnol au Würm. *Supplément au Bulletin de l'Association française pour l'Etude du Quaternaire, 1*(50), 23-31.

Mary, G. (1990). La evolución del litoral cantábrico durante el Holoceno. In *The environment and the human society in the western Pyrenees and the Basque Mountains during the Upper Pleistocene and the Holocene Conference abstracta*. Universidad del País Vasco, pp. 81–87.

Mary, G., & De Beaulieu, J. L. (1973). Un diagramme sporopollinique et des datations 14c pour la tourbiere du llano ronanzas (asturies-espagne).

Mary, G., Medus, J., & Délibrias, G. (1975). Le Quaternaire de la côte asturienne (Espagne). *Quaternaire, 12*(1), 13-23. https://doi.org/10.3406/quate.1975.1253.

Mayewski, P. A., Rohling, E. E., Stager, J. C., Karlén, W., Maasch, K. A., Meeker, L. D., Gasse, F., van Kreveld, S., Holmgren, K., Lee-Thorp, J., Rosqvist, G., Rack, F., Staubwasser, M., Schneider, R. R., & Steig, E. J. (2004). Holocene climate variability. *Quaternary research,* 62(3), 243-255. https://doi.org/10.1016/j.yqres.2004.07.001.

Menéndez-Amor, J. (1950a). Estudio de las turberas de la zona oriental asturiana. *Las Ciencias, XV* (4), 801-816.

Menédez-Amor, J. (1950b). *Perfiles polínicos de las turberas de las rasas de Asturias.* XIII Congresso Luso-Espanhol para o progresso das Ciencias, Associaçao portuguesa para o progresso das Ciencias. Lisboa, 351-364.

Menéndez-Amor, J. (1968). Estudio esporo-polínico de una turbera en el Valle de la Nava (provincia de Burgos). Boletín de la Real Sociedad Española de Historia Natural. Sección Geología, 66, 35-39.Menéndez-Amor, J., & Florschütz, F. (1963). Sur les éléments steppiques dans la végétation quaternaire de l'Espagne. *Boletín de la Real Sociedad Española de Historia Natural. Sección Geología, 61*, 121-133.

Menéndez-Amor, J. (1971). Estudio esporo-polínico de dos turberas en la Sierra de Queija (Orense). *Boletín de la Real Sociedad Española de Historia Natural (Geología)*, *69*(1), 85-92.

Menéndez-Amor, J. (1975). Análisis esporo-polínico de los sedimentos turbosos de los lagos Enol y Ercina. *Boletín de la Real Sociedad Española de Historia Natural. Sección Geología, 10,* 311-313.

Menéndez-Amor, J., & Florschütz, F. (1961). Contribución al conocimiento de la historia de la vegetación en España durante el Cuaternario. *Estudios geológicos*, *17*, 83-99.

Menéndez-Amor, J., & Florschütz, F. (1963). Sur les éléments steppiques dans la végétation quaternaire de l'Espagne. *Boletín de la Real Sociedad Española de Historia Natural. Sección Geología, 61*, 121-133.

Michelutti, N. M., & Smol, J. P. (2013). Multiproxy approaches, in: Elias, S. A. (Ed.) The encyclopedia of quaternary science, vol 3. Elsevier, Amsterdam, pp. 339-348. https://doi.org/10.1016/B978-0-444-53643-3.00239-9.

Mighall, T. M., Cortizas, A. M., Biester, H., & Turner, S. E. (2006). Proxy climate and vegetation changes during the last five millennia in NW Iberia: Pollen and non-pollen palynomorph data from two ombrotrophic peat bogs in the North Western Iberian Peninsula. *Review of palaeobotany and palynology*, *141*(1-2), 203-223. https://doi.org/10.1016/j.revpalbo.2006.03.013.

Morales-Molino, C., Antón, M. G., & Morla, C. (2011). Late Holocene vegetation dynamics on an Atlantic–Mediterranean mountain in NW Iberia. *Palaeogeography, Palaeoclimatology, Palaeoecology*, *302*(3-4), 323-337. https://doi.org/10.1016/j.palaeo.2011.01.020.

Morales-Molino, C., García-Antón, M., Postigo-Mijarra, J. M., & Morla, C. (2013). Holocene vegetation, fire and climate interactions on the westernmost fringe of the Mediterranean Basin. *Quaternary Science Reviews*, *59*, 5-17. https://doi.org/10.1016/j.quascirev.2012.10.027.

Morales-Molino, C., Tinner, W., García-Antón, M., & Colombaroli, D. (2017). The historical demise of Pinus nigra forests in the Northern Iberian Plateau (south-western Europe). *Journal of Ecology*, *105*(3), 634-646. https://doi.org/10.1111/1365-2745.12702.

Morellón, M., Aranbarri, J., Moreno, A., González-Sampériz, P., & Valero-Garcés, B. L. (2018). Early Holocene humidity patterns in the Iberian Peninsula reconstructed from lake, pollen and speleothem records. *Quaternary Science Reviews*, 181, 1-18. https://doi.org/10.1016/j.quascirev.2017.11.016.

Moreno, L., Gallego, J. L. R., Ortiz, J. E., Torres, T., & Sierra, C. (2009). Distribución de elementos traza en el registro de la Turbera de Roñanzas (Asturias, España). *Geogaceta*, (46), 123-126.

Moreno, A., Stoll, H., Jiménez-Sánchez, M., Cacho, I., Valero-Garcés, B., Ito, E., & Edwards, R.L. (2010a). A speleothem record of glacial (25–11.6 kyr BP) rapid climatic changes from northern Iberian Peninsula. *Global* *and Planetary Change*, 71(3-4), 218-231. https://doi.org/10.1016/j.gloplacha.2009.10.002.

Moreno, A., Valero-Garcés, B. L., Jiménez-Sánchez, M., Domínguez-Cuesta, M. J., Mata, M. P., Navas, A., González-Sampériz, P., Stoll, H., Farias, P., Morellón, M., Pablo-Corella, J., & Rico, M. (2010b). The last deglaciation in the Picos de Europa National Park (Cantabrian Mountains, northern Spain). *Journal of Quaternary Science, 25*(7), 1076-1091. https://doi.org/10.1002/jqs.1265.

Moreno, A., López-Merino, L., Leira, M., Marco-Barba, J., González-Sampériz, P., Valero-Garcés, B. L., López-Sáez, J. A., Santos, L., Mata, P., & Ito, E. (2011). Revealing the last 13,500 years of environmental history from the multiproxy record of a mountain lake (Lago Enol, northern Iberian Peninsula). *Journal of Paleolimnology*, *46*(3), 327-349. https://doi.org/10.1007/s10933-009-9387-7.

Moreno-Amat, E., & Iglesias-González, R. (2009). Huellas de la presencia pasada de pinares montanos en la submeseta norte de la Península Ibérica: Tubilla del Lago y Tubilla del Agua, in: *Congresos Forestales*.

Muñoz-Fernández, E., & Llamosas, C. S. M. (1987). *Carta arqueológica de Cantabria.* Tantin, Santander.

Muñoz-Fernández, E. (1991). Excavaciones arqueológicas en la Cueva del Ruso I. Avance preliminar. Arquenas, 1, 61-130.

Muñoz-Fernández, E., & Serna, A. (1994). Los niveles solutrenses de la Cueva del Ruso I. Sautuola, 161-176.

Muñoz-Fernández, E., & Serna, A. (1999). Los niveles solutrenses de la Cueva del Ruso I (Igollo de Camargo, Cantabria). Sautuola: Revista del Instituto de Prehistoria y Arqueología Sautuola, (6), 161-176.

Muñoz-Fernández, E., Montes, R., Gómez-Laguna, A. J., & Rasines, P. (2007). El arte rupestre de la Cueva del Cuco o de Sobera. *E. Muñoz Fernández y R. Montes Barquín (coord.), Intervenciones arqueológicas en Castro Urdiales*, *3*, 229-251.

Muñoz-Sobrino, C. (2001). Cambio climático y dinámica del paisaje en las montañas del noroeste de la península Ibérica. Escola Politécnica Superior. Universidade de Santiago de Compostela.

Muñoz-Sobrino, C., Ramil-Rego, P., & Guitián, M. R. (1997). Upland vegetation in the north-west Iberian peninsula after the last glaciation: forest history and deforestation dynamics. *Vegetation History and Archaeobotany*, *6*(4), 215-233. https://doi.org/10.1007/BF01370443.

Muñoz-Sobrino, C., Ramil-Rego, P., Guitián, M. A. R. (2001). Vegetation in the mountains of northwest Iberia during the last glacial-interglacial transition. *Vegetation History and Archaeobotany, 10*, 7-21. https://doi.org/10.1007/PL00013366.

Muñoz-Sobrino, C., Rego, P. R., & Orellana, L. G. (2003). La vegetación postglaciar en la vertiente meridional del Macizo del Mampodre (Sector Central de la Cordillera Cantábrica). *Polen*, (13), 31-44.

Muñoz-Sobrino, C., Ramil-Rego, P., & Gómez-Orellana, L. (2004). Vegetation of the Lago de Sanabria area (NW Iberia) since the end of the Pleistocene: a palaeoecological reconstruction on the basis of two new pollen sequences. *Vegetation History and Archaeobotany*, *13*(1), 1-22. https://doi.org/10.1007/s00334-003-0028-1.

Muñoz-Sobrino, C., Ramil-Rego, P., Gómez-Orellana, L., & Díaz-Varela, R. A. (2005). Palynological data on major Holocene climatic events in NW Iberia. *Boreas 34*(3), 381-400. https://doi.org/10.1111/j.1502-3885.2005.tb01108.x.

Muñoz-Sobrino, C., Pérez, F. S., Fernández, H. N., Casado, M. F., Gómez-Orellana, L., Rodriguez-Guitián, M. A., Fernández-Prieto, J. A., & Ramil-Rego, P. (2012). Environmental changes in the westernmost Cantabrian Range during the postglacial period: the Pena Velosa (Muniellos, Asturias) pollen record, in: Campar-Almeida, A., Bettencourt, A.M.S., Moura, D., Monteiro-Rodrigues, S., Caetano-Alves, M.I. (Eds.), Environmental changes and human interaction along the western atlantic edge. Associação Portuguesa para o Estudo do Quaternário Coimbra, pp. 79-94.

Muñoz-Sobrino, C., Heiri, O., Hazekamp, M., Van der Velden, D., Kirilova, E. P., García-Moreiras, I., & Lotter, A. F. (2013). New data on the Lateglacial period of SW Europe: a high resolution multiproxy record from Laguna de la Roya (NW Iberia). *Quaternary Science Reviews, 80*, 58-77. https://doi.org/10.1016/j.quascirev.2013.08.016.

Muñoz-Sobrino, C., García-Moreiras, I., Gómez-Orellana, L., Iriarte-Chiapusso, M. J., Heiri, O., Lotter, A. F., Ramil-Rego, P. (2018). The last hornbeam forests in SW Europe: new evidence on the demise of *Carpinus betulus* in NW Iberia. *Vegetation History and Archaeobotany, 27*(4), 551-576. https://doi.org/10.1007/s00334-017-0654-7.

Naughton, F., Goñi, M. S., Desprat, S., Turon, J. L., Duprat, J., Malaizé, B., Joli, C., Cortijo, E., Drago, T., & Freitas, M. C. (2007). Present-day and past (last 25 000 years) marine pollen signal off western Iberia. *Marine Micropaleontology*, *62*(2), 91-114. https://doi.org/10.1016/j.marmicro.2006.07.006.

Núñez, S. (2018). *Dinámicas socio-ecológicas, resiliencia y vulnerabilidad en un paisaje atlántico montañoso: la Región Cantábrica durante el Holoceno*. Universidad de Cantabria.

Obregón-Goyarrola (2010). Poblamiento y comunicaciones de Cantabria durante la Edad de Hierro: castros y caminos de altura. In Castros y castra en Cantabria: fortificaciones desde los orígenes de la Edad del Hierro a las guerras con Roma: catálogo, revisión y puesta al día (pp. 60-73). Federación ACANTO.

Olid, C., Garcia-Orellana, J., Martínez-Cortizas, A., Masqué, P., Peiteado-Varela, E., & Sanchez-Cabeza, J. A. (2010). Multiple site study of recent atmospheric metal (Pb, Zn and Cu) deposition in the NW Iberian Peninsula using peat cores. *Science of the total environment*, *408*(22), 5540-5549. https://doi.org/10.1016/j.scitotenv.2010.07.058.

Ontañón, R. (2000). *El calcolítico en la cornisa cantábrica*. Universidad de Cantabria.

Ontañón, R. (2002). Las puntas líticas con retoque plano del Calcolítico cantábrico: Análisis tecnotipológico y contextual. *Zephyrvs*, *55*, 199-229.

Ontañón, R. (2003). Sols et structures d'habitat du Paléolithique supérieur, nouvelles données depuis les Cantabres: la Galerie Inférieure de La Garma (Cantabrie, Espagne). *l'Anthropologie*, *107*(3), 333-363. https://doi.org/10.1016/S0003-5521(03)00037-2.

Ontañón, R. (2015). Desarrollo histórico y dinámicas sociales en la Prehistoria reciente de Cantabria. *Sautuola: Revista del Instituto de Prehistoria y Arqueología Sautuola*, (20), 75-90.

Ontañón, R., & Armendáriz, A. (2005). Cuevas y megalitos: los contextos sepulcrales colectivos en la Prehistoria reciente cantábrica. *Munibe Antropologia-Arkeologia*, (57), 275-286.

Ontañón, R., Altuna, J., Alvarez-Fernández, E., Chauvin, A., Cubas, M., & Fernández, R. (2013). Contribution al'étude de la néolithisation dans la région Cantabrique: La grotte de Los Gitanos (Cantabrie, Espagne). *Anciens peuplements littoraux et relations homme/milieu sur les cô tes de l'Europe atlantique, BAR International Series*, *2570*.

Orton, C., Tyers, P., Vince, A., Barceló, R., & Barceló, J. A. (1997). *La cerámica en Arqueología*.

Ortega-Mateos, L. (1982). Arpones inéditos del Magdaleniense de la cueva de "El Pendo" (Santander). *Boletín del Seminario de Estudios de Arte y Arqueología: BSAA*, (48), 73-84.

Ortiz, J. E., Gallego, J. R., Torres, T. D., Moreno, L., & Villa, R. (2008). Evolución paleoambiental del Norte de España durante los últimos 2500 años a partir del estudio de biomarcadores de la Turbera de Roñanzas (Asturias). *Geogaceta*, *44*, 79-82.

Ortiz, J. E., Gallego, J. L. R., Torres, T., Díaz-Bautista, A., & Sierra, C. (2010). Palaeoenvironmental reconstruction of Northern Spain during the last 8000 cal yr BP based on the biomarker content of the Roñanzas peat bog (Asturias). *Organic Geochemistry*, *41*(5), 454-466. https://doi.org/10.1016/j.orggeochem.2010.02.003.

Peñalba, M. C. (1994). The history of the Holocene vegetation in northern Spain from pollen analysis. *J. Ecol. 82*, 815-832. https://doi.org/10.2307/2261446.

Peñalba, M. C., Arnold, M., Guiot, J., Duplessy, J. C., & de Beaulieu, J. L. (1997). Termination of the last glaciation in the Iberian Peninsula inferred from the pollen sequence of Quintanar de la Sierra. *Quaternary Research, 48*(2), 205-214. https://doi.org/10.1006/qres.1997.1922.

Peña-Chocarro, L., Zapata, L., Iriarte, M. J., Morales, M. G., & Straus, L. G. (2005). The oldest agriculture in northern Atlantic SpaIn new evidence from El Mirón Cave (Ramales de la Victoria, Cantabria). *Journal of archaeological science*, *32*(4), 579-587. https://doi.org/10.1016/j.jas.2004.12.001.

Pérez-Bartolomé, M. P. (2019). *El Mesolítico en Cantabria centro-oriental.* Archaeopress Publishing Ltd.

Peralta-Labrador, E. J., Mayor, J. C., & Torres-Martínez, J. F. (2019). Recent research on the Cantabrian Wars: The archaeological reconstruction of a mountain war. *Journal of Roman Archaeology*, *32*, 421-438.

Pérez-Díaz, S., López-Sáez, J. A., & Galop, D. (2015). Vegetation dynamics and human activity in the Western Pyrenean Region during the Holocene. *Quaternary International*, *364*, 65-77. https://doi.org/10.1016/j.quaint.2014.10.019.

Pérez-Díaz, S., Núñez de la Fuente, S., Frochoso, M., González-Pellejero, R., López-Sáez, J. A. (2016a). Seis mil años de gestión y dinámica antrópica en el entorno del Parque Natural de los Collados del Asón (Cordillera Cantábrica Oriental). *Cuaternario y Geomorfología, 30*(3-4), 49-73. https://doi.org/10.17735/cyg.v30i3-4.49677.

Pérez-Obiol, R., Jalut, G., Julià, R., Pèlachs, A., Iriarte, M. J., Otto, T., & Hernández-Beloqui, B. (2011). Mid-Holocene vegetation and climatic history of the Iberian Peninsula. *The Holocene*, *21*(1), 75-93. https://doi.org/10.1177/0959683610384161.

Pérez-Obiol, R., García-Codron, J. C., Pelachs, A., Pérez-Haase, A., & Soriano, J. M. (2016). Landscape dynamics and fire activity since 6740 cal yr BP in the Cantabrian region (La Molina peat bog, Puente Viesgo, Spain). *Quaternary Science Reviews*, *135*, 65-78. https://doi.org/10.1016/j.quascirev.2016.01.021.

Pérez-Rodríguez, M., & Martínez-Cortizas, A. (2014). Caracterización preliminar de la diversidad microbiana funcional usando perfiles de utilización de fuente-única de carbono en el Tremoal do Pedrido (Galicia, NW España). *Spanish Journal of Soil Science*, *4*(2).

Pettitt, P., Maximiano Castillejo, A., Arias, P., Ontanon Peredo, R., & Harrison, R. (2014). New views on old hands: the context of stencils in El Castillo and La Garma Caves (Cantabria, Spain). *Antiquity.*, *88*(339), 47-63. https://doi.org/10.1017/S0003598X00050213.

Pike, A. W., Hoffmann, D. L., García-Diez, M., Pettitt, P. B., Alcolea, J., De Balbin, R., González-Sainz, C., de las Heras, C., Lasheras, J. A., Montes, R., & Zilhão, J. (2012). U-series dating of Paleolithic art in 11 caves in Spain. *Science*, *336*(6087), 1409-1413. https://doi.org/10.1126/science.1219957.

Pike-Tay, A., Valdés, V. C., & de Quirós, F. B. (1999). Seasonal variations of the Middle–Upper Paleolithic transition at El Castillo, Cueva Morín and El Pendo (Cantabria, Spain). *Journal of Human Evolution*, *36*(3), 283-317.

Pontevedra-Pombal, X., Rey-Salgueiro, L., García-Falcón, M. S., Martínez-Carballo, E., Simal-Gándara, J., & Martínez-Cortizas, A. (2012). Pre-industrial accumulation of anthropogenic polycyclic aromatic hydrocarbons found in a blanket bog of the Iberian Peninsula. *Environmental Research*, *116*, 36-43. https://doi.org/10.1016/j.envres.2012.04.015.

Pontevedra-Pombal, X., Castro, D., Souto, M., Fraga, I., Blake, W. H., Blaauw, M., López-Sáez, J. A., Pérez-Díaz, S., Valcárcel, M., & García-Rodeja, E. (2019). 10,000 years of climate control over carbon accumulation in an Iberian bog (southwestern Europe). *Geoscience Frontiers*, *10*(4), 1521-1533. https://doi.org/10.1016/j.gsf.2018.09.014.

Portero, R., Cueto, M., Pardo, J. F. J., Pérez, J. B., & Álvarez-Fernández, E. (2019). The persistence of red deer (*Cervus elaphus*) in the human diet during the Lower Magdalenian in northern SpaIn Insights from El Cierro cave (Asturias, Spain). *Quaternary International*, *506*, 35-45. https://doi.org/10.1016/j.quaint.2019.01.016.

Power, M. J., Marlon, J., Ortiz, N., Bartlein, P. J., Harrison, S. P., Mayle, F. E., Ballouche, A., Bradshaw, R. H. W., Carcaillet, C., Cordova, C., Mooney, S., Moreno, P. I., Prentice, I. C., Thonicke, K., Tinner, W., Whitlock, C., Zhang, Y., Zhao, Y., Ali, A. A., Anderson, R. S., Beer, R., Behling, H., Briles, C., Brown, K. J., Brunelle, A., Bush, M., Camill, P., Chu, G. Q., Clark, J., Colombaroli, D., Connor, S., Daniau, A. -L., Daniels, M., Dodson, J., Doughty, E., Edwards, M. E., Finsinger, W., Foster, D., Frechette, J., Gaillard, M. -J., Gavin, D. G., Gobet, E., Haberle, S., Hallett, D. J., Higuera, P. E., Hope, G., Horn, S., Inoue, J., Kaltenreider, P., Kennedy, L., Kong, Z. C., Larsen, C., Long, C. J., Lynch, J. A., Lynch, E. A., McGlone, M., Meeks, S., Mensing, S., Meyer, G., Minckley, T., Mohr, J., Nelson, D. M., New, J., Newnham, R., Noti, R., Oswald, W., Pierce, J., Richard, P. J. H., Rowe, C., Sanchez-Goñi, M. F., Shuman, B. J., Takahara, H., Toney, J., Turney, C., Urrego-Sanchez, D. H., Umbanhowar, C., Vandergoes, M., Vanniere, B., Vescovi, E., Walsh, M., Wang, X., Williams, N., Wilmshurst, J., & Zhang, J.H. (2008). Changes in fire regimes since the Last Glacial Maximum: an assessment based on a global synthesis and analysis of charcoal data. *Climate Dynamics 30,* 887–907. https://doi.org/10.1007/s00382-007-0334-x.

Radke, L. F., Hegg, D. A., Hobbs, P. V., Nance, J. D., Lyons, J. H., Laursen, K. K., Weiss, R. E., Riggan, P. J., & Ward, D. E. (1991). Particulate and trace gas emissions from large biomass fire in North America, in: Levine,

J. S. (Ed.) *Global Biomass Burning: Atmospheric, Climatic, and Biospheric Implications. The MIT Press, Cambridge, Massachusetts*, pp. 209-216.

Railsback, L. B., Gibbard, P. L., Head, M. J., Voarintsoa, N. R. G., & Toucanne, S. (2015). An optimized scheme of lettered marine isotope substages for the last 1.0 million years, and the climatostratigraphic nature of isotope stages and substages. *Quaternary Science Reviews,* 111, 94-106. https://doi.org/10.1016/j.quascirev.2015.01.012.

Ramil-Rego, P., Taboada Castro, M. T., & Aira-Rodríguez, M. J. (1993). Estudio palinológico y factores de formación de la turbera de Gañidoira (Lugo, España). *Estudios sobre Cuaternario, medios sedimentarios, cambios ambientales, hábitat humano. Universitat de València, València*, 191-197.

Ramil-Rego, P., & Aira-Rodriguez, M. J. (1993a). Análisis polínico de la turbera de la Charca do Chan da Cruz (Ferreira do Valadouro, Lugo. NO de España). *Ecologia mediterranea*, *19*(3), 71-78. https://doi.org/10.3406/ecmed.1993.1723.

Ramil-Rego, P. R., & Aira-Rodríguez, M. J. (1993b). Estudio palinológico de la turbera de Pana Veira (Lugo). In Anales del Jardín Botánico de Madrid (Vol. 51, No. 1, pp. 111-122). Real Jardín Botánico.

Ramil-Rego, P., & Aira-Rodríguez, M. J. (1993c). Estudio palinológico de la turbera de Sever (Lugo). *Acta Botanica Malacitana, 18,* 125-133. https://doi.org/10.24310/abm.v18i.8984.

Ramil-Rego, P., & Aira-Rodríguez, M. J. (1994). Estudio palinológico de la turbera de Schwejk (Lugo). *Studia Botanica*, *12*, 259-269.

Ramil-Rego, P., Orellana, L. G., Sobrino, C. M., & Guitián, M. R. (1996). Valoración de las secuencias polínicas del Norte de la Península Ibérica para el último ciclo glaciar-interglaciar. *Férvedes: Revista de investigación*, (3), 33-116.

Ramil-Rego, P., Muñoz-Sobrino, C., Rodríguez-Guitián, M., & Gómez-Orellana, L. (1998). Differences in the vegetation of the North Iberian Peninsula during the last 16,000 years. *Plant Ecology*, *138*(1), 41-62. https://doi.org/10.1023/A:1009736432739.

Ramil-Rego, P., Gómez-Orellana, L., Ferreiro da Costa, J., Muñoz Sobrino, C., Rodríguez Guitián, M.A. (2018). Génesis y dinámica de las turberas de la región biogeográfica Atlántica de la Península Ibérica, in: J. M. Fernández-García, F. J. Pérez, Identificación, valoración y restauración de turberas: contribuciones recientes, pp. 207-224.

Rasilla-Vives, M., & Straus, L. G. (2004). El poblamiento en la región cantábrica en torno al último máximo glacial: Gravetiense y Solutrense. *Las Sociedades del Paleolítico en la Región Cantábrica*, *8*, 209-242.

Rasmussen, S. O., Vinther, B. M., Clausen, H. B., & Andersen, K. K. (2007). Early Holocene climate oscillations recorded in three Greenland ice cores. *Quaternary Science Reviews,* 26(15-16), 1907-1914. https://doi.org/10.1016/j.quascirev.2007.06.015.

Rasmussen, S. O., Bigler, M., Blockley, S. P., Blunier, T., Buchardt, S. L., Clausen, H. B., Cvijanovic, I., Dahl-Jensen, D., Johnsen, S. J., Fischer, H., Gkinis, V., Guillevic, M., Hoek, W. Z., Lowe, J., Pedro, J. B., Popp, T., Seierstad, I. K., Steffensen, J. P., Svensson, A. M., … & Winstrup, M. (2014). A stratigraphic framework for abrupt climatic changes during the Last Glacial period based on three synchronized Greenland ice-core records: refining and extending the INTIMATE event stratigraphy. *Quaternary Science Reviews*, 106, 14-28. https://doi.org/10.1016/j.quascirev.2014.09.007.

Rauch, S., Peucker-Ehrenbrink, B., Kylander, M. E., Weiss, D. J., Martinez-Cortizas, A., Heslop, D., Olid, C., Mighall, T. M., & Hemond, H. F. (2010). Anthropogenic forcings on the surficial osmium cycle. *Environmental science & technology*, *44*(3), 881-887. https://doi.org/10.1021/es901887f.

Reyes, O., & Casal, M. (2000). Fuego de Especies Forestales de Galicia. *Cuadernos de La S.E. C.E. I Reunión Grupo de Incendios Forestales*, (9), 109–114.

Rink, W. J., Schwarcz, H. P., Lee, H. K., Valdés, V. C., De Quirós, F. B., & Hoyos, M. (1996). ESR dating of tooth enamel: comparison with AMS14C at El Castillo Cave, Spain. *Journal of Archaeological Science*, *23*(6), 945-951.

Rink, W. J., Schwarcz, H. P., Lee, H. K., Valdés, V. C., De Quiros, F. B., & Hoyos, M. (1997). ESR dating of Mousterian levels at El Castillo cave, Cantabria, Spain. *Journal of Archaeological Science*, *24*(7), 593-600.

Ríos-Garaizar, J., Maíllo-Fernández, J. M., Marín-Arroyo, A. B., Carro, M. Á. S., Salazar, S., Medina-Alcaide, M. Á., San Emerito, A., Martínez de Pinillos, L., Garate, D., & Rivero, O. (2020). Revisiting Hornos de la Peña 100 years after. *Journal of Archaeological Science: Reports*, *31*, 102259. https://doi.org/10.1016/j.jasrep.2020.102259.

Rodríguez, J., Burjachs, F., Cuenca-Bescós, G., García, N., Van der Made, J., González, A. P., Blain, H. –A., Expósito, I., López-García, J. M., García-Antón, M., Allué, E., Cáceres, I., Huguet, R., Mosquera, M., Ollé, A., Rosell, J., Parés, J. M., Rodríguez, X. P., Díez, C., ..., & Carbonell, E. (2011). One million years of cultural evolution in a stable environment at Atapuerca (Burgos, Spain). *Quaternary Science Reviews*, *30*(11-12), 1396-1412. https://doi.org/10.1016/j.quascirev.2010.02.021.

Rodríguez-Coterón, S. *El papel del fuego en la configuración del paisaje vegetal en la montaña cantábrica central desde el Holoceno medio* [PhD thesis in progress]. Universidad de Cantabria.

Rossi, C., Bajo, P., Lozano, R. P., & Hellstrom, J. (2018). Younger Dryas to Early Holocene paleoclimate in Cantabria (N Spain): Constraints from speleothem Mg, annual fluorescence banding and stable isotope records. *Quaternary Science Reviews*, 192, 71-85. https://doi.org/10.1016/j.quascirev.2018.05.025.

Ruiz-Fernández, J., Oliva, M., Cruces, A., Lopes, V., da Conceição Freitas, M., Andrade, C., García-Hernández, C., López-Sáez, J. A., & Geraldes, M. (2016). Environmental evolution in the Picos de Europa (Cantabrian Mountains, SW Europe) since the last glaciation. *Quaternary Science Reviews,* 138, 87-104. https://doi.org/10.1016/j.quascirev.2016.03.002.

Ruiz-Zapata, M., Correia, A. I., & Gil García, M. J. (1995). Evolución del paisaje en la Sierra de Peneda (NO de Portugal) durante los últimos 3500 BP. *Geogaceta, 18,* 105-108.

Ruiz-Zapata, M., Jiménez, M., Gil-García, M. J., Dorado-Valiño, M., Valdeolmillos-Rodríguez, A., & Farias-Arquer, P. (2000). Registro palinológico de un depósito postglaciar en el Parque Natural de Redes (Cordillera Cantábrica, Noroeste de España): implicaciones climáticas. *Geotemas 1*(4), 279-283.

Ruiz-Zapata, M., García, M. G., Valiño, M. D., Rodríguez, A. V., Vegas, J., & Pérez-González, A. (2002a). Clima y vegetación durante el Tardiglaciar y el Holoceno en la Sierra de Neila (Sistema Ibérico Noroccidental). *Cuaternario y Geomorfología*, *16*(1-4), 9-20.

Ruiz-Zapata, M., Jiménez, M., Farias-Arquer, P., Gil-García, M.J., Dorado-Valiño, M., & Valdeolmillos-Rodríguez, A. (2002b). Registro palinológico de un depósito holoceno del Parque Natural de Redes (Cordillera Cantábrica), in: Moreno-Grau, S., Elvira-Rendueles, B., Moreno-Angosto, J. M. (Eds), Libro de Textos Completos. Universidad Politécnica de Cartagena, pp 391-400.

Ruiz-Zapata, M., Jiménez, M., Gil-Garcia, M., Dorado, M., Valdeolmillos, A., & Farias, P. (2002c). Secuencia polínica del depósito de Comella (Picos de Europa, Asturias): implicaciones paleoclimáticas, in: *Proceedings of the XIIIth Symposium APLE. Book of Complete Texts. Universidad Politécnica de Cartagena, Cartagena,* pp. 381-392.

Ruiz-Zapata, M., Valiño, M. D., García, M. J. G., & Rodríguez, A. V. (2003). El paisaje vegetal en el entorno del castro de Samartín (Asturias): estudio polínico. *Polen*, (13), 45-53.

Ruiz-Zapata, M., Gil-García, M. J., Gómez-González, C., Moya-Palomares, M. E., Dorado-Valiño, M., Valdeolmillos-Rodríguez, A., Martín-Arroyo, T., Jiménez-Sánchez, M., & Villa-Valdés, A. (2005). The geological heritage of the archaeological sites. An example of the climate-human interaction during roman times in the 'Chao de Samartín' archaeological site (Asturias, Spain), in: Abstracts IV International Symposium ProGEO on the Conservation of the Geological Heritage, 13-16 September, Braga, Portugal: 60.

Saa-Otero, M. P., & Víaz-Fierros, F. (1988). Contribución al estudio paleobotánico mediante análisis de pólen. *Estudios geolôgicos, 44*(3-4), 339-349. https://doi.org/10.3989/egeol.88443-4551.

Salas, L. (1993). Análisis palinológico de la turbera de Pico Ano, implicaciones de las variaciones climáticas del Holoceno final. *Estudios sobre Cuaternario, medios sedimentarios, cambios ambientales, hábitat humano,* 179-183.

Sánchez-Fernández, G., & Bernaldo de Quirós, F. (2008). El final del Musteriense Cantábrico: el nivel 20e de la Cueva de El Castillo (Cantabria). *Férvedes: Revista de investigación*, (5), 117-126.

Sanchez-Goñi, M. F. (1996). Vegetation and sea level changes during the Holocene in the estuary of the Bidasoa (Southern part of the bay of Biscay)[Changements de la végétation et des niveaux marins pendant l'Holocène dans l'estuaire de la Bidassoa (Sud-Est du Golfe de Gascogne)]. *Quaternaire*, *7*(4), 207-219. https://doi.org/10.3406/quate.1996.2073.

Sánchez-Goñi, M. F., & Hannon, G. E. (1999). High-altitude vegetational pattern on the Iberian Mountain Chain (north-central Spain) during the Holocene. *The Holocene*, *9*(1), 39-57. https://doi.org/10.1191/095968399671230625.

Sánchez-Goñi, M. F., Loutre, M. F., Crucifix, M., Peyron, O., Santos, L., Duprat, J., Malaizé, B., Turon, J. -L., & Peypouquet, J. P. (2005). Increasing vegetation and climate gradient in Western Europe over the Last Glacial Inception (122–110 ka): data-model comparison. *Earth and Planetary Science Letters*, *231*(1-2), 111-130. https://doi.org/10.1016/j.epsl.2004.12.010.

Sánchez-Goñi, M. F., Landais, A., Fletcher, W. J., Naughton, F., Desprat, S., & Duprat, J. (2008). Contrasting impacts of Dansgaard–Oeschger events over a western European latitudinal transect modulated by orbital parameters. *Quaternary Science Reviews*, *27*(11-12), 1136-1151. https://doi.org/10.1016/j.quascirev.2008.03.003.

Sánchez-Hernández, C., Gourichon, L., Pubert, E., Rendu, W., Montes, R., & Rivals, F. (2019). Combined dental wear and cementum analyses in ungulates reveal the seasonality of Neanderthal occupations in Covalejos Cave (Northern Iberia). *Scientific reports*, *9*(1), 1-18. https://doi.org/10.1038/s41598-019-50719-7.

Sánchez-Hernando, L. J., Gómez-Manzaneque, F., Masedo, F., Morla, C., & Del Nido, J. (1999). Identificación de macrorrestos vegetales holocenos en las cuencas altas de los ríos Porma, Curueño y Esla (León, España). *Boletín de la Real Sociedad Española de Historia Natural. Sección Biología, 95,* 31-42.

Sánchez-Morales, M., Pèlachs, A., García-Codron, J. C., Carracedo, V., & Pérez-Obiol, R. (2022). Landscape dynamics and fire regime since 17,550 cal yr BP in the Cantabrian region (La Molina peat bog, Puente Viesgo, Spain). *Quaternary Science Reviews*, *278*, 107373. https://doi.org/10.1016/j.quascirev.2022.107373.

Santos-Fidalgo, L. (1992). Estudio polínico de una turbera reciente en la Serra de Queixa (Ourense, Galicia, España). *Cuaderno do Laboratorio Xeolóxico de Laxe,17,* 137-143.

Santos-Fidalgo, L., Bao, R., & Jalut, G. (1993). Estudio micropaleontológico de una turbera litoral holocena en la Ría de Ares (A Coruña, España). *Cuaderno do Laboratorio Xeolóxico de Laxe, 18,* 175-188.

Santos-Fidalgo, L., Vidal-Romaní, J. R., & Jalut, G. (1997). Contribución al conocimiento de la vegetación holocena en el NO de la Península Ibérica (Galicia, España). *Cadernos do Laboratorio Xeolóxico de Laxe, 22*, 99-119.

Santos-Fidalgo, L., Vidal-Romani, J. R., & Jalut, G. (2000). History of vegetation during the Holocene in the Courel and Queixa Sierras, Galicia, northwest Iberian Peninsula. *Journal of Quaternary Science: Published for the Quaternary Research Association*, *15*(6), 621-632.

Sarasketa-Gartzia, I., Villalba-Mouco, V., Le Roux, P., Arrizabalaga, Á., & Salazar-García, D. C. (2018). Late Neolithic-Chalcolithic socio-economical dynamics in northern Iberia. A multi-isotope study on diet and provenance from Santimamiñe and Pico Ramos archaeological sites (Basque Country, Spain). *Quaternary International*, *481*, 14-27. https://doi.org/10.1016/j.quaint.2017.05.049.

Sauvet, G., Fortea Pérez, F. J., Fritz, C., & Tosello, G. (2008). Crónica de los intercambios entre los grupos humanos paleolíticos. La contribución del arte para el periodo 20000-12000 años BP. *Zephyrus,* 33-59.

Schellekens, J., Buurman, P., Fraga, I., & Martínez-Cortizas, A. (2011). Holocene vegetation and hydrologic changes inferred from molecular vegetation markers in peat, Penido Vello (Galicia, Spain). *Palaeogeography, Palaeoclimatology, Palaeoecology*, *299*(1-2), 56-69. https://doi.org/10.1016/j.palaeo.2010.10.034.

Schellekens, J., Buurman, P., Kuyper, T. W., Abbott, G. D., Pontevedra-Pombal, X., & Martínez-Cortizas, A. (2015). Influence of source vegetation and redox conditions on lignin-based decomposition proxies in graminoid-dominated ombrotrophic peat (Penido Vello, NW Spain). *Geoderma*, *237*, 270-282. https://doi.org/10.1016/j.geoderma.2014.09.012.

Seierstad, I. K., Abbott, P. M., Bigler, M., Blunier, T., Bourne, A. J., Brook, E., Buchardt, S. L., Buizert, C., Clausen, H. B., Cook, E., Dahl-Jensen, D., Davies, S. M., Guillevic, M., Johnsen, S. J., Pedersen, D. S., Popp, T. J., Rasmussen, S. O., Severinghaus, J. P., Svensson, A., & Vinther, B. M. (2014). Consistently dated records from the Greenland GRIP, GISP2 and NGRIP ice cores for the past 104 ka reveal regional millennial-scale δ18O gradients with possible Heinrich event imprint. *Quaternary Science Reviews, 106*, 29-46. https://doi.org/10.1016/j.quascirev.2014.10.032.

Severinghaus, J. P., Sowers, T., Brook, E. J., Alley, R. B., & Bender, M. L. (1998). Timing of abrupt climate change at the end of the Younger Dryas interval from thermally fractionated gases in polar ice. *Nature*, 391(6663), 141-146. https://doi.org/10.1038/34346.

Sherratt, A. (1995). Instruments of conversion? The role of megaliths in the Mesolithic/Neolithic transition in northwest europe. *Oxford Journal of Archaeology*, *14*(3), 245-260.

Slimak, L., Fietzke, J., Geneste, J. M., & Ontañón, R. (2018). Comment on "U-Th dating of carbonate crusts reveals Neandertal origin of Iberian cave art". *Science*, *361*(6408). https://doi.org/10.1126/science.aau1371.

Smith, A. C., Wynn, P. M., Barker, P. A., Leng, M. J., Noble, S. R., & Tych, W. (2016). North Atlantic forcing of moisture delivery to Europe throughout the Holocene. *Scientific Reports,* 6, 24745. https://doi.org/10.1038/srep24745.

Solomina, O. N., Bradley, R. S., Hodgson, D. A., Ivy-Ochs, S., Jomelli, V., Mackintosh, A. N., Nesje, A., Owen, L. A., Wanner, H., Wiles, G. C., & Young, N. E. (2015). Holocene glacier fluctuations. *Quaternary Science Reviews,* 111, 9-34. https://doi.org/10.1016/j.quascirev.2014.11.018.

Solórzano, J. A., Vázquez-Álvarez, R., & Blanco-Campos, B. (1999). *Atlas histórico de Cantabria.* Govierno de Cantabria, Santander.

Soto, A., Alday, A., Montes, L., Utrilla, P., Perales, U., & Domingo, R. (2015). Epipalaeolithic assemblages in the Western Ebro Basin (Spain): The difficult identification of cultural entities. *Quaternary International*, *364*, 144-152. https://doi.org/10.1016/j.quaint.2014.05.041.

Souto, M. S. (2018). *Reconstrucción paleoambiental de turberas del Norte de la Península Ibérica mediante análisis de macrofósiles vegetales y grado de humificación de la turba.* Universidade de Santiago de Compostela.

Souto, M., Castro, D., Pontevedra-Pombal, X., Garcia-Rodeja, E., & Fraga, M. I. (2016). Characterisation of Holocene plant macrofossils from North Spanish ombrotrophic mires: vascular plants. *Mires Peat*, *18*, 1-21. https://doi.org/10.19189/MaP.2016.OMB.236.

Spiering, E. D., Pevida, L. R., Maldonado, C., González, S., García, J., Varela, A., Arias, D., & Martin-Izard, A. (2000). The gold belts of western Asturias and Galicia (NW Spain). *Journal of Geochemical Exploration*, *71*(2), 89-101. https://doi.org/10.1016/S0375-6742(00)00147-3.

Spratt, R. M., & Lisiecki, L. E. (2016). A Late Pleistocene sea level stack. *Climate of the Past,* 12(4), 1079-1092. https://doi.org/10.5194/cpd-11-3699-2015.

Steffensen, J. P., Andersen, K. K., Bigler, M., Clausen, H. B., Dahl-Jensen, D., Fischer, H., Goto-Azuma, K., Hansson, M., Johnsen, S. J., Jouzel, J., Masson-Delmotte, V., Popp, T., Rasmussen, S. O., Röthlisberger, R., Ruth, U., Stauffer, B., Siggaard-Andersen, M., L., Sveinbjörnsdóttir, Á. E., Svensson, A., & White, J. W. (2008). High-resolution Greenland ice core data show abrupt climate change happens in few years. *Science,* 321(5889), 680-684. https://doi.org/10.1126/science.1157707.

Straus, L. G. (1975). El Solutrense de las cuevas del Castillo y Hornos de la Peña (Santander) en el Museo Arqueológico Nacional de Madrid. *Trabajos de Prehistoria*, *32*, 9.

Straus, L. G. (2011). Were there human responses to Younger Dryas in Cantabrian Spain? *Quaternary International*, *242*(2), 328-335. https://doi.org/10.1016/j.quaint.2011.02.041.

Straus, L. G. (2015). The human occupation of southwestern Europe during the Last Glacial Maximum: Solutrean cultural adaptations in France and Iberia. *Journal of Anthropological Research*, *71*(4), 465-492. https://doi.org/10.3998/jar.0521004.0071.401.

Straus, L. G. (2018a). Environmental and cultural changes across the Pleistocene-Holocene transition in Cantabrian Spain. *Quaternary International*, *465*, 222-233. http://dx.doi.org/10.1016/j.quaint.2016.10.005.

Straus, L. G. (2018b). The Pleistocene–Holocene transition in Cantabrian SpaIn current reflections on culture change. *Journal of Quaternary Science*, *33*(3), 346-352. https://doi.org/10.1002/jqs.2943.

Straus, L. G., & González-Morales, M. R. (2007). Further radiocarbon dates for the upper paleolithic of El Mirón Cave (Ramales de la Victoria, Cantabria, Spain). *Radiocarbon*, *49*(3), 1205-1214. https://doi.org/10.1017/S0033822200043113.

Straus, L. G., & González-Morales, M. R. G. (2012a). El Mirón Cave, Cantabrian SpaIn the site and its Holocene archaeological record. University of New Mexico Press.

Straus, L. G., & González-Morales, M. R. (2012b). The Magdalenian settlement of the Cantabrian region (northern Spain): the view from El Mirón Cave. *Quaternary International*, *272*, 111-124. https://doi.org/10.1016/j.quaint.2012.03.053.

Straus, L. G., & Langlais, M. (2020). Magdalenian chrono-stratigraphic correlations and cultural connections between Cantabrian Spain and Southwest France... and beyond. In *Actes de la Séance de La Société préhistorique Française,* 2018. Soriété prehistorique française, Paris.

Straus, L. G., & Morales, M. R. G. (2016). El Mirón Cave (Ramales, Cantabria, Spain) date list V: Middle Paleolithic and Lower Magdalenian. *Radiocarbon*, *58*(4), 943. https://doi.org/10.1017/RDC.2016.84.

Taylor, K. C., Mayewski, P. A., Alley, R. B., Brook, E. J., Gow, A. J., Grootes, P. M., Meese, D. A., Saltzman, E. S., Severinghaus, J. P., Twickler, M. S., White, J. W. C., Whitlow, S., & Zielinski, G. A. (1997). The Holocene-Younger Dryas transition recorded at Summit, Greenland. *Science,* 278(5339), 825-827. https://doi.org/10.1126/science.278.5339.825.

Teller, J. T., & Leverington, D. W. (2004). Glacial Lake Agassiz: A 5000 yr history of change and its relationship to the δ18O record of Greenland. *Geological*

Society of America Bulletin, 116(5-6), 729-742. https://doi.org/10.1130/B25316.1.

Thompson, L. G., Brecher, H. H., Mosley-Thompson, E., Hardy, D. R., & Mark, B. G. (2009). Glacier loss on Kilimanjaro continues unabated. *Proceedings of the National Academy of Sciences, 106*(47), 19770-19775. https://doi.org/10.1073/pnas.0906029106.

Torres-Martínez, J. F. K. (2010). El Medio ambiente antiguo, la construcción del territorio y la obtención de recursos en la Edad del Hierro de Cantabria. In A. Serna, A. Martínez, A. y Fernández, V. (coords.), *Castros y Castra en Cantabria. (Fortificaciones desde los orígenes de la Edad del Hierro a las guerras con Roma). Catálogo, revisión y puesta al día*, 74-109.

Törnqvist, T. E., Janssen, C. R., & Alberti, A. P. (1989). Degradación antropogénica de la vegetación en el noroeste de Galicia durante los últimos 2500 años. *Cuadernos de Estudios gallegos*, *38*(103), 175-198.

Turner, C., & Hannon, G. E. (1988). Vegetational evidence for late Quaternary climatic changes in southwest Europe in relation to the influence of the North Atlantic Ocean. *Philosophical Transactions of the Royal Society of London. B, Biological Sciences*, *318*(1191), 451-485. https://doi.org/10.1098/rstb.1988.0019.

Uzquiano, P., Yravedra, J., Zapata, B. R., Garcia, M. J. G., Sesé, C., & Baena, J., (2012). Human behaviour and adaptations to MIS 3 environmental trends (> 53–30 ka BP) at Esquilleu cave (Cantabria, northern Spain). *Quaternary International*, *252*, 82-89. https://doi.org/10.1016/j.quaint.2011.07.023.

Valladas, H., Cachier, H., Maurice, P., Bernaldo de Quiros, F. B., Clottes, J., Valdes, V. C., Uzquiano, P., & Arnold, M. (1992). Direct radiocarbon dates for prehistoric paintings at the Altamira, El Castillo and Niaux caves. *Nature*, *357*(6373), 68-70.

Vandenberghe, J., French, H. M., Gorbunov, A., Marchenko, S., Velichko, A. A., Jin, H., Cui, Z., Zhang, T., & Wan, X. (2014). The Last Permafrost Maximum (LPM) map of the N orthern H emisphere: permafrost extent and mean annual air temperatures, 25–17 ka BP. *Boreas*, 43(3), 652-666. https://doi.org/10.1111/bor.12070.

Van der Knaap, W. O., & Van Leeuwen, J. F. N. (1995). Holocene vegetation succession and degradation as responses to climatic change and human activity in the Serra de Estrela, Portugal. *Review of Palaeobotany and Palynology*, *89*(3-4), 153-211. https://doi.org/10.1016/0034-6667(95)00048-0.

Van der Knaap, W. O., & Van Leeuwen, J. F. N. (1997). Late Glacial and early Holocene vegetation succession, altitudinal vegetation zonation, and climatic change in the Serra da Estrela, Portugal. *Review of Palaeobotany and Palynology*, *97*(3-4), 239-285. https://doi.org/10.1016/S0034-6667(97)00008-0.

Vega-Maeso, C., Carmona-Ballestero, E., Sainz-Aja, A. S., & Marín-Arroyo, A. B. (2016). El Abrigo de la Castañera (Cantabria, Spain): A Chalcolithic cattle stable? *Quaternary International*, *414*, 226-235. https://doi.org/10.1016/j.quaint.2015.09.047.

Vidal-Romaní, J., & Santos-Fidalgo, L. (1994). La deglaciación finicuaternaria en el noroeste peninsular (Serra de Queixa-Invernadoiro, Ourense, Galicia): datos geomorfológicos y paleobotánicos. *Cuaternario y Geomorfología*, *8*, 33-44.

Von Engerlbrechten, S. (1998). *Late-glacial and Holocene vegetation and environmental history of the Sierra de Urbión, North-Central Spain*. University of Dublin.

Walker, M., Johnsen, S., Rasmussen, S. O., Popp, T., Steffensen, J. P., Gibbard, P., Hoek, W., Lowe, J., Andrews, J., Björck, S., Cwynar, L. C., Hughen, K., Kershaw, P., Kromer, B., Litt, T., Lowe, D. J., Nakagawa, T., Newnham, R., & Schwander, J. (2009). Formal definition and dating of the GSSP (Global Stratotype Section and Point) for the base of the Holocene using the Greenland NGRIP ice core, and selected auxiliary records. Journal of Quaternary Science: Published for the *Quaternary Research Association,* 24(1), 3-17. https://doi.org/10.1002/jqs.1227.

Walker, M., Head, M. J., Berkelhammer, M., Björck, S., Cheng, H., Cwynar, L., Fisher, D., Gkinis, V., Long, A., Lowe, J., Newnham, R., Rasmussen, S. O., & Weiss, H. (2018). Formal ratification of the subdivision of the Holocene Series/Epoch (Quaternary System/Period): two new Global Boundary Stratotype Sections and Points (GSSPs) and three new stages/subseries. *Episodes,* 41(4), 213-223. https://doi.org/10.18814/epiiugs/2018/018016.

Walker, M., Head, M. J., Lowe, J., Berkelhammer, M., Björck, S., Cheng, H., Cwynar, L. C., Fisher, D., Gkinis, V., Long, A., Newnham, R., Rasmussen, S. O., & Weiss, H. (2019). Subdividing the Holocene Series/Epoch: formalization of stages/ages and subseries/subepochs, and designation of GSSPs and auxiliary stratotypes. *Journal of Quaternary Science,* 34(3), 173-186. https://doi.org/10.1002/jqs.3097.

Wanner, H., & Buetikofer, J. (2008). Holocene Bond Cycles: real or imaginary. *Geografie,* 113(4), 338-349. https://doi.org/10.37040/geografie2008113040338.

Wanner, H., Solomina, O., Grosjean, M., Ritz, S. P., & Jetel, M. (2011). Structure and origin of Holocene cold events. *Quaternary Science Reviews,* 30(21-22), 3109-3123. https://doi.org/10.1016/J.QUASCIREV.2011.07.010.

White, R., Bosinski, G., Bourrillon, R., Clottes, J., Conkey, M. W., Rodriguez, S. C., Cortés-Sánchez, M., de la Rasilla Vives, M., Delluc, B., Feruglio, V., Floss, H., Foucher, P., Fritz, C., Fuentes, O., Garate, D., González-Gómez, J., González-Morales, M. R., Gonzalez-Pumariega, M., Groenen, M., ..., & Willis, M. D. (2019). Still no archaeological evidence that

Neanderthals created Iberian cave art. *Journal of Human Evolution*, *144*, 102640. https://doi.org/10.1016/j.jhevol.2019.102640.

Whitlock, C., & Millspaugh, S. H. (1996). Testing the assumptions of fire-history studies: an examination of modern charcoal accumulation in Yellowstone National Park, USA. *The Holocene*, *6*(1), 7-15. https://doi.org/10.1177/095968369600600102.

Whitlock, C., & Larsen, C. (2001). Charcoal as a fire proxy, in: Smol, J.P., Birks, H.J.B., Last, W.M. (Eds.), Tracking Environmental Change Using Lake Sediments, Terrestrial, Algal, and Siliceous Indicators, vol. 3 (pp. 75-97). Kluwer Academic Publishers, Dordrecht, The Netherlands.

Whitlock, C., Higuera, P. E., McWethy, D. B., & Briles, C. E. (2010). Paleoecological perspectives on fire ecology: revisiting the fire-regime concept. *The Open Ecology Journal*, *3*(1). https://doi.org/10.2174/1874213001003020006.

Wood, R., Bernaldo de Quirós, F., Maíllo-Fernández, J. M., Tejero, J. M., Neira, A., & Higham, T. (2018). El Castillo (Cantabria, northern Iberia) and the Transitional Aurignacian: Using radiocarbon dating to assess site taphonomy. *Quaternary International*, *474*, 56-70. https://doi.org/10.1016/j.quaint.2016.03.005.

Yravedra, J. (2006). Acumulaciones biológicas en yacimientos arqueológicos: Amalda VII y Esquilleu III-IV. *Trabajos de prehistoria*, *63*(2), 55-78.

Yravedra, J. (2013). New contributions on subsistence practices during the Middle-Upper Paleolithic in northern Spain. *Zooarchaeology and Modern Human Origins*, 77-95. https://doi.org/10.1007/978-94-007-6766-9_6.

Yravedra, J., & Gómez-Castanedo, A. (2010). Tafonomía en Cueva Morín. *Resultados preliminares de un estudio necesario. Zephirus*, *67*, 69-90.

Yravedra, J., Castanedo, A. G., & Fernández, E. M. (2010). Estrategias de subsistencia en el yacimiento paleolítico del ruso (Igollo de Camargo, Cantabria, España. *Espacio, Tiempo y Forma*, (3), 39.

Yravedra, J., & Gómez-Castanedo, A. (2014). Taphonomic implications for the Late Mousterian of South-West Europe at esquilleu Cave (Spain). *Quaternary International*, *337*, 225-236. https://doi.org/10.1016/j.quaint.2013.09.030.

Yravedra, J., Gómez-Castanedo, A., Picado, J. A., & Preysler, J. B. (2014). Specialised hunting of Iberian ibex during Neanderthal occupation at El Esquilleu Cave, northern Spain. *Antiquity*, *88*(342), 1035-1049.

Yravedra, J., Gómez-Castanedo, A., Aramendi-Picado, J., Montes-Barquín, R., & Sanguino-González, J. (2016). Neanderthal and *Homo sapiens* subsistence strategies in the Cantabrian region of northern Spain. *Archaeological and Anthropological Sciences*, *8*(4), 779-803. https://doi.org/10.1007/s12520-015-0253-4.

Zapata, L. (2000). La recolección de plantas silvestres en la subsistencia mesolítica y neolítica: datos arqueobotánicos del País Vasco. *Complutum*, (11), 157-170.

Zapata, L. (2002). Origen de la agricultura en el País Vasco y transformaciones en el paisaje: análisis de restos vegetales arqueológicos. Bizkaiko Foru Aldundia.

Zapata, L., Peña-Chocarro, L., Pérez-Jordá, G., & Stika, H. P. (2004). Early neolithic agriculture in the Iberian Peninsula. *Journal of world Prehistory*, *18*(4), 283-325. https://doi.org/10.1007/s10963-004-5621-4.

Zapata, L., & Pena-Chocarro, L. (2005). L'agriculture néolithique de la façade atlantique européenne. Unité et diversité des processus de néolithisation sur la façade atlantique de l'Europe (6e–4e millénaires avant J.-C), Mémoire, 36.