The oldest agriculture in northern Atlantic Spain: new evidence from El Mirón Cave (Ramales de la Victoria, Cantabria)

Leonor Peña-Chocarro\textsuperscript{a}, Lydia Zapata\textsuperscript{b}, Maria Jose Iriarte\textsuperscript{b}, Manuel González Morales\textsuperscript{c}, Lawrence Guy Straus\textsuperscript{d,*}

\textsuperscript{a}Laboratorio de Arqueobotánica, Instituto de Historia, CSIC, C/ Duque de Medinaceli 6, 28014 Madrid, Spain
\textsuperscript{b}Area de Prehistoria, Universidad del País Vasco, 01006 Vitoria-Gasteiz, Spain
\textsuperscript{c}Instituto de Prehistoria, Universidad de Cantabria, Avda. de los Castros, 39005 Santander, Spain
\textsuperscript{d}Department of Anthropology, University of New Mexico, Albuquerque, NM 87131, USA

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Abstract

Emmer wheat (\textit{Triticum dicoccum}) has been positively identified from the stratigraphically oldest ceramic- and domesticated livestock-bearing level of El Mirón Cave in the Cantabrian Cordillera. The grain is AMS \textsuperscript{14}C-dated to 5550±40 BP. This date is congruent with six others from the same layer, higher within which were found other grains of wheat, including einkorn as well as emmer. Although wild ungulates (mainly red deer) were still hunted, abundant ovicaprines, together with small numbers of cattle and pigs, appear in this level— for the first time in the 40,000-year record at El Mirón. Potsherds (undecorated, but of very good quality) also appear abruptly and abundantly. However, the associated lithic assemblage contains specific tool types also found in late Mesolithic contexts in Cantabrian Spain. In addition to the full suite of Neolithic indicators at El Mirón, as confirmed by less unambiguous early agro-pastoral evidence from other sites in the Vasco-Cantabrian region, there are megalithic monuments both in the vicinity of the cave and throughout the region that are similarly dated. All these data tend to suggest that Neolithic adaptations—already present about a millennium earlier not only along the Mediterranean coast, but also much closer, to the southeast of the Cordillera—were quickly adopted as “a package” by Cantabrian Mesolithic foragers, possibly as a consequence of social contacts with Neolithic groups in southern France and/or the upper Ebro basin of north-central Spain.

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1. Introduction

Particularly since the synthetic work of Zvelebil and Rowley-Conwy [47], there has been considerable interest in and debate about the nature and timing of the transition from foraging to farming along the Atlantic facade of western Europe. That synthesis had been produced against the backdrop of the influential “demic diffusion” model of Ammerman and Cavalli-Sforza [4–6], which emphasized actual westward human migrations as the mechanism for the spread of agricultural adaptations across Europe. The more complex (“mosaic”) model favored by Zvelebil and Rowley-Conwy stressed the active role of extant Mesolithic hunter-fisher-gatherers in resisting and ultimately incorporating elements of or adopting the complete socio-economic package of agro-pastoralism into their lifeways at differing rates in the various regions of Atlantic Europe. Coastal Atlantic regions with relatively high densities of forager populations, which seem to have had limited mobility because of locally rich wild food resources,
present interesting cases for asking by what means, with how great a time-lag, how fast, to what extent and why food production (with its attendant changes in social organization and ideology) was ultimately adopted (e.g., Refs. [12, 19, 24–29, 38, 43, 44, 46]). If coastal Atlantic forager populations were so secure in their subsistence during the mid-Holocene, how and why did they ultimately (albeit tardily) become incorporated into the world of Neolithic farmers and herders? In the three decades since Ammerman and Cavalli-Sforza first proposed their straightforward migration model for substantial population replacement, alternative models have proliferated (e.g., subsistence pressure caused by population packing and/or encroachment, environmental change, forager–farmer symbiosis, competition, warfare, inter-marriage, navigation, trade/exchange, expropriation/ raiding, agriculturalist in-filling of “empty” or lightly populated areas, forager acquisition or imitation of high-status goods). Diverse specific process models could have been applicable to the many different and fluid ecological situations that existed among the complex physical and human geographies of Europe during the early-mid Holocene. The Cantabrian case, with inlets and small estuaries lined by Mesolithic shellmiddens immediately adjacent to a densely wooded, mountainous interior only lightly exploited by hunter-gatherers, is both similar and different from other examples of the late adoption of agro-pastoralism and Neolithic technologies along the Atlantic facade (e.g., southern and central Portugal, Aquitaine, Brittany, Britain, Scotland, Ireland, Denmark) [17, 31, 32, 35]. It is similar in that diversified foraging systems heavily dependant on marine resource exploitation seem to have had relatively low mobility and were very late to adopt agriculture or pastoralism relative to the situation in the Mediterranean Basin. It is different from other regions, such as Portugal or northwestern continental Europe, in that the entire region was characterized by Mesolithic adaptations until the abrupt appearance of Neolithic traits which seem to have been adopted rapidly, without evidence of continued Mesolithic “hold-outs”. It is the diversity of modes and tempos that is now recognized to characterize the spread of the Neolithic into the westernmost regions of Europe. While instructive, models developed for Portugal, Denmark, or England, for example, cannot be directly applied to the Cantabrian situation, due to its particular topographic, climatic and edaphic conditions, as well as to its own regional historical background.

The antiquity and rapidity of the establishment of agriculture and Neolithic lifeways in eastern and southern Spain and southern Portugal are well established at ca. 6600 BP uncal. (= 5500 cal BC) [13, 45]. Ceramics and food production were quickly adopted by local Mesolithic foragers in the interior of Mediterranean Iberia, including the upper Ebro basin, by ca. 6500 BP [1, 20]. However, the situation was radically different on the nearby Atlantic side of the Cantabrian Cordillera, a humid, equable, and densely forested region, ecologically distinct from the rest of Spain. There is controversy about the nature and timing of the adoption of agriculture and associated changes in technology and society in Cantabrian Spain: was “the Neolithic” an intrusive package that abruptly, completely replaced local Mesolithic lifeways or were certain aspects of the Neolithic system grafted onto those Mesolithic adaptations to produce a kind of hybrid culture in which foraging was not completely abandoned [10]? Was the transition to food production a gradually staged process or did all classic aspects of Neolithic culture—including the construction of megalithic monuments—appear essentially simultaneously [15]? Here we report on the first unambiguous case of the early appearance of the full suite of Neolithic attributes—cereal grain, domesticated livestock and well-developed ceramics—associated with Mesolithic-like stone tools in the context of a large, clearly stratified, carefully excavated and extensively 14C-dated site in the northern fore-ranges of the Cantabrian Cordillera: El Mirón Cave (Ramales de la Victoria, Cantabria, Spain).

2. The Neolithic of El Mirón Cave

El Mirón is located at ca. 260 m above sea level in the upper Río Asón valley, some 25 km inland of the Holocene shore in eastern Cantabria. Surrounded by Cordilleran peaks near or above 1000 m a.s.l., El Mirón is strategically situated on historic avenues of communication between coastal Cantabria and both the Basque Country and the northern meseta of Old Castile (Fig. 1). On a steep, rocky cliff, the cave is in caprine habitat. However, there are areas of well-watered valley floor below the cave that would have been suitable for agriculture. Facing due west, El Mirón has a sheltered, dry, sunlit vestibule: 30 m deep by 8 m wide and 13 m high (Fig. 2) [33, 34, 36, 37].

Excavations directed by LGS and MGM since 1996 have concentrated on two 9 m2 areas in the vestibule, connected by a 8 × 1 m dogleg trench. All sediments are water-screened through 2 mm and 4 mm mesh and large samples are subjected to flotation, with collection in 250 μm mesh. The complete culture-stratigraphic sequence spans the period between the Middle Paleolithic and the Middle Ages, with 54 radiocarbon dates spanning the period between 41,000 BP (uncal.) and AD 1400 (cal). The Neolithic has been found in the outer vestibule (“Cabin”) excavation area and in the adjacent western half of the connecting trench. It consists of a series of clearly defined levels, rich in charcoal and ash, ceramics and animal bones, as well as smaller quantities
of lithic artifacts. In the “Cabin” area the Neolithic sequence (from bottom to top) consists of levels 10, 9 and 8 with several lenses and pit fill units. In the Trench, the corresponding Neolithic levels are 303.3, 303.2, 303.1 and 303 (Fig. 3). Table 1 presents the radiocarbon dates for the Neolithic levels, which extended from about 4600 to about 3600 cal. BC.

The find we report here is flotation sample 374 from grid square M5, Level 303.3—the lowest ceramic-bearing layer in the Trench. It is a charred grain, morphologically identified (with its characteristic pointed ends and marked dorsal ridge) by LP-C as *Triticum dicoccum*: emmer wheat (Fig. 4). The accelerator radiocarbon date of 5550 ± 40 BP was obtained by A. Cherkinsky. At 2σ, this date overlaps with the assay done on charcoal from the same level. It is stratigraphically coherent with the dates from overlying Levels 303.1 and 303; it also coincides closely with the dates from Level 10 in the adjacent Corral area.

The other domesticated seeds identified from Neolithic levels in El Mirón are a possible, extremely distorted cereal fragment from Level 8 in the Cabin area and, from Level 303, one grain each of *Triticum monococcum* (einkorn wheat) and *T. dicoccum* (both hulled species), two that could be either einkorn or emmer (*T. monococcum/dicoccum*), six grains of free-threshing wheats that cannot be distinguished on the basis of grains alone between the tetraploid *T. durum* and the hexaploid *T. aestivum*, two grains of *Triticum* sp., plus one whole grain and five fragments of unidentifiable cereals (and one from Level 303.2). Although present in a few other early Neolithic contexts in the coastal Basque provinces, barley (*Hordeum vulgare*) is apparently absent at El Mirón. Despite the large number of samples carpologically analyzed (*n* = 368), seed densities of even wild taxa are generally low.

Wood charcoal analyses by LZ indicate that the Neolithic occupations took place in mid-Holocene times when luxuriant, mixed, deciduous forest still dominated landscapes around El Mirón, with especially abundant deciduous and semi-deciduous oaks (*Quercus* subg. *Quercus*), hazels (*Corylus avellana*), ashes (*Fraxinus*), wild cherries (*Prunus* sp. *avium*) and trees in the *Pomoideae* family, and small numbers of charcoal fragments from a few other taxa, including birch (*Betula*) and elm (*Ulmus*), and yew (*Taxus baccata*). Branches of ash and oaks may have been collected not
only for fuel, but also as “tree fodder” for domesticated livestock stabled in the cave. Despite repeated sampling, pollen does not seem to have been preserved in the earliest Neolithic levels in either excavation area. Mid-late Neolithic samples, analyzed by MJI, show high percentages of arboreal pollen (AP: 88–67%), but with hints of deforestation particularly concerning the main taxa (*Corylus* and, to a lesser extent, *Quercus*). The presence of clearings is suggested by pollen of grasses (*Poaceae*) and *Compositae liguliflora*. A modest, but general decline in Neolithic forest cover is suggested by pollen spectra at several other bog and archeological sites throughout the region-in both coastal and montane settings. Most relevant is the bog at Los Tornos Pass (920 m a.s.l., 8 km south of El Mirón) which has yielded cereal pollen and evidence of incipient deforestation in this area at a time contemporaneous with the Mirón Neolithic [22,23]. Analysis of micro-mammalian remains by G. Cuenca Bescós also suggests some deforestation and the appearance of humid meadowlands in the Mirón vicinity during the mid-late Neolithic [3].

Study of ungulate remains from the Neolithic levels by J. Altuna and K. Mariezkurrena reveals a striking (albeit not complete) break in faunal composition vis-à-vis the underlying Mesolithic [3]. While Mesolithic Level 10.1 in the Cabin area has 100% wild ungulate remains (mainly red deer, plus some roe deer and boar), overlying Neolithic Level 10 has 70% domesticated ungulates (almost all sheep/goat [*Capra hircus/Ovis aries*], with traces of cattle and pig). The faunal samples from the earliest Neolithic levels (303.3–303.1) in the connecting trench have even higher percentages of domesticates (97–100%), again dominated heavily by ovi-caprines (91% of all three total assemblages), also with traces of cattle and pig. Red deer is the only wild game species represented. The later Neolithic levels in the Cabin (9.8, 9.7, 9.6, 9 and 8) and Trench (303) have between 92 and 98% remains of domesticated taxa among their ungulates, with a distinct increasing trend among the cattle and, to a lesser extent, the pigs, relative to the still-dominant ovi-caprines. The wild animals are mainly red deer, with traces of ibex and boar. A taphonomic study by M. Pérez Ripoll shows a marked difference in the human treatment of the bones of wild and domesticated animals, the former being more heavily processed (presumably for marrow extraction) [3]. The presence of bite marks on many of the Neolithic bones suggests the presence of dog, although its remains have not been found at El Mirón.

These botanical and faunal remains are accompanied in all the Neolithic levels by abundant ceramic assemblages. The sherds are undecorated, but thin and of excellent quality, fired under high temperatures. Temper materials are dominated by quartz and calcite, with some mica. This is a well-developed technology; the oldest El Mirón sherds do not represent initial,
experimental stages of pottery-making, suggesting that—like the domesticated animals and cultigens—ceramics were imported into the Cantabrian region and then were adopted by local Mesolithic foragers.

This scenario is implied by the lithic artifacts from the suite of Neolithic levels, which include 45 retouched implements. Among these are an endscraper, a few burins, backed blades and backed points, and several continuously retouched pieces, notches, denticulates and splintered pieces. In addition, there are a trapeze, three circle segments—one of which has beveled “Helwan” retouch—five backed and one retouched bladelets. All these types are found among some of the Mesolithic industries of the region, with no ceramic (or domesticate) associations—for example at the small, nearby cave of Tarrerón, with a radiocarbon date of 5780 ± 120 BP [7].
3. Discussion

The cultural and economic situation in the Cantabrian region in the centuries just before and after 5500 BP (uncal. = 4350 cal. BC) seems to have been complex, but part of the apparent mosaic may be the product of 14C dates run on materials of different types (e.g., long-lived versus short-lived plants), by different methods (conventional versus AMS), often with low levels of precision, by different labs, and at sites with highly diverse degrees of stratigraphic resolution and provenience control. The site of Tarrerón (where no archeobotany was done) has lithics that include such transcultural types as Helwan circle segments, but no ceramics or domesticated animals; another, Herriko Barra (an open-air site in coastal Guipúzcoa), has similar lithics, no ceramics, only abundant wild animals (92% red deer), but cereal pollen apparently in a context

Table 1
El Mirón Cave Neolithic radiocarbon dates

<table>
<thead>
<tr>
<th>Zone</th>
<th>Level</th>
<th>Date BP</th>
<th>SD</th>
<th>GX Lab No.</th>
<th>Material</th>
<th>Method</th>
<th>Calibrated date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabin</td>
<td>8.1</td>
<td>4680</td>
<td>60</td>
<td>22131</td>
<td>Ch</td>
<td>AMS</td>
<td>3612–3371 BC</td>
</tr>
<tr>
<td>Cabin</td>
<td>9</td>
<td>5170</td>
<td>170</td>
<td>22128</td>
<td>Ch</td>
<td>Conv.</td>
<td>4221–3789 BC</td>
</tr>
<tr>
<td>Cabin</td>
<td>9</td>
<td>5280</td>
<td>40</td>
<td>24461</td>
<td>Ch</td>
<td>AMS</td>
<td>4217–4001 BC</td>
</tr>
<tr>
<td>Cabin</td>
<td>9.6</td>
<td>5250</td>
<td>150</td>
<td>24462</td>
<td>Ch</td>
<td>Cxcnt.</td>
<td>4318–3945 BC</td>
</tr>
<tr>
<td>Cabin</td>
<td>10</td>
<td>5570</td>
<td>50</td>
<td>23414</td>
<td>Ch</td>
<td>AMS</td>
<td>4449–4359 BC</td>
</tr>
<tr>
<td>Cabin</td>
<td>10</td>
<td>5690</td>
<td>50</td>
<td>23413</td>
<td>Ch</td>
<td>AMS</td>
<td>4582–4458 BC</td>
</tr>
<tr>
<td>Trench</td>
<td>Pit 98</td>
<td>4910</td>
<td>80</td>
<td>28211</td>
<td>Ch</td>
<td>Conv.</td>
<td>3773–3641 BC</td>
</tr>
<tr>
<td>Trench</td>
<td>303</td>
<td>5500</td>
<td>90</td>
<td>25854</td>
<td>Ch</td>
<td>Conv.</td>
<td>4451–4280 BC</td>
</tr>
<tr>
<td>Trench</td>
<td>303.1</td>
<td>5520</td>
<td>70</td>
<td>25855</td>
<td>Ch</td>
<td>Conv.</td>
<td>4451–4281 BC</td>
</tr>
<tr>
<td>Trench</td>
<td>303.3</td>
<td>5550</td>
<td>40</td>
<td>30910</td>
<td>Grain</td>
<td>AMS</td>
<td>4450–4344 BC</td>
</tr>
<tr>
<td>Trench</td>
<td>303.3</td>
<td>5790</td>
<td>90</td>
<td>25856</td>
<td>Ch</td>
<td>Cxcnt.</td>
<td>4768–4540 BC</td>
</tr>
</tbody>
</table>

Ch, charcoal; AMS, accelerator mass spectrometry; Conv., conventional; Cxcnt., conventional extended count. *CALIB 4.1.2; range at 1σ.
dated on bone between 5810±170 and 6010±90 BP [18,21]. Pico Ramos (a small cave in coastal western Vizcaya) has recently yielded a barley grain directly dated by AMS to 5370±40 BP, but with neither ceramics nor domesticated animals [39,40]. Kobaederra (coastal central Vizcaya) also has a barley grain directly dated to 5375±90 BP [41]. The latter cave has a series of interesting Neolithic levels; the lowest one yielded the barley grain associated with a few high-quality combed and digitally impressed ceramics, geometric microliths (including a Helwan segment) and marine molluscs, but it is overlain by other levels with older dates (5630±100 and 5820±240 BP) that also include fine ceramics, geometric microliths (including several Helwan segments) and many marine molluscs, as well as domesticated ovicaprinus [42]. All the Kobaederra dates overlap at 2σ and the strata seem to have been disturbed by later human burials. Lumentxa Cave (eastern coastal Vizcaya) has recently produced a barley grain from a level dated between 5200 and 5000 BP [40]. Marizulo Cave (eastern interior Guipúzcoa) contained a human buried together with a dog and a lamb. Bones from this burial produced a 14C date of 5285±65 BP [2]. There are remains of another sheep/goat, as well as numerous remains of red deer, boar and roe deer, together with traces of ibex and chamois and various carnivores. The association of ceramics with the Marizulo burial is unclear. A dog scapula was also found in the underlying "Mesolithic" level, which has no other domesticates. The cave of Arenaza (western interior Vizcaya, ca. 35 km from El Mirón and 10 km from Pico Ramos) has a post-Mesolithic level (Ic1 = IC2) with geometric microliths, undecorated ceramics and two bovine remains classified as cattle (Bos taurus) and directly dated to 6040±75 and 5755±65 BP, although a third cattle jaw bone, supposedly from the same level, yielded an AMS date of 10,860±120 BP, while the level in question was itself dated to 4965±195 BP [11]. Domesticated ovicaprine and pig remains were also identified in this layer. The Arenaza Mesolithic levels contain similar geometric microliths, but no ceramics or domesticated animals. Unfortunately the stratigraphy is plagued by uncertainties, as is that of the small cave of Los Canes in montane eastern Asturias [8,10]. At the latter site, which had three late Mesolithic burials with geometric microliths including Helwan segments, there is a sherd from an overlying level that has been dated directly on organic temper to 5865±70 BP (4935–4580 cal BC) [9]. This sherd is not clearly associated with domesticated plants or animals. The microlithic industry seems to continue into the ceramic horizon. Coastal middens—so abundant in the early Holocene of the Cantabrian region—continued to be formed by massive human collection of molluscs well into the Atlantic period, perhaps contemporaneously with the first evidence of agriculture in the region. Some of these late concheros contain a few (probably intrusive) ceramic sherds, but others (e.g., La Trecha, near Pico Ramos in eastern Cantabria, with dates as recent as 5600–5850 BP and no associated domesticates [16]) do not.

Human populations in the narrow, but high-relief region of Cantabrian Spain underwent a dramatic socio-economic change within a period as short as 300 years in the mid-Atlantic phase. Individual sites may not tell the whole story of a society’s subsistence system at any given time; essentially “Neolithic” base camps like El Mirón, with the full suite of characteristic economic and technological traits, could have been linked to other, special-purpose, “Mesolithic”-appearing camps for hunting (like Herriko Barra or Tarrerón) or for mollusc-gathering (like La Trecha), for example. Alternately, the overlap in 14C dates between “early Neolithic” and “late Mesolithic” sites could be more apparent than real, with an abrupt and nearly complete abandonment of foraging in favor of agro-pastoralism as the main basis of subsistence ca. 4600–4300 cal BC. The suite of finds in El Mirón Levels 10/303.3–303 does provide clarity in an until-now somewhat confusing picture of Mesolithic-Neolithic transition in northern Atlantic Spain and they do tend to support a scenario whereby local foraging groups ultimately, but abruptly adopted the complete Neolithic “package” after a long period of either ignorance of or resistance to the changes that had for centuries been occurring in the nearby

![Fig. 4. (a) Photo and (b) drawing of dated Triticum dicoccum from Mirón level 303.3 (scale = 1 mm).](image-url)
Mediterranean environments of the upper Ebro and southern France. While hunting continued, the fundamental basis of human subsistence seems to have quickly shifted to food production, a fact which also rapidly engendered basic changes in settlement, social organization and belief systems, as attested by the dramatic shift in the kinds of uses to which caves of the Cantabrian region—including El Mirón—were put (either for major residence and stabling, or for specialized burial) in the late Neolithic, Chalcolithic and Bronze Age periods. Of course, since Neolithic research (compared with Paleolithic and Mesolithic research) is still in its infancy in Cantabrian Spain, further evidence of early agriculture is likely to appear.

It is striking to note in conclusion that very soon after the adoption of a food production economy, some human groups in the northern Atlantic regions of Spain began to construct megalithic monuments. Among the dolmens and other tumuli there are construction-related radiocarbon dates going back as far as 5800 BP (4600 cal. BC) in both the far western (Asturias) and far eastern (Guipúzcoa) sectors of the Cantabrian region (Monte Areo VI and Larrarte, respectively) [10,14]. However, the bulk of the dates fall within the range between 5500 and 5000 BP (4300–3700 cal. BC).

Recently, a dolmen (Hayas, on a ridge dominating the eastern (Guipu´zcoa) sectors of the Cantabrian region (Monte Areo VI and Larrarte, respectively) [10,14]. However, the bulk of the dates fall within the range between 5500 and 5000 BP (4300–3700 cal. BC). Recently, a dolmen (Hayas, on a ridge dominating the Asón valley between La Trecha and El Mirón) was excavated and charcoal from the floor of the central burial chamber was dated [30]. The result—5490 ± 120 BP—is within 1σ of the 14C age of the emmer wheat grain from El Mirón Level 303.3. These facts suggest that, although the economic change from Mesolithic to Neolithic lifeways was a complex process during the short period between ca. 5800 and 5500 BP, once human groups made the change to a heavily agro-pastoral way of life (with hunting, fishing and gathering as increasingly secondary subsistence activities), they “staked out” their territories, marking them prominently with their dead, in costly, visible structures. The process of “domesticating” the landscape began very quickly once the fundamental shift from foraging to farming had been made by long-time inhabitants of the Cantabrian region. New uses of the land, involving forest clearance, tillage and pasturage, had begun, as new forms of relations between humans and the land, and among the humans themselves also began to take hold.

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