Gruta Nova da Columbeira (Bombarral, Portugal): Site stratigraphy, age of the Mousterian sequence, and implications for the timing of Neanderthal extinction in Iberia

Gruta Nova da Columbeira (Bombarral, Portugal): Fundplatz-Stratigraphie, Alter der Moustérien-Schichtenfolge, und Schlussfolgerungen für die Chronologie des Aussterbens der Neanderthaler auf der Iberischen Halbinsel

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Abstract - The Gruta Nova da Columbeira is recurrently mentioned in the literature concerning the Middle-to-Upper Palaeolithic transition in Iberia as documenting the persistence beyond 30 000 calendar years ago of a Neanderthal-associated Mousterian. This claim is based on conventional radiocarbon dates obtained in the 1960's and the 1970's. In order to assess its validity, we undertook archival research to obtain unpublished details concerning the actual composition and chemistry of the dated samples, replicated the dating of samples of the same kind (carbonaceous sediments) and collected in the same deposits from the back of the cave whence came the 1970's results, and obtained an U-series age estimate for a bone tool from the base of the Mousterian sequence excavated at the entrance of the cave in 1962. We then cross-checked all the stratigraphic and dating information thus assembled against the original field documents. Our results show that (a) the cave entrance sequence formed between MIS-5 and early MIS-3, (b) the deposits at the back of the cave probably formed in the Tardiglacial, and (c) the presence in these deposits of significant amounts of inherited charcoal derived from the entrance area explains the "Early Upper Palaeolithic" (EUP) age determinations obtained for the 1970's samples. The association of such determinations with the Mousterian has been based on an unwarranted assumption of lateral stratigraphic continuity. While the entrance deposits correspond to an in situ Mousterian sequence, those from the back of the cave are primarily made of clay accumulated under temporary waterlogged conditions, with the few artefacts of Middle Palaeolithic affinities recovered therein being in secondary position. The evidence from Gruta Nova can no longer be used to counter the existence of a late Aurignacian in the region. In southern and western Iberia, the Neandertal-to-modern and Middle-to-Upper Palaeolithic transitions occurred no later than about 37 000 years ago.

Zusammenfassung - *Auf der Grundlage konventioneller Radiokarbondaten aus den 1960er und 1970er Jahren werden Grabungsergebnisse aus der Gruta Nova da Columbeira (Bombarral) in der Fachliteratur auch heute noch verschiedentlich als Beleg für eine zeitliche Überlappung des späten Moustérien mit dem älterem Jungpaläolithikum genannt. Die unerwartet jungen ^{14}C-Daten werden weiterhin als Beleg für eine Fortdauer der Neanderthaler bis in eine Zeit jünger als 30 000 Jahre vor heute herangezogen. Zur Überprüfung dieser Hypothese haben wir zahlreiche historische Dokumente zu den früheren Grabungen, wie auch der ^{14}C-Datierungen, zusammengestellt und einer kritischen Sichtung unterzogen. Mit Hilfe der historischen Grabungsdokumente konnten zahlreichen Details der ursprünglichen Stratigraphie von Gruta Nova rekonstruiert werden. Auf dieser Grundlage wurden dann gezielt Nachuntersuchungen vorgenommen, um Probenmaterial zur erneuten ^{14}C-Datierung aus gleicher stratigraphischer Position zu erhalten. Ferner wurde eine U/Th-Datierung an einem Knochenwerkzeug des Moustérien aus der Basis der Schicht 8 vorgenommen. Die Datierungsergebnisse zeigen, (1) dass es am Höhleneingang tatsächlich Fundschichten mit Artefakten gibt, die zwischen MIS-5 und MIS-3 datieren, aber (2), dass die ursprünglich anhand der ^{14}C-Daten als ein „frühes Jungpaläolithikum" interpretierten Schichten im rückwärtigen Teil der Höhle wahrscheinlich aus dem Spätglazial und durch Sedimente mit alten Holzkohlen aus dem Eingangsbereich kontaminiert wurden. Wie die Rekonstruktion der stratigraphischen Situation zeigt, gibt es in Gruta Nova — bei den heute nicht mehr akzeptablen ^{14}C-Daten — keine ernstzunehmenden Indizien für die Existenz eines späten Moustérien. Damit liegt auch kein Beleg für einen späten Übergang - nach 37 000 Jahren vor heute - vom Mittel- zum Jungpaläolithikum im südlichen und westlichen Bereich der Iberischen Halbinsel vor.*

Keywords - Middle Palaeolithic, Neanderthals, Iberia, Portugal, Radiocarbon, U-series
Mittelpaläolithikum, Neanderthaler, Iberia, Portugal, Radiokarbon, U-Serien

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Introduction

In Iberian regions to the south of the Ebro drainage, radiometric dating and chronostratigraphic patterns support the persistence of a Neanderthal-associated Mousterian beyond ~36.5 ^{14}C ka BP (~41.5 calBP) — i.e. into a time range when the Protoaurignacian is first documented in northern Catalonia, the Basque Country, Cantabria and Asturias. While reliable dates of ~32-33 ^{14}C ka BP (~38-37 calBP) have been obtained for the Middle Palaeolithic at Gruta da Oliveira (Portugal), Gorham's Cave (Gibraltar) and Cueva Antón (Murcia, Spain), the Protoaurignacian and the Aurignacian I remain unknown in these regions, where the Upper Palaeolithic sequence begins with a later Aurignacian. Elsewhere in Europe, the Aurignacian II post-dates ~33-32 ^{14}C ka BP (~38-37 calBP), while the scarce, well-dated occurrences of the rather elusive Aurignacian III-IV fall in the ~30-29 ^{14}C ka BP (~35-34 calBP) interval; the chronometric results currently available for the later Aurignacian of southwestern Iberia are consistent with this dating evidence (Zilhão 2006a, b; Pesesse 2008; Walker et al. 2008; Angelucci & Zilhão 2009; Michel 2010; Zilhão et al. 2010a, b).

The European Mousterian was made by Neanderthals only. The Protoaurignacian, although lacking directly associated human remains, is coeval with the earliest directly dated European modern humans, those from the Romanian site of Oase (Trinkaus et al. 2003), and the association of the later Aurignacian with diagnostic skeletal remains of modern humans is unambiguously documented (e.g. at the French sites of Les Rois and La Crouzade; Henry-Gambier & Sacchi 2008; Ramirez-Rozzi et al. 2009). The implication of these patterns is that, south of the Ebro, the Middle-to-Upper Palaeolithic and Neanderthal-to-modern human transitions correspond to a single, integrated biocultural process, i.e. one that consists of Upper Palaeolithic modern humans replacing Middle Palaeolithic Neanderthals. However, due to the sparseness of available results and the problems of accuracy, precision and sample association that afflict radiocarbon dating in this time range, other interpretations of the record remain possible. For instance, some have challenged the persistence pattern itself (e.g. Jöris et al. 2003; Vaquero 2006; Bradtmöller et al. 2011), while others have argued that, instead of a punctuated replacement or assimilation process, we could be dealing in fact with multiple regional mosaics of long-term, side-by-side contemporaneity-with-no-admixture between late Neanderthals and early modern humans.

For northern Catalonia and interior Cantabria, a scenario of Neanderthals in the highlands and moderns in the adjacent lowlands has been proposed on the strength of radiocarbon dates younger than ~41.5 ka calBP for Mousterian deposits from the mountain cave sites of Ermitons and Esquilleu (Maroto et al. 2005). For southern Andalucía, and also on the strength of radiocarbon dates seemingly indicating a persistence of the Mousterian in Gorham's Cave until as late as ~28, or even ~24 ka calBP, the suggestion has been one of full sympatry, made possible by genetic incompatibility coupled with non-overlapping ecological niches (Finlayson et al. 2006, 2008; Jimenez-Espejo et al. 2007). In all likelihood, however, these mosaic patterns are an artefact of dating problems and site taphonomy, namely, (a) at Esquilleu, the upper part of the stratigraphy was cryoturbated, (b) at Gorham's, carbon percolated between adjacent levels and the dated charcoal particles were of extremely small size, which magnifies the effect of potential contamination, and (c) at Ermitons, the stratigraphic inconsistency of the results obtained for bone samples that were not ultrafiltrated suggests they are minimum ages only (Zilhão 2006a; Zilhão & Pettitt 2006; Mallol et al. 2010). Moreover, such mosaic scenarios are at odds with demographic, ecological and geographical logic. As hunter-gatherers living at low population densities, residual Neanderthals could not have survived for several millennia as a separate biological entity unless they controlled a territory large enough to sustain a bounded, viable reproductive network. To remain stable over long periods, such a network would require at least several hundred people. For low population densities, this translates into a territory with an area in the range of tens of thousands of square kilometres. Thus, the existence of an Aurignacian II at Cueva Bajondillo, in Málaga (Cortés et al. 2001, 2005), could be consistent with a putative post-35 ka calBP Neanderthal settlement of Gibraltar, 150 km to the southeast, only if such a settlement represented the eastern frontier of a refugium that extended all the way to the Atlantic façade of Iberia.

The identification in Portugal of sites of the Aurignacian II and III-IV (Zilhão 1997, 2006b; Thacker 2001; Aubry et al. 2006; Zilhão et al. 2010b) contradicts the notion of such a Neanderthal refugium, but the Portuguese evidence is not uncontroversial. The number of occurrences is small and their Aurignacian nature has been challenged, with some contending that (a) the earliest Upper Palaeolithic of the country is a middle Gravettian and (b) the regional Mousterian survived until, if not beyond ~26.5 ^{14}C (~31 cal) ka BP (Marks 2000; Straus et al. 2000; Bicho 2005). If such contentions were to be empirically verified, then the twin notions that the very young results obtained for Gorham's are associated with the local Mousterian and that Neanderthal communities persisted in Gibraltar and Portugal until as late as the Last Glacial Maximum would remain within the realm of the conceivable.

In this context, and as the first Mousterian site of Iberia to have yielded seemingly credible but much younger than expected radiocarbon results, the Gruta Nova da Columbeira (Bombarral; 39°17'53"N, 09°12'03"W; Fig. 1) is of historical and methodological significance. The site also remains of direct relevance in current controversies because those young results

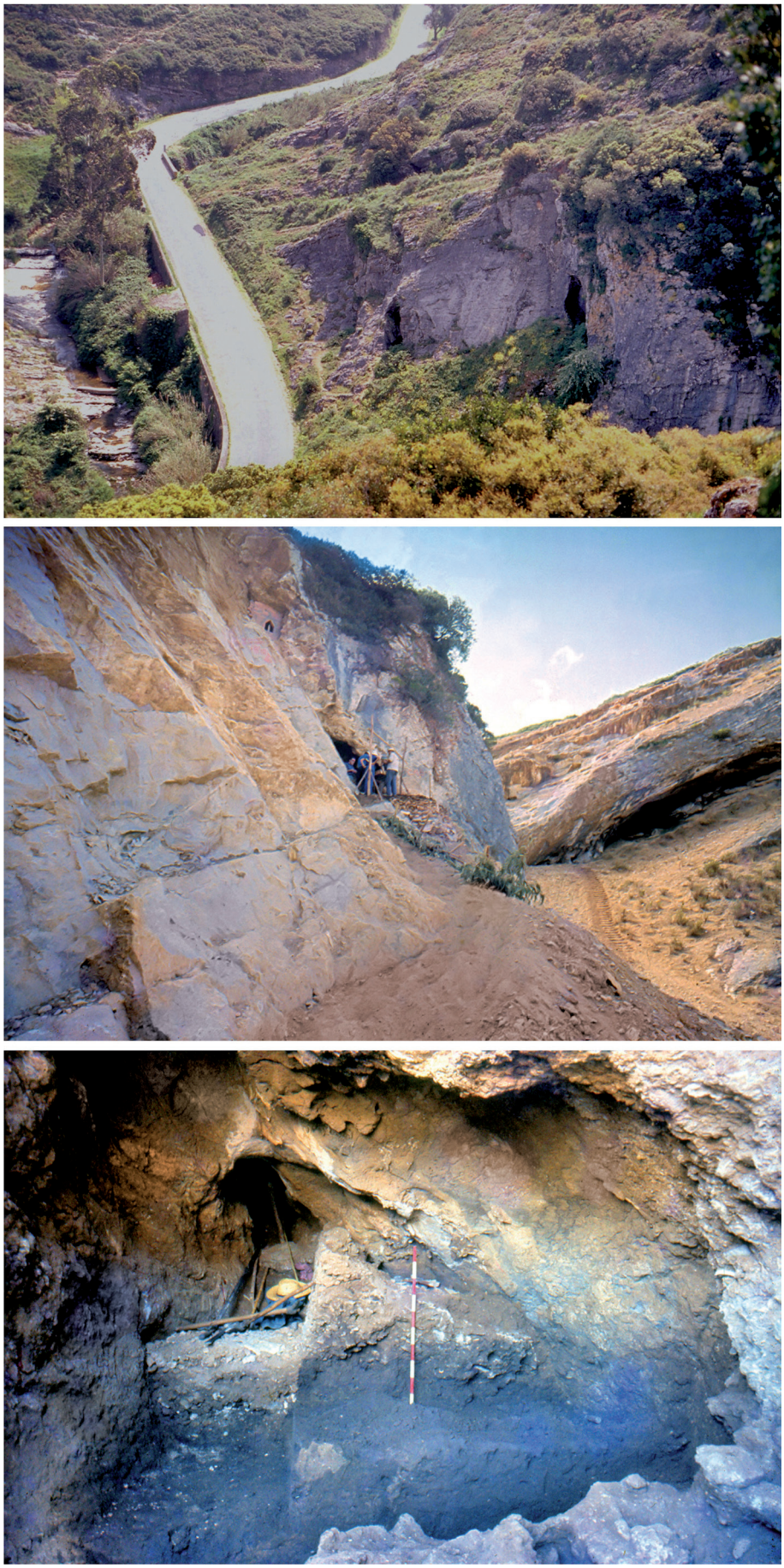

Fig. 1. The site. Top: downslope view from the NW, taken in 1986, showing the entrance to the cave and the Vale Roto canyon (photo by J. Zilhão); of the two openings visible in the escarpment, the Gruta Nova is that located at higher elevation. Middle: upslope view from the E along the path openon the freshly quarried limestone strata taken during the 1962 excavation work (Veiga Ferreira Archive; the date on the corresponding Ektachrome slide sleeve is September 4, 1962). Bottom: view of the site in sectors 4 to 6 taken during the 1962 excavations; note the black color of level 8, already excavated against the East wall, where the original surface of the Pleistocene deposits is well marked, and their inward slope beyond sector 6 readily apparent; against the West wall, the two main units of the overlying fill (the level 7 brown soil and the level 6 breccia) are easy to recognize in the profile seen above the stratigraphic baulk (Veiga Ferreira Archive; the date on the corresponding Ektachrome slide sleeve is September 4, 1962).

Abb. 1. *Der Fundort. Oben: Ansicht von NW, aufgenommen 1986; gezeigt wird der Höhleneingang und die Vale Roto-Felsschlucht (Aufnahme von J. Zilhão); von den zwei sichtbaren Öffnungen ist Gruta Nova die obere. Mitte: Ansicht aus Osten entlang des neuen Pfades an der Kalkabbaukante. Aufgenommen während der Ausgrabungen 1962 (Veiga Ferreira-Archiv; das Datum auf der zugehörigen Ektachrome-Diahülle lautet: 4. September 1962). Unten: Ansicht des Fundortes, Abschnitte 4 bis 6, aufgenommen während der Ausgrabungen 1962; beachtenswert ist die schwarze Färbung an der bereits an der Ostwand ausgegrabenen Schicht 8, wobei die ursprüngliche Oberfläche der Pleistozänablagerungen gut ausgeprägt ist; ihre Neigung über Abschnitt 6 hinaus ist ohne weiteres erkennbar; an der Westwand sind am oberhalb der stratigrafischen Schwelle sichtbaren Profil die zwei Hauptteile der Deckschicht (braune Erde an Schicht 7 sowie Breccie an Schicht 6) leicht zu erkennen (Veiga Ferreira-Archiv; das Datum auf der zugehörigen Ektachrome-Diahülle lautet: 4. September 1962).*

were never satisfactorily explained and keep cropping up in the literature, where they have been used in all sorts of manner despite the fact that neither the ^{14}C measurements, nor the chemical properties of the dated samples or their stratigraphic position have been assessed with the necessary depth and detail. Here, we report on research undertaken over the last decade aimed at solving the different pending issues concerning the stratigraphy and age of this important Iberian Palaeolithic locality.

Research history

Opened to the north in a side gully of the Vale Roto canyon, the Gruta Nova is a karstic cave accidentally exposed by quarrying in the spring of 1962 and then excavated by a team of the Geological Survey of Portugal directed by Octávio da Veiga Ferreira over a single, two-and-a-half month-long field season. The excavation diary published by Cardoso et al. (2002) records the first and last day of fieldwork as August 20

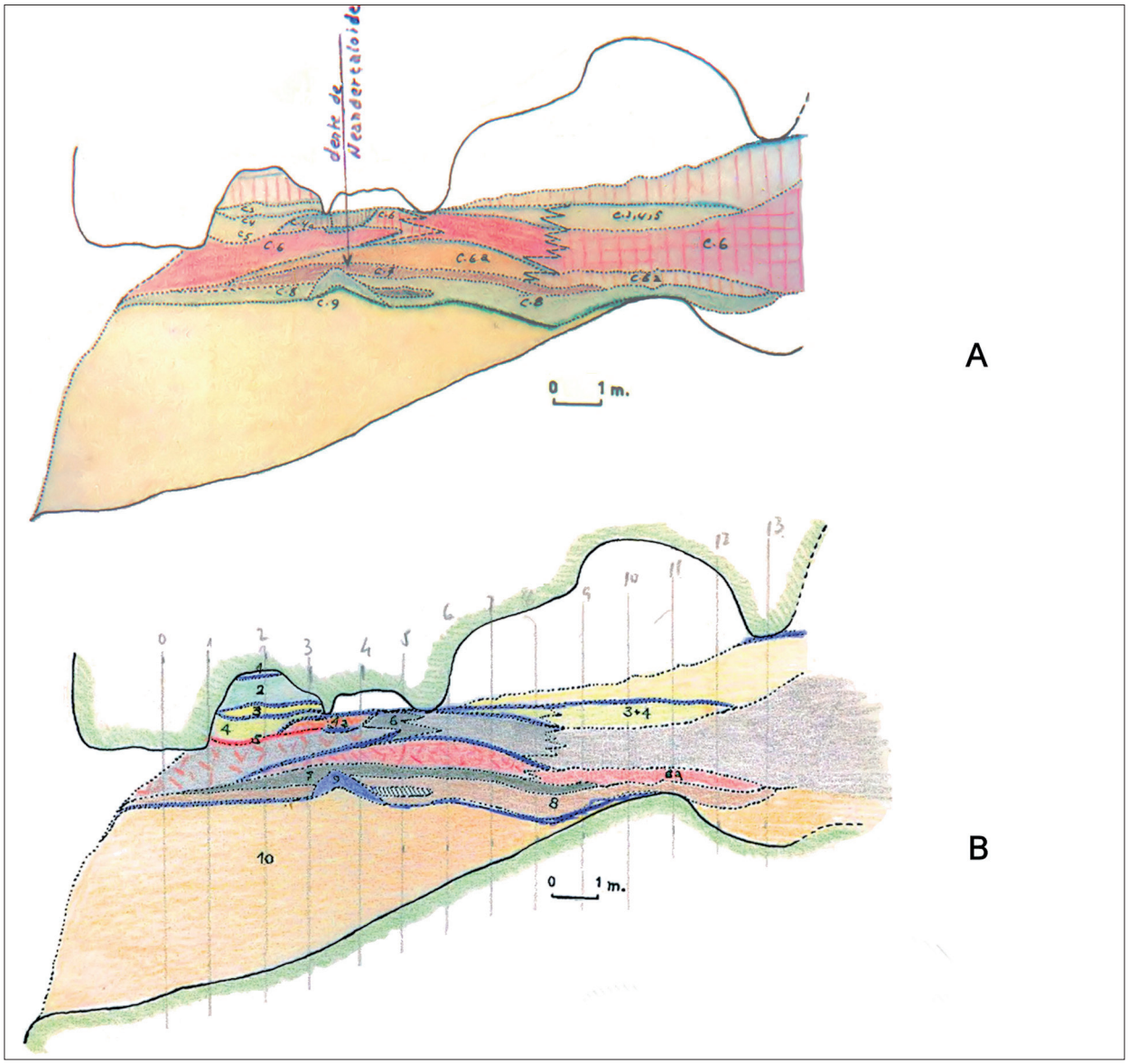

Fig. 2. Stratigraphic documents. The three profiles published or drawn by Veiga Ferreira were mirrored in order to present the same orientation — entrance to the left — as the plan and profiles generated by Roche's subsequent work. A: the 1962 longitudinal profile (Veiga Ferreira Archive, reproduced in Cardoso et al. 2002); note the zigzag line and the use of a different graphical convention to represent deposits located inward of that line but at the same elevation as level 6 of the entrance sequence. B: another drawing of the 1962 profile (Veiga Ferreira Archive, reproduced in Cardoso 2006); note the same indications of lateral discontinuity, albeit expressed differently.

Abb. 2. *Grabungsdokumentation. Die drei von Veiga Ferreira veröffentlichten oder gezeichneten Profile werden spiegelbildlich dargestellt, um die gleiche Ausrichtung — Eingang zur Linken — des im Laufe der späteren Arbeit Roches entstandenen Plans bzw. Profile zu ermöglichen. A: Längsprofil 1962 (Veiga Ferreira-Archiv, nachgebildet in Cardoso et al. 2002); beachtenswert sind die Zickzacklinie sowie der Einsatz verschiedener Signaturen zur Darstellung der Ablagerungen, die sich diesseits der Linie, jedoch auf gleicher Höhe wie Schicht 6 der Eingangsabfolge befinden. B: eine weitere Zeichnung des Profils aus 1962 (Veiga Ferreira-Archiv, nachgebildet in Cardoso 2006); zu beachten ist ein grafisch anders dargestellter aber ähnlich erfasster Verlauf einer seitlichen Diskontinuität.*

and October 31, respectively. A Quaternary succession entirely made up of Middle Palaeolithic deposits spanning a thickness of ~3 m and subdivided in different levels was recognized. This sequence was thoroughly excavated to bedrock across the whole width of the cave and up to ~13 m inward from the original exposure. In a short paper published some twenty years after the fact, the excavator provided a stratigraphic profile (Fig. 2C) and mentioned, with no additional detail, a result of ~25 ka ^{14}C BP obtained for basal level 8. This level was very rich in hearth features, faunal remains, burnt bone, charcoal and stone tools, while a Neanderthal tooth was found embedded in a stalagmitic "islet" located at the interface with the equally rich, overlying level 7. From these observations, Veiga Ferreira (1984: 368) concluded: "The ^{14}C date obtained by Prof. Schwabedissen of Hanover indicates an age around 25 000 years, which goes to show that the Neanderthal Man of Columbeira was in the final stage of its existence and living side by side with the Cro-Magnon Man of the Upper Palaeolithic" *[A datação do C. 14, obtida pelo Prof.*

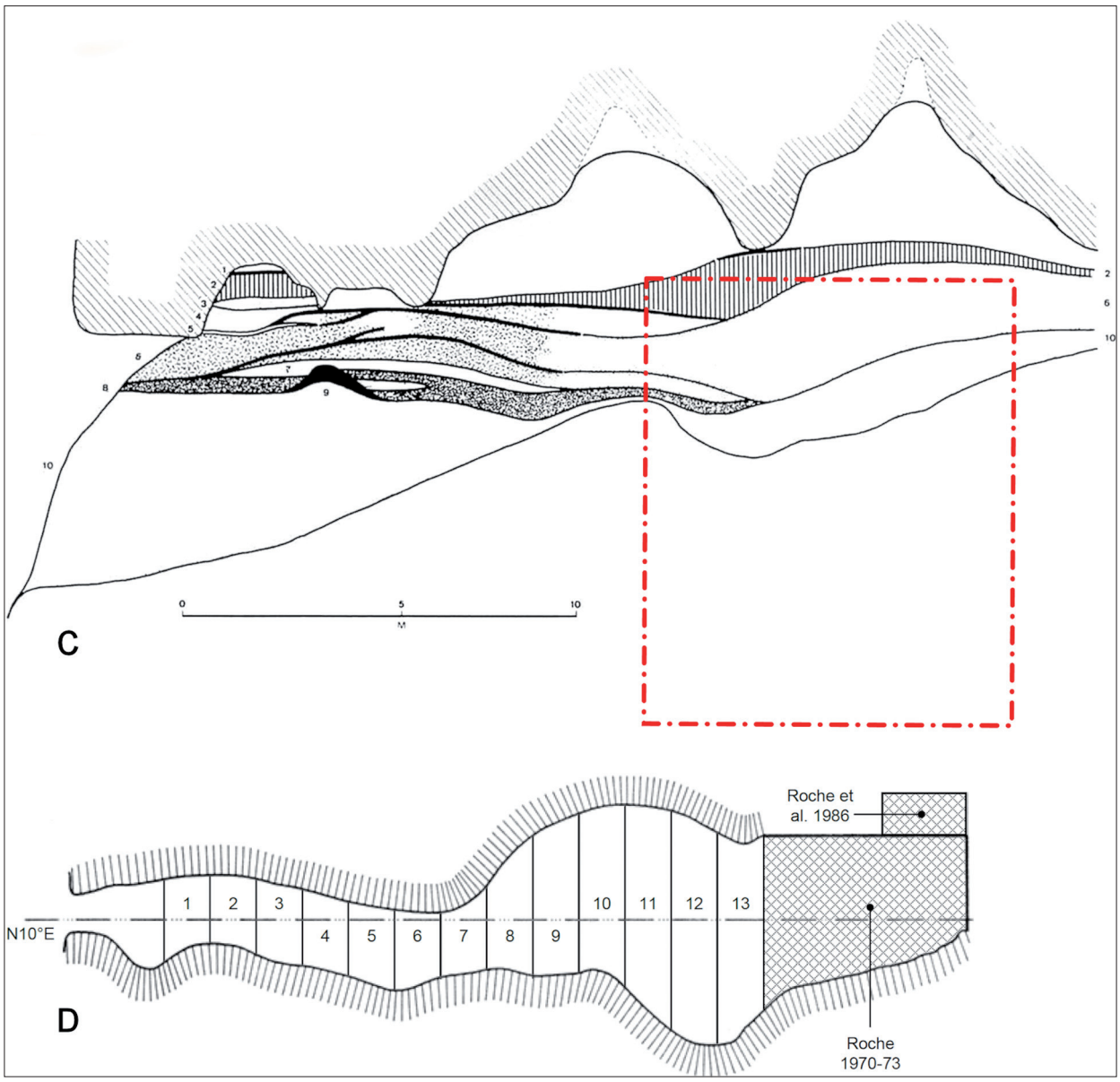

Fig. 2. C: Veiga Ferreira's (1984) published version of the field profile; the red rectangle corresponds to the area also thusly marked in Figure 4A. D: plan of the cave, reproduced from Roche et al. (1986); the limits of Veiga Ferreira's 1962 sectors were placed using the indications given in his field drawings and aligning plan and profiles, after reduction to the same scale, by the position of the entrance to the cave; the 2 x 1 m rectangle denotes the area where Roche et al. (1986) cut a 1 m² trench into the profile extant at the end of the 1973 field season.

Abb. 2. *C: Veiga Ferreiras (1984) veröffentlichte Fassung des Profils; das rote Viereck entspricht der ähnlich markierten Fläche in Bild 4A. D: Höhlenplan, nachgebildet nach Roche et al. (1986); die Abgrenzungen der von Veiga Ferreiras 1962 erfassten Abschnitte wurden anhand der in seinen Feldaufzeichnungen, sowie der in Plänen und Profilen enthaltenen Angaben eingezeichnet; dabei wurden alle Angaben auf einen einheitlichen Maßstab umgezeichnet und in Bezug gesetzt zur Position des Höhleneingangs; das 2 x 1 m Viereck bezeichnet die Stelle, an der Roche et al. (1986) einen 1 m²-Schnitt im Profil der Grabungskampagne 1973 anlegten.*

Schwabedissen de Hannover, indica uma data à volta dos 25 000 anos que vem demonstrar estar o Homem de Neandertal da Columbeira já no final da sua existência e vivendo em paralelo com o Homem de Cro-magnon do Paleolítico superior].

A couple of years later, *Radiocarbon* published a Gif-sur-Yvette date list including two results obtained on samples from Gruta Nova (Delibrias et al. 1986: 22-23). These samples had been collected by Jean Roche in the framework of research that he carried out at the site in the early 1970s, in collaboration with archaeologists from the town museum of Bombarral (Roche 1973). This work concerned the remnant deposits left by Veiga Ferreira at the back of the cave, where Roche identified black levels that he correlated with the bottom part of the sequence recorded by the original excavator. The samples, described as "carbonaceous earth" by Delibrias et al., were dated as 26 400 ± 750 ^{14}C BP (Gif-2703) for level 16 and 28 900 ± 950 ^{14}C BP (Gif-2704) for level 20, respectively, of Roche's profile (Figs. 3 & 4A). These results were in stratigraphic order and seemingly corroborated the Hanover date of "around 25 000 years," but the laboratory accompanied them with a comment to the effect that the "dates are evidently too young" and "should be considered lower limit of ages."

In that same year of 1986, coinciding with the publication of the results for his 1970s samples, Roche undertook two further, short seasons of profiling and excavation of the remnant, this time in collaboration with the *Grupo de Estudos Arqueológicos do Porto* (GEAP; Oporto Archaeological Studies Group) (Roche et al. 1986). The purpose of this work was principally to obtain a modern geological description of the sequence and to collect samples for TL dating, although additional radiocarbon samples were taken at this time too. In order to obtain well provenanced artefactual and palaeoenvironmental samples, a 1 m^2 trench was also dug into the profile left by Roche in 1973 (Figs. 4C & 5).

The dosimetry work was carried out by Sheridan Bowman, of the British Museum, but the TL signal of the dosimeters did not yield a "particularly homogeneous environmental dose-rate," while the sampled stalagmite was found to be aragonite instead of calcite and therefore inappropriate for TL dating (personal communication of S. Bowman to Jean-Pierre Texier, letter dated January 3, 1989). Sixteen samples of carbonaceous samples were also collected but never dated and their whereabouts were subsequently lost (personal communication of J.-P. Texier to J. P. Cunha-Ribeiro, letter dated March 6, 2003; personal communication of José Meireles to J. Zilhão, e-mail message dated February 17, 2003).

While the work carried out by Roche at the site remained unpublished — largely because its dating component was unsuccessful — the wider significance of the Gif results soon became apparent. 1986 was also the year of a conference held in Liège to celebrate the 100th anniversary of the discovery of the Spy Neanderthals, where Spanish researchers put forth the notion that the Mousterian could have lasted until as late as ~30 000 ^{14}C BP in both Andalucía and Valencia, a notion they further supported with papers along the same lines given two years later at the Nemours conference on the Middle-to-Upper Palaeolithic transition (Vega Toscano et al. 1988; Vega Toscano 1990; Villaverde & Fumanal 1990). Their arguments were based on bio- and climato-stratigraphy but dovetailed nicely with the dates from Gruta Nova to suggest that, across most of Iberia, the disappearance of the Neanderthals from the palaeoanthropological record had occurred significantly later than elsewhere in Europe.

The chronometric and stratigraphic evidence available at the end of the 1980s eventually came together in the "Ebro Frontier" model (Zilhão 1993, 2000, 2006a, 2009), in the framework of which the Gruta Nova results were (a) initially, treated with reservations, given the associated laboratory comments and (b) eventually, outright rejected, as evidence began to accumulate that early Upper Palaeolithic sites dated to the same time frame existed in Portugal (Zilhão 1997). Other authors, however, suggested that the critical comments provided by the dating laboratory itself simply reflected *a priori* notions concerning the "right" age to be expected for the Mousterian, and continued to argue that no strictly analytical reasons existed to question the validity of the Gif results on the grounds of sample chemistry (Cardoso et al. 2002).

In an attempt at settling the controversy, Raposo & Cardoso (1998) also sought to obtain U-series dates on enamel from animal teeth sampled from the faunal collections and referenced to basal levels 7 and 8 of

Level	Material	Lab #	Result (^{14}C BP)	δ^{13}C	Reference
8 (Veiga Ferreira)	charcoal	KN-199/Hv-1350	22 350 ± 990	-25,6 ‰	this paper
16 (Roche)	charcoal	KN-5596	18 000 ± 185	-25,47 ‰	this paper
	charcoal	Gif-2703	26 400 ± 750	—	Delibrias et al. 1986
20 (Roche)	charcoal	KN-5597	14 800 ± 120	—	this paper
	charcoal	Gif-2704	28 900 ± 950	—	Delibrias et al. 1986

Fig. 3. Radiocarbon dates for the Gruta Nova da Columbeira.

Abb. 3. *Radiokarbondatierungen für die Gruta Nova da Columbeira.*

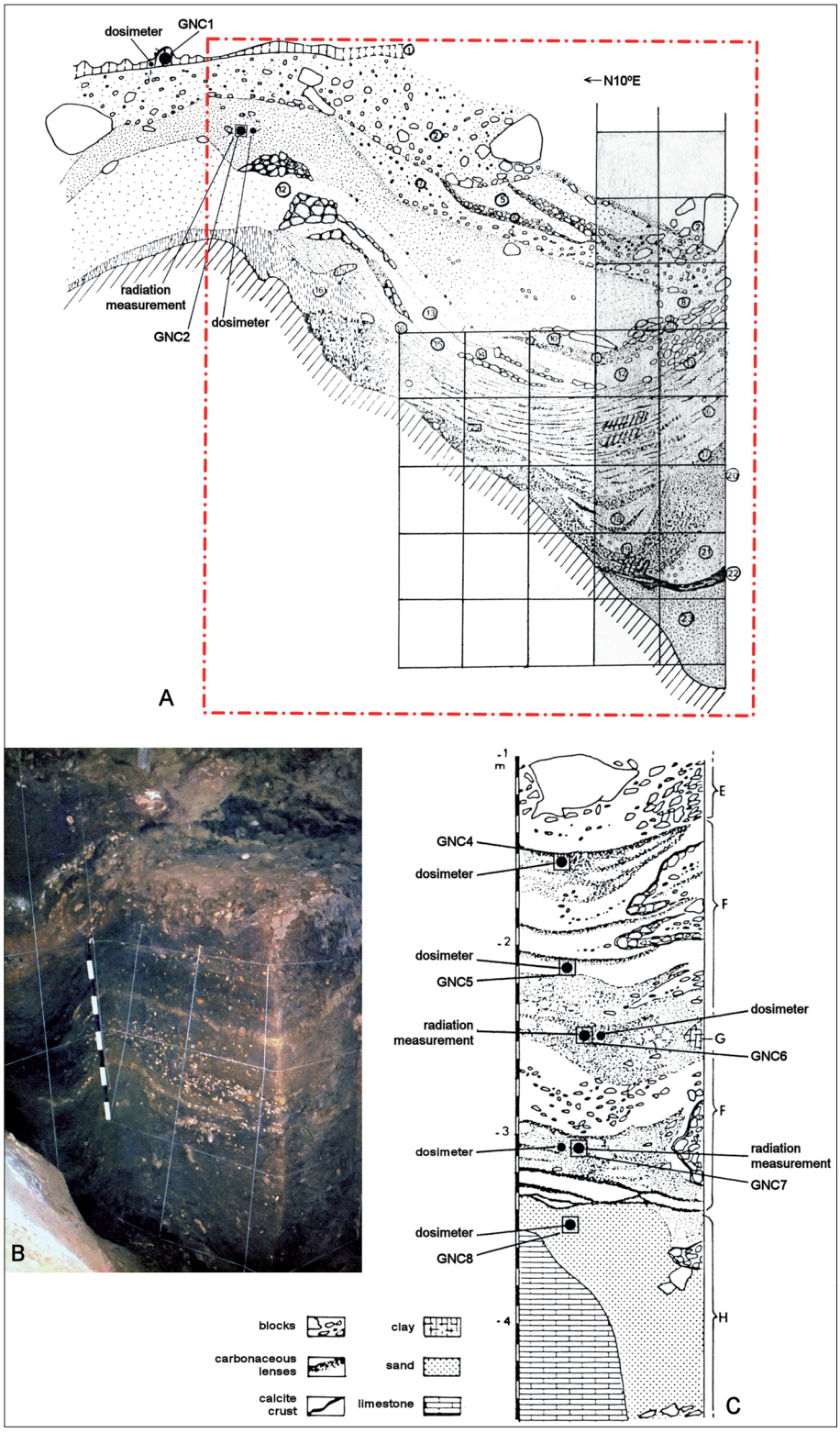

Fig. 4. Stratigraphic documents (Roche's excavations); the points concerned by the TL dating work (placement of dosimeters, in situ measurement of environmental radiation, collection of sediment samples labeled GNC) are indicated. A: Roche et al.'s (1986) unpublished drawing of the 1973 profile (the grid is 50 x 50 cm); the red rectangle corresponds to the area also thusly marked in Figure 2C and the shaded grid units at the right hand of the profile are those excavated in 1986. B: view of the deposits filling the back of the cave during the 1970's excavations (Veiga Ferreira Archive; undated slide); this view must correspond to an initial stage, when the new work had just begun to advance beyond the transversal profile left at the back of the cave in 1962, which was approximately coincident with the inner face of sector 13. C: Roche et al.'s (1986) unpublished drawing of the back face of the trench cut by them into the 1973 profile.

Abb. 4. *Stratigrafische Dokumentation (Ausgrabungen Roche); die für die TL-Datierungsarbeiten in Frage kommenden Punkte sind angegeben (Dosimeteraufstellung, Umweltstrahlungsmessungen in situ, Sammlung von mit GNC beschrifteten Sedimentproben). A: Roche et al. (1986) unveröffentlichte Zeichnung des 1973er Profils (50 x 50 cm Raster); das rote Viereck entspricht der ähnlich markierten Fläche in Bild 2C; auf der rechten Seite des Profils werden die Quadrate schattiert dargestellt, die 1986 ausgegraben wurden. B: Blick auf Sedimente, die den hinteren Teil der Höhle ausfüllen; während der 1970er Ausgrabungen aufgenommen (Veiga Ferreira-Archiv; undatiertes Dia); diese Ansicht dürfte an den Grabungsbeginn datieren, die neuen Arbeiten hatten zum Ziel über das 1962 angelegten Querprofil weiter vorzudringen; das Profil deckt sich in etwa mit der Innenfläche von Abschnitt 13. C: Roche et al. (1986) unveröffentlichte Zeichnung des hinteren Bereichs der Grabung, die in das Profil von 1973 gelegt wurde.*

the 1962 excavation. The dating work was carried out by Curtis McKinney (Southern Methodist University, Dallas, USA), under Early Uptake assumptions, and yielded four results. Their mid-points (35.9, 54.4, 60.9 and 101.5 ka) were not consistent with the notion of an unusually young Mousterian, but the very large standard deviations (ranging from 22 249 to 55 919 years) rendered them largely inconclusive.

Results

Our research followed a number of different routes, namely: a) archival investigation concerning the unpublished Hanover date; (b) re-dating of the same levels, on the same kinds of samples and with the same technique, in order to assess whether analytical error could lie behind the Gif dates; (c) directly dating a