MIDDLE MIOCENE VERTEBRATE LOCALITIES FROM ABOCADOR DE CAN MATA (ELS HOSTALETS DE PIEROLA, VALLÈS-PENEDÈS BASIN, CATALONIA, SPAIN): AN UPDATE AFTER THE 2006-2008 FIELD CAMPAIGNS

Localidades de vertebrados del Mioceno Medio del Abocador de Can Mata (els Hostalets de Pierola, cuenca del Vallès-Penedès, Cataluña, España): una actualización tras las campañas 2006-2008

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ABSTRACT

The paleontological intervention at Abocador de Can Mata (ACM, Vallès-Penedès Basin, Catalonia, Spain) was initiated due to the need to enlarge a preexisting rubbish dump in the fossiliferous area of els Hostalets de Pierola. After six years of almost uninterrupted fieldwork (including paleontological control, excavation and sampling), the local stratigraphic series of ACM currently comprises more than 150 fossil vertebrate localities. These localities are distributed along a 300 m thick series, which ranges approximately from 12.5 to 11.3 Ma, mainly corresponding to biozones MN7 and MN8 (Late Aragonian, Middle Miocene). To date, more than 38,000 fossil vertebrate macroremains and thousands of small mammal teeth have been recovered from late 2002 onwards. Here we report an updated list of the localities thus far discovered and their relative stratigraphic position, on the basis of published information (regarding the 2002-2005 field campaigns) as well as unpublished data recovered during the last three years (2006, 2007 and 2008); an updated synthetic faunal list for the ACM series is also provided. Finally, the main contributions of the ACM fauna to the understanding of late Middle Miocene terrestrial ecosystems in southwestern Europe are discussed.

Keywords. Late Aragonian, Neogene, Iberian Peninsula, fossil vertebrates.

RESUMEN

La intervención paleontológica en el Abocador de Can Mata (ACM, cuenca del Vallès-Penedès, Cataluña, España) se inició debido a la necesidad de ampliar un vertedero preexistente en el área fosilífera dels Hostalets de Pierola. Tras seis años de trabajo de campo prácticamente ininterrumpido (incluyendo control, excavación y muestreo paleontológicos), la serie estratigráfica local del ACM actualmente comprende más de 150 localidades de vertebrados fósiles. Estas localidades se hallan distribuidas a lo largo de una serie de 300 m, que abarca aproximadamente desde 12.5 hasta 11.3 Ma, correspondiendo principalmente a las biozonas MN7 y MN8 (Aragoniense Superior, Mioceno Medio). Hasta la fecha, desde 2002, se han recuperado más de 38.000 macrorestos de vertebrados fósiles y miles de dientes de pequeños mamíferos. Se da a conocer aquí una lista actualizada de las localidades descubiertas hasta le fecha y de su posición estratigráfica relativa, en base a información ya publicada (correspondiente a las campañas 2002-2005) así como en base a datos inéditos recuperados durante los últimos tres años (2006, 2007 y 2008); también se presenta también una lista faunística sintética de la serie del ACM. Finalmente, se discuten las principales aportaciones de la fauna del ACM a la comprensión de los ecosistemas terrestres del Mioceno Medio en la Europa suroccidental.

Palabras clave. Aragoniense Superior, Neógeno, Península Ibérica, vertebrados fósiles.

INTRODUCTION

The results of paleontological research at Abocador de Can Mata (ACM) have been previously reported in several preliminary synthesizing papers (Alba *et al*., 2006a,b, 2007), as well as several specialized works dealing with particular taxa (Moyà-Solà *et al*., 2004, 2005, 2009; Alba *et al*., 2008; Casanovas-Vilar *et al*., 2008a,c; Almécija *et al*., 2008, in press) or particular sites (Casanovas-Vilar *et al*., 2008b). Even though the faunistic and biostratigraphic background of ACM have been recently reviewed (Casanovas-Vilar *et al*., 2008b), the most recent summary account of ACM localities (Alba *et al*., 2006b) was based only in the 2002-2005 field campaigns. Paleontological fieldwork at ACM has continued without interruption during the years 2006, 2007 and 2008 (and it is still in progress). Thus, the aim of this communication is to provide an updated account of the vertebrate faunas of ACM, particularly regarding the faunal list composition and the stratigraphic situation of the newly discovered localities.

Historical background

The fossiliferous potential of els Hostalets de Pierola was discovered by Mario Guerín. He reported it to paleontologist Josep Ramon Bataller, who surveyed the area and published several fossil sites situated close to the Riera de Claret (Bataller, 1938). Later on, paleontologists Miquel Crusafont and Josep F. de Villalta further surveyed the area comprised between the farm houses of Can Mata de la Garriga, Can Vila, Mas d'Ocata and Can Flaquer, collecting abundant fossil material that appeared in several publications during the 1940s and 1950s (e.g. Villalta & Crusafont, 1941; Villalta Comella & Crusafont Pairó, 1941; Schaub, 1947; Crusafont Pairó, 1952; Crusafont & Truyols, 1954). Further paleontological surveys and excavations were done at the same area during the 1970s and 1980s, mainly at Can Mata I, and more publications appeared on the basis of the Hostalets material (Crusafont-Pairó & Golpe-Posse, 1973; Golpe-Posse, 1974; Crusafont-Pairó, 1979; Agustí, 1980; Agustí & Gibert, 1982; Agustí *et al*., 1985). Nevertheless,

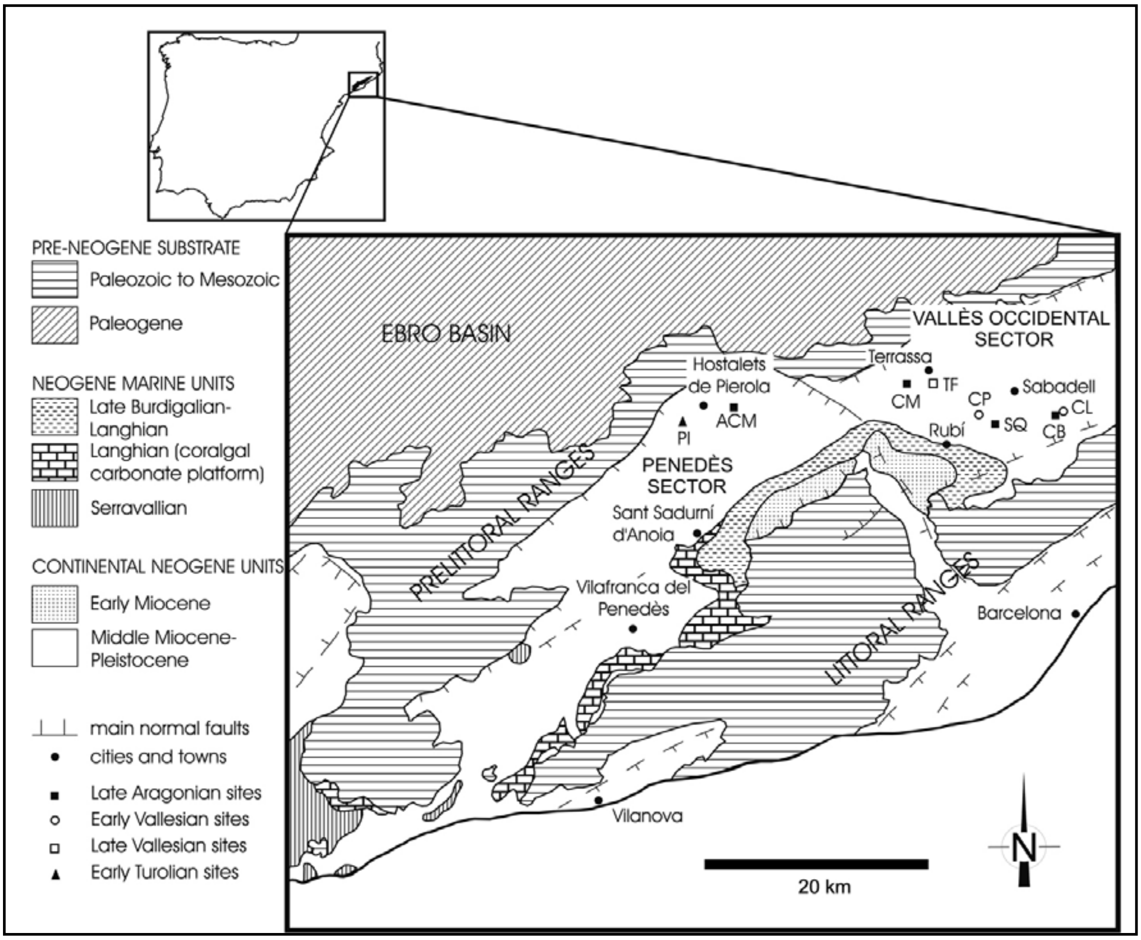

Figure 1. Schematic geological map of the Vallès-Penedès Basin, showing the main geological units as well as some of the main Middle and Late Miocene sites. Abbreviations: **ACM** = Abocador de Can Mata; **CB** = Castell de Barberà; **CM** = Can Missert; **CL** = Can Llobateres; **CP** = Can Ponsic; **PI** = Piera; **SQ** = Sant Quirze; **TF** = Torrent de Febulines. Modified from Casanovas-Vilar *et al*. (2008a). All the classical "localities" from Hostalets are scattered around the town of Hostalets de Pierola and ACM; due to scale, the geographic position of the several localities from ACM reported in Table 1 cannot be indicated here, although an updated map of ACM indicating the several sectors as well as the situation of Can Mata I and III has been published by Moyà-Solà *et al.* (2009: Fig. 2).

with the passing of time, Catalan paleontologists became more interested in the Vallès sector from the same basin. In the meantime, a rubbish dump developed along the course of a water stream near Can Mata de la Garriga, which eventually gave rise to the present Abocador de Can Mata. Over the years, an extension of the dump was planned, and a paleontological intervention was devised in order to control the removal of Miocene sediments by the excavators. Beginning in November 2002, this paleontological fieldwork has continued almost without interruption, leading to the recovery of thousands of fossil vertebrate remains.

Geological setting

Geologically, the area of els Hostalets de Pierola is situated in the Vallès-Penedès Basin, on the NE margin of the Iberian Peninsula (Catalonia, Spain) (Figure 1). This basin is a NNE-SSW-oriented Neogene half-graben, situated between the Littoral and Pre-littoral Catalan Coastal Ranges (Bartrina *et al*., 1992; Cabrera & Calvet, 1990; Roca & Desegaulx, 1992; Roca & Guimerà, 1992; Cabrera *et al*., 2004), which originated due to the rifting of the NW Mediterranean region during the Neogene. The sedimentary sequences of the basin cover most of the Miocene. Some marine and transitional sequences were deposited in this basin during the

Early and Middle Miocene, but most of the basin infilling is attributable to alluvial fan sediments (Bartrina *et al*., 1992; Cabrera & Calvet, 1990, 1996; Roca & Desegaulx, 1992; Roca & Guimerà, 1992; Cabrera *et al*., 2004; De Gibert & Robles, 2005).

The southeast-dipping Vallès and Penedès major fault segments bound the Vallès-Penedès basin and define moderate-to-high altitude foot-wall blocks to the northwest (Pre-littoral Range) and hanging-wall blocks to the southeast, which include the syntectonic basin fill and some northwestward tilted basement blocks, whose uplifted sides constitute the Littoral Range. Tectonic subsidence of the basin was controlled by these faults, their listric geometry being responsible for the accentuated asymmetry of the half-graben infill, with thickened sedimentary sequences (more than 3,000 m) developing at the northwestern active margin. Basin subsidence coupled with rift shoulder uplift along the Pre-littoral Range (Gaspar Escribano *et al*., 2004; Cabrera *et al*., 2004) probably sustained an inherited elevated Paleogene relief (1,500 m; López Blanco *et al*., 2000) along the northwestern margin of the Vallès-Penedès Basin during most of the Miocene.

Despite the fact that Early and Middle Miocene (mainly Late Burdigalian and Langhian to Early Serravallian) marine and transitional sequences were deposited in the southwestern zones of the Vallès-Penedès, most of the basin fill consists of proximal to distal-marginal alluvial fan sediments (Cabrera & Calvet, 1990, 1996; Cabrera *et al*., 2004; De Gibert & Robles, 2005). The Middle Miocene sequences in the area of els Hostalets de Pierola consist of red-to-brown mudstones, sandstones, breccias and conglomerates, which correspond to alluvial fan sediments. Coarse-grained deposits can be grouped into two types on the basis of clast composition and fabrics. First, monogenic siliciclastic brecciated conglomerates with clasts of Paleozoic phyllites and quartz; and second, polygenic, well-rounded conglomerates with a variety of clasts of Paleozoic rocks, as well as Mesozoic and Paleogene limestones and sandstones. This indicates that sediments were deposited in the distal-to-marginal, inter-fan zones of two major coalescing alluvial fan systems. Some sediments correspond to a short-radius alluvial fan system (els Hostalets de Pierola System) that was sourced from the northwestern Pre-littoral range by very close, local catchments dominated by Paleozoic metamorphic rocks. Others correspond to a coalescing and radially extensive alluvial fan system (Olesa System), sourced from the northeast by more extensive catchments in the Pre-littoral Range, where a variety of metamorphic Paleozoic and sedimentary Mesozoic and Paleocene rocks cropped out.

The area of els Hostalets de Pierola is characterized by thick Middle to Late Miocene sedimentary sequences that resulted from high-rate accumulation, most likely controlled by its proximity to the actively subsiding northwestern margin. In addition, it is also possible that the existence of a fault-release zone between the Penedès and the Vallès fault segments may have preferentially directed sediment supply towards this area. High subsidence rates determined sediment trapping at the foot of the marginal faults as well as the rapid transitions from proximal-middle alluvial fan coarse-grained sediments to distal-marginal and inter fan mud-flat mudstones. The combination of high rates of both subsidence and sediment supply must have favored rapid burial in a mudstone dominated sedimentary environment, with a positive effect on the preservation potential of vertebrate remains.

The mudstone-dominated alluvial successions in els Hostalets de Pierola show widespread evidences of soil formation, which changed in intensity. The dominant pale tan, red-brown, grayish, mottled, and pale-yellow mudstones suggest that, under shallow burial, these sediments were affected by oscillating water table conditions, which resulted in the development of a vadose zone where Eh changes may have been significant. As a consequence, the alluvial sediments were affected by alternating reducing and oxidizing conditions, resulting in the multi-colored sediments. Intensely red paleosol horizons are thin and scarce; they record punctuated episodes of a lowered water table with development of well aerated, oxidizing conditions. Widespread early diagenetic carbonates also occur in the fine-grain-dominated alluvial successions. This early diagenetic carbonate generation took place in a variety of conditions, under the influence of both meteoric water and more evolved, carbonate-rich groundwaters. The widespread occurrence of Mesozoic carbonates and Paleogene carbonate conglomerates in the Pre-littoral Range catchments would account for the high groundwater calcium bicarbonate content. This high carbonate content would have triggered incipient carbonate cementation of the coarse-grained alluvial facies, as well as the development of widespread nodular pedogenic and lenticular groundwater calcretes.

RESULTS

The ACM local stratigraphic series

More than twenty classical "localities" are known from the area of els Hostalets de Pierola (Crusafont & Truyols, 1954; Golpe-Posse, 1974), although except for Can Mata I, they do not correspond to a single stratigraphic level but to fossil findings of uncertain stratigraphic provenance (Agustí *et al*., 1985; Alba *et al*., 2006b). Accordingly, an accurate dating of the remains from most classic Hostalets "localities" is not possible, being merely grouped into Lower Hostalets (Aragonian levels) and Upper Hostalets (Vallesian levels). The dating uncertainties that surround the classical "localities" from Hostalets thus heavily contrast with the situation of the ACM local stratigraphic series (Alba *et al*., 2006a; Moyà-Solà *et al*., 2009). Until the end of 2008, 156 fossil vertebrate localities had been discovered (Table 1), being distributed along a continuous Late Aragonian section of nearly 300

Locality	Campaign	Position	MN
CCVI	2002-2003	292	MN8
C6-Ca	2008	256	MN8
C6-Aa	2008	254	MN8
C5-Ad	2007	248	MN8
C6-Ac	2008	247	MN8
C6-Ab	2008	247	MN8
C6-Ad	2008	243	MN8
C5-Ac	2007	243	MN8
C6-A2	2008	242	MN8
C6-A1	2008	242	MN8
C5-Dc	2008	241	MN8
C5-A1 (=C5-Aa)	2005	239	MN8
C6-Cb	2008	237	MN8
C6-Ah	2008	237	MN8
C4-Ad	2005	237	MN8
C6-A4	2008	235	MN8
C5-Db	2008	234	MN8
C6-Af	2008	233	MN8
C5-D1 (=C5-Da)	2008	233	MN8
C4-Aa	2005	233	MN8
C5-Dg	2008	232	MN8
C5-D2 (=C5-De)	2008	232	MN8
C6-A5 (=C6-Ag)	2008	229	MN8
C5-D3	2008	228	MN8
C5-Dd	2008	228	MN8
C5-D4 (=C5-Df)	2008	226	MN8
C5-A4 (=C5-Ab)	2007	226	MN8
C6-Ae	2008	225	MN8
C5-A7	2007	224	MN8
C5-A3	2007	223	MN8
C5-A5 (=C5-Ae)	2007	219	MN8
C6-A3	2008	218	MN8

C5-A6 (=C5-Af)	2007	218	MN8
C4-A1 (=C4-Ae)	2005	211	MN8
C5-D5 (=C5-Dh)	2008	211	MN8
C6-Aj	2008	211	MN8
C5-Di	2008	210	MN8
C4-Ac	2005	208	MN8
C4-A3	2005	204	MN8
C5-Dj	2008	203	MN8
C6-Ak	2008	202	MN8
C4-Ab	2005	202	MN8
C6-Bc	2008	201	MN8
C5-Ag	2007	201	MN8
C6-Bb	2008	200	MN8
C6-Ba	2008	199	MN8
C4-A4	2006	196	MN8
C5-A8 (=C5-Ah)	2007	195	MN8
C5-A9 (=C5-Ai)	2007	194	MN8
C6-Bd	2008	192	MN8
C5-C2 (=C5-Cb)	2007	191	MN8
C5-C1 (=C5-Ca)	2007	190	MN8
C4-Af	2005	186	MN8
C6-Ai	2008	181	MN8
C5-Cd	2007	181	MN8
C3-AT	2004	179	MN8
C3-A1	2004	178	MN8
C2-A1	2004	178	MN8
C5-C4 (=C5-Ce)	2007	178	MN8
C5-Cf	2007	178	MN8
C4-Cb	2005	175	MN8
C5-C3 (=C5-Cc)	2007	174	MN8
C4-Cc	2005	172	MN8
C4-C1 (=C4-Ca)	2005	171	MN8
C3-Aa	2004	171	MN8
C3-A2	2004	171	MN8
C3-Ak	2004	170	MN7 or MN8
C3-Af	2004	170	MN7 or MN8
C3-Ae	2004	170	MN7 or MN8
C4-Ap	2006	169	MN7 or MN8
C3-A4	2004	166	MN7 or MN8
C4-C2 (=C4-Ce)	2005	165	MN7 or MN8
C3-A5 (=C3-Ac)	2005	165	MN7 or MN8
C4-C3	2005	163	MN7 or MN8
C3-Ah	2004	163	MN7 or MN8
BCV5	2007	162	MN7 or MN8
C3-Cf	2005	161	MN7 or MN8
C3-A3	2004	161	MN7 or MN8
C3-Ab	2004	159	MN7 or MN8
C4-Cd	2005	158	MN7 or MN8
C4-Cg	2006	155	MN7 or MN8
C3-Az	2004	155	MN7 or MN8
C3-A6 (=C3-Ad)	2004	155	MN7 or MN8

C4-Cp	2006	153	MN7 or MN8
C2-A2	2004	150	MN7 or MN8
C2-Aa	2004	149	MN7 or MN8
C3-Aj	2004	148	MN7 or MN8
BCV4	2007	147	MN7 or MN8
C3-Ap	2005	147	MN7 or MN8
C3-Aq	2005	145	MN7 or MN8
C2-A3	2004	145	MN7 or MN8
C3-Al	2004	143	MN7 or MN8
C3-An	2005	142	MN7
BCV1 (=BDA-SW2,3)	2002-2003	142	MN7
C3-A7	2004	140	MN7
BDA1	2002-2003	139	MN7
VIE-C1	2002-2003	138	MN7
BCV3 (=BDA-SW4)	2002-2003	138	MN7
C3-Ai	2004	134	MN7
C3-B2 (=C3-Bb)	2004	128	MN7
C2-A4	2004	128	MN7
VIE-C3	2002-2003	128	MN7
C3-B2 (=C3-Bb)	2004	128	MN7
BCV2 (=BDA-SW1)	2002-2003	127	MN7
C3-Am	2004	126	MN7
C3-Ba	2004	125	MN7
BDA2	2002-2003	125	MN7
BDA7 (=BDAb)	2002-2003	124	MN7
VIE-C4	2002-2003	123	MN7
BDA8 (=BDAa, BDAc)	2002-2003	115	MN7
BDA3	2002-2003	115	MN7
C3-Bc	2004	112	MN7
C1-A1	2002-2003	107	MN7
C3-Bd	2005	103	MN7
BDAd	2002-2003	103	MN7
C1-A2	2002-2003	103	MN7
C1-A3	2002-2003	99	MN7
C1-A5	2002-2003	96	MN7
C1-A4	2002-2003	96	MN7
C3-B3	2005	92	MN7
C2-Ba	2002-2003	89	MN7
C2-B1	2002-2003	89	MN7
C2-Bb	2002-2003	88	MN7
C2-B2	2004	86	MN7
C2-B3	2004	84	MN7
C2-Bc	2004	81	MN7
BDA4	2002-2003	80	MN7
C1-E4	2002-2003	77	MN7
C1-E10	2002-2003	75	MN7
C1-E9 (=C1-Ef)	2002-2003	74	MN7
C1-C1	2002-2003	66	MN7
C1-Ed	2002-2003	64	MN7
C1-Ea	2002-2003	64	MN7
C1-E6	2002-2003	64	MN7

C1-Eb	2002-2003	63	MN7
C1-E5	2002-2003	ca. 63	MN7
C1-E3	2002-2003	ca. 63	MN7
C1-Fa	2002-2003	61	MN7
C1-C3	2002-2003	60	MN7
C1-E*	2002-2003	ca. 60-75	MN7
C1-E2	2002-2003	58	MN7
C1-C4	2002-2003	57	MN7
C1-E1	2002-2003	ca. 54	MN7
VIE-E1	2002-2003	53	MN7
C1-Ee	2002-2003	ca. 50-63	MN7
C1-E7+8 (=C1-Ec)	2002-2003	52	MN7
BDA6	2002-2003	48	MN7
C1-ET2	2002-2003	47	MN7
C1-ET	2002-2003	47	MN7
C1-Ex	2002-2003	46	MN7
C1-D1	2002-2003	41	MN7
C9-A1	2006	39	MN7
BDA5	2002-2003	39	MN7
BDL3	2002-2003	37	MN6 or MN7
BDL2	2002-2003	36	MN6 or MN7
BDL1	2002-2003	29	MN6 or MN7

Table 1. Updated list of the vertebrate localities discovered until the end of 2008 at Abocador de Can Mata. For each locality, the campaign of discovery and the stratigraphic position (in meters) in the local stratigraphic series are indicated. This list updates the information provided by Alba *et al.* (2006b), which included localities discovered until the end of 2005.

m. These localities are very heterogeneous, ranging from a few square meters up to about 100 m^2, and having yielded each from a few tens of remains up to more than 6,000. Isolated findings are also habitual, their stratigraphic position being recorded in the case of most identifiable remains. As a result, the stratigraphic position of most of the fossil remains thus far recovered is accurately recorded..

Magnetostratigraphy

Thanks to the extensive outcrops generated by the digging activity (Figures 2A-D), and to the continuous paleontological control (Figures 2E-F), the ACM stratigraphic series is based on firm litho-, magneto- and biostratigraphic grounds (Moyà-Solà *et al.*, 2009), which allows a precise dating of the several localities and most of the isolated remains. On the first place, the stratigraphic position of each locality is recorded on its corresponding section, which are correlated to one another on lithostratigraphic grounds. A paleomagnetic analysis (Moyà-Solà *et al.*, 2009), based on 369 samples distributed over a 460 m thick composite section including ACM and its surroundings, further permits a correlation with the astronomically-tuned Neogene time scale ATNTS2004 (Lourens *et al.*, 2004a,b,). In particular, a high-resolution sampling (at 1 m intervals) was carried out on three stratigraphically overlapping sections of ACM, representing an interval of 360 m. Also, a 200 m thick sedimentary sequence was sampled at 2 m intervals along the Riera de Claret. This section is laterally equivalent to the top sediments of ACM, further extending upwards to include the Aragonian/Vallesian boundary, which in this area is located between the historical sites of Can Mata I and Can Mata III. To sum up, this paleomagnetic analysis has yielded a high-quality local magnetic polarity that can be successfully correlated to the geomagnetic polarity time scale (Figure 3). The location of the Aragonian/Vallesian boundary, well dated in the Vallès-Penedès and other Spanish basins (Garcés *et al.*, 1996, 2003; Agustí *et al.*, 2001), enables an unambiguous correlation of the topmost (100 m-thick) normal magnetozone with the characteristic long normal chron C5n. On this basis, the match of the local magnetic polarity

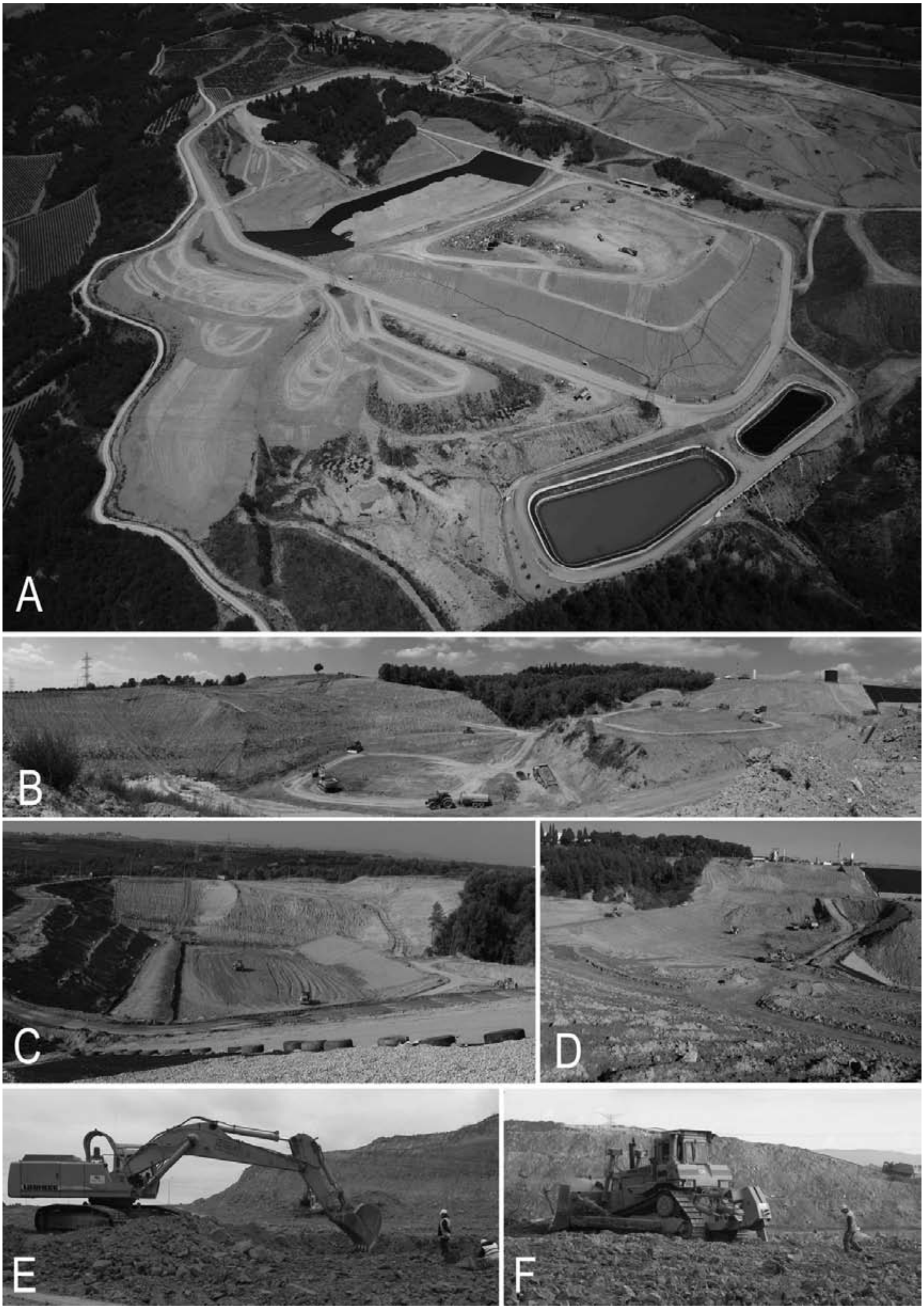

Figure 2. (A) Aerial photograph of Abocador de Can Mata during 2006, kindly provided by Cespa Gestión de Residuos, S.A.; (B) Panoramic view of Cell 5 during August 2007; (C) Different view of Cell 5 during October 2007; (D) View of C6 during December 2008; (E) Paleontologist controlling a digger at C6-A in April 2008; (F) Paleontologist following a bulldozer at C6-A in January 2008.

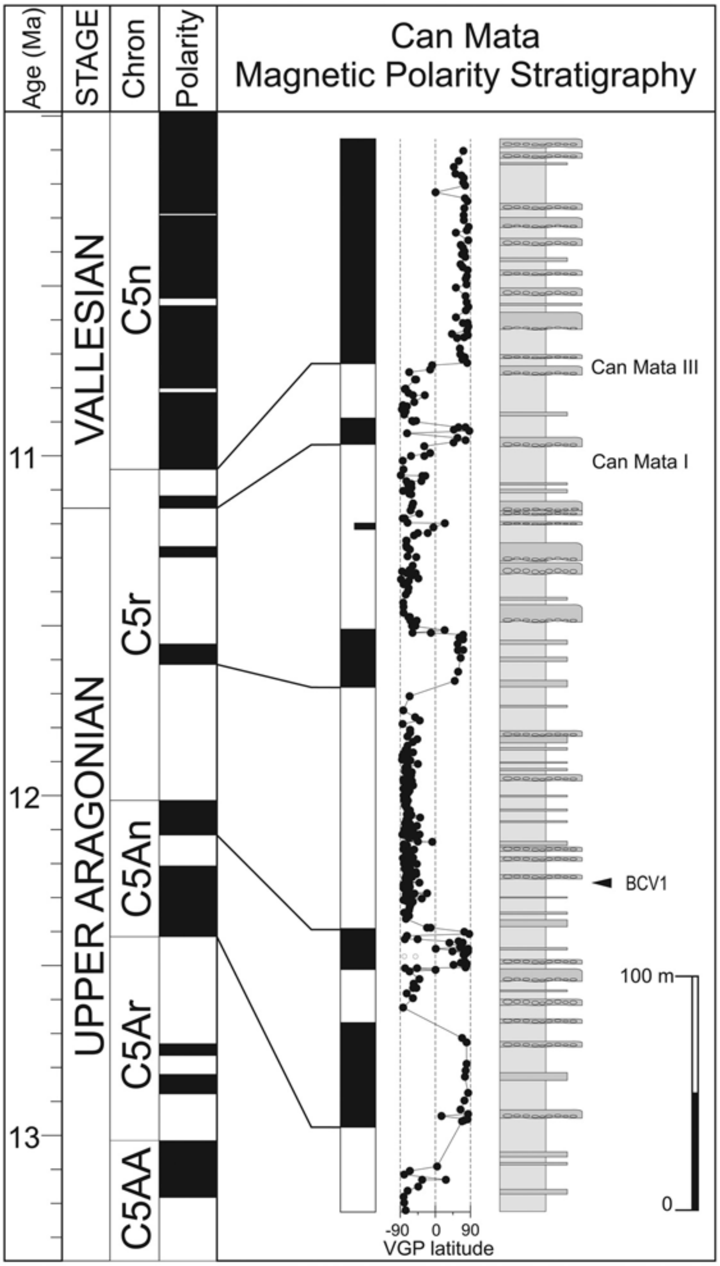

Figure 3. Composite magnetic polarity stratigraphy of ACM and correlation with the astronomically tuned geomagnetic polarity time scale ATNTS2004, indicating the situation of BCV1 and of the classical localities of Can Mata I and III. Modified from Moyà-Solà *et al.* (2009: Fig. 5).

stratigraphy and the global polarity time scale is excellent, providing evidence for stratigraphic completeness and steady sedimentation over the studied interval. On the basis of the ATNTS2004 (Lourens *et al.*, 2004a,b), the composite (ACM/Riera de Claret) section spans from 12.6 to 10.6 Ma, whereas the ACM series that have yielded fossil localities and vertebrate remains during the construction of the rubbish dump ranges from about 12.5 to 11.3 Ma.

Biostratigraphy

The biostratigraphic correlation of fossil vertebrate localities from the European Neogene is customarily based on the MN (Mammal Neogene) biozones (Mein, 1975). Mein (1975) distinguished three biozones (MN6, MN7 and MN8) for the Late Aragonian, and although the two latter were subsequently fused into a single biozone MN7+8 (de Bruijn *et al.*, 1992; Agustí *et al.*, 2001), most recently Mein & Ginsburg (2002) redefined the MN7 and

Order Insectivora	*M.* cf. *crusafonti*	Order Artiodactyla
Soricidae indet.	*M. ibericus*	*Listriodon splendens*
Crocidosoricinae indet.	*Anomalomys gaudryi*	*Conohyus steinheimensis*
Talpa minuta	*Keramidomys carpathicus*	*Propotamochoerus palaeochoerus*
cf. *Proscapanus* sp.	*Eomyops* cf. *oppligeri*	*Albanohyus pygmaeus*
Parasorex socialis	*Glirudinus undosus*	cf. *Taucanamo* sp.
Galerix sp.	*Muscardinus sansaniensis*	*Dorcatherium naui*
Erinaceinae indet.	*M. hispanicus*	*Miotragocerus* cf. *monacensis*
Dinosorex cf. *sansaniensis*	*Myoglis meini*	cf. *Eotragus* sp.
Plesiodimylus chantrei	*Microdyromys complicatus*	*Micromeryx flourensianus*
Order Chiroptera	*Paraglirulus werenfelsi*	*Euprox furcatus*
Gen. et sp. indet.	*Bransatoglis astaracensis*	Order Carnivora
Order Lagomorpha	*Albanensia* cf. *a. albanensis*	*Martes munki*
Prolagus oeningensis	*A. a. quiricensis*	*Ischyrictis mustelinus*
Eurolagus fontannesi	*Miopetaurista neogrivensis*	*Trocharion albanense*
Order Rodentia	*M.* cf. *crusafonti*	*Sansanosmilus jourdani*
Eumyarion leemani	*Heteroxerus* sp.	*Leptoplesictis* cf. *aurelianensis*
Hispanomys decedens	*Spermophilinus bredai*	*Pseudaelurus* sp.
H. daamsi	*Chalicomys batalleri*	*Thalassictis montadai*
H. lavocati	Order Proboscidea	*Protictitherium crassum*
H. cf. *aguirrei*	*Deinotherium giganteum*	cf. *Protictitherium* sp.
Democricetodon b. brevis	*Gomphotherium angustidens*	Order Primates
D. brevis nemoralis	Order Perissodactyla	*Pliopithecus* sp. nov.
D. larteti	*Chalicotherium grande*	*Pierolapithecus catalaunicus*
D. crusafonti	*Anchitherium* sp.	*Dryopithecus fontani*
Megacricetodon m.minor	*Alicornops simorrensis*	Hominidae gen. et sp. nov.
M. minor debruijni	cf. *Hoploaceratherium tetradactylum*	

Table 2. Updated faunal list of mammalian species from the local stratigraphic series of Abocador de Can Mata. This list updates the information provided by Alba *et al.* (2006b) and Casanovas-Vilar *et al.* (2008b).

MN8 on the basis of La Grive fissure fillings. This division is likely to have a restricted geographic extension, but in any case, it can be successfully applied to the ACM series.

Alba *et al.* (2006b) divided the ACM series into three local biozones. The *Megacricetodon ibericus* + *Democricetodon crusafonti* biozone corresponds to the upper part of the sequence, whereas the *M. ibericus* + *D. larteti* biozone characterizes most of the lower part of the series. The former biozone can be correlated to La Grive M, which is the reference locality for the MN7 sensu Mein & Ginsburg (2002), being characterized, ammong others, by the presence of *Democricetodon larteti*, as well as by the absence of some inferred MN8 immigrants. In its turn, the lower part of the series can be correlated to La Grive L3, which is the type locality for the MN8 sensu Mein & Ginsburg (2002), and in which *Democricetodon crusafonti* is found instead of its inferred ancestor, *D. larteti*. Thus, for example, BCV1 (the type locality of *Pierolapithecus catalaunicus*), which shares an important number of micromammal species with La Grive M (Casanovas-Vilar *et al.*, 2008b), can be correlated to the MN7 (Alba et al., 2006b; Casanovas-Vilar et al., 2008b), hence being older than other late Aragonian sites of the same basin, such as Can Mata I, Sant Quirze and Castell de Barberà, which are correlated to the MN8.

The uppermost locality of the ACM series is CCV1, which can be correlated to MN8, corresponds to subchron C5r.2r and has an estimated age of 11.5 Ma. With regard to the lowermost portion of the series, the oldest locality is BDL1, which corresponds to subchron C5Ar.1 and has an estimated age of 12.4 Ma. The similarly aged localities BDL2 and BDL3, stratigraphically situated 7-8 m above BDL1, correspond to subchron C5An.2n. Preliminary study of the limited small mammal sample from BDL1 led Alba *et al.* (2006b) to propose a tentative correlation to the MN6 for the lowest portion of the series. However, the most extensive rodent assemblage recovered from C9-A1 (unpubl. data), only 2 m above BDL3, indicates that this locality corresponds to the MN7. The MN6/MN7 boundary was tentatively situated at to 12.5-13.0 Ma by Agustí *et al.* (2001), i.e. only slightly older than the lowermost ACM localities. Data from ACM indicate that most of the lower portion of the series corresponds to the MN7, but more data would be required in order to test whether the three oldest localities from the series can be correlated to the MN6.

Faunal composition

Besides several isolated findings of birds, amphibians, and small reptiles (including anguids, snakes and turtles), the fauna from ACM mainly includes mammals (Table 2): 9 insectivores, 1 chiropter, 2 lagomorphs, 30 rodents, 2 proboscideans, 4 perissodactyls, 10 artiodactyls, 9 carnivorans and 4 primates.

The large-mammal fauna, with deinotheres and gomphotheres, diverse suids (including the large-bodied *Listriodon* and the small-bodied *Albanohyus*), the cervid *Euprox*, the bovid *Myotragocerus*, several small artiodactyls (the ubiquitous *Micromeryx* and the extremely rare *Dorcatherium*), fits well with the typical faunas from other Middle Miocene localities from the Vallès-Penedès Basin, such as Sant Quirze and Castell de Barberà. The same may be argued regarding the small-mammal fauna, although castorids are much rarer than in the Vallès sector. It should be taken into account, however, that the faunal list reported in Table 1 mixes species that must have not necessarily coexisted in time, given the fact that the ACM series represents a timespan of approximately one million years. Alba *et al.* (2006b) provide a general discussion on the ACM fauna as well as a comparison with taxa previously reported for Lower Hostalets. Accordingly, only the most recent significant discoveries are discussed below.

A new species of castorid, *Chalicomys batalleri*, was recently described by Casanovas-Vilar *et al.* (2008a) on the basis of a hemimandible and several dentognathic remains from C4-C2 (estimated age 11.8 Ma). An almost complete femur from the similarly aged locality C3-Ak, tentatively attributed to the same species, has enabled this authors to make some locomotor inferences for this taxon. In particular, the authors conclude that, like living beavers, *Chalicomys* was an efficient swimmer highly committed to aquatic locomotion. The presence of an extinct castorid with aquatic adaptations in the Hostalets area, together with sedimentological evidence, suggests more humid conditions than previously assumed—at least for a restricted time interval, given the rarity of castorid remains elsewhere in the ACM series.

More recently, remains of the leptarctine mustelid *Trocharion albanense* from several ACM localities (estimated age 12.2-12.4 to 11.7 Ma) have been described by Robles (2008). This taxon has been reported from several Middle to Late Miocene European localities. Besides dental remains, the newly recovered *Trocharion* material includes several mandibles and two partial crania, which have revealed features thus far unknown for this taxon, indicating that it most likely occupies a basal position within the Leptarctinae.

The most striking discoveries at ACM, in any case, refer to several primate taxa. These include a new species of *Pliopithecus* (Alba *et al.*, 2008) as well as three different hominoids (Moyà-Solà *et al*., 2004, 2009, in prep.; Almécija *et al*., 2008): a partial skeleton of *Pierolapithecus catalaunicus*; the first maxillary remains of *Dryopithecus fontani*; and a partial skull of a new, thus-far undescribed genus (Moyà-Solà *et al*., in prep.). These hominoid remains will significantly contribute to the understanding of the great ape and human clade, and have already provided important insights regarding the evolution of the locomotor apparatus in this group (Moyà-Solà *et al*., 2004, 2005; Almécija *et al*., 2008, in press). The oldest hominoid remains from ACM come from locality C1-E*, with an estimated age of 12.3 Ma (Casanovas-Vilar *et al*., 2008c), while other hominoid-bearing localities have an estimated age of 11.9 to 11.8 Ma. This coincides with the presence of castorids, suggesting the existence of a particularly humid and forested environment by this age. Interestingly, the new pliopithecid species has been recorded from several localities spanning between 11.7 and 11.6 Ma, and further pliopithecid remains are known by 12.0 Ma (Alba *et al*., 2008). Thus far, these two primate groups have not been found together at the same locality, so it is currently unknown whether they coexisted in time, or replaced one another repeatedly due to changes in environmental conditions.

Paleoecology

Casanovas-Vilar *et al*. (2008b) have provided a paleobiogeographic and paleoecological analysis of the ACM faunas, with particular emphasis on the micromammals of BCV1. The large-mammal composition of ACM is consistent with the presence of a warm to tropical, relatively humid, dense evergreen forest, hosting a considerable diversity of mammals. The presence of some taxa, such as tragulids and castorids, together with the high primate diversity in ACM, might indicate more humid conditions than in Lower Hostalets «localities», although the possibility cannot be excluded that these rare humid taxa have been found at ACM merely thanks to a larger sampling effort. A multivariate analysis reported by Casanovas-Vilar *et al.* (2008b), following the methodology of Hernández Fernández *et al.* (2003), classifies ACM and Lower Hostalets as tropical deciduous forests (implying tropical temperatures and a summer rain season), with ACM being close to La Grive but somewhat intermediate with respect to evergreen tropical rain forests. Paleobotanical data, however, are not consistent with the existence of tropical forests in Western Europe during the latest Middle Miocene, suggesting instead the presence of warm-temperate forests with a notorious proportion of deciduous taxa (e.g., Kovar-Eder, 2003; see also discussion in Casanovas-Vilar *et al*., 2008b). A multivariate analysis based on the small mammal fauna from BCV1 (Casanovas-Vilar *et al*., 2008b), as compared to other European localities, shows that the former locality, like Castell de Barberà and Sant Quirze A, are more similar to French and Central European fossil localities, thus contrasting with those from inner Iberian basins. During the Miocene, the Vallès-Penedès Basin apparently more closely resembled French localities by displaying more humid and forested conditions than elsewhere in Iberia (Casanovas-Vilar et al., 2005; Casanovas-Vilar & Agustí, 2007; Casanovas-Vilar et al., 2008b). This would explain why great apes and pliopithecids have not been recorded in the Iberian Peninsula outside the Catalan basin.

CONCLUSIONS

Besides the impressive number of fossil remains thus far recovered, which permits to sample rare taxa such as primates, the scientific potential of the ACM local stratigraphic series relies on the detailed stratigraphic control by through litho-, bio- and magnetostratigraphic correlation. The densely sampled, 300 m thick local stratigraphic series of ACM, thanks to its accurate chronology, provides a unique opportunity for understanding the faunal dynamics in terrestrial ecosystems during the latest Middle Miocene in southwestern Europe. Paleontological fieldwork still goes on at ACM, so that the number of localities and recovered fossil remains will surely increase during next years.

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