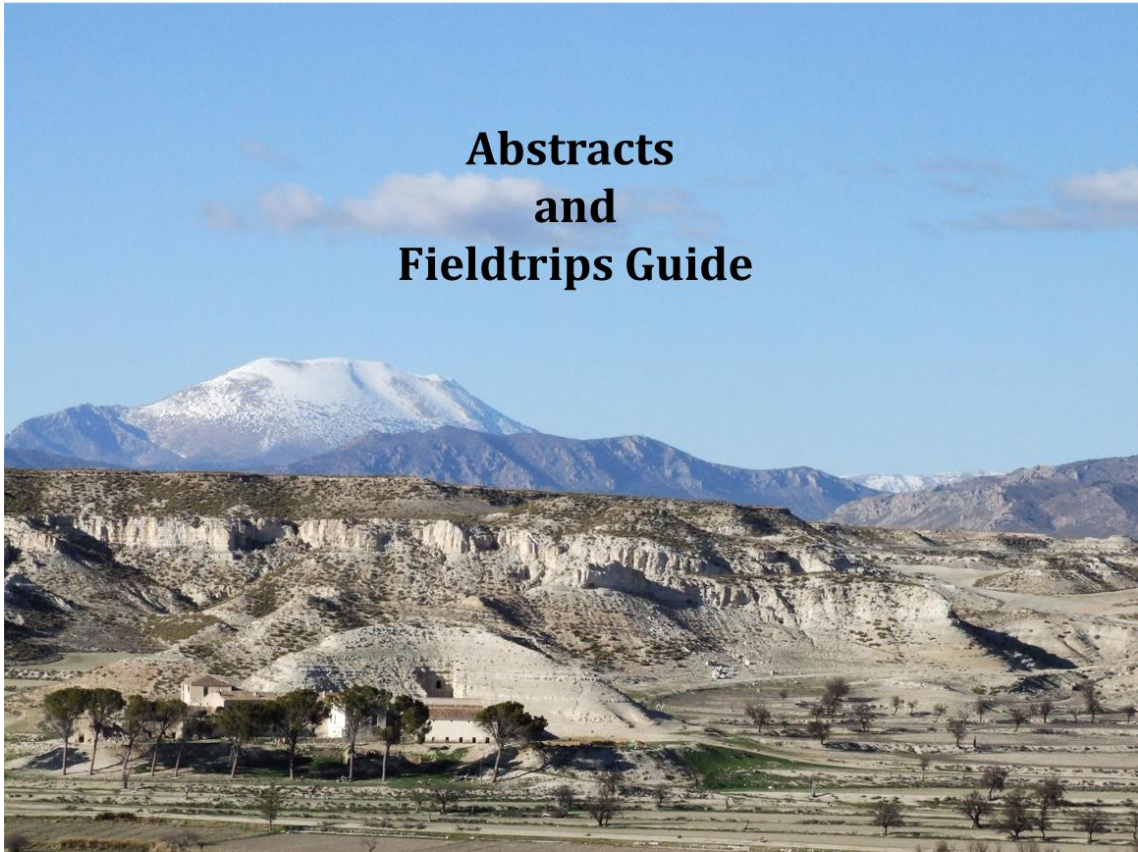# Orce and Lucena (Spain)
2009 SEQS Annual Congress
September 28th - October 3rd

The Quaternary of southern Spain: a bridge between Africa and the Alpine domain

**Abstracts
and
Fieldtrips Guide**

INQUA SEQS IPHES *Institut Català de Paleoecologia Humana i Evolució Social* **ABePH** Asociación Bética de Paleoecología

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First Circular

The Quaternary of southern Spain:
a bridge between Africa and the Alpine domain

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ABSTRACT VOLUME
and
FIELDTRIPS GUIDE

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ABSTRACTS

Oral Presentations

EVOLUTIONARY RESPONSE OF MAMMALIAN FAUNA TO CLIMATE
CHANGE OVER THE LATE CENOZOIC

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Changes in mammal faunal diversity over time have often been considered the result of
bioevents linked to major climatic changes: physical and/or biotic environmental
modifications caused by the climatic change can determine concurrent bioevents in
multiple lineages, affecting taxonomic diversity and changing community structure.
Although the composition of regional faunas would be dependent on both physical
environmental parameters and competition/coevolution dynamics, scholars are still
divided about the actual role played by climate change/environmental factors in the
evolution of large mammal fauna. Some researchers claim that climate shifts affect
biodiversity patterns to a great extend, others deny or minimize the influence of global
changes as driver of fauna evolution.

Summarizing the most popular hypothesis which stress the role of physical factors, the
"Stationary" model states that diversity is primarily regulated by density-dependent
factors in the physical environment; the "Habitat Theory", "Turnover Pulse
Hypothesis", "Traffic Light model" and "Relay Model" assume that evolutionary
changes are mainly driven by changes in the physical environment (such as physical
parameters and primary resources), and "Court Jester" models regard climatic change as
a very important stimulus to evolution. The "Coordinated Stasis" theory also states that
"without ….. collapse of stable ecosystems there would have been little movement in
the history of life''. In the end, following ORD (orbitally forced range dynamics), rapid
10-100 ka climatic shifts throughout the Earth's history would have caused the
extinction, splitting and merging of gene pools as well as changes in the geographical
distribution of clades, and speciation.

Alternatively, climatic change has been regarded as a sort of "background noise, while
the major driver of evolutionary change would be inter- and intra-guild interactions. The
"Red Queen Hypothesis", and related models (which maintain that climatic shifts are
less important than biotic interactions), assume that changes in equilibrium may be due
to the internal dynamics of competitive relationships, and do not necessarily indicate a
strict interdependence of major climatic changes and evolutionary events. Equilibrium
conditions can be maintained by density-dependent extinctions and originations
(immigrations) and by coevolution.

Climatic control of the evolution of mammals, believed to have less environmental
sensitivity than other organisms, is actually a high complex phenomenon, and it seems
reasonable to suppose that both climate change and intrinsic biotic controls would have
contributed to fauna evolution, though at a different temporal scaling and extent. For
instance, climate would trigger functional turnover, if not evolutionary processes, by
removing key stone species.

Much research needs to be done in this area, and greater knowledge of changes over
long and short geological time is needed to understand the spatiotemporal complexity of
ecological dynamics and answer the debated question: how does climatic change affect
terrestrial biodiversity? The extensive large-mammal fossil record of South-western

Europe offers the remarkable opportunity to consider the constraining effects that both biotic interactions and physical environmental changes exerted on large mammal "community" structure over a 5 Ma. During this time-span, several important global climatic events can be detected, across different climatic regions.

The double aim is to provide a concise picture of the functional turnovers which occurred over a period during which middle latitude faunas had undergone the transition from relatively warm to generally cooler climates, and to investigate to which extent and to which temporal scale climate changes and biotic interactions contributed to mammal fauna rebuilding.

Results obtained suggest that throughout the Plio–Pleistocene, mammals more frequently reacted to climate shifts not by evolving and producing new species, but by migrating or by varying their area of diffusion, in keeping with the vegetational cover and latitudinal displacement of biomes. The most important taxonomical turnover relate to major global climatic changes (noticeably cold-shift oscillations around 2.6 and 1.0 Ma). Faunal turnover might mark the beginning of more or less long altering periods of rise and fall of biodiversity.

Climate appears to be a critical factor in driving faunal renewals, promoting dispersal, perhaps removing keystone species, altering the internal equilibrium of palaeocommunities, giving rise to new inter-guild and intra-guild dynamics, and creating new types of competition among species. These events modify the structure of mammalian faunas, thus the evolutionary patterns of large mammals from South-western Europe indicate that a number of minor functional changes occurred throughout the Plio–Pleistocene, in addition to the major, climate driven turnovers.

Diachroneity in local functional turnover as well as in diversity trends, would probably have relied on differences in local dynamic patterns of competition/coevolution even if the different manifestations of global climate changes in different geographic settings would have contributed to the scaling of local bioevents.

We can also hypothesize that cause-and effect relationships between climatic oscillations and faunal changes may be the cumulative result of the responses of individual species to changing, moreover niche differentiation and biotic interactions would be among the factors influencing evolutionary patterns.

ORIGIN OF THE APPARENT INCONSISTENCIES OBSERVED IN THE DISTRIBUTION OF THE PLEISTOCENE RAISED AND SUBMERGED BEACHES DATED IN AND OFF BRITTANY (FRANCE).

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Compilation of the ages of the Pleistocene raised beaches and lower cliffs material dated by geochronology in Brittany (van Vliet-Lanoë et al., 2000) as well as those inferred from stratigraphic studies (Monnier, 1973) has been compared with the age of the submerged beaches studied in the English Channel (Danukalova and Lefort, 2009). Taken as a whole the distribution of those remnants of the previous shores appears to be random and unorganized (See figure below). However some light comes out if the submarine data are separated from the onshore data and if the results of Western Brittany are separated from those of Eastern Brittany.

- Offshore, the Pleistocene studied formations are now known to be the result of a continuous regressive episode (even if affected by second order oscillations), leading to a complete emersion of the English Channel. The former beaches, which now appear as a conglomerate constituted by marine shells and cobbles, consolidated during 4 different stable stages of regression of the sea under various loess covers. Their formation ranges between 120 and 18 Ka. They consequently span between OIS 5c-d and OIS 3 (Danukalova and Lefort, 2009). The clear younging of the ages observed towards the West is thus easily explainable.

- Onshore, and save in two localities, there is on the contrary a clear younging of the ages of the raised beaches from the West towards the East since we are ranging from OIS 5 (and even 2) in the East to OIS 13 in the West. This is, without any doubt, related with the differential uplift of Brittany. This uplift has been observed directly by terrain leveling and GPS technique (Le Notre et al., 1999), but also by the study of the indentation of the rivers (Bonnet, 1998). It is only when the long wavelength undulations of the Moho have been compared with topography that the origin of this phenomenon has been fully explained (Lefort and Agarwal, 2002). Brittany is a complex area since it shows uplift in the West and subsidence in the East associated with two different behaviors of the lithosphere (Lefort and Agarwal, 2000). The figure below shows how the uplift axis (U on the figure) cross cut obliquely the subsiding zone (S on the figure). This explains the complexity of the distribution in ages we observe onshore. It is important to stress that the uplift and subsiding phenomena are completely independent respect with one another. The former being of isostatic origin and the second related with the Alpine buckling of the crust. In any case we must keep in mind that the isostatic uplift phenomenon is a long and slow process which cannot stop or restart rapidly. We don't really know if more recent Pleistocene marine sediments ever deposited in the West and were latter eroded. This is theoretically possible since OIS 11 and 9 sea levels have been reaching almost the same altitude as OIS 13 (van Vliet-Lanoë et al., 2000). However, we postulate that sediments of those ages never covered

our oldest raised beach because of the slow but significant uplift previously described. In the East, in the subsiding zone, beneath the Holocene sediments, some remnants of the Upper Pleistocene loess are known but they were deeply eroded by large braided rivers when the Channel was at its lowest level (Lautridou et al., 1995). For the same reason as that given above, the subsidence was very slow. It is nowadays still active (between -0.2 and -0.4 mm/year) since the Alps are continuing to build up.

It is clear that there has been a competition during the Upper Pleistocene between the offshore sediments deposition associated with the general regression of the English Channel and the onshore uplift which took place in Western and Central Brittany. The topographic uplift was probably rising at the same rate during the Upper Pleistocene. It is now of 0.8 mm/year close to the uplift axis (Le Notre et al., 1999), but the uplift velocity is probably much less away from this axis when we reach the center of the English Channel. Calculation of the mean regression velocity of the English Channel between 120 Ka and 20 Ka shows that it was around 1.2 mm/year. That is to say much higher than the uplift velocity. Taken as a whole the opposition in the pattern of the ages observed between the onshore and offshore areas simply evidences that the sea level changes were faster than the isostatic uplift at the same time.
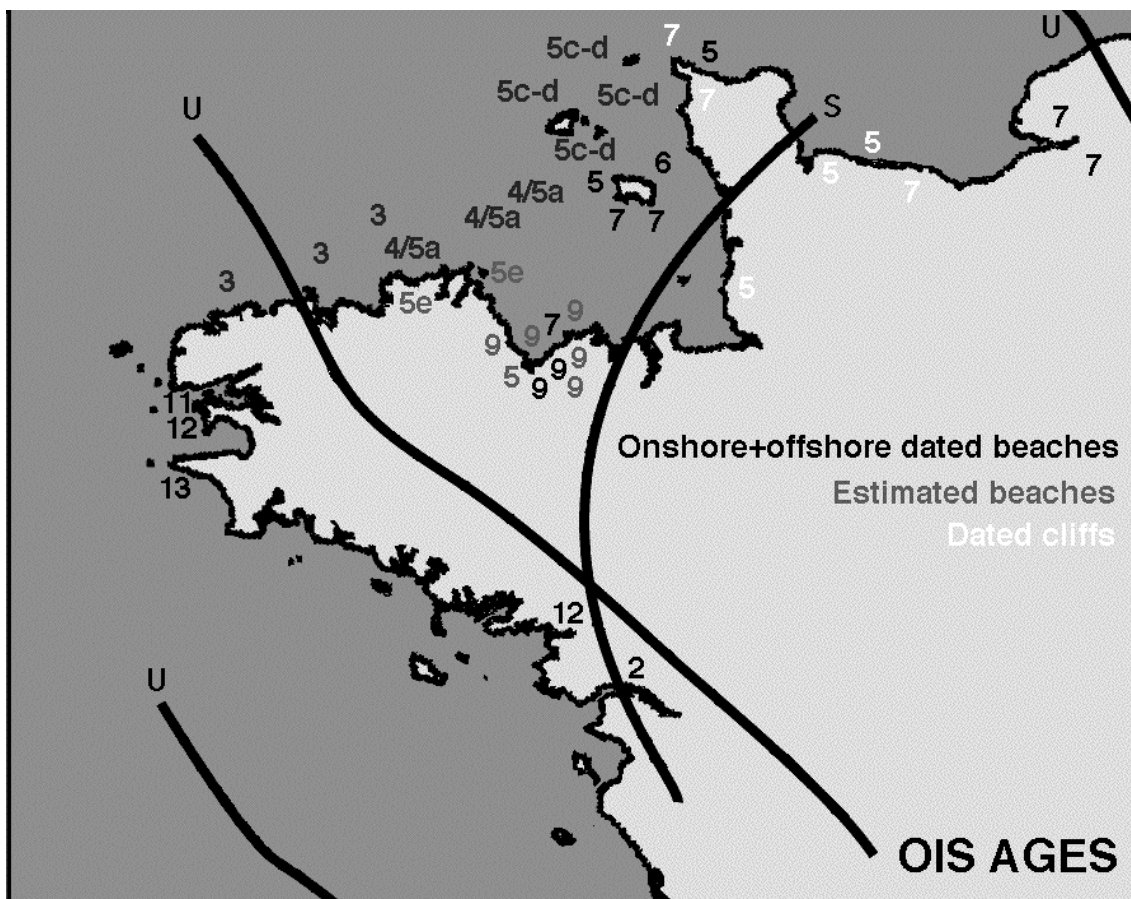
THE EFFECTS OF GEOLOGICAL FORMATION ON QUALITY OF
QUATERNARY AQUIFERS

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Abstract
Providing fresh water for irrigation, industry and drinking is one of the most important limitations for progress especially in arid and semiarid regions. In these areas, the main source of water belongs to underground water, and the quality of water depends on the geological formation and salinity of upper players of the aquifer. So, the chemical properties of sediments and geological formations of the studied areas are very important.
The effect of various geological formations from Pre- Cambrian to the recent Era in Iran has been considered to see their effects on water quality. The kinds and concentration rates of different materials in water depend on rocks and composited materials, which are in contact with water.
According to the geological map of Iran, there are 212 geological formations in Iran with different properties such as: lithology, erodibility, and rate of chemical weathering, salinity and so on.
The study was done in 4 different provinces named as: Fars, Hamadan, Semnan and Zanjan. There was a flood spreading research station in each province. Soil and water samples were collected from soil surface, groundwater and corresponding rivers and analyzed for EC, PH, cations, anions and calculation of SAR. The results showed that geological formation is one of the most important and effective agents on the quality of water. Also sedimentary formation with respect to igneous and metamorphic ones plays a large role in quality of water. However, Miocene, marl formations affected the groundwater quality and increased it's concentration and EC.

Key words: water quality, Quaternary, Geological Formations, aquifer.

THE EFFECTS OF TECTONIC ON QUATERNARY STRATIGRAPHY OF IRAN

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ABSTRACT

The Quaternary deposits have been covered half past of Iranian territory and in order to important consist of alluvial, evaporate, eolian, beach sand, effusive activities, landslide-debris and glacial drift deposits.

The late walachian minor events and pasadenian main pulsation vigorous were caused uplifting of mountains and subsidence of valleys.

The Quaternary alluvial deposits have been composed of thick stratigraphic sediments, which formed by conglomerate, coarse gravels, boulders, pebbles, sand, silt and marls. Intervals of different stages have been distinct by changing in sedimentation.

In the four distinguished areas of Iranian platform typically different, Quaternary deposits had similar characters, which indicated mentioned factors influence contemporaneous all part of Iran.

In the central part of Iran, the Quaternary and recent Formations are mainly presented by extensive gravel sheets, deposited salt-water, brackish-water and fresh water lakes (Lake deposits, Lut and Kawir deposits, Recent salts), and by Aeolian sand, loess occurs in the western foothills of the Alborz and in the western spurs of the Kopet-Dagh.

In the north part of Alborz mountains, Mazandran-Gorgan plain has been formed by marine deposits.

KEY WORDS: Iran, Quaternary, Tectonic, Stratigraphy, Sediments, Alluvium and marine deposits.

TECTONICS VS. CLIMATE DRIVEN SEDIMENTATION: THE PLEISTOCENE RECORD OF CENTRAL ITALY

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The Apennines has an asymmetrical geological setting and different style and rates of tectonic activity. The chain, locally well above 2000 m asl, is actively rising although with different rates. The long-term uplift rates can be inferred by the presence of Early Pliocene marine deposits on top of the higher part of the chain (Abruzzi Apennines) that indicate uplift rates of ca 0,7 mm/yr. To the north, in the Umbro-Marchean Apennines, the rates are ca. of 0.2-0.3 mm/yr. To the east, the hilly Periadriatic basin, since the beginning of the Pleistocene at 2.5 Ma, is also rapidly rising up to 0,4-0,5 mm/yr closer to the chain axis (i.e Monte Ascensione, southern Umbro-Marchean Apennine). In this sector coastal and continental deposition is recorded up to the Middle Pleistocene. These deposits also seal a series of Early Pliocene thrust fronts. On the western side of the Apennines the uplift rates since the Late Pliocene are ca. 0,2-03 mm/yr (Cetona-Chianti Ridge, Tuscany Region). In this sector the Pliocene coastal and continental sedimentation took place inside sinform sinking basins that since the Early Pleistocene were uplifted although partially balanced by west dipping NW-SE trending high angle normal faults that generated horsts and grabens (Tiber Basin, Gubbio, Norcia, L'Aquila, Sulmona, etc.). In order to establish the importance of climate and tectonics we investigated the Early Pleistocene record in the already mentioned Monte Ascensione area. In this part of the Periadriatic basin the accommodation space for sedimentation was provided by sinking in front of a rising mountain chain (the Apennines) although still with a very reduced relief. Detailed chronology is provided by paleontological data and previous paleomagnetic investigations on the marine sediments. We also revised the Late Pleistocene fluvial record that is better known and well constrained by chronological data.
Since the Early Pleistocene in the whole Peninsula the deposition of thick coarse-grained sediments down to the edges of the continental escarpment is associated to the cold stages. Glacial and crionival processes at higher elevations fed bajadas of aggrading alluvial fans and associated braid-plains along the trunk valleys. Interstadials were characterised by a thinner and fine-grained sedimentation associated to a change of fluvial styles even at high elevations. River incision characterises the Interglacials in the down to the rising sea level generating a flight of thin unpaired terraces as well as paired thicker cold stage terraces. However, in many valleys cut in limestone ridges after a major incision at the glacial-interglacial transition thicker sedimentation was locally provided by thick sequences of calcareous tufa. The continental platform was drowned by the rising sea level that was responsible for the unconformity that partially eroded the cold stages record. After the transgression, at the edge of the continental escarpment, Interglacial clay and silt were deposited. Unfortunately, in most of the area a good thick record for the coastal deposition during Interglacials is missing and the Holocene conditions are strongly influenced by human induced changes in terms of sedimentation.
However, along the steeper slopes of the Apennines, including those generated by Pleistocene fault activity, and at the feet of the present-day active faults escarpment the

sedimentation is almost absent, even under the present day Interglacial conditions. Also very fast fault reactivations, (ca. 80 cm 1915 Avezzano earthquake) did not influenced fluvial sedimentation.

Therefore, tectonics (uplift and faulting) is responsible for the creation of mountain fronts and basins that generated the relief that could be affected by degradational processes and the accommodation space for the accumulation of thick continental sequences. However, lithofacies and architecture of fluvial and coastal deposition in pre-Holocene times was always climatically driven.

CONTROVERSIAL DATING OF LATE-MIDDLE PLEISTOCENE KEY DEPOSITS
OF SARDINIA (ITALY)

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Two major synthems have been recognised during the investigation of 5 key sites along
the coasts of Sardinia: Is Arenas (Cagliari Gulf), Scala é Crocca and Cala Gonone
(Orosei Gulf), Santa Reparata and Rena Bianca (S.Teresa di Gallura), Capo S.Marco
and S.Giovanni di Sinis (Oristano Gulf). The older synthem is composed of two sub-
synthem, the oldest of which is made by a high energy boulder beach, a thin condensed
transgressive sequence usually located at the feet of a marine cliff. The overlying sub-
synthems were generated by aeolian, slope, interdunal ponds and alluvial depositional
environments; it is widespread and terraces and relict dune fields are usually deeply
dissected. Its deposition is associated to cold and arid climate. The aeolian and alluvial
deposition was interrupted by the evolution of steppe-prairie soils. A more evolved
reddish brown Bt paleosoil is found at the top of the sequence. The younger synthem is
more variable in thickness, rest unconformable over the previous one and it does not
have any sedimentary cover. It is laterally correlated to the present day morphologies
such as alluvial sediments and beach deposits. The fact that beach deposits of this
synthem are found up to 5 m asl and a marine notch up to 6-7 m (Capo S.Marco), the
widespread idea that Sardinia is a stable area and that marine sea level during the
Holocene was never higher than nowadays led to their previous attribution to the MIS
5e. Stratigraphic, geomorphic and pedological evidence indicate that only the older
sub-synthems could be attributed with the MIS 5e high stand while aeolian and alluvial
deposits at Cala Gonone, Santa Reparata, Capo S.Marco and S.Giovanni di Sinis were
deposited during the Late Pleistocene. The younger synthem (Is Arenas, Scala é
Croccas, Santa Reparata and Capo San Marco) would have been deposited during the
Holocene. This attribution is confirmed by radiocarbon dates. However, the
luminescence results indicate a depositional age for most of the investigated sites prior
to and during marine isotope stage (MIS) 5. These discrepancies are rather unexpected
as both dating methods are considered reliable.

THE EARLY PLEISTOCENE FLUVIAL SYSTEM OF KEY REFERENCE SITES IN THE TEGELEN-MAALBEEK AREA (THE NETHERLANDS).

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The Late Pliocene (Reuverian) and Early Pleistocene (Tiglian, Eburonian) key reference site are situated in the Tegelen-Maalbeek area on the Peel Block south of Venlo. The Lower Pleistocene fluvial deposits in this area form part of the Waalre Formation. The preserved fluvial sequence consists of a coarse-grained gravel-bearing basal part that fines upwards into up to 10 m thick clayey floodplain deposits. Three main facies types can be distinguished within the fine-grained floodplain deposits. Flood-basin fines are relatively wide-spread and consist of massive clay deposits with crumbly to prismatically structured horizons representing initial soil formation. In some cases thin intercalated peat layers occur. The second facies type is characterised by up to 10m thick sequences of bedded clay that forms the fill of abandoned channels (i.e. oxbows). The third facies type consists of crevasse-splay deposits and/or overbank fines. They are typified by being irregularly distributed and having a strongly varying lithology over short distances. All facies types are closely related and grade gradually into each other, although distinct boundaries occur occasionally.

Pollen assemblages derived from the fine-grained floodplain sediments show that they are partly influenced by the facies development but they also reveal indications of climate change. Three locally defined pollen zones, respectively T-A, T-B, and T-C have already formed for a long time the basis for the main chronostratigraphical subdivision of the Tiglian Stage. In the pit Maalbeek pit these three pollen zone are situated on top of each other in the upper nearly 10 m thick series of floodplain fines. Recently collected (small) mammal remains are mainly sampled from fossil rich layers enclosed in the sedimentary infill of an oxbow lake.

From a sedimentological point of view it is argued that this consistent pattern of floodplain fines at the top of the Lower Pleistocene fluvial sequence in the Tegelen-Maalbeek area represents the final stage of the fluvial sequence preserved in the district. It is concluded that the time of deposition of these floodplain fines can represent only a small fragment of time available during the Early Pleistocene. As a consequence a re-assessment of the significance of the biotic evidence gained from these Lower Pleistocene deposits is needed including a thorough review of the taphonomy of the (micro) fossils.

THE GEOLOGY OF DMANISI, THE EARLIEST OCCUPATION OF EURASIA

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Recent integration of stratigraphic, sedimentologic and geochronologic data permit an integrated summary of the age, geologic history and formation processes at Dmanisi, the earliest known occupation of Eurasia. Dmanisi is located in the Southern Caucasus (Georgia). There, a series of volcanic ashes bury the Masavera Basalt, dated to 1.85 Ma. The basalt is overlain by two major stratigraphic units: Stratum A deposits are the result of a series of ash falls which exhibit weak pedogenic features and minor erosional contacts. Stratum B deposits includes primary ashes as well as colluvium. At the transition from A to B, a complex of gullies and pipes formed resulting in the rapid burial and excellent preservation of numerous fossils of *Homo erectus*. Lithic artifacts and abundant vertebrate fossils have been recovered from Stratum B and stratified lithic assemblages from Stratum A. Dating of Dmanisi was accomplished by Ar/Ar dating of basalts and detailed magnetostratigraphic studies which revealed that Stratum A is correlated with the latest Olduvai Subchron and Stratum B with earliest Matuyama Chron. Stratum A is thus dated between 1.85 Ma and 1.78 Ma and stratum B is dated between ca. 1.78 and ca 1.75 Ma. We present a summary of our analysis of formation processes at this important site documenting the first known occupation of Eurasia by hominins.

THE LATE PLIOCENE AND EARLY PLEISTOCENE SUCCESSION IN THE GUADIX-BAZA BASIN (SECTOR OF BAZA)

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ABSTRACT:

The Plio-Pleistocene continental sequence in the NE Guadix–Baza Basin (south of Spain) comprises alluvial and lacustrine deposits (Baza Formation).The results of an updated lithostratigraphical correlation between sections from the middle and upper members of the Baza Formation in the northeast part of the basin, supported by detailed mapping, is presented. The position of micromammal sites in the lithostratigraphical scheme, together with the results of intensive palaeontological sampling for small mammal remains, has allowed us to develop a high-resolution biostratigraphical frame work for the area. This provides an opportunity to refine the biozonation for the Plio-Pleistocene micromammal faunas, and to define faunal events from the late Villanyian (late Pliocene) to the early Pleistocene. On the basis of the lithostratigraphical and biostratigraphical approaches a calibarted sequence of biozones for the late Pliocene and early is proposed.

ESR DATING OF THE LOWER PLEISTOCENE SITES OF ORCE (GUADIX-BAZA BASIN, ANDALUSIA, SPAIN): FUENTE NUEVA III, BARRANCO LEÓN AND VENTA MICENA

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The Guadix-Baza basin (Andalusia, Spain) is one of the foremost places in Europe with evidence of early human settlements. The basin has accumulated a massive sequence of Neogen-Quaternary sediments which contains a detailed archive of the palaeoenvironmental and palaeoclimatic changes since the Miocene. The numerous palaeontological remains discovered from more than a hundred sites, together with a well-defined magnetostratigraphical framework, have established the basin as a reference sequence for the European Pliocene-Quaternary period.

The most famous Plio-Pleistocene localities are located in the eastern part of the basin, near the village of Orce. The sites of Fuente Nueva III and Barranco León have delivered an archaic lithic industry associated with Early Pleistocene fauna, indicating one of the oldest occupations of Western Europe. A third site, Venta Micena, which contained large and detailed palaeontological assemblages (several thousands of remains), has become a reference locality for the Early Pleistocene biochronology. The chronostratigraphical framework of these sites was established mainly by the combination of several methods: biochronology (small and large-mammals) and palaeomagnetism. In order to complement this framework and to test the reliability of the Electron Spin Resonance (ESR) dating method, fossil teeth and sedimentary quartz recovered from these three localities were analysed. Our results unambiguously demonstrate the antiquity of the sites and their Early Pleistocene ages, but show also some methodological limits of the ESR method for such ancient periods in fluvio-lacustrine sedimentary environments.

PEDO-SEDIMENTARY FINGERPRINTS OF RECURRENT EXCEPTIONAL EVENTS DURING THE EARLY PLEISTOCENE AT BARRANCO LEÓN SITE (ORCE BASIN, GRANADA, SPAIN).

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Multidisciplinary palaeoenvironmental study have now widely documented the great potential offered by the continental Plio-Pleistocene deposits rich in fossil mammal sites occurring thoughout the Guadix-Baza intra-mountain basin in the Betic range (SE Spain).This nearly continuous sequence of ca 20m thick succession is one of the few reference site for refining the chronology and occupational conditions encountered by the first humans when expanding throughout Southern Europe. The endoreic filling of the Guadix-Baza basin displays the subhorizontal alternation throughout the region of alluvial, fluvial and lacustrine deposits. The cyclical accumulation from the Neogene to the Early Pleistocene is interpreted to have formed under considerably more humid climate (700-1000 mm) than the present aridity (300 mm/year) in response to climate oscillations and related environmental changes. This cumulative record ended at around 600 Kya due to tectonic movements that initiated irreversible entrenchment and prolonged erosion (Gibert et al., 2007)

We focus here on the archaeo-palentological layers encountered at the Barranco Léon site close to the Orcé town. Archaeological excavation has allowed to identify a series of seven paleontological units (Turq et al. 1996) with variable amount of micrommamifers and large mammals that contain at present only one 30 cm thick archaeological layer reported as layer E or BL-5. Previous magnetostratigraphic data helps to frame the layer E within a Reverse magnetochron presumably C1r.2r (late Matuyama) below the Jamarillo episode (0,99-1,07 Ma), possibly at ca. 1.25 Ma broad age of the two short polarity events identified in the Orcé basin (Scott et al. 2007). ESR and OSL datings have been unable to refine the previous time range due to marked chemical desequilibrium in the related layers that yet remains to be elucidated in terms of syn and post-depositional processes (Duval, 2008).

The abundant lithic assemblage was assigned to a preoldowayen technological complex or Mode 1 (Toro et al., 2003; Carbonell and Pedro Rodriguez, 2006). The joint occurrence of fresh materials with rounded elements suggested a possible contamination of the well preserved occupation strata by materials reworked from previous archaeological layers. Based on the lithostratigraphic characteristics and the fauna assemblage layer E was previously identified as a drying episode with torrential

fluviatile discharge and channel erosion between two high lacustrine water stands associated to humid forested environments (Turq et al., 1996; Palmqvist et al., 2005).

Our main goal is to refine the paleoenvironmental interpretation of the archaeological layer E and the associated lacustrine D and F layers by performing a high resolution sequential analysis of the related pedo-sedimentary facies. This was achieved by combining a micromorphological study of a continuous sampling column through D, E and F layers and a multi-analytical characterization adjusted to the specific components encountered (Courty, 2001; Courty et al., 2008). Our first results confirm the exceptional quality of the archaostratigraphic sequence (layer E) with respect to the time period considered. This is reflected by the repeated occurrence of microstratified lenses formed of pale grey calcitic fine silt, yellowish brown iron-rich organic clay with abundant in situ fragmented terrestrial shells that are embedded in loosely packed quartzitic sands. This distinctive pedo-sedimentary facies (msFF) reflects dust accumulation in shallow depressions that recorded seasonal fluctuations between development of shallow soils under grass cover and low energy flooding by gentle rains. The msFF alternates with discontinuous lenses of loosely packed, rounded to subrounded coarse calcareous gravels (lpCF) showing a wide range of pale grey to yellowish brown micritic facies that are typical of lacustrine to palustrine conditions. Their morphology and overall heterogeneity reflect the reworked origin of the coarse facies (lpCF), most probably derived from collapsed overbanks of the small channels that incised the previously formed lacustrine deposits (layer F). The lpCF traces episodes of extensive sheet flooding due to sudden water discharge, possibly related to rapid snow melt. The marked corrosion of the micritic facies corroborates their remobilization by rainwater with a low carbonate charge, compatible with the one from snowfalls. The integration of the the reworked archaeological materials within the well preserved occupation layers appears to more likely relate to the water discharge episodes. In addition to the contrasting assemblage and texture, the msFF microstratified units present throughout layer E a high amount of exogenous components that range from fine silt to coarse sands, and more rarely gravels. Their angular morphology, the textural continuum and the petrographic coherence of the related exotic assemblage suggest an origin from debris-fall episodes then followed by their in situ fragmentation and low energy redistribution before rapid burial of the exposed surface. The repeated presence of vitrous vesicular carbon and charred plant fragments, together within the incorporation of black carbon to the organic clay suggests the joint occurrence of flash burning to the debris-fall episodes. The exotic assemblage is dominated by components of igneous origin together with scoriaceous volcanic elements, dolomitic carbonate, glass shards and devitrified glass spherules. The high amount of native metals at their surface together with the occurrence of carbonaceous polymorphous are the diagnostic characteristics for interpreting the debris-fall episodes during the course of layer E to a series of impact events. High resolution sampling through the microstratified sequence is required for identifying the exact number of exceptional events and to recognize their distinctive facies pattern. They could provide reliable time markers for supporting spatial correlation at local to global scales. This multi-scalar control is crucial for debating the consequences of the exceptional debris-fall events on human behavior and ecological equilibrium. in the Guadix-Baza basin during the Early Pleistocene.

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THE AGE OF THE ORCE SITES, A MAGNETOSTRATIGRAPHIC PERSPECTIVE

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During the 10 years since the last INQUA workshop held at Orce, research based on magnetostratigraphy has greatly improved the chronological knowledge of the fossiliferous sites near Orce, Spain. The initial studies published in 1997 and 2000 revealed only reverse magnetic polarities at the sites of Fuentenueva-1, and Barranco León, respectively. This indicated an Early Pleistocene age, but without magnetozone boundaries, more specific dates could not be determined. Expanding the magnetostratigraphy required a more comprehensive understanding of the litho-stratigraphy, depositional facies and paleo-environments in this part of the Baza Basin. We now understand that the 60 meter thick outcrops in the Orce region are the Early Pleistocene part of a thick (~600 meter) Late Neogene accumulation. A magnetozone of normal magnetic polarity (verified with numerous field and laboratory tests), indicating the Pliocene/Pleistocene boundary, was found 40 meters below the hominin/tool sites. We can now provide minimum ages for the 3 main fossil quarries: Venta Micena= ~1.3 Myr, Barranco León= ~1.25 Myr, Fuentenueva-1= ~1.2 Myr. These are considered minimum dates owing to erosion and loss of exposure at the top of the sequence, however only slight increases of ~0.1 Myr appear probable. Biochronologically, the abundant fauna from these 3 Orce sites are from a short time range (~100 kyr) and can be considered a single paleo-fauna, the *Venta Micena Fauna*.

THE BRUNHES-MATUYAMA BOUNDARY IN THE GUADIX-BAZA BASIN

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Recent work in the Baza Basin provides a detailed lithostratigraphic frame for the NE sector, around Orce-Venta Micena, along with the magnetostratigraphic location of the Pliocene-Pleistocene boundary. This frame is expanded both northwards to Huéscar and southwestwards to Cúllar. Numerous stratigraphic sections have been measured in and between these three areas, permitting some insight into the complexity of deposition facies and the paleo-topographic relationships across the NE part of the Baza Basin. These different paleo-geographical situations show lateral lithologic changes, ranging from the coarse-grained facies typical of paleo-margins, to the fine-grained sulfate dominated facies around the central paleo-lake. Although a detailed (bed for bed) lithostratigraphic correlation between these three marginal sites remains ellusive, the addition of magnetozones greatly improves the temporal correspondence.
Two new polarity sequences are now available in the Baza Basin: Cúllar (81m) and Huéscar (29m). The extensively sampled Cúllar section has 6 major magnetozones. Near the base of the uppermost normal zone (Brunhes Chron) is the paleontological-archaeological site CB-1 (Cúllar-Baza) with abundant mammalian remains and lithic tools indicating human activity. We can give an age to CB-1 of 0.75 Myr. The shorter Huéscar section has 2 magnetozones: a 15m reverse zone, followed by a 14m normal polarity magnetozone. This lower reverse zone includes the sites of PL (Puerto Lobo), LQ-1, LQ-2 (Loma Quemada) and HU-1, with a large collection of micro and macro fauna but no evidences of human activity. No fossiliferous sites have been described from the normal polarity zone, however, we identified lithic artefacts in the conglomeratic gravel bed that caps this section. We can give an age to HU-1 (Huéscar-1) of ~0.9 Myr. This includes the arvicolid rodent *Microtus huéscarensis*.

THE EARLY-MIDDLE PLEISTOCENE FAUNAL TURNOVER AND THE ARRIVAL OF THE ACHEULIAN CULTURE INTO EUROPE.

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The latest Early Pleistocene-earliest Middle Pleistocene faunal turnover is characterized by the extinction of most of the late Villafranchian faunas, i.e. most of the carnivore guild (including the giant hyena *Pachycrocuta brevirostris,* the felids *Megantereon whitei, Acinonyx pardinensis, Puma pardoides* and *Panthera gombaszoegensis,* or the large canid *Lycaon lycaonoides*) and many ungulates (i.e. the megaherbivore *Mammuthus meridionalis,* the horses *Equus altidens* and *E. Sussenbornensis*, and others). These species were substituted by a new guild of carnivores, some of the them of African origin, such the spotted hyaena *Crocuta crocuta* (García, 2003; Sardella, 2004), recorded at 0.8 Ma at Atapuerca (Spain) –this species was found at 'Ubeidiya, but this is the only site older than 1.0 Ma outside Africa, where this hyenid species was found (Ballesio 1986; Martínez-Navarro et al. 2009)-, and later the lion *Panthera leo* (Sala, 1990) at Isernia La Pineta (Italy) at 0.6 Ma, and the leopard, *P. pardus* for which the oldest record is probably at Valdemino Cave, Italy, around 0.6 Ma (Nocchi and Sala, 1997). Also two large ungulates colonized Europe around 0.6-0.7 Ma, the elephant *Palaeoloxodon antiquus* (Lister, 2004) a descendant of the African *Elephas recki* and, of course, *Bos primigenius,* a descendant of the African buffalo *Pelorovis*. But most of the new taxa that colonized Europe were from Asian origin, i. e. *Mammuthus trogontherii, Cervus elaphus,* or *Equus ferus,* among others, but also including the Indian origin Bovini *Hemibos galerianus* (Martínez-Navarro and Palombo, 2004) recorded at Ponte Galeria and Ponte Milvio, Central Italy, around 0.7-0.8 Ma. Martínez-Navarro (in press) has named this faunal turnover as "the *Crocuta crocuta* event".
Martínez-Navarro et al. (2007; 2009in press) established a parallelism between the dispersal of the Acheulian culture into Eurasia and the dispersal of *Bos*, because they are found together in 'Ubeidiya at ~1.2-1-5 Ma (Martínez-Navarro et al., 2009), where the lithic assemblage corresponds to an early and primitive Acheulian, and at GBY at 0.7-0.8 Ma, with a developed Acheulian assemblage, and finally in Europe at 0.5-0.6 Ma.

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EVALUATING THE TEXITURAL DISCONTINUITY HYPOTHESIS AND ECOSYSTEM CONVERGENCE: A CASE STUDY OF PLIO-PLEISTOCENE MAMMALIAN FAUNA FROM THE ITALIAN PENINSULA.

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The textural discontinuity hypothesis (TDH), proposed by Holling in 1992, assumes that animal body mass distribution within a given system relies on the specific pattern and structure of available resources. Since resource distribution is discontinuous across landscape scales, animal body mass distributions should exhibit discontinuities that have been supposed to reflect the texture of the landscape consistently with the changes in the scale of resource availability. Thus, body mass distributions of terrestrial animals would broadly reflect ecosystem function. Terrestrial ecosystems either geographically or chronologically disconnected, but showing similar body mass distributions, would suggest ecosystem convergence. On the other hand, habitat oscillations almost never undergo cyclical returns to previous conditions, thus modern counterparts of past communities are hard to find. In evaluating the Texitural Discontinuity Hypothesis and Ecosystem Convergence, our aim is also to test whether the ecosystem behaviour might be driven by a limited number of key processes -as evidence of ecosystem convergence would suggest - or be the net result of all the complex internal systems.

The analysis of ecological structure of Plio-Pleistocene faunas of the Italian peninsula (inferred on the basis of preferred habitat, ecological behaviour and body mass of each species) has been considered particularly consistent with this goal, because the ecological structure of mammal complexes of the Italia peninsula turned over several times during the Plio-Pleistocene, but some chronologically distant faunal complexes show some affinities in their ecological structures despite the progressive change in faunal composition over time.

Results obtained confirm that major functional turnovers depend on major climate changes, while more gradual modifications depend on intrinsic biotic control (changes in inter- intra-specific competition), as well as resilience of pre-existing species. Nevertheless, there is little evidence of ecosystem convergence, especially with regard to body mass distribution.

AMPHIBIANS AND REPTILES FROM THE EARLY PLEISTOCENE OF BARRANCO LEÓN AND FUENTE NUEVA 3 (GRANADA, SPAIN): SYSTEMATIC, PALEOBIOGEOGRAPHY AND PALEOECOLOGY

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The early Pleistocene archeo-paleontological localities of Barranco León and Fuente Nueva 3 have furnished a diversified fauna of amphibians and reptiles, including toads, frogs, turtles, tortoises, anguid, scincid and lacertid lizards and several snakes.

In the site of Barranco León the following amphibians and reptiles have been identified: *Discoglossus* cf. *D. jeanneae*, *Pelobates cultripes*, *Bufo bufo*, *Bufo calamita*, *Bufo* sp., *Hyla meridionalis*, *Rana* cf. *R. perezi*, *Emys orbicularis* s.l., *Mauremys leprosa*, *Testudo* sp., cf. *Chalcides*, cf. *Timon lepidus*, Lacertidae indet., *Ophisaurus* sp., *Natrix maura*, *Natrix natrix*, *Rhinechis scalaris* and *Malpolon monspessulanus*.

In Fuente Nueva 3, the herpetofauna is composed by: *Discoglossus* cf. *D. jeanneae*, *Bufo* sp., *Rana* cf. *R. perezi*, *Chalcides* cf. *Ch. bedriagai*, cf. *T. lepidus*, Lacertidae indet., *Natrix maura*, *Natrix natrix*, *Rhinechis scalaris* and *Malpolon monspessulanus*.

From a paleobiogeographical point of view, Barranco León corresponds for the moment to the earliest mention in Western Europe for the stripeless treefrog (*H. meridionalis*) and for the Mediterranean terrapin (*M. leprosa*), and to one of the earliest mentions for the western spadefoot (*P. cultripes*) and the European pond turtle (*E. orbicularis*). From another hand, the sites of Barranco León and Fuente Nueva 3 document the presence of the last *Ophisaurus* (exclude *Pseudopus*) of Europe.

A large part of the taxa cited above have a current distribution that include the Iberian Peninsula and the North of Africa (*B. bufo*, *H. meridionalis*, *E. orbicularis*, *M. leprosa*, *Chalcides*, *Timon*, *Natrix* and *M. monspessulanus*) that may testify to the existence of faunal exchange between Europe and Africa.

These two contemporaneous associations of amphibians and reptiles in their whole suggest warmer (principally with less contrasted seasonality) and above all more humid climatic conditions than those that we can currently observe in the Guadix-Baza Basin. The use of the Mutual Climatic Range method on the amphibian and squamate reptile association has permitted to estimate climatic parameters such as temperature and precipitations. They show that mean annual temperature was equal to $16.7 \pm 1.6°C$ (i.e. $+ 4.2°C$ in relation with present) and that mean annual precipitations was 732 ± 216 mm (i.e. $+ 432$ mm in relation with present). From an environmental point of view, the herpetofauna mainly suggests the presence of a sunny aquatic environment with shores made of loose soils and with developed paludal vegetation. The terrestrial environment may be composed by an alternation of open-dry areas with scrubland-type vegetation and moist woodland areas. Such environmental and climatic conditions may be put in relation with an interglacial period of the end of the early Pleistocene.

SMALL MAMMALS FROM GORHAM'S CAVE (GIBRALTAR, UK)

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Gorham's cave is located on the British territory of Gibraltar in the southernmost of the Iberian Peninsula (36º N 0.5' W). Gibraltar overlooks the Strait of Gibraltar, a 14-kilometer wide stretch of open water connecting the Mediterranean Sea with the Atlantic Ocean, and separating Europe from northern Africa. Gorham's Cave was discovered in 1907 and first excavated in the 1950s by John Waechter of the Institute of Archaeology in London. In addition to Phoenician, Carthaginian and Neolithic occupations in the cave, there are 16 meters of Pleistocene deposits. The top part of the Pleistocene consists of two Upper Paleolithic deposits, identified as Solutrean and Magdalenian (level III), with an AMS radiocarbon dates between 18,000 and 10,000 years ago. Below that, and reported to be separated by five thousand years is a level of pure Mousterian (level IV), and, according to the latest AMS radiocarbon dates, was occupied between 23,000 and 33,000 years ago.
The preliminary study of this sequence has already yielded a poor assemblage of small mammals, but significant important for an environmental and climatic reconstruction. The faunal list includes 9 species (Fig. 1A): 1 insectivore (*Talpa occidentalis*); 3 chiropters (*Myotis myotis, Myotis nattereri* and *Miniopterus schreibersii*); 5 rodents (*Iberomys cabrerae, Terricola duodecimcostatus, Arvicola* sp.*, Apodemus sylvaticus* and *Eliomys quercinus*).
In order to reconstruct the environment at Gorham's cave, we use the method of habitat weightings, distributing each small mammal taxa in the habitat(s) where it is possible to find them at present in the Iberian Peninsula. The habitats were divided into five types: open land in which dry and wet meadows are distinguished, woodland and woodlandmargin
areas, surrounding water areas and rocky areas. Interesting is that the small mammal association in both levels is more related with a woodland/edgewoodland meadow (Level IV: 59%; Level III: 50%) and an open humid environment (Level IV: 10%; Level III: 19%) than an open rocky environment as it is today, suggesting that the marine platform now under the Mediterranean sea, was at this time a forest parched by meadows (Fig. 1B).
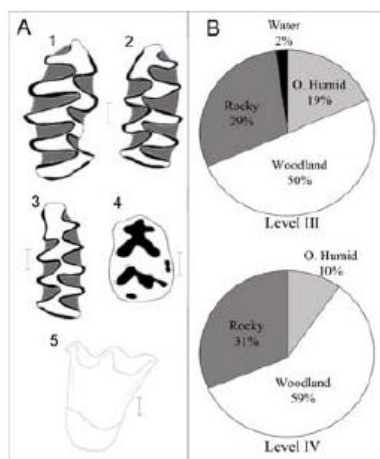
Figure 1. A. Some small mammal from Gorham's cave: 1 m1 right *Iberomys cabrerae*; 2. m1 left *Iberomys cabrerae*; 3. m1 left *Terricola duodecimcostatus*; 4. m1 right *Apodemus sylvaticus*; 5. M2 left *Myotis myotis*. B. Small mammal association by habitat from the percentage of Minimum Number of Individuals.

In order to evaluate palaeoclimatic parameters, we use the principle of mutual climatic range that consists of defining the climatic conditions of the area currently inhabited by the extant fauna from the site. Such an intersection for the Gorham's cave layers suggests mean annual temperatures (MAT) lower than at present (between -3,7 y -4,1 ºC); at present MAT_{Tarifa}= 17,5 ºC at the meteorological station of Tarifa) and mean annual precipitation (MAP) higher than at present (between + 23 y + 75 mm; at present MAP_{Tarifa} = 749 mm at Tarifa station). The mean temperature of the coldest month (MTC) for Gorham's cave level IV is equal to 3,5 ±1,3 ºC and for level III is equal to 3,6 ±1,4 ºC (at present MTC_{Tarifa}= 13,5 ºC) and for the warmest month (MTW) for level IV it is equal to 21,7 ±1,9 ºC and for level III is equal to 21,6 ±1,8 ºC (at present MTW_{Tarifa}= 21,9 ºC. This suggest that when Neanderthals and Anatomically Modern Humans lived in the cave the temperatures where lower (-3,7 ºC) in the Andalusia area, with temperate summers (-0,2 ºC) and harsher winters (-8,7 ºC), maintaining the Mediterranean character of the climate.

PALYNOLOGYCAL STUDY OF THE EARLY PLEISTOCENE BOGATYRY/SINYAYA BALKA AND RODNIKI SITES (TAMAN PENINSULA, RUSSIA)

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New Early Palaeolithic sites Bogatyri/Sinyaya Balka and Rodniki, are reported from the Taman Peninsula in southern Russia [Shchelinsky, Kulakov, 2007; Shchelinsky et al., 2008]. The abrasion shoreline of the Sea of Azov provides numerous outcrops of the Late Cenozoic deposits. Geological settings of the sites clearly indicate the Early Pleistocene age of the deposits. The Upper Pliocene and Quaternary deposits occur in dislocated position that the studied area locates in the active tectonic zone with mud volcanism wide spreading [Dodonov et al., 2008].

Three main layers are recognized in the Bogatyri/Sinyaya Balka exposure. The basal layer 3 (0.4-0.9 m) is formed with clastic products and contains rounded and angular fragments of solid sand-detritus conglomerate, thin lenses of light-gray sand and silt with shell detritus. It has an tectonic contact with underlying dark Kujalnik clays. Layer 2 (2 m) is composed of light-gray and yellowish sand with small lenses of rubble. Layer 1 (>1.5 m) represents the main bone breccia. It contains the abundance of large and small bone fragments, belonging mainly to *Archidiskodon meridionalis tamanensis* and *Elasmotherium caucasicum*.

The basal part of Bogatyri/Sinyaya Balka (layer 3) produced palynospectra dominated by pollen of pines. The arboreal group contains notable pollen numbers of *Ulmus* and *Betula* and sporadic occurrences of *Tsuga, Picea, Abies, Quercus, Betula, Salix, Corylus*, and *Carpinus*. Herbs are represented by pollen of Asteraceae, Chenopodiaceae, Caryophyllaceae, and Polygonaceae. These spectra indicate forest-steppe and steppe landscapes, and mixed forests (pine-small-leaved forest with broadleaved species) along river valleys. Intermediate sandy layer 2 produced sporadic pollen of conifers *Tsuga, Abies, Picea,* and *Pinus,* and leaved forms *Betula, Alnus, Salix, Ulmus, Celtis,* and *Juglans*. The herbaceous group is dominated by pollen of Chenopodiaceae and Plumbaginaceae. The spectra indicate meadow-steppe vegetation alternating with patches of mixed forests. The bone breccia (layer 1) contains abundant (up to 90%) redeposited pollen of Pinaceae, *Podocarus, Cedrus, Engelhardtia, Carya, Platycarya*, etc. of the Miocene-Pliocene age. These spectra also contain pollen of *Tsuga*, Taxodiaceae, *Abies, Ulmus pumila, U. suberosa, U. foliaceae, Juglans, Pterocarya, Fagus*, and *Tilia*. Also dinoflagellates typical for shallow brackish-water basins were recorded here. More reliable and unbiased picture is given by samples from the sedimentary infillings in bone inner cavities. These spectra contain much lower amount of ancient pollen and no dinoflagellates. They document the predominant pollen of *Pinus.* Also present sporadic grains of Abies, *Picea,* and Taxodiaceae. The broad-leaved group is dominated by pollen of *Ulmus* and Juglandaceae. Other arboreal forms (*Pistacia, Fagus, Acer,* and *Alnus*) occur sporadically. The herbaceous group contains Artemisia, Asteraceae, Chenopodiaceae, and Poaceae. These spectra evidence the presence of elm and walnut forests without underbrush and mixed forests on gully slopes.

Rodniki sections (Rodniki 1 and Rodniki 2) are situated to the west from the Bogatyri/Sinyaya Balka exposure. The site Rodniki sequence occurs between 25 and 30

m above the sea level and overlays the Late Pliocene dark clays. The Rodniki 1 shows the following structure: the bedrock Pliocene clays (0.4-0.5 m), poorly rounded rock debris with siltstone, sandstone, dolomite blocks and rare pebbles, and grey sand as a matrix (0.5 m), brown clay with sand (8-10 m). Rodniki 2 has a very similar structure with a higher thickness of sandy.

The underlying clays in Rodniki 1 and 2, and Bogatyri/Sinyaya Balka contain predominant pollen of conifers (up to 90%) with the leading role of pines, and presence of *Tsuga,* Taxodiaceae, *Picea,* and *Abies*. Broad-leaved trees are represented by *Juglandaceae, Ulmus, Carpinus, Tilia, Fagaceae, Moraceae, Celtis, Liquidambar*, and *Platicarya*. The herbaceous group contains pollen of Asteraceae, Chenopodiaceae, *Artemisia*, and *Ephedra*. The bedrock clays contain diverse dinoflagellates - *Deflandrea phosphoritica, Batiacasphaera* spp., *Gonyaulax digitale, Galeoacysta etrusca, Spiniferites cruciferus, Achomosphaera andalusiense, Systematosphora* spp., and *Hystrichosphaeropsis obscura.* This pollen and dinocyst composition is indicative of Miocene and Early Pliocene age [Ananova, 1974; Shchekina, 1979; Munsterman, Brinkhuis, 2004; Filippova, 2005]. Clays seem to contain a considerable amount of redeposited pollen and phytoplankton due to reworking and mud volcanic activity.

Spectra from the basal bed in Rodniki 1 and 2 are dominated by pollen of *Pinus, Ulmus, Juglans cinerea, Carya, Pterocarya*, and Chenopodiaceae. The herbaceous group is diverse and contains *Artemisia*, Asteraceae, *Salsola*, Brassicaceae, Plumbaginaceae, Polygonaceae, *Thalictrum*, and Fabaceae. These spectra indicate widespread forest-steppe landscapes represented by the combination of mixed forests and meadow-steppe vegetation. Basal beds in Rodniki 1 and 2 are well correlated in pollen composition with increased amount of *Ulmus*, Juglandaceae, Chenopodiaceae, and Asteraceae. These basal spectra in Rodniki are similar with spectra from the basal layer (layer 3) in Bogatyri/Sinyaya Balka in increased content of *Ulmus*, Chenopodiaceae, and some decrease in pollen of pines. The sporadic occurrence of walnut pollen in Bogatyri, however, precludes a direct correlation of these beds.

In general, the predominance of walnuts, including *Juglans cenerea*, is recorded in western Georgia in the Early Pleistocene time. In this time interval walnuts became the main arboreal element in broad-leaved mountain forests at medium elevations [Shatilova, 1974].

The palynological data shows, that deposits formation of Bogatyri/Sinyaya Balka and Rodniki sites occurred under rather arid climate conditions and prevalence of forest-steppe vegetative communities. The correlation of the received pollen data with available palynological materials from the Southern Russian Plain assumes the Early Pleistocene age of the deposits.

VEGETATION CONTEXT AND CLIMATIC LIMITS FOR THE EARLY
PLEISTOCENE HOMINID PRESENCE IN EUROPE

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The vegetation and climatic context in which the first hominids entered and dispersed in
Europe during the Early Pleistocene are reconstructed, using literature review and a new
climate simulation. Both in situ fauna and in situ vegetation at the eleven sites taken in
consideration indicate the occurrence of open landscapes: grasslands or forested
steppes. Such conditions with the presence of ancient hominids (*H. erectus* and
descendants) are only possible at the transition from glacial to interglacials periods, the
full glacials being too cold for them. Glacial–interglacial cycles forced by obliquity
showed paralleled vegetation successions, which repeated c. 42 times during the course
of the early Pleistocene (2.58 to 0.78 Ma), providing 42 times a narrow window of
opportunity to disperse in Europe.

The climatic conditions of this protocratic phase of vegetation are compared to the 9 ka
ago climate, as this time period is so far the best analogue available. The climate at the
beginning of the present interglacial was wetter over south of Greece and Turkey and
had colder springs and winters with warmer summers, therefore displaying a stronger
seasonality. Forest cover would not have been hampered though, indicating that other
factors linked to refugia location and soils should be considered to leave this period
relatively free of forests. The eleven sites fall within rather narrow summer precipitation
range, and narrow range of temperature for the coldest month.

A NEW, RECENTLY DISCOVERED, EARLY PLEISTOCENE MAMMAL FAUNA
FROM TEGELEN-MAALBEEK (THE NETHERLANDS).

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Since the end of the 19th century fossil mammals are collected in the clay pits near
Tegelen (The Netherlands) and the Tegelen Clay yielded one of the classical Early
Pleistocene larger mammal faunas described during the first half of the 20th century by
e.g. Bernsen and Schreuder. Willemsen (1988) re-investigated the Mustelid remains and
indicated the presence of *Mustela palerminea* and *Enhydrictis ardea*. The presence of
Pannonictis pliocaenica in the Tegelen fauna, mentioned by Schreuder (1935) appeared
to be based on a misidentification (Willemsen, 1988). Spaan (1992) studied the deer
remains from the old Tegelen collection and concluded that only two species are
represented; the large deer *Eucladoceros tegulensis* and the smaller one *Cervus
rhenanus.*
A rich smaller mammal assemblage from the Tegelen-Egypte clay pit, has been
collected in 1970. This assemblage has been investigated in detail by Reumer (1984)
(the Soricidae), Rümke (1985) (the Desmaninae) and Tesakov (1998) (the voles).
Alexey Tesakov (Moscow) studied the Tegelen voles in great detail and indicated the
presence of six different voles: *Mimomys pliocaenicus*, *M. reidi, M. tigliensis, M.
pitymyoides*, *Clethrionomys kretzoi* and *Ungaromys dehmi*. Tesakov concluded that the
medium-sized hypsodont *Mimomys*, previously assigned to *Mimomys blanci* by
Freudenthal et al. (1976), and Van Kolfschoten & Van der Meulen (1986), should be
referred to as a new species *Mimomys tigliensis* (Tesakov, 1998). Based on the absence

of *Microtus* (*Allophaiomys*) *deucalion* Tesakov (1998) assumes that the Tegelen fauna pre-dates the Olduvai Event.

MAALBEEK

The claypit Maalbeek is well known amongst palaeontologists because of the discovery of the remains of a tapir and a mastodont. The upper and lower (pre)molars of the tapir *Tapirus arvernensis*, described and figured by Kortenbout van der Sluijs (1960), were found in 1930 in the southern part of the former pit at Maalbeek. The upper molar of the mastodont *Anancus arvernensis* was found in situ in 1960 in the pit Van Cleef, about 300 m due north of the locality where the tapir remains were discovered (Kortenbout van der Sluijs, 1960; Zagwijn, 1963). New exposures, additional palynological research and a reappraisal of the primary data indicate the stratigraphical age of the fauna from Maalbeek. The clay with the mastodont molar is now referred to as the Tiglian-B pollenzone. The tapir remains might be slightly older and are correlated to the Tiglian-A pollenzone (Westerhoff et al., 1996). It has been shown that the mammal fauna from Maalbeek is older than the fauna from the Tegelen pits. The presence of *Tapirus arvernensis* in particular indicates that the fauna should be correlated with the Early Villafranchian whereas the Tegelen larger mammal fauna corresponds better to the Late Villafranchian faunas (cf. Azzaroli 1970).

Recently, a new horizon rich is fossil vertebrates have been discovered in the Maalbeek pit. The horizon yielded thousands of mammalian remains, mainly small mammals. Preliminary investigation of part of the remains indicates the presence of more or less the same vole species as recovered in the Tegelen-Egypte smaller mammal fauna. However, the composition of the vole community differs and in addition, the voles from Maalbeek are less advanced. This supports the hypotheses that at least part of the Maalbeek sequence clearly predates the Tiglian TC5 fauna.
However, Westerhoff investigated the Late Pliocene and Early Pleistocene sequences exposed in the Tegelen – Maalbeek region and in particular the sequence in the Maalbeek pit and in his PhD thesis Westerhoff questions the stratigraphical value of the Tiglian A, B and C zonation and moreover he argues that the clays in Maalbeek and the clays in the upper part of the Tegelen-Egypte section are part of one sedimentary cycle covering a restricted amount of time (Westerhoff, 2009). If this assumption is correct we have to accept that the observed evolution within the fossil voles took place is a relative short period of time. This has of course major biostratigraphical implications. In order to investigate the proposed assumption, a multidisciplinary research team has been formed and the exposed Maalbeek sequence has been sampled. Sediment samples for botanical, malacological as well as theriological investigations have been processed. In addition a large number of samples for palaeomagnetic research as well as OSL research have been taken. The promising, preliminary results of the different investigations will be presented and put in a wider, pan-European context.

LARGE DEER FROM THE VILLAFRANCHIAN OF EASTERN EUROPE (SEA OF AZOV REGION): EVOLUTION AND PALEOECOLOGY

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Deer as well as others herbivorous mammals, are index forms for Villafranchian terrestrial deposits of Eastern Europe. Deer react to landscapes' changes more precisely than elephants and horses, because they are attached to more narrow ecological niche, as they are browsing animals, mainly.. Finds of remains of large deer of two lineages - *Eucladoceros-Praemegaceros* and *Arvernoceros* are more usual in Villafranchian layers of the Eastern Europe. They are typical for communities of Khapry (Middle Villafranchian), Psekups (Late Villafranchian) and Taman (Epivillafranchian) Faunistic complexes.

Khapry Faunistic complex (KFC) is characterized by the presence of *Pliocrocuta perrieri*, *Homotherium crenatidens*, *Archidiskodon meridionalis gromovi, Anancus arvernensis alexeevae*, *Equus (Allohippus) livenzovensis, Elasmotherium chaprovicum,* and *Paracamelus alutensis* (Baigusheva, 1971; Titov, 2008). The most part of animal's bones occurs from the bottom of alluvial cross sections of Khapry and Liventsovka sand pits. Remains of small mammals from these layers allow to date KFC as Late Villanyian and zone MN 17 (Tesakov, 2004). There are rather numerous remains of *Eucladoceros* cf. *dicranios* and *Arvernoceros* sp. beside small deer *Cervus (Rusa) philisi* (Baigusheva, 1994).. *Eucladoceros* from KFC with large massive antlers looks like to *E. dicranios* by dichotomy bifurcation of the first branch. It differs by the absence of a significant caudal curving of the distal ramifications and by more significant flattening of the whole antler. *Arvernoceros* sp. is another form of the deer of KFC (Baigusheva, 1994; Croitor, Kostopoulos, 2004). It has of some incomplete skulls, antlers, lower jaws and postcranial bones. *Arvernoceros* were initially known from some Early Villafranchian localities of zone MN 16 - Les Etouaires, Vialett (France), Villaroya (Spain), and Kvabebi (Georgia) (Heintz, 1970; Vislobokova, 1990).. The antler is known from the site Kushkuna (Azerbaijan) together with the remains of rodents, and mollusks of Middle Akchagylian. Paleomagnetic and biostratigraphic data of the layers allow to carry them to the second half of Middle Pliocene, Early Villanyian, and zone MN 16b (Tesakov, 2004). However, nowadays a whole series of *Arvernoceros* finds from Late Pliocene – Early Pleistocene sites of Europe is known (Croitor, 2005). *A. verestchagini* was described from Salcia sand pit (Moldova). Its complete antler was found jointly with remains of Late Pliocene - Early Pleistocene animals (David, 1992). The analysis of the Late Pliocene association allows to speak about the presence on the south of Eastern Europe of warm and relatively dry climate with hot summer and slight snowy winter with weak cold weather, warmer and drier, than the modern ones. The absence of forms adapted to droughty habitats, and the abundance of species, that are typical for open and semi-open landscapes were characteristic for the Complex.

For Psekups (Odessa) Faunistic Complex (PFC) the presence of *Archidiskodon meridionalis meridionalis, Stephanorhinus* cf.. *etruscus, Equus (A.)*. cf.. *major,* and *Pseudodama nestii* were typical. During this period *Anancus* and *Paracamelus alutensis* continue to exist, but become less numerous. For the first time *Bison* appeared. The

most representative fauna of this type occurs from Ciscaucasus (sites Saratovskaya and Bakinskaya) from the basis of Psekups River's coastal sections. Deposits with Psekups fauna belong to an early part of Matuyama epoch, and small mammal fauna concerns to the end of Villanyian, and early Upper Villafranchian, to the end of zone MN 17 (Tesakov, 2004).. The skull and the antler of *Eucladoceros* "*pliotarandoides*" have been found near village Bakinskaya (Gromov, 1948). The plan of the antler's structure with the distinctive dichotomy bifurcation and upper teeth allow to describe a new genus and a species "*Psekupsoceros*" *orientalis* (Samson, Radulesco, 1967). I.A. Vislobokova (1990) has attributed this deer to *E.. orientalis*. There is another point of view on the genus definition of this specimen – *Megaceroides orientalis* (Azzaroli, Mazza, 1992).. R. Croitor (2006) has ascribed this antler to *Praemegaceros (Ortogonoceros) pliotarandoides* based on the similarity to an antler's fragment of "*Cervus*" *pliotarandoides* from Cortiglone Monferrato (Italy). Remains of *Arvernoceros* from PFC localities are not known. However such form of deer was characteristic for the given time interval of East Europe and adjacent territories. *Arvernoceros* sp. from Georgian site Dmanisi (Vekua, 1995), and from Romanian site Fantana lui Mitinan (Croitor, 2005) are pointed out.. There were no radical reorganizations in the structure of large mammal association in comparison with the previous stage. Probably, from this time a "savanna-type" Eurasian landscapes began to transform to recent steppe and forest-steppe as a result of an intensification of aridization..

For Taman Faunistic Complex (TFC) was characterized by *Canis tamanensis, C.. (Xenocyon) lycaonoides, Ursus* sp*. Lutra simplicidens, Pachycrocuta brevirostris, Panthera* sp*., Homotherium latidens, Archidiskodon meridionalis tamanensis*, *Stephanorhinus* cf*. etruscus, Elasmotherium caucasicum, Equus* (*Allohippus*) *major*, *Sus* cf*. strozzii, Bison tamanensis, Pontoceros ambiguus, Tragelaphus* sp*..*, and *Gazella* sp.. In unknown locality of Taman peninsula of the Sea of Azov Region the skull (afterwards destroyed) with antler of *Eucladoceros* cf. *orientalis* was found. This antler differs from Psekups one only by larger size. It keeps the same number and the size of two basal tines, dichotomy bifurcation of the unique branch and similar proportions of the beam. Croitor (2005) attributes this specimen to *P. (O). pliotarandoides.* The morphology of the skull and its fossilisation are identical with those of the skull of *Eucladoceos* sp. from Tsimbal sand pit (Taman peninsula) whence remains of Taman fauna occur. Microtheriofauna of that site is referring to a late stage of TFC, Early Biharian and zone MQ 1. The similar antler were found out in other localities of TFC (sand pit on the right bank of Sredniy Egorlyk, on the coast of the Sea of Azov near the Semibalki village) (Baigusheva, 2000). From numerous localities of TFC form the Sea of Azov Region remains *Arvernoceros* were not determined. However these deer are known from other European sites of the same age: *Arvernoceros* sp. from Chishmikioi (Moldova), *A.. cf. verestchagini* from Apollonia-1 (Greece) (Croitor, Kostopoulos, 2004; Croitor, 2005). The staff of animals' complex specifies a variety of biotopes ascribing to steppe and forest-steppe landscapes, and the absence of psychrophilic elements. Dominating forms of large mammal in taphocoenosis of the TFC were inhabitants of semi-open and open habitats.

The transitional form from *Eucladoceros* to *Praemegaceros* is the specimen from the collection of Mariupol local museum (Ukraine). Unfortunately, the exact locality of this antler is not known. However one can suppose its Early Pleistocene age. The structure specifies the occurrence of features of similarity with *Praemegaceros,* such as the second basal tine considerably bents downwards, and the beam is considerably deflected

laterally. But the tuber of the first basal tine and dichotomy bifurcation are kept. This find was determined as *P.. pliotarandoides* (Croitor, 2005). Croitor (2006) has attributed some other antler's finds from sites of PFC and TFC from territory of the East Europe to the same species.

In the Sea of Azov Region the change of large deer from *Eucladoceros* to *Praemegaceros* and also gradual disappearance of *Arvernoceros* are clearly found. *Eucladoceros* become larger, the size and flatness of a beam and basal tines of antlers changed with the preservation of dichotomy bifurcation. All these changes happened on a background of gradual intensification of the climate aridization and an expansion of steppe types vegetative communities.

THE EARLY PLEISTOCENE (LATE VILLAFRANCHIAN) CARNIVORES (MAMMALIA) FROM PIRRO NORD (APULIA, ITALY)

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We describe the carnivore assemblage from the Early Pleistocene Pirro Nord site, a suite of fissure filings outcropping within a quarry complex in the area between Apricena and Poggio Imperiale (Gargano, Apulia, Italy).
The rich sample, one of the most complete in Europe, has been collected since late 1970's by several researchers and fossils are stored in different institutions (Bari, Florence, Roma "Sapienza" and Turin Universities). Fourteen carnivore taxa have been identified at present: Mustelidae indet., *Mustela* cf. *M. palerminea*, *Meles meles, Ursus etruscus*, *Vulpes alopecoides*, *Canis mosbachensis*, *Lycaon lycaonoides*, *Megantereon whitei*, *Homotherium latidens*, *Lynx issiodorensis* ssp., *Acinonyx pardinensis, Panthera ex gr. toscana-gombaszoegensis,* Felidae indet. (*Puma* size), *Pachycrocuta brevirostris* (Petrucci 2008 and unpublished data).
Canis mosbachensis, *Homotherium latidens* and *Pachycrocuta brevirostris* are the most frequently recorded taxa. In addition, the assemblage includes rare species such as *Meles*, *Mustela* and a *Puma*-size felid have been also unearthed.
Carnivores are important elements of the dispersal events from Africa to Europe that took place at the Plio-Pleistocene transition. *Pachycrocuta brevirostris* and *Panthera* ex gr. *toscana-gombaszoegensis* are recorded in Europe around 2.0 Ma. *Megantereon whitei* arrived in western Europe together with *Homo* at 1.8 Ma, as it is recorded at the Georgian site of Dmanisi. Just later, other taxa such *Theropithecus* sp. and *Hippopotamus antiquus* are found in the continent at around 1.5-1.6 Ma. Faunal assemblages characterised by the occurrence of these taxa have been found across Europe, from Spain (Venta Micena, Fuente Nueva-3, Barranco León-5, Cueva Victoria and Incarcal), France (Sainzelles, Le Vallonet), Italy (Monte Argentario), Germany (Untermassfeld), Greece (Apollonia and Ravin de Voulgarakis) (Koufous, 1992; Martínez-Navarro, 2002; Kahlke, 2006; Arzarello et al., 2007; Sardella et al., 2008). The Pirro Nord faunal assemblage is a diversified sample providing valuable information on the biochronology, evolution and ecology of Early Pleistocene carnivore guild.

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SMALL AND/TO LARGE CANIDS IN SOUTH-WESTERN EUROPE:
TAXONOMIC STATUS AND BIOCHRONOLOGICAL CONTRIBUTION

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The Caninae are especially abundant in the Plio-Pleistocene record from Western Europe where several genera, sub-genera and species have been recognized, some still under discussion about taxonomical attribution. They have important ecological role among carnivoran guilds during all the Quaternary and some are high-leveled competitors. Their appearance and dispersal can be considered as major bioevents during different phases of Quaternary, and then are relevant biochronological markers which can be correlated with main European faunal turnovers; from the 'wolf-event' (Azzaroli 1983) at the end of Pliocene, followed by high taxonomic diversity by Early to Middle Pleistocene and specific lineage with high size variation during the Middle and Late Pleistocene. Indeed, as many other mammals with very wide distribution, Canids demonstrate a relative high morphological and size (clinal) variability which in our sense are often underestimates and lead to create many taxa from a biogeographical base, especially in south-western Europe characterized by high regional peculiarities (*e.g.* peninsular condition). In this paper we would like to propose a preliminary analysis (mostly on teeth morphometry) of the taxonomy of wolf- and coyote-sized canids from distinct examples in south-western Europe: small canids of early Pleistocene, discussion on genus *Cuon* and precision on *etrucus-mosbachensis-lupus* lineage. The contribution of Canids as biochronological tools would be discussed.

A NEW PLEISTOCENE PALEONTOLOGICAL SITE FROM SOUTHWESTERN

IBERIA, SIERRA DEL CHAPARRAL, VILLALUENGA DEL ROSARIO, CÁDIZ, SPAIN: PRELIMINARY DATA

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The Sierra del Chaparral site is a new Early Pleistocene paleontological outcrop that has been found during the speleological prospection's made by the G.I.E.X. Caving Group (Jerez, Spain) in the karstic mountains of the "Manga de Villaluenga del Rosario (Parque Natural de la Sierra de Grazalema, Cádiz)". Fossil bones were founded into a calcareous breccia corresponding to the lower part of a doline filled with autochthonous *terra rossa* deposit and calcareous blocks from a Jurassic formation located in the eastern slope of the "Sierra del Chaparral", at 1080 meters above sea level (Fig. 1). An interdisciplinary team undertakes a preliminary excavation in order to approach the geomorphology, paleontology, taphonomy, palaeoenvironment and archaeology of the site, faced with the possibility of human presence.

For the moment seven taxa of large-meso mammals have been recovered from the Sierra del Chaparral site: three herbivores (*Bos* sp., *Cervus* cf. *elaphus* and *Dama dama*), two carnivores (*Panthera* sp., Canidae indet.), one chelonian (Chelonia indet.) and one lagomorph (*Oryctolagus* sp.). The bone remains correspond to a small sample recovered in the site for a first diagnose, and are principally composed by indeterminable fragments. With the exception of *Dama dama* which is very abundant, the other taxa are represented by a few numbers of bones. Due to the fact that this species (*D. dama*) is represented by complete skeletons in anatomic connection, we

suppose that it is possible that the animals fall inside the doline (sinkhole) after death. As small vertebrates are concerned 12 taxa have been identified (Fig. 1): one salamander (*Salamandra salamandra*), two anurans (*Pelodytes* sp. and *Bufo bufo*), three snakes (*Coronella* sp., *Natrix maura* and *Vipera latasti*), two insectivores (*Talpa* sp. and *Crocidura* sp.) and four rodents (*Allophaiomys lavocati, Apodemus* sp*., Sciurius* sp. and *Hystrix* sp.). As a whole, this small vertebrate assemblage is indicative of wet and open Mediterranean woodland areas, with the presence of *Apodemus* sp., *Talpa* sp., *S. salamandra* and *B. bufo*. While *V. latasti* is indicative of dry stony areas and *N. maura* of aquatic environments. With the exception of *A. lavocati*, *Hystrix* sp. (and probably *Talpa* sp. and *Crocidura* sp.) all the other taxa are currently represented in western Andalusia.
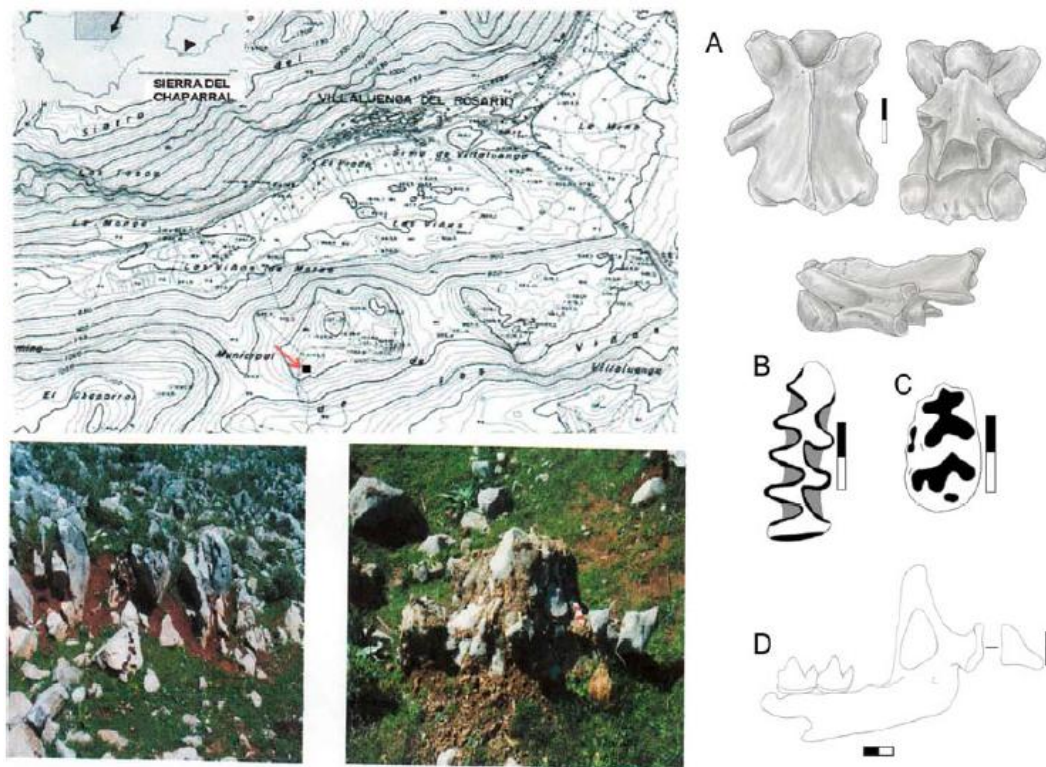
Figure 1. **Up-left:** Location of the Sierra del Chaparral site in Southwestern Spain. **Down-left**: Left: doline's bottom; right: calcareous breccia into doline's bottom. **Right:** Some small vertebrate of the Sierra del Chaparral. A: Trunk vertebra *Salamandra salmandra* (dorsal, ventral and lateral views), B: right m1 *Allophaiomys lavocati* (occlusal view), C: left m1 *Apodemus* sp. (occlusal view), D: right mandible *Crocidura* sp. (lingual and posterior views). Scale 1 mm.

CORRELATION BETWEEN THE LATE PLIOCENE – EARLY PLEISTOCENE SEQUENCES OF CAUCASUS (GEORGIA) AND IBERIAN PENINSULA (GUADIX-BAZA BASIN)

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Caucasus and Iberian Peninsula, at the opposite edges of the Mediterranean realm, contain some of the most remarkable continental sequences of western Eurasia. Also, both contain the first evidences of human occupation out of Africa.

Ongoing paleontological and geocronological work enables to establish a detailed correlation between the two areas. Therefore the Middle Pliocene is best represented by the series of Kwabebi, which contains a rich paleontological site with *Nyctereutes megamastoides, Ursus arvernensis, Lynx issiodorensis, Anancus arvernensis, Hipparion rocinantis, Stephanorhinus megarhinus* and other Villafranchian elements. The Kwabebi section exactly correlates to Zujar 11 site, which also contains *Anancus arvernensis*. In the Guadix baza basin these levels are followed by several late Pliocene levels such as Fuente Nueva 1 and Galera 2 sites.

The earliest Pleistocene is best represented in Georgia by the site of Dmanisi which have yielded the oldest hominine remains of Eurasia. The sequence in this site covers the Olduvai and lowermost upper Matuyama chrons. In Guadix-baza the site of Barranco Conejos is probably the closest one to Dmanisi, although slightly younger. The Barranco Conejos level (*Tcharinomys osvaldoreighi* biozone) is followed by the well known site of Venta Micena (*Allophaimoys ruffoi* biozone).

LATE PLIOCENE-EARLY PLEISTOCENE EVOLUTION OF THE WESTERN EURASIAN RODENT COMMUNITIES

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Western Eurasian Early Pliocene rodent communities were in general very similar to those of the late Miocene, characterized by high richness levels. They were dominated mainly by murids, cricetids and spalacids. However, as a difference with the late Miocene ones, most of the early Pliocene communities were characterized by the occurrence of the first archaic arvicolids (*Promimomys*) or by closely related arvicolid-like cricetids (*Bjornkurtenia*, *Celadensia,Trilophomys, Baranomys, Microtoscoptes*). A first radiation of arvicolids (*Pliopotamys, Ellobius, Mimomys*) characterizes the middle Pliocene, leading to the present subfamilies and tribes of the family. However, murids and cricetids continue to prevail in the small mammal communities of the middle latitudes.

A major change took place at 3.2 Ma, as it has been dated in the Galera and Zújar sections of the Guadix-Baza Basin. Although not accompanied by a significant structural change, at this time the arvicolids of the genus *Mimomys* became the dominant elements of the small mammal communities, the diversity of other families (especially murids) decreasing dramatically, both in richness and relative abundance. In contrast, no major change is seen at 2.6 Ma. This time is characterized by a number of lineages which follows a parallel anagenetic trend towards increasing size and hypsodonty. This trend reach a maximum at the end of the Pliocene, when the genus *Mimomys* is widely represented by very large and hypsodont species, like *Mimomys pliocaenicus* and *Mimomys ostramosensis*. *Mimomys pliocaenicus* is present at the site of Dmanisi, enabling the correlation of this site with those of the same biozone in western and central Europe. In south-western Europe, these forms are replaced by local lineages ("*Kislangia" gusii, Mimomys medasensis*), which, however, show similar trends.

A second *Mimomys* lineage (for which the subgenus *Tcharinomys* was erected) is characterized by different trends. Here, increase in hypsodonty is accompanied by a reduction in size and a simplification of the dental pattern. The origin of the first un-rooted microtines of the genus *Allophaiomys* lies close to this group.

The first *Allophaiomys* species, *A. deucalion*, is reported from several late Pliocene sites from eastern and central Europe, but this species is lacking in the late Pliocene of south-western Europe, thus suggesting a strong latitudinal component for the dispersal of this vole. Actually, the first un-rooted microtines making their first occurrence in the earliest Pleistocene of the Guadix-Baza sequence are not members of the genus *Allophaiomys* but archaic ones of the genus *Tibericola*. *Tibericola* has been so far described in Israel and Turkey and its presence in the early Pleistocene beds of Guadix-Baza strongly suggest that the first wave of immigrants in Western Europe came from the East. *Tibericola vandermeuleni* from the Guadix-Baza Basin is accompanied by the last members of the small and large *Mimomys* lineages, which finally develop ever-growing molars in a parallel way with the *Allophaiomys* lineage.

Early Early Pleistocene rodent communities in most of Europe are characterized by the vole *Allophiaomys pliocaenicus*. A similar form, *Allophaiomys ruffoi*, characterizes the rodent communities in the southern peninsulas, being present in the localities of Venta

Micena and Pirro Nord. *Allophaiomys ruffoi* is larger and more archaic than the central-European species, suggesting a direct origin from *A. deucalion* (as happened with *Tibericola* in Anatolia and Middle East). At the same time, the water voles of the species *Mimomys savini* are widespread in Europe.

A trend to develop nivaloid morphotypes is observed in these southern populations, leading to *Allophaiomys burgondiae* and *A. lavocati,* in the case of *A. ruffoi*, and *Tibericola jordanica*, in the case of *T. vandermeuleni.* This kind of forms are characteristic of middle early Pleistocene sites such as Barranco León D and Fuente Nueva 3 (*A.* aff. *lavocati*) and Ubeidiya (*T. jordanica*).

Late Early Pleistocene rodent communities from Europe are characterized by the sudden occurrence of a new group of microtines, either referred to the genus *Allophaiomys* (*A. nutinesis*) or *Microtus* (*M. tenni*). The first lower molars of these microtines are characterized by the constriction of the T – T connection, an evolutionary innovation that was not present in earlier forms and that can be considered as a derived feature of the genus *Microtus (s.l.)*. Elements of this group are present in a number of sites, such as Le Vallonet and Les Valerots, in France, Monte Peglia in Italy and Untermassfeld in Germany.

At this time, the archaic *Allophaiomys* populations almost disappear from Europe, being only represented by the southern endemism *A. chalinei.* In contrast, the *M. nutiensis-thenii* group evolves into the first representatives of the *Microtus (s.s.; Microtus hintoni)* and *Iberomys (I. huescarensis). Mimomys savini* is still a common element in these latest Pleistocene rodent communities.

MOLE VOLES (ELLOBIUSINI, ARVICOLINAE) AS MARKERS OF EARLY
PLEISTOCENE EURASIAN-AFRICAN BIOTIC CONNECTIONS.

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Mole voles (genus *Ellobius* s.l.) are burrowing rodents common in open and
mountainous landscapes in Eastern Europe and Asia. In the Early Pleistocene the group
dispersed from western areas of Eurasia to North Africa marking the expansion of
steppe-like conditions in this region. Two recent genera (earlier frequently regarded as
subgenera) *Ellobius* Fischer von Waldheim and *Bramus* Pomel (=*Afganomys*
Topachevsky, younger synonym) are recognized. The earliest fossil record of both
groups dates back to the Late Pliocene of Central Asia and North Caucasus. In the Early
Pleistocene, mole voles broadly dispersed throughout western Asia and eastern Europe
as common elements of the mammalian fauna adapted to open landscapes of the vast
steppe belt in the middle latitudes of Eurasia.

While mole voles of the genus *Ellobius* s.str. apparently never migrated outside the
Eurasian continent, the other group, *Bramus,* could spread through Central Asia,
western Siberia, southern Urals, Azov and Black Sea areas, Near East, and North
Africa. The African fossil record, first described by Pomel [1895] under the new genus
name *Bramus,* was subsequently studied in detail by Jaeger [1988] who attributed it to
the genus *Ellobius* and described several species successive in time. Among these
forms, *E. africanus – E. atlanticus – E. barbarus* represent a well defined endemic
phyletic lineage that demonstrates clear morphological trend to higher hypsodonty,
dental complexity, and size increase. Additional ample materials on these forms from
several localities in Morocco and the detailed analysis of co-occurring large and small
mammalian fauna provided a biostratigraphic context for this lineage apparently
spanning the late Early through the late Middle Pleistocene [Geraads, 1994, 2002]. The
morphological evolution of the African lineage of mole voles in many features mimics
the Eurasian lineages leading to recent *Bramus lutescens* and *B. fuscocapillus*. The
Early Pleistocene fossil record of Eastern Europe (Crimea Peninsula and lower Don
River area) illustrates an ancient form of the genus (*Bramus tarchancutensis*)
[Topachevsky, 1963; Tesakov, 2008].

The earliest European and African forms (*B. tarchancutensis* and *B. africanus*) share an
almost identical plesiomorphic morphology and stage of evolution indicating a possible
conspecificity of these forms. Therefore, the dispersal event of mole voles to Africa can
be biochronologically dated to at least mid Early Pleistocene.

The Early Pleistocene biological success of larger mole voles in Eastern Europe was
apparently associated with the combination of warm climate and expansion of open
steppe-like landscapes. Similar conditions facilitated the expansion of the group to the
Middle East and North Africa. The subsequent endemic evolution of mole voles in

North Africa in the Early through Middle Pleistocene [Jaeger, 1988; Geraads, 2002] provides an excellent example of parallelism in mammals. The considerable climatic cooling in the region at the Early-Middle Pleistocene transition could have caused the disappearance of *Bramus* in Eastern Europe by the late Early Pleistocene. Likewise, the extinction of the North African *Bramus* lineage in the late Middle Pleistocene is believed to be associated with climate-based environmental fluctuations [Jaeger, 1988] and/or with a drastic aridification and a possible competition with gerbils.

THE ARCHAIC STONE-TOOL INDUSTRY FROM BARRANCO LEÓN AND FUENTE NUEVA 3, ORCE, SPAIN. AN EVIDENCE OF THE OLDEST PRESENCE OF HOMININS IN SOUTHERN EUROPE.

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The Barranco León and Fuente Nueva 3 sites are located in the Guadix-Baza Basin, in Orce (Andalusia, Spain), about 80 km from the Mediterranean sea. Both sites were located in swampy areas, near the eastern edge of Baza paleo-lake, where hominins and hyenas competed for access to carcasses of large herbivores abandoned by carnivores. The Barranco León and Fuente Nueva 3 sites, whose ages have been evaluated by large and small mammal biochronology, magnetostratigraphy AND BY SRE to around 1,4 - 1,2 Myrs., have yielded fauna and lithic artefacts in place. The sedimentary deposits show negative polarity which, along with biochronological data, suggests a correspondence to the middle Matuyama reverse polarity event (1,780 to 1,070 Myrs.) preceding the positive Jaramillo event (1 070 000 to 984 000 Myrs.). Systematic excavations at Barranco León and Fuente Nueva 3, underway since the 1990's contribute to growing evidence of hominin presence in southern Europe well before 1,3 Myrs. ago.

At Barranco León, the archeological level consists of silty-sandy clays with pebbles, rich in fresh water mollusc shells. At Fuente Nueva 3, the deposits are also made up of silty-sandy clays with some fresh water mollusc shells.

Recent studies of the lithic material from both Barranco León and Fuente Nueva 3 have revealed that there is little variation between the two assemblages. The artefacts were knapped from flint and limestone available in the immediate vicinity of the sites. The flint originates from Jurassic marine limestone formations situated south of the basin and outcrops in secondary deposits 2 km or less from the sites, along with marly or silicified limestone nodules. There are also a few elements knapped in quartzite pebbles collected from a nearby source.

Both assemblages comprise numerous small, un-modified flakes, alongside some angular fragments, cores and larger limestone percussion instruments. There are no intentionally retouched tools nor are there any standardized large configured tools. At both sites, the paucity of pebble tools may be explained by the relative scarcity of pebbles in the area. There are however some irregularly worked stone instruments that seem to have served as percussion or slicing instruments.

At both sites, relatively long and standardized knapping sequences were observed on flint matrixes. Flatter flint matrixes were reduced using bidirectional or centripetal strategies on one or two surfaces while, thicker flint matrixes were knapped using mainly orthogonal reduction strategies. For the latter, peripheral removals were sometimes extracted using bipolar hard hammer on an anvil technology. In both cases, knapping strategies were progressively adapted as the matrixes evolved into different forms. Hard hammer multiplatform knapping (a variant of orthogonal knapping) is also frequently observed with previous removal negatives serving as extraction surfaces for new, non-recurrent extractions requiring frequent direction changes. This procedure lead to the production of small, polyhedron shaped cores. The apparent aim was to produce small sized, non-standardized flakes The goal of applying these debitage strategies was therefore to obtain small flakes, most often from 10 mm to 40 mm long and more or less square shaped with an average cutting edge length of 20 mm, to accommodate immediate needs, thus explaining the reduced size and polyhedral form of most residual cores left at the sites.

For the limestone, knapping strategies varied according to initial block morphology and some of the material may or may not be defined as cores, given the non standardized morphology of large configured tools at these sites. These large limestone tools may have served to break large herbivore bones to extract marrow. Flat limestone supports were reduced by hard hammer technique using unifacial, crossed or centripetally oriented removals. Thicker cube or sub spherical shaped limestone supports were initiated by centripetally oriented invasive surface removals and then further reduced on a single surface using centripetal or peripheral technology or on several surfaces using multidirectional strategies. In both cases, hard hammer and/or hard hammer on an anvil methods were applied accordingly.

The Barranco León and Fuente Nueva 3 stone assemblages express a variant of Mode 1 technology that seems to be more evolved than that observed at some earlier African sites, mainly because of the presence of systematic multiplatform knapping strategies alongside various unidirectional reduction strategies, as well as the distinctive use of two types of raw materials for the fabrication of non standardized small cutting tools and larger percussion instruments.

EVALUATING PATTERNS OF CRANIAL MORPHOLOGICAL DISPARITY IN EARLY *HOMO* AND INFERENCES ON THE TAXONOMIC AFFINITIES OF THE FIRST HUMAN POPULATION THAT DISPERSED OUT OF AFRICA

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In this contribution we evaluate patterns of craniometric disparity in Early *Homo* for developing inferences on the taxonomy and paleobiology of the first human population dispersing out of Africa.
The relationship in hominins between the relative development of the face (a cranial complex related with mastication) and the neurocranium (which houses the brain) has been considered a key topic for addressing human evolution, as the increase in brain size of the genus *Homo* is associated with a decrease in the degree of prognathism (e.g., Lieberman *et al.,* 2002; Weidenreich 1941).

Here we analyze the craniometric variability of a sample of anatomically modern humans ($N = 163$, including 141 healthy adults, four microcephalics, 13 toothless individuals, and five juveniles), the big apes (*Gorilla gorilla*, $N = 34$, including 30 adults and four juveniles; *Pan troglodytes* $N = 59$, including 54 adults and five juveniles; *Pan paniscus*, $N = 22$, only adults; *Pongo pygmaeus*, $N = 14$, all adults) and most crania of extinct hominins (including all the specimens preserved relatively complete in the human fossil record).

Our first objective is to search for overall craniometric patterns among the big apes, the australopiths, the extinct members of *Homo* and the modern humans. More specifically, we have estimated six low-tech metric variables, including the length and width of the face (BPL and NPH, measured as basion-prosthion and nasion-prosthion, respectively), the length, height and width of the neurocranium (GOL, BBH and XCB, measured as glabella-opistocranium, basion-bregma and maximum biparietal width, respectively) and the bizygomatic breadth (ZYB).

Results obtained in a principal components analysis of the correlation matrix for these variables (transformed logarithmically prior to analysis) allow representing an empirical morphospace for the living hominoids and the extinct hominins. This is achieved with a bivariate plot defined by the first two components, which jointly account for more than 93% of the original variance.

According to the factor loadings of the metric variables, we interpret the first component as a shape vector, in which the specimens with a large face and a comparatively small neurocranium (e.g., the big apes) take negative scores while those with a reduced face and an enlarged neurocranium (e.g., the modern humans) take positive ones. In contrast, the second component is a size vector, in which all the variables show positive loadings, and it is highly correlated with the geometric mean of the six metric measurements ($R^2 = 0.97$, $p < 0.0001$). As a result, this component distributes the specimens as a function of their overall size (from bonobos and human microcephalics to male gorillas).

The scatter of the specimens in the multivariate shape-space defined by these two components allows recognizing three distinct morphological patterns:

1) The big apes and the australopiths (both gracile and robust), which share a similar cranial morphology. Among these taxa, the crania that are smaller (e.g., the bonobos and the gracile australopiths) are more human-like and their differences are only a matter of size.

2) The extinct members of *Homo*, which reverse the trend displayed by the big apes and the australopiths, showing larger neurocrania which are more human-like.

3) The anatomically modern humans, with a more developed neurocranium and a smaller face than in those extinct members of *Homo* of similar size.

It is worth noting that the relationship between the face and the neurocranium in extinct *Homo* can be interpreted not only as a morphometric pattern but also as an evolutionary trend (Lieberman *et al.,* 2002). This is evidenced by a significant correlation between the geologic age of the specimens (log-transformed) and their scores in the first principal component ($R^2 = 0.71$, $p < 0.0002$).

The differences among these patterns result from changes in the growth rates of the face and the neurocranium, which ultimately evidence paleobiological adaptations (e.g., dietary improvements toward a more carnivore diet in the transition from the gracile australopiths to early *Homo*).

In order to evaluate in further depth the taxonomic implications of the variability in the first human population that dispersed out of Africa, a range study was performed using as variables the scores in the first two principal components.

Concerning the general craniometric pattern, the variability in shape and size observed for the individuals assigned to *H. habilis*, *H. rudolfensis* and the Dmanisi sample (*H. rudolfensis,* three crania) is not higher than in the sample of modern humans (which includes juvenile and toothless individuals). In addition, if the healthy adult specimens of early *Homo* (i.e., D 2282, KNM-ER 1470, KNM-ER 1813, OH 24, KNM-ER 3733 and Stw 53) are joined, the shape variability of this sample does not exceed the one found in any of those formed by the adult healthy individuals of the extant hominoid species. However, *H. erectus s.l.* (including specimen D 2282) shows a very high variability, with a shape vector range that is greater than in all other hominoids except *P. pygmaeus*.

Therefore, our analysis suggests the probability of a better fit of the Dmanisi population with the 'habilines' than with the 'erectines' (e.g., Jiménez-Arenas, 2006; Lordkipanidze *et al.,* 2007).

The main conclusions of this study are the following:

1) The australopiths share a plesiomorphic craniometric pattern with the big apes, while the pattern shown by the extinct members of *Homo* represents an autapomorphy.

2) The main evolutionary novelties associated to the emergence of the genus *Homo* are the development of the brain and the reduction of the teeth, aspects that both can be linked with an increase in dietary quality.

3) Such dietary enrichment was probably achieved through the access to ungulate carcasses abandoned by saber-tooth cats (Martínez-Navarro & Palmqvist, 1996), which could have represented the key ethological innovation that facilitated the dispersal toward higher latitudes and more seasonal ecosystems.

4) The first population dispersing *out of Africa* (Dmanisi) shows higher morphological affinities with the 'habilines' than with the 'erectines'.

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VM-0, A HOMININ SKULL FRAGMENT 1.3 MY OLD FROM VENTA MICENA

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The Orce cranial fragment VM-0 was found in 1983 at the Lower Pleistocene site of Venta Micena and classified as human. Because the presence of a small internal crest in the occipital some students suggested that the fóssil belonged to and equid 2 month old. Nerver in the litherature and equid skull of similar characteristics than VM-0 has been reported. Radiographic studies and anatomical and immunological arguments have been refuted the equid hypothesis Recently, Dr. Martínez-Navarro considers VM-0 as the bregmatic zone of a juvenile female ruminant without cranial appendages. This new interpretation is based on three points: (1) similarity between the sutures and angles of the bregmatic regions in skulls of ruminants and VM-0; (2) anatomic similarity of the bregma region of the ruminant exocranium with that of VM-0; and (3) similarity in the bregmatic region of the endocranium (presence of a crest, sagittal sulcus, and cerebral impressions).

In this communication we refute these assertions and we add a discussion about new points that permits to discriminate VM-0 from ruminants and allow us to consider it as a human one.

ON THE ECOLOGICAL CONTEXT OF THE FIRST HUMAN DISPERSAL IN EUROPE AND THE SCAVENGING NICHE AVAILABLE TO THE HOMINIS: RECONSTRUCTING THE ECOPHISYOLOGY OF THE EARLY PLEISTOCENE LARGE MAMMALS AND PREDATOR-PREY RELATIONSHIP IN THE PALEOCOMMUNITY

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Research into the reconstruction of the dietary regimes, habitat preferences and ecological interactions among the large mammal species from the early Pleistocene community of Venta Micena (Orce, Guadix-Baza basin, SE Spain) has focused on biogeochemical and ecomorphological approaches (Palmqvist *et al.,* 2003, 2008a, 2008b). Bone hydroxylapatite and collagen successfully extracted from 18 mammalian species have allowed estimating the relative abundance of carbon (δ^{13}C), nitrogen (δ^{15}N) and oxygen stable-isotopes (δ^{18}O). These isotopes, combined with the appropriate morphometric ratios (e.g., the hypsodonty index for ungulates; Mendoza & Palmqvist, 2008), provide interesting clues on the ecophysiology of the large mammals, which helps in deciphering aspects of community trophic structure and vegetation, as well as in the analysis of predator-prey interactions.

Specifically, the Venta Micena ungulates can be classified among grazers (*Equus altidens, Bison* sp., *Praeovibos* sp., *Hemitragus albus, Hippopotamus antiquus,* and *Mammuthus meridionalis*), mized-feeders (*Soergelia minor* and *Pseudodama* sp.) and browsers (*Stephanorhinus* sp. and *Praemegaceros* cf. *verticornis*). δ^{13}C values show that these herbivores consumed exclusively C$_3$ plants. For this reason, significant differences in isotopic values between perissodactyls (monogastric, hindgut fermenters) and ruminants (foregut fermenters) must reflect physiological differences related to their rates of methane production and digestive efficiency (e.g., a cow can subsist on a lesser

amount of food per day, 70% on average, than a horse, which translates in differences in the assimilation of carbon-isotopes between both groups).

$\delta^{18}O$ ratios allow the interpretation of the dietary water source of these species, suggesting that *Pseudodama* sp., *H. albus* and *S. minor* derived a significant fraction of their metabolic water from the vegetation consumed. This agrees with expectations from their living closest relatives (e.g., modern goats and fallow deer, which are well-adapted for arid conditions and obtain most of their water requirements from the vegetation). In contrast, elephant *M. meridionalis,* hippo *H. antiquus,* rhino *Stephanorhinus* sp., megacerine deer *P. verticornis,* and muskoxen *Praeovibos* sp. exhibit the lowest $\delta^{18}O$ values, which indicate greater water dependence for these species.

A "taxon-free" comparison of the abundance of ecological categories in the Venta Micena large mammal fauna with those found in recent mammalian communities from Africa and Asia reveals that the trophic structure of this ancient community is indicative of a wooded savanna (Mendoza *et al.,* 2005).

Carnivore species have higher $\delta^{15}N$ values than herbivores, which records the isotopic enrichment expected with an increase in trophic level. However, the unexpectedly high $\delta^{15}N$ values of *H. antiquus* and *Praeovibos* sp. suggest that these ungulates had unusual diets, consuming predominantly aquatic plants and lichens, respectively.

Modern hippos feed on terrestrial grasses and show $\delta^{15}N$ values similar to those of sympatric grazing artiodactyls and smaller than in carnivores (Sealy *et al.,* 1987). The unexpected diet of *H. antiquus* probably relates to the huge size of this species: our preliminary estimates, based on the diaphyseal diameter of major limb bones, provide a figure of 3200 kg for this species, which contrasts with the average mass of *H. amphibious,* 1500 kg. In addition, the metapodials of *H. antiquus* were relatively shorter than in modern hippos (Kahlke, 1997), which must have posed more severe limitations for terrestrial locomotion in this ancient species and probably translated in a more amphibious life style.

Inferences on predator-prey relationships within this ancient community, derived using the dual linear mixing model (Pérez-Claros & Palmqvist, 2008), indicate resource partitioning among sympatric predators, suggesting that African dirk-toothed felid *Megantereon whitei* and European jaguar *Panthera* cf. *gombaszoegensis* have lower $\delta^{15}N$ values, which indicates that they ambushed browsing deer and horses in forested habitat. In contrast, scimitar-toothed felid *Homotherium latidens* and hunting dog *Lycaon lycaonoides* show higher $\delta^{15}N$ values, which confirms that they were coursing predators in open environment. More specifically, the linear mixing model suggests that *H. latidens* pursued juvenile elephants and adult grazing *Bison,* while *L. lycaonoides* specialized in low-to-medium sized ungulates such as goat and fallow deer, although it also consumed a significant fraction of horse. Finally, the giant, short-faced hyena *Pachycrocuta brevirostris* scavenged the prey of these hypercarnivores, specially those carcasses obtained through kleptoparasitism in unforested areas, as revealed by the comparatively high $\delta^{15}N$ values obtained for this species.

According to these results, we can tentatively suggest that the hominins specialized in scavenging the prey of ambushing predators like *M. whitei,* which presumably abandoned the carcasses of their prey in forest areas, as this implies that such resources would be less accessible to the hyenas. Given that *M. whitei* presumably left, on these carcasses, large amounts of flesh and bone nutrients within, its arrival in Eurasia at the Plio-Pleistocene transition opened broad opportunities for scavenging by the hominins,

which helps to explain the success of the Oldowan tools in this continent until 0.5 Ma (Arribas & Palmqvist, 1999; Martínez-Navarro & Palmqvist, 1995, 1996; Palmqvist *et al.,* 2007).

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ON THE BONE-CRACKING BEHAVIOR AND SCAVENGING ABILITIES OF THE GIANT, SHORT-FACED HYENA *PACHYCROCUTA BREVIROSTRIS:* A DUAL APPROACH COMBINING TAPHONOMY AND SKULL BIOMECHANICS

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As emphasized by the great paleontologist George Gaylord Simpson, it is difficult to conceive a more challenging task than deciphering the paleobiology of an extinct species. With a skull that paralleled that of the largest southern African male lions and a body size 20% larger than that of a spotted hyena, *Pachycrocuta brevirostris* (Aymard) was the largest hyaenid that ever existed and was well adapted for dismembering carcasses and consuming bone (Werdelin & Solounias, 1991; Turner & Antón, 1996; Arribas & Palmqvist, 1998). Apart from its huge size, *P. brevirostris* differed from the modern hyenas in the shortening of the distal limb segments; as a result, the overall height of the giant hyenas was not much greater than that of a large spotted hyena, as the skull size alone would suggest (Turner & Antón, 1996). This indicates a less cursorial life style for *P. brevirostris* than that of the living hyenas, although it provided greater power and more stability to dismember and carry large pieces of ungulate carcasses to their dens, which is in agreement with the scavenging behavior deduced from taphonomic analysis of bone assemblages collected by this extinct hyena (Palmqvist & Arribas, 2001).

However, it has been argued (Dennell *et al.,* 2008) that the huge size of *P. brevirostris* could have been advantageous for the capture and subduing of medium-to-large-sized ungulate prey under concerted action within a pack, as well as in any contest with other predators in defense of a kill or during aggressive scavenging (kleptoparasitism). For example, Turner & Antón (1996) point to several aspects of the morphology of spotted hyenas that only make sense in relation to their hunting ability when viewed within the context of group activity, such as their body and limbs more heavily built and massive than in brown and striped hyenas, which both need to cover longer distances searching for scavengeable carcasses. In any case, it is worth noting that even the behavior of an

extant carnivore can not be extrapolated directly from the study of living populations, as evidenced by the marked differences between the diet of spotted hyenas in Serengeti and Ngorongoro National Parks (Kruuk, 1972). For this reason, the question of whether an extinct carnivore habitually killed its own prey or scavenged the prey captured by others will be always a difficult one to address.

Here we report in the results obtained in a study aimed to deciphering the paleobiology of *P. brevirostris* using a combined biomechanical and taphonomic approach. The biomechanical analysis focuses on features of the craniodental and postcranial morphology of this extinct hyena related to feeding preferences and locomotive performance, including new estimates of its body mass. The taphonomic study concentrates on the preservational bias introduced by the bone-cracking behavior of *P. brevirostris* in the large mammal assemblage of Venta Micena, a locality currently interpreted as an early Pleistocene denning site of the giant hyenas (Palmqvist *et al.,* 1996; Arribas and Palmqvist, 1998; Palmqvist and Arribas, 2001).

Bone-consuming sequences by the giant hyenas in Venta Micena were tested with a multidimensional contingency table, which allows to make comparisons of the abundance of major limb bones preserved as complete elements, isolated epiphyses or diaphyses. The analysis was conducted in the ungulate species better represented in the assemblage, equid *Equus altidens* and ruminants *Bison* sp., *Hemitragus albus, Soergelia minor, Pseudodama* sp. and *Praemegaceros* cf. *verticornis.* Results obtained show an overrepresentation of limb bones with respect to elements of the axial skeleton such as vertebrae and ribs. Among the major limb bones, the frequencies of bone portions preserved agree well with the types of bone-modifying activities by the hyenas established by Palmqvist & Arribas (2001): a proximodistal pattern in the case of humerus and tibia, and a sequence of consumption of variable direction in the case of radius, metapodials and femur. The overall patterns of skeletal representation for bovids and cervids are remarkably similar except in the case of deer metapodials, less abundantly preserved in the assemblage given their slenderness and higher marrow contents. Given the selective bone-cracking behavior of *P. brevirostris,* this reveals that the skeletal elements preserved in the fossil assemblage are those that remained once all within-bone nutrients were consumed by the hyenas.

A least squares regression analysis between the percentage of major limb bones of bovids, cervids and horse preserved as complete elements and the volume of their medullary cavities reveals an inverse and statistically very significant relationship between both variables. This indicates that those bones with greater nutritional value (e.g., femur, humerus and tibia) were preferentially fractured by the hyenas (thus being preserved in the bone assemblage as bone portions), while those others that provided less marrow (e.g., radius and metapodials) tend to be better represented as complete elements.

Size estimates for *P. brevirostris* were obtained using regression equations adjusted with modern carnivores for body mass on postcranial measurements. Specifically, the most accurate estimate is the one provided by the equation of Andersson (2004), in which mass is adjusted on the perimeter of the distal humerus trochlea, a weight-bearing joint whose surface scales similarly throughout the order Carnivora. This equation gives size estimates for the tree living hyenas that are remarkably close to their actual masses. In the case of *P. brevirostris,* the estimate obtained for the humerus from Incarcal (116.3 mm) is 116.6 kg, while in the case of the distal humerus from Dmanisi (104.4 mm) is 104.4 kg. This provides an average mass of 110.5 kg for the giant hyena.

The biomechanics of the skull of *P. brevirostris* reveals that the giant hyenas had mechanical advantages for bone fracturing of their robust premolar teeth, powerfully developed jaw closing muscles (especially the masseter and pterygoid) and deep mandibles well designed for resisting high dorsoventral loads.

The picture of *P. brevirostris* that emerges from these analyses is the one of a colossal scavenger, with the mass of a lioness, massive limbs with shortened distal bones and a heavy, powerfully built mandible with robust, well-developed premolars. All these features reflect its adaptation for dismembering ungulate carcasses, transporting large pieces of them without dragging to the denning site and fracturing bones for marrow extraction. For this reason, the giant hyena must have represented a major contender for the hominins in their access to those ungulate carcasses abandoned by the hypercarnivores.

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PRESENCE OF TWO DIFFERENT BUFFALOES AT THE SITE OF VENTA
MICENA (ORCE, SPAIN)

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The large bovids of the European Early Pleistocene are dominated by the presence of
the genus *Bison*, a descendant of the Late Pliocene forms of *Leptobos*.
Bison is known from Dmanisi, at 1.8 Ma, where it was firstly named *Dmanisibos*
(Vekua 1995), until the Holocene, and it is the most abundant Quaternary buffalo of the
continent and, practically it is the only one genus recorded at most of the Early
Pleistocene sites of Europe.
The revision of all the large Bovidae collection from the site of Venta Micena (~1.5 Ma)
shows that there are two species of buffaloes at this Early Pleistocene locality. One of
them is clearly a form of *Bison*, as it was published by Moyà-Solà (1987), and the other
corresponds to another different Bovini of small size and less sexual dimorphism than
Bison.
Microwear analysis of the dental material show that one of these species is feeding on
grasses (*Bison*, the large one), while the other is more browser. Thus, *Bison* was
probably living in open environments and the smaller species inhabited more forested or
mixed areas.

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ABSTRACTS

Posters

ORIGINS OF NORTH AFRICAN PLEISTOCENE FAUNAS

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In most cases, the North African faunas are characterized by alloctoneous taxa of different geographic origins, e.g. tropical, Sahelian, Mediterranean, Eurasian, and endemic. Its geographical position (bipolarity Sahara-coast), controlled by climatic variations, is the source of its richness and diversity in faunal peopling.

The faunas are marked by the continued predominance of Ethiopian forms and the arrival of some Eurasian taxa at different times through the Pleistocene. Taxa of Eurasian origins are marginal in spite of the geographical proximity between the Maghreb and Europe. However, they are considered as good biostratigraphic markers for the subdivision of the Maghrebian Quaternary.

BIOSTRATINOMY APPLIED TO THE INTERPRETATION OF THE SCAVENGER ACTIVITY IN PALEOECOSYSTEMS

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There is not scientific guarantee that vertebrate remains preserved in archaeological and paleonthological sites can be a significant sample of the paleocommunity to which they belonged, or were part of human consumption. Also, we do not know the qualitative and quantitative consequences of pre-depositional processes of trophic activity of human population and of any other scavengers. As a result, we performed a biostratinomic study of the carcass association scattered throughout Doñana Biological Reserve (DBR) to know if there are general patterns that can be applied to the taphonomic study of archaeological sites.

It has been designed a general methodology of study -inferred from the biostratinomic study of macromammals inhabiting in Doñana Biological Reserve (DBR) (Huelva, SW Spain)- which allows to compare pre-depositional characteristics of any anthropological or natural tanathocenosis and taphocenosis. We have observed the accumulation per surface unit and the individual conservation in order to characterize bone deposits and to quantify the loss or gain of biological information from it.

Doñana Biological Reserve has four well-differentiated ecosystems: schrublands (the so-named *Monte*), sand dunes, marshlands and the so-called *Vera* (this is the ecotone between marshlands and shrublands, where the highest faunistic and floristic richness is found). There are 208 bird species, 32 of mammals, 22 of reptiles, 10 of amphibia, and 8 of fish in Doñana, but, in the studied tanathocenosis between 1989 and 1991:

- Only 13 vertebrate species have been found (5% of Doñana species). Then, the terrestrial vertebrate community from DBR is not represented in the tanathocenosis.

- Mammal community is best represented by species with weight greater or equal to 1 kg. Specifically, 6 species of ungulate are present (all with more than 50 kg), 2 carnivorous and 1 lagomorph (European rabbit, with less than 3 kg). All these remains represent a 29% of mammal community in Doñana, while birds and reptiles are represented by 1% and 9% respectively. We did not find remains of small mammals with the methodology of direct observation for sampling.

- The Doñana tanathocenosis is similar to that observed by Behrensmeyer and Boaz (1980) in Amboseli National Park (Kenia). But, with the differences observed between these two natural reserves, we could identify a greater or lesser intensity of the activity of scavengers and carnivores that were part of the community (permanently or seasonally, E.g. scavenging birds). In both ecosystems, Doñana and Amboseli, carcass accumulation follows similar patterns:

a) All the species whose individuals have more than 50 kg are represented in the tanathocenosis.

b) Seasonality and occasionality of some behavioural events (such as ungulate rutting -*ronca* and *berrea*- in red deers and fallow deers), epizootics events (plague during 1988 in wild boars) and climatic events (flooding, sand dunes movements, drought), cause a higher mortality rate in mammal populations (which is registered in the frequency of carcasses and bone remains). E.g. in *Vera* and *Monte* we found 59 carcasses (45.8% from total) and the maximum accumulation of the year (1988-1989) was in November (27 carcasses). 21 of these carcasses were of recently dead animals.

c) The age structure of the mammal community is not represented in the tanathocenosis: young individuals remains appear in low frequency. The higher frequency observed of located young carcasses is in ungulates between October and November, disappearing from the surface in a few months.

d) The distribution of carcasses in the different biotopes is an indicator of habitat preference by species and the abundance of carnivores and scavengers in the area (16 individuals/km^2 in *Vera*; 5.5 individuals/km^2 in *Monte*; 8.3 individuals/km^2 in marshlands and 16.7 individuals/km^2 in sand dunes).

e) Carcasses density was 10.8 vertebrate individuals/km^2 (the total number of carcasses was 150), with weights range between 80 g to more than 400 Kg. The 95% of this sample were ungulates (9.5 cadavers/km^2).

f) In Doñana the majority of ungulate carcasses were found under cork oaks of *Monte* and *Vera*, which were surrounded by patches of ferns and blackberries over 1 m. In Amboseli, the higher frequency of ungulate carcasses was found in marshlands, areas with vegetation cover less than 50 cm. We deduce that in Amboseli the most carcasses were predation products. In Doñana, however, the distribution of the carcasses response to disease deaths (animals in search of shelter and water).

g) We have confirmed that the aggregation index F= s^2/x (a ratio between variance and mean) of the carcasses of each biotope is higher than 1, which indicates that the probability of finding a carcass is greater where there is another. The largest number of red deer carcasses was found in leafy areas of *Monte* (the preferred habitat for this species). Cows, as well as fallow deers, wild boars, mongooses, foxes and rabbits, also select specific locations to die (all in biotopes of *Vera*).

All these results have shown that paleobiological interpretations need biostratinomical studies to interpret the past, and the present work has presented the analyses of an organic deposit in a determined natural ecosystem. It remains to be known the differences with other ecosystems located in different latitudes to define a general model to explain the formation of bone deposits.
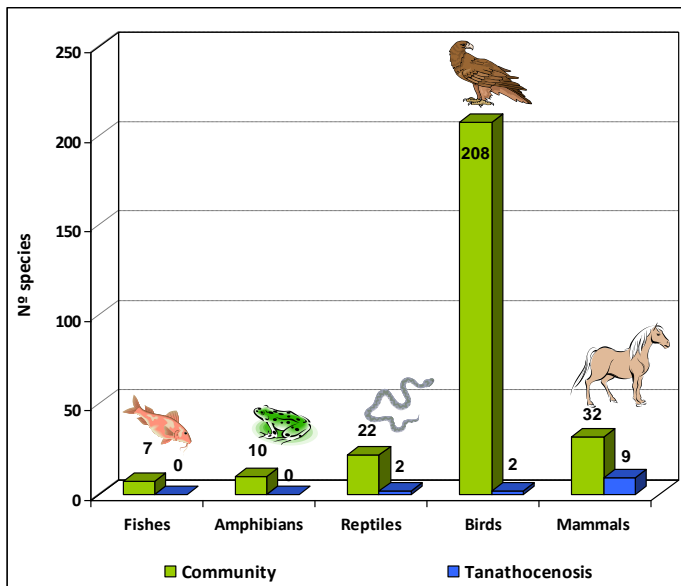
Figure 1: Number of species of the community and of the tanathocenosis in Doñana National Park.

THE GEOARCHAEOLOGICAL ALLUVIAL TERRACE SYSTEM IN TARAZONA: CHARACTERIZATION OF TRANSIT OF MODE 2 TO 3 DURING THE MIDDLE PLEISTOCENE IN THE GUADALQUIVIR RIVER VALLEY (SEVILLE, SPAIN).

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The aim of this article is to advance in the detailed knowledge of the Paleolithic sequence at the Guadalquivir river valley, through the study of the lithic assemblages obtained *in situ* in occasional locations and Tarazona III (TR III archaeological excavation from 2008 to 2009) in alluvial sediments of Tarazona terrace (T11, +35-45m.) from the Pleistocene Sequence of the Guadalquivir (PSG).

The PSG (Fig. 1a) shows lithic artefacts in abundance. The geochronological interpretation is
there are the first evidences correlated with the Middle and Late Cromerian and the extensive Acheulian, that in Iberian Peninsula would appear about the boundary Matuyama-Brunhes (780 ky), besides a technological innovation what supposes the appearance of the *levallois* technique correlated with the MIS 9-8. That means the boundary between the latest Lower Paleolithic and Middle Paleolithic in some geographical sites (for ex. the Somme valley, France), but in general developped during the Middle Paleolithic (MIS 7 to 5).

Geoarchaeological analysis of the PSG shows an existence of a system of alluvial terraces with 14 levels generated along the last 1,5 My. They have a lot of lithic assemblages, which are found frequently *in situ*, in fluvial contexts. The Palaeolithic technological culture of the PSG is formed by five big cultural episodes (Fig. 1a): 1º) indeterminated Lower Paleolithic (T5 and T6, +139-115 m.) with lithic artefacts of the type Mode 1 (?); 2º) the oldest Acheulian lithic assemblages in High Terraces (T7 to T9, +100-75 m.); 3º) Acheulian in Middle Terraces (T10 and T11, +50-35 m.); 4º) transitional Upper Acheulian (T12, +29 m., there are locations of U/Th samples, whose chronology is older before 80 ky), and 5º) Middle Paleolithic (Mode 3) (T13, +14 m. and others of correlative formations in connection with MIS 5).

The Tarazona (TR) formation is located at Seville. Is the most representative alluvial system of the middle terraces in Guadalquivir valley (T11, +35-45 m. of PSG) (Fig. 1a, 1b). In this site it is possible to find a high overlapping of alluvial deposits, with a great thickness (between 6 and more than 15 m.). In three locations (TR I, II and III) we see lithic artefacts distributed for one o more of his sedimentary deposits (Fig.1c).

In TR I, in the low level, there are series of 568 artefacts whose the most part of them are of quartzite, technological assimilable to the complex Acheulian (Mode 2). In TR II, the lithic assemblages (2601 pieces) of classic Middle Paleolithic of cave (Mode 3) are inside the top level, with a very significant importance of the flint materials (22 %). In the local stratigraphy of the TR III (archaeological excavation) more than 4000 pieces hare been collected along four of his stratigraphical levels, nowadays in study. However is possible to know that practically the 100 % of the industry has been elaborated in gravels stones of quartzite, little rounded, with a Middle Paleolithic classification. It is

probably that all stages of the operating chain are represented: cores, flakes and retouched flakes (scrappers, end scrappers, notches, denticulates, etc.). In summary these evidences suggest that in Tarazona terrace system is located the transit of Mode 2 to 3.
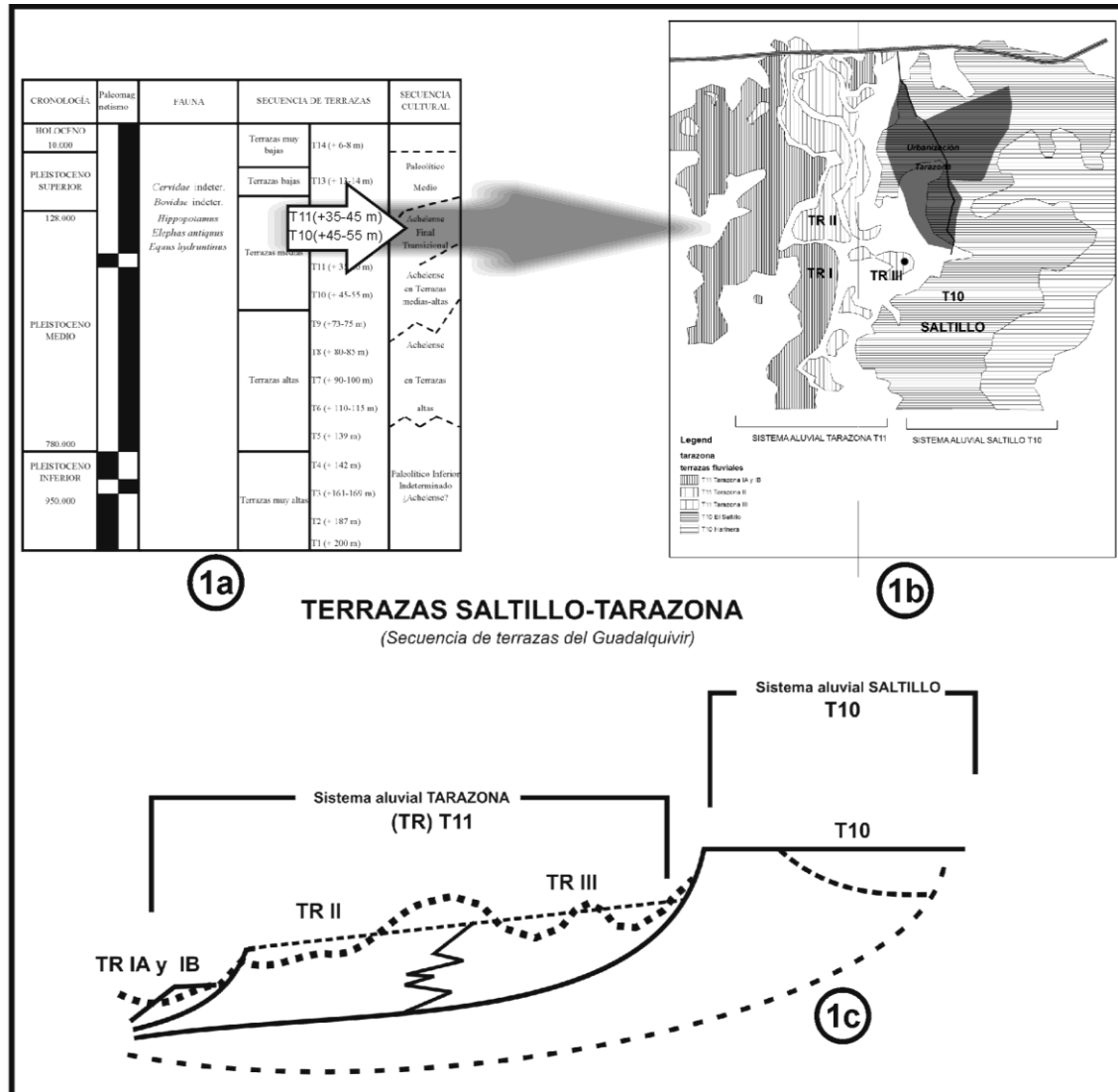
Fig. 1.

EARLY WEICHSELIAN GLACIATION IN THE SOUTH-EASTERN BALTIC

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The reliable stratigraphic correlation of sediments is one of the most important and complicated problems of Quaternary geology in the Lithuanian Maritime Region as well as in the whole South-eastern Baltic. The structure of Quaternary is presented by Pleistocene sediments formed during a few glaciations and interglacials; the uppermost part of Quaternary is composed by late-glacial and Holocene sediments formed during different stages of the Baltic Sea development. The stratigraphy of Pleistocene deposits in the South-eastern Baltic is one of the unsolved questions.

A number of the infrared optically stimulated luminescence (IR-OSL) dating of the inter-till sandy sediments were done during the engineering-geological mapping of the Klaipėda Strait dislocated between the Curonian Spit and continental coast of the Lithuania, i.e. strait links the Curonian Lagoon and the Baltic Sea. Absolute majority of the IR-OSL ages of investigated inter-till sediments fall within the age range of MIS 5d–5a, i.e. in the four dated borehole sections the ages fall into the relatively narrow time span: from 76.5 ± 4.9 to 114.1 ± 7.3 kyr. The sampled inter-till sediments are occurring not *in situ*: they are lying in the glaciodislocations (as blocks, rafts) in the till beds. According to general geological setting of investigated region and mentioned results of IR-OSL dating, the till with incorporated inter-till sediments have been formed by ice advance during the Weichselian early pleniglacial maximum (MIS 4). This conclusion not support the former standpoint that the till beds beneath the bottom of the Klaipėda Strait was formed during the Warthanian (Medininkai, MIS 6) glaciation.

QUATERNARY LARGE MAMMAL FAUNAS OF SOUTH SIBERIA:
ADAPTATIONSAND PALEOECOLOGICAL RECONSTRUCTIONS

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The vast territory of Siberian sub-continent, especially its southern regions, had played an important role in formation, development and migration of many genera and species of the most important groups of large mammals in Late Cenozoic. The history of Quaternary teriofauna of Southern Siberia was most completely reconstructed (from Early Pleistocene to Holocene) on the basis of numerous paleontological materials from the two largest stratoregions of Kuznetsk Basin (vast intermountain depression at the South-East of Western Siberia with largest coalmining pits) and North-Minusinsk Basin (located in South-Central Siberia, left bank of Yenisei river, Kurtak archaeological district) (Foronova, 1990, 1998, 1999, 2001). Analysis of the rich material belonging to orders of Carnivora, Proboscidea, Perissodactyla, and Artiodactyla allowed us to trace evolutionary changes in these groups and distinguish several stages of fauna development. They correspond to the time of existence of faunal complexes and faunas of Eastern and Western Europe. These stages are the ground for biostratigraphical division of sediments of the region not only to Lower, Middle, and Upper Pleistocene, but to more detailed subdivisions.

Paleozoological analysis of the faunas showed that the main role was played by the forms typical for Quaternary faunal assemblages of European-Siberian province. Significance of Central-Asian elements was much lower. Nevertheless, they are recorded with a certain periodicity beginning from the second half of Early Pleistocene and imply several climatic changes (during the Quaternary) in the direction of aridization and predominance of open spaces. Generally there are faunas of open spaces that have been formed on the Southern Siberia during the Quaternary.

In terms of number of species and fossil remains the most representative are Elephantidae, Equidae, and Bovidae. They were studied applying both traditional and innovative methods for statistical analysis of morphometrical (morphofunctional) features of dental system and distal parts of limbs. These methods permitted to obtain new information on systematics and phylogeny of these groups as well as to reveal some ecological (trophic and locomotorial) adaptations. The latter fact makes possible a wider usage of these group in biostratigraphy and paleoecological reconstructions. History of mammoth lineage development — from ancient representatives of *Archidiskodon* to the latest *Mammuthus* — was reconstructed for the South of Siberia. Original method (Foronova, Zudin, 1999, Foronova, 2001) permitted to create a multidimensional model for lineage structure that illustrates discreteness of the macro- and micro-evolutional processes and significant variability of the group. In addition to the already known, new taxa were distinguished, for example, a range of intermediate forms between *Mammuthus trogontherii* и. *Mammuthus primigenius* s.l. It was found that tendencies of group development in this region (as well as in entire Eurasia) were determined by adaptations to periodic changes of periglacial and interglacial environments. In the case of Equidae, it has been determined that from the beginning of the Early Pleistocene Southern Siberia was inhabited by different subgenera (*Plesippus, Equus* and *Hemionus*) whose evolutionary changes were the result of adaptation to

different landscape and climate conditions. Generally, caballine forms (subgenus *Equus*) were predominant in Pleistocene. Quantitative ratio of robust caballine equids that inhabited relatively humid stations and more gracile forms (representatives of other ecological groups) varied in different epochs of Pleistocene (Foronova, 1990, 2001). During Late Pleistocene there were significantly small forms generally retaining morphological features and proportions of ancestors. Two sub-genera of genus *Equus* (*Equus* and *Hemionus*) existed within the fauna of Late Pleistocene in South-Western and South-Central Siberia (Foronova, 2006). Still, difference of some natural and climatic parameters (temperature and humidity regimes, relief, vegetation) could have conditioned various quantity proportions of equids and hemiones in faunas of the two regions. Detailed morphological study of metapodials of hemiones of South-Central Siberia showed two forms of this species have existed on the territory under study. China, Mongolia, Turkmenistan and Kazakhstan were the closest regions from which hemiones could have been spreading to steppe zone of Southern Siberia during arid epochs of Late Pleistocene and Holocene.

Specific adaptations in elephant lineage and periodical regroupings of Equidae were used for more fractional division of embedding sediments. They also gave grounds to provisionally envisage periglacial and interglacial faunas, synchronous to climato-stratigraphic horizons of regional and global stratigraphical scales.

"Cold elements" in the faunas of Southern Siberia occur from the beginning of Pleistocene. Presence of Ovibovini and first large Bovini indet. in the deposits this time imply arid environment, probably, periglacial forest-steppe. In general, fauna of the beginning and all Early Pleistocene is evident of global changes in environmental conditions of this time towards continental climate, significant cooling and predominance of open spaces. In Southern Siberia faunas, analogous to Early Cromerian, contained very large *Panthera* sp., *Mammuthus trogontherii*, *Equus* aff. *simionescui, Bos* sp., *Bison* ex gr. *priscus*. Occurrence of Central-Asian elements (*Equus* aff. *sanmeniensis* и *Coelodonta* cf. *tologoijensis*) implies xerophytisation of landscapes. Later here become predominant *Mammuthus trogontherii*, *Equus mosbachensis, Bison* aff. *priscus*, psychrophile animals also appear: *Gulo* cf. *schlosseri* and *Rangifer* sp. Periglacial faunas of Middle and especially Late Pleistocene comprised: *Canis lupus, Ursus* cf. *arctos, Panthera spelaea, Coelodonta antiquitatis, Bison priscus, Alces alces, Rangifer tarandus, Ovibos* sp.*, Saiga* cf. *borealis*, which were part of biotic community of periglacial steppes, forest-steppes, forest-tundra and probable tundra. Relatively thin-enamel representatives of genus *Mammuthus* and gracile horses, adopted to walking on firm soil *Equus* aff. *taubachensis, Equus przewalskii, Equus hemionus* were predominant in this faunas. The most advanced extremely thin-enamelled *Mammuthus primigenius* were typical of Late Pleistocene. Ecology, as well as morphofunctional features of such forms as musk-ox, saiga and koulan allow to propose low snow cover of periglacial tuntra-steppes.

Interglagial faunas are, in general, worse studied, than the fauna of cold epochs, and as for Siberia, they have not been described until recently. It has been found that the faunas of Southern Siberian were not typically of forest type. Due to continental type of Siberian climate and specific zonality of vegetation, these were the faunas of open landscapes. They retained the features of steppe and forest-steppe communities (which make them very hard to distinguish), but differ from periglacial faunas by absence of arctic elements and abundance of forms, connected to humid biotopes: predominant are broad-legged caballine horses and various deers. It's also important to emphasize, that *Dicerorhins mercki* and recently found *Palaeoloxodon* cf. *namadicus* (Foronova, 2008) are good indicators of relatively "warm" interglacial faunas of the end of the Middle and

the beginning of Late Pleistocene. Rare finds of these animals in Siberia, probably, imply their seasonal intrusions into the territory. Interglacial faunas of Middle Pleistocene include: *Ursus rossicus, Ursus* cf. *arctos, Panthera spelaea,* wide-fingered *Equus* ex gr. *mosbachensis-germanicus, Dicerorhinus mercki, Bison priscus*, deers - *Cervus elaphus, Megaloceros giganteus* and *Alces* cf. *alces*, and also relatively tick-enameled *Mammuthus* aff. *chosaricus*, one of transitional forms from *Mammuthus trogontherii* to true *Mammuthus primigenius*. The fauna characterictic to Late Plesitocene comprises*: Canis lupus, Vulpes vulpes, Ursus* cf. *arctos, Crocuta spelaea, Panthera spelaea, Mammuthus primigenius, Equus gallicus, Equus* sp.*, Coelodonta antiquitatis, Cervus elaphus, Megaloceros giganteus, Alces alces, Rangifer tarandus, Bison priscus, Saiga* cf. *borealis.*

PHYLOGENETIC HISTORY AND BIOGEOGRAPHIC ASPECTS OF FOSSIL AND EXTANT TERRICOLA (MAMMALIA, RODENTIA) OF SOUTHERN ITALY: A CASE STUDY

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Voles of the *Microtus* (*Terricola*) subgenus underwent significant evolution during the Middle-Late Pleistocene and, nowadays, many species of this group are distributed uniquely in the European peri-Mediterranean regions. The Savi vole, *Microtus* (*Terricola*) *savii* (de Sélys Longchamps, 1838), is a characteristic species of the Italian peninsula and of Sicily and has been object of several studies in the last years. This vole is potentially a very interesting study case for investigating the effects of climatic changes on the evolution and dispersals of what is nowadays a typical element of the southern Mediterranean fauna.

Microtus (Terricola) savii is the only living arvicolid in Sicily and its systematic is strongly questioned from both molecular and morphological point of views.

The present work gives a contribution to better understand the phylogenetic history of thistaxon during the interval late Middle Pleistocene – Holocene in the attempt to reconstruct therelationships between insular and continental populations and to clarify somepaleobiogeographical aspects. The presence of this species in Sicily is attested by several fossil findings dating to Holocene (Grotta dell'Uzzo, Grotta di Cala Mancina, Riparo Castello), Late Pleistocene (Grotta d'Oriente, San Teodoro, K22, Contrada Pianetti) and Middle/Late Pleistocene (Grotta d'Isolidda 3).

In order to highlight the micro-evolutionary differences among *M.* (*T.*) *savii* and similar species, the analysis focused on the comparison of fossil and extant Central-Southern Italian and European populations. The extant Italian samples are referred to: *M.* (*T.*) *savii* (Tuscany), *M.* (*T.*) *savii nebrodensis* (Sicily) and *M.* (*T.*) *brachycercus* from Calabria. All the fossil Southern Italian populations are attributed to *M.* (*T.*) ex gr. *savii.* The extant European samples belong to M. (*T.*) *subterraneus* (France) and *M.* (*T.*) *lusitanicus* (Spain). Considering the peculiar paleogeographic situation between Sicily and the Maltese archipelago, the comparison has been extended including the Maltese fossil vole, *M.* (*T.*) *melitensis*. For the same purpose the Savi vole from Favignana Island has been considered. All the samples from Sicily and the Italian peninsula have a "simplex" third upper molar.

The morphometrical data has been acquired by measurements of the first lower molar (the tooth showing the greatest morphological variability) and have been analysed by means of bivariate scatter diagrams, Principal Components Analysis and Cluster Analysis (carried out with the PAST software).

The analysis pointed out that fossil Sicilian samples have a greater size variation than extant ones and include several populations that reached the largest size among the considered samples. The wide size variation could be related to local environmental conditions – like humidity rate that could have affected vole populations - and/or to the strong isolation. Furthermore, two different morphological groups have been identified and named: a "subterraneomorpha" group (characterized by tighter symmetric anterior

cap and longer anteroconid, similar to European *M.* (*T.*) *subterraneus* forms) and a "savimorpha" one (more confluent and asymmetric anterior cap and shorter anteroconid, occasionally with the accentuation of morphological characters of *M.* (*T.*) *savii*). It is interesting to note that among the living populations the samples from Tuscany and that from Calabria are definitely more subterraneomorph than the other Italian peninsular and insular populations.

Among fossils, the older populations from Grotta Isolidda 3, Grotta Grande di Scario (Cilento Peninsula, Campania) and Grotta del Cavallo (Salento Peninsula, Apulia, unpublished) are the most relevant. The first one, that can be assigned to the end of Middle Pleistocene or the beginning of the Late Pleistocene, represents at the moment the oldest Terricola find in Sicily and it shows many similarities with pre-and post-Tyrrhenian populations from Scario and the "subterraneomorpha" group, standing aside the other, more recent, Sicilian samples. The Grotta del Cavallo sample presents a great variability among different layers and the most ancient populations (layer N) show unique features, with the accentuation of savimorpha characters that can be ascribed to the isolation of this population (likely due to its very peripherical geographical position) or to particular palaeo-climatic conditions. The morphological similarity among Last Glacial Sicilian populations and the Late Glacial Grotta della Serratura one is also remarkable (fig.1).

The results, in particular the differences between Pleistocene and Holocene Sicilian populations and their similarities with the mainland ones, suggest that the Savi vole dispersed at least twice in Sicily. A first colonization probably took place during the cold stage MIS6 or MIS4 (recorded at Grotta Isolidda 3) with dispersal events made possible by the sea level drop and the connection with the mainland, and a second one (documented at San Teodoro and younger sites) during MIS3 (by accidental transit or limited faunal exchanges) or MIS2 (by land bridge dispersal events).
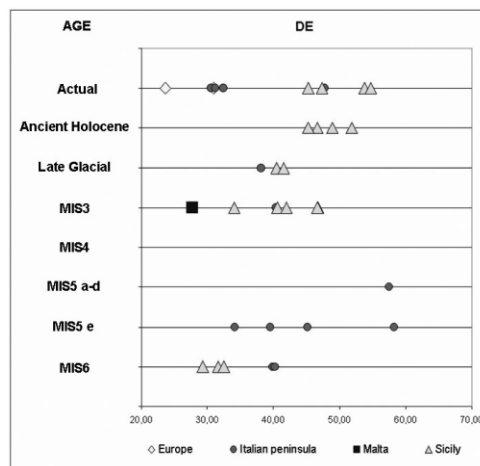
Fig.1 DE index Vs Time. Ordinate represents time slices.

This investigation shows a tendency in the savi vole to develop "savimorph-lusitanicus" morphology along north-south morphoclines, confirming what observed by other authors, and how these morphologies are acquired in time as evolutionary differentiations. Rather surprising is the evidence of a strict parallelisms among Eemian populations from southern Apulia and modern Sicilian populations, suggesting that the savimorph morphology is somewhat linked to adaptations to interglacial Mediterranean landscapes.

BIOSTRATIGRAPHIC IMPORTANCE OF THE EARLY PLEISTOCENE FAUNA OF ŻABIA CAVE (POLAND) IN CENTRAL EUROPE

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The Żabia Cave, developed in Upper Jurassic limestones of Oxfordian age, is located in the north-eastern slope of Mt. Sulmów, a fragment of the Częstochowa Upland, southern Poland. It is a system of large karst wells divided by bridges of calcite and limestone lumps, with deposits overlaying them and filling corridors and fissures. The discovery of bone remains triggered intense excavations. Since 1980 deposits of the Żabia Cave have been systematically explored. Twenty one layers were distinguished, most of them bone-bearing. Strata 1-15 were distinguished in well III while strata 13-21 were distinguished in the corridor connecting wells II and III, and in well II. Geological studies on the deposits of the cave show that they were formed in several sedimentation cycles in the early Pleistocene. Layers 1-4 formed in conditions of a warm Mediterranean climate with dry and humid periods. The deposition was interrupted by waters flowing through the cave which, eroding the earlier deposits, at the same time produced deposits of layer 5 (climatic cycle II). It is not excluded that the cycle was a cool episode (?periglacial). The next climatic cycle corresponds to layers 6 and 7, and it was a period of warming and drying of the climate. A slight cooling is indicated by deposits of the fourth cycle (layers 7a, 8 and 9), then the climate warmed and was of a temperate character, with clearly marked warm and dry, as well as cold and humid periods (layer 10). Layer 1-10 did not contained vertebrate remains. The period between cycles IV and V was probably one of intensified erosion associated with cooling and increased humidity of the climate (cycle V). The cave was filled with mud deposits with limestone blocks (strata 11-12). The water in the cave stagnated probably during a longer period, which is indicated by the silty deposits (layer 13). Deposits of layers 14 and 15 and probably 16, separated by an erosion gap, testify to another period of cooling and increased humidity (cycleVI). Cycle VII included layers 17-19. They were deposited in conditions of a warmer climate with short-lasting changes in environmental conditions. Probably another period of cooling (cycle VIII) is documented by the laminated deposits of grey clays (layer 20) and probably grey limestone loams (layer 21). The animal remains include slugs, amphibians (4 species), reptiles (10 species), few birds (2 taxa), and mammals (48 taxa): insectivores (13 taxa), bats (2 species), lagomorphs (4 taxa), rodents (17 species), carnivores (7 taxa), equids (1 species), cervids (3 species) and bovids (1 taxon). Amphibian and reptile remains include extinct species, species now occurring in Central Europe and species close to recent taxa found in the Mediterranean region, e.g. a slow worm (*Ophiosaurus pannonicus*). The presence of an extinct amphibian close to the olm (*Mioproteus wezei*) is noteworthy. Its occurrence may indirectly suggest that in the past the cave system was more extensive than the one known today. Besides, a newt (*Triturus* cf. *vulgaris*), toads (*Bufo bufo*, *B. viridis)* and frogs (*Rana*) were found among the amphibians. Besides *Ophisaurus pannonicus*, another two lizards were found (*Anguis fragilis* and

Lacerta sp.) and at least five snake species (*Elaphe longissima, Coronella austriaca, Natrix natrix, Natrix* cf. *tessellata, Vipera berus*). Most of the described remains of amphibians and reptiles were forms of temperate climate, living near water bodies or associated with aquatic habitats. Among insectivores (at least 13 taxa) abundant mole remains (*Talpa minor* and *Talpa fossilis*) and an extinct shrew (*Beremendia fissidens*) are noteworthy. Besides, the hedgehog (*Erinaceus* sp.), white-toothed shrew (*Crocidura* cf. *kornfeldi*) and several shrews: the extant *Sorex minutus* as well as *S. runtonensis, Sorex* sp. nov., *S. (Drepanosorex) praearaneus, Neomys newtoni, Petenyia hungarica, Asoriculus gibberodon* and *Paenelimnoecus pannonicus* were found. Lagomorphs, mainly associated with open areas, are represented by two species of early pikas (*Ochotona polonica* and a new species *Ochotona zabiensis*) and a hare *Hypolagus brachygnathus*. Rodent remains are the most numerous (17 species). Forest-dwelling forms and species from the boundary of forests and open areas include squirrels (*Sciurus* sp.), a bank vole *Clethrionomys* cf. *hintonianus*, a mouse *Apodemus dominans*, dormice (*Glirilus pusillus, Glis sackdillingensis, Muscardinus avellanarius*) and the northern birch mouse *Sicista* cf. *praeoloriger*. Taxa associated with steppe areas are hamsters (*Allocricetus bursae, A. ehiki, Cricetus runtonensis*) an extinct steppe lemming *Prolagurus ternopolitanus*, a cold-loving lemming *Lemmus* cf. *kowalskii* and a primitive vole *Microtus (Allophaiomys) deucalion*. Besides them, the fauna comprises several rooted voles: *Mimomys pusillus, M. savini, M. pitymyoides* (only one tooth), *Pliomys episcopalis* and *Ungaromys nanus*. Larger carnivores are represented by an unidentified bear *Ursus* sp. and a canid *Canis* sp. Another canid is a primitive fox *Vulpes praeglacialis*. Mustelids constitute the most numerous group. Remains of the oldest wolverine *Gulo schlosseri* are dominant. Besides, the ancestor of the present-day pine marten (*Martes vetus*) a primitive ermine *Mustela palerminea*, an early weasel *Mustela praenivalis*, a large weasel *Mustela strandi* a polecat-resembling form *Mustela stromeri*, a primitive badger *Meles atavus* and an otter *Lutra simpliceidens* were found. The occurrence of the Pallas's cat *Otocolobus* cf. *manul* is noteworthy. All these forms are characteristic for the early and middle Pleistocene; they appeared in Europe with immigration waves from Asia and were able to live in a cooler climate. They are mainly eurytopic forms occupying a variety of habitats, though some could prefer different habitats. Some species, especially most of the mustelids, could, like recent forms, inhabit forest edges, seeking shelter in the forest and foraging in open areas. The cervids include three taxa. The primitive fallow deer *Dama vallonetensis* is a representative of European Villafranchian faunas and like other early fallow deers, was adapted to life in dry, open areas. The elk *Cervalces carnutorum* represents a group of cervids new for Europe and able to live in a cold climate; they immigrated from Asia after disappearance of the Akchagil reservoir. The cervid remains from the Żabia Cave indicate a mosaic environment with forests, open areas and wetlands. The Żabia Cave is one of the few localities in Poland with early Pleistocene faunal remains. It was a very important period in the evolution of the faunas in Eurasia. At that time the structure of faunal assemblages changed considerably. As a result of consecutive waves of cooling of the Pretegelen and Eburon, a zone of boreal coniferous and mixed forests and steppe areas came into existence in Europe; in the north of the continent Arctic tundra and steppe-tundra appeared and numerous cold-loving, boreal species with it. The locality provides evidence for these processes. Besides forms known from the Pliocene, new components characteristic for cold Pleistocene periods appear. The results of geological and faunistic studies seem to indicate an early Pleistocene age of layers of cycles III-VIII (layers 6-21), the end period of the „Otwock cooling" and the „Celestynów interglacial", corresponding to the end of Eburonian and the first part of Waalian in western European stratigraphy.

DIATOMS FROM THE BAZA BASIN (SE SPAIN)

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Different outcrops with diatoms have been identified for fist time in the late Neogene Baza Basin. Two of the outcrops located in the NE margin of the Basin present a diatom flora dominated by *Epithemia adnata – Epithemia turgida*., a littoral epiphytic on aquatic plants. This diatom assemblages typical from a fresh to slightly brackish water in a shallow and alkaline lake.

Those lake deposits are interstratified between alluvial deposits and represent permanent lakes with a low bathymetric coefficient developed during two wet periods of time. The oldest of these lake events is dated by fauna as late Miocene (Turolian), the young lake episode is dated by paleomagnetism and mammals between approximately 2.5my and 1.85my.

In addition to these marginal deposits, other outcrops with diatoms have been identified in more central areas of the Basin.

One those is located near the town of Galera at the top of lake deposits rich in gypsum developed in a saline mud flat environment, these diatoms presents a fresh to slight-saline diatoms association (*Epithemia adnata – Epithemia turgida –Cyclotella socialis – Fragilaria*).

New outcrops located in more central area of the basin (near the town of Castillejar), presents species (*Navicula digitoradiata – Surirella* spp. *aff. ovata* & varietie *pinnata*) which indicate more saline waters.

The distribution of the diatom flora in the Baza basin agrees with stratigraphic data which indicates an increase of evaporitic facies towards the center of the basin and the occurrence of different kinds of lakes within the basin.

MAIN BIOCLIMATIC SIGNALS OF LATE PLIOCENE AND EARLY PLEISTOCENE IBERIAN BIRDS

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The Iberian peninsula is the territory whose Early Pleistocene avifaunas are probably the best known. However, its Pliocene record is not apparently so rich and, in consequence, the acquaintance with those birds is fairly lower so far.

Late Pliocene
More than 20 species are recorded in Higueruelas (Alcolea de Calatrava, Ciudad Real province, Villanyian, MN 16), a locality formed in a volcanic region with important bodies of water by that time. The aquatic birds constitute the largest ecological group: *Podiceps auritus*, *P. nigricollis*, *Cygnus cygnus*, *Anser* sp., *Tadorna* sp.*, Marmaronetta angustirostris*, *Aythya* sp., *A. marila, Mergus albellus* and *Oxyura leucocephala*. Moreover, some other species connected with banks and shores have been found: *Ardea cinerea*, *Nycticorax nycticorax*, *Lymnocryptes minutus, Plegadis falcinellus* and *Actitis hypoleucos*. Some of the species recorded are currently very infrequent in Iberia, as the Mute Swan (*Cygnus cygnus*), the Scaup (*Aythya marila*) and the Smew (*Mergus albellus*). They breed in North Eurasia and some contingents move south to Anatolia and the Balkans in winter. Such displacements East-West of the migration routes around 3 million years ago were probably owing to a drop in the northern hemisphere temperatures.
The other bird-bearing localities allocated to the MN 16 biozone –Orrios III, Cerro de los Espejos, Escorihuela, Moreda and La Puebla de Almuradiel- are very poor and, therefore, of very limited value for learning of the corresponding avifaunas. Among them, only Morella provides a part of an overview of the inland spread out of *Tyto balearica*, the owl that occupied at least the westernmost Europe for this period.

Early Pleistocene
The most outstanding ecological feature inferred from the Early Pleistocene ornithocaenoses of Dolina and Elefante (Atapuerca complex) is the presence of a large humid area probably composed of lakes, marshes, a slow river, etc., just close to the karstic cavities. This area attracted a wide variety of water-connected wintering and migrant species for a long period lasting some hundred thousand years. The climatic conditions were somewhat colder and fairly moister.
A coherent bioclimatic signal is found south and east. At least, 10 out of 14 avian taxa from Huéscar 1 (Guadix-Baza basin, Granada province) correspond to anatids and one grebe. However, in contrast with the Atapuerca sites, its fossil assemblage lacks shorebirds. Apparently, Huéscar 1 outcrop also formed in an area where aquatic wintering species congregated. The avian assemblages of Quibas and Cueva Victoria (Murcia province) show that well-developed woodland biotopes were present in both regions, in particular, near or around Cueva Victoria.
In addition, the current partition of the Iberian peninsula between the two genera of partridges –*Perdix*: North Atlantic region, *Alectoris*: Mediterranean region-, is likewise clearly seen, with some differences, in the Early Pleistocene. *Perdix* is present in the Atapuerca complex, and *Alectoris*, meanwhile, in Quibas, Victoria and Huéscar 1. It seems that todaylike Mediterranean conditions did not occur in the Iberian peninsula yet, although some Mediterranean parameters were already established.

FIELTRIPS GUIDE

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INTRODUCTION TO THE PLEISTOCENE SITES OF BARRANCO LEÓN, FUENTE NUEVA 3 AND OTHER SITES FROM THE ORCE AREA (GUADIX BAZA BASIN, SPAIN).

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1-GEOLOGICAL FRAME
The Guadix-Baza Basin is located in the Betic Ranges (Southern Spain, see figure 1) and covers a large extension (approximately 3000 km^2). This basin is located in the contact area between the External Zones (mainly Mesozoic cover rocks) and the Internal Zones (Mainly Paleozoic basement rocks) of the ranges. This basin (see general sedimentary schemes by Fernández et al., 1996, Soria et al, 1998) was filled by marine sediments during part of the Tertiary. Several changes that took place by 8 Ma (Hüsing, work in progress) led to the continentalization of the basin.
The Plio-Pleistocene continental sediments of the basin display thick sections with abundant paleontological sites in well exposed outcrops with horizontal bedding and scarce tectonics. Such sediments can clearly be differentiated belonging to either a proximal or distal paleogeographic domain. The alluvial Guadix Formation (Viseras, 1991) and the lacustrine Baza Formation are the most extensive within the proximal and distal domains, respectively. The lacustrine environments also include the Gorafe-Huélago and Solana formations, restricted to the Guadix sub-basin (Vera, 1970). The location of the lacustrine environments (Viseras, 1991) was the result of changes in the drainage fluvial system (including an axial system and transverse systems). The stratigraphic study of the sedimentary formations (particularly in the north east of the basin, see figure 2) allows a high resolution physical frame for the Plio-Pleistocene faunal succesion (see Oms et al., 2000a, among others). Paleontological and archaeological sites are mainly located in shallow lacustrine facies of the Baza Fm, close to the basin margin. This is the case for Venta Micena, Barranco León, Fuente Nueva III and Cúllar Baza sites. In the lacustrine Solana Formation, the archeological and paleontological site of La Solana de Zamborino is also found. Apart from the basin fluvio-lacustrine fill, the karstic ranges bounding the Guadix-Baza depression host important Pliocene-to present day cave-fill sites (Moreda, Píñar, Cueva Horá etc.).

2-STRATIGRAPHY AND PALEOENVIRONMENT OF THE BARRANCO LEON AND FUENTE NUEVA PALEONTOLOGICAL-ARCHAEOLOGICAL SITES
The Lower Pleistocene paleontological-archaeological open air sites of Barranco León (Turq et al., 1996) and Fuente Nueva-3 (Turq et al., 1996; Martínez-Navarro et al, 1997) are located in the Orce area, NE Guadix-Baza Basin. In this area the lacustrine deposits of the Plio-Pleistocene Baza Formation (Vera, 1970) crop out extensively and are arranged in three members (Vera et al., 1985; Oms et al., 1998): Lower Member (lacustrine, calcareous deposits), Middle Member (alluvial, detrital deposits) and Upper Member (lacustrine, silty calcareous deposits). Figure 2 (up) provides a map of this areas and figure 3, most representative sections with significant sites.

The Upper Member in the Orce - Fuente Nueva area originated basically during the Lower Pleistocene as a result of a major expansion of the Baza lacustrine system. This age is based on the abundant mammal sites (Oms et al. 2000a) together with paleomagnetic data, which record deposition under reverse magnetic polarity(Oms et al. 2000b, among others). Lithologies are lacustrine carbonates and mudstones and clastics to the top (sands and gravels with abundant ostracods). In this member, abundant pedogenic features related to shallow lacustrine and palustrine environments that underwent episodic emersions are found. Salinity changes are also well recorded in these marginal lacustrine deposits by changes in the invertebrate fauna and the geochemistry of biogenic carbonates, mainly from ostracods (Anadón et al., 1986, 1987, 1994; Anadón and Julià, 1990, Gabàs and Anadón, 1998, Anadón and Gabàs 2009). During some episodes the salinity was very low due to freshwater inputs derived from the surrounding prominent reliefs of Mesozoic carbonates. The Upper Mb of the Baza Fm includes several paleontological levels such as Fuente Nueva 2 and 3, Barranco León, Venta Micena, Barranco de Los Conejos, Orce D, etc. Some of these sites, which also have yielded some lithic artifacts (Barranco León and Fuente Nueva 3) are located very close to the ancient lake margin.

The archaeological level at Barranco León (BL-5 Turq et al., 1996; Oms et al., 2000a, see figs 3 to 5) is 0.05 to 0.65 m thick. It is formed, to the base, by sandy gravels which have yielded lithic artifacts and mammal bones. The upper part is formed by grey sands. This level is included in a sequence of grey to yellow sands, mudstones and limestones. The gravels in BL-5 are mainly formed by angular pebbles to small cobbles of palustrine, intrabasinal limestones. Pebbles from Mesozoic rocks are rare. The invertebrate fauna of BL-5 indicates a fresh to oligosaline shallow lacustrine environment. This level is included in a shallow lacustrine sequence which also records some fluvial inputs, and local emersions. The recorded salinity ranges from fresh-oligosaline in the underlying levels to mesosaline in some overlying levels.

The Barranco León site is located in a larger section (see Figs 3 and 4) which provides an excellent record of the paleoenvironmental conditions in the lake margin. The lower unit (Middle, red detrital Mb of the Baza Fm) is formed mainly by alluvial deposits, 30-40 m thick, which consist of red to yellow carbonate lutites with interbedded sandstones and conglomerates, and minor gypsum. Lacustrine deposits, 25 to 30 m thick, mainly form the Upper, silty calcareous Mb of the Baza Fm. They include limestones, dolostones, lutites, sandstones and conglomerates. The Plio-Pleistocene marginal lacustrine deposits at Barranco León, contain rich limnic faunas, including the presence of foraminifers and molluscs of thalassic affinity, that record saline and freshwater environments (Anadón et al. 1987; Anadón and Gabàs, 2009). Stable isotope and trace element contents of ostracod valves from the Barranco León allowed reconstructing the geochemical record of environmental changes in this marginal area of the basin (Anadón and Gabás, 2009). The hydrochemical features recorded in the upper levels of Barranco León have been influenced by changes in water source, solute composition, and water level during the past. Three water types that underwent a complex mixing in the marginal area were deduced from the studied intervals: 1) waters of the main Baza lacustrine system that underwent large precipitation - evaporation changes, 2) dilute, meteoric water inputs (surface and shallow groundwaters), 3) saline groundwater inputs of meteoric origin that acquired their salinity by halite and gypsum dissolution. Concerning the paleolimnological record of Barranco León, four stages have been differentiated in Anadón and Gabàs (2009). Stage I records a lacustrine expansion phase from the Pleistocene inner saline-lake system (type 1 water) to the marginal, alluvial mud flat zones in the Orce–Venta Micena area (highstand episode). This is

recorded by the lower beds of the carbonate sequence. Stage II corresponds to an overall retraction of the lacustrine system leading to shallow ponds in the marginal areas that were probably fed by bicarbonate-rich springs (type 2 water) derived from the Mesozoic carbonate ranges. A major emersion event is recorded in the BL area by a top paleosoil. Stage III is characterized by wide ranges in the trace element data and isotopic composition of the ostracod valves, reflecting evaporation (concentration) and dilution episodes in a shallow, closed-lake environment. The transition from stage III to IV corresponds to a major hydrochemical change and significant lowering in the isotopic composition of the ostracod valves. Stage IV is characterized by a strong influence of isotopically dilute waters and a through-flowing open lake environment that accounts for the small variation in geochemical features of the ostracod calcite. This through-flowing open lacustrine system in the marginal area of the Baza Basin was fed by groundwater and streams and it was connected to a larger, inner closed saline lacustrine system. The BL 5 mammal site with lithic tools corresponds to a particular episode within this stage of the environmental evolution of this marginal zone of the Baza Basin.

The stratigraphic succession in the FN-3 site (see figures 2 down, 3 and 6) is formed by a basal limestone level which is overlain by calcareous mudstones with pedogenic features. The mudstones, 3.7 m thick, are overlain by limestone beds up to 1m thick. The basal limestone consists of nodular lithofacies, with abundant pedogenic features and pseudomicrokarst, and conglomerate lenses. All these features indicate a palustrine environment of deposition. The mudstone beds contain, apart of mammal bones and, in some levels lithic artifacts, an abundant invertebrate fauna, mostly ostracod valves and mollusc shells and opercula. The invertebrate fossils record some minor changes in water salinity from fresh water to oligosaline and low mesosaline, in a shallow lacustrine-palustrine environment (Anadón et al., 2003).

3-THE MICROMMAMMAL SUCCESSION OF THE GALERA ORCE-FUENTE NUEVA SECTOR

The rich microvertebrate record from the Guadix-Baza Basin has enabled the establishment of a detailed biozonation, primarily based on rodents (Agustí, 1986; Oms et al., 2000a; Agustí et al., 2007). Therefore, for the time-span covering the late Pliocene and the early Pleistocene, up to five biozones can be distinguished. The late Pliocene includes the biozone with *Kislangia gusii* (localities of Galera 2 and Zújar 14; Agustí et al., 1993 a and b) and the biozone with *Mimomys* cf. *reidi* (localities of Alquería, Galera 1H and Fuente Nueva 1).

The lowermost Pleistocene is represented by the biozone with *Tcharinomys oswaldoreigi*. It includes the sites of Barranco Conejos, Orce 2 and Orce D (Agustí, 1992; Agustí et al., 1993a).

Following this biozone, the early Pleistocene sequence continues with the biozone with *Allophaiomys ruffoi,* which includes the famous site of Venta Micena and other levels such as Cañada de Murcia 1, Fuente Nueva 2 and Orce 7 (Agustí et al., 1987 a and b). The second half of the early Pleistocene starts with the biozone with *Allophaiomys* aff. *lavocati*, which includes the sites of Barranco León 5 and Fuente Nueva 3, where the first evidences of human presence have been reported (Martínez-Navarro et al., 1997; Oms et al., 2000b; Toro et al., 2003). It includes also the site of Orce 3.

Following this biozone, the early Pleistocene ends with the levels included in the biozone with *Iberomys huescarensis*, which includes the sites of Huéscar 1, Puerto Lobo and Loma Quemada (Mazo et al., 1985; Agustí et al., 1987 c).

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FIGURES
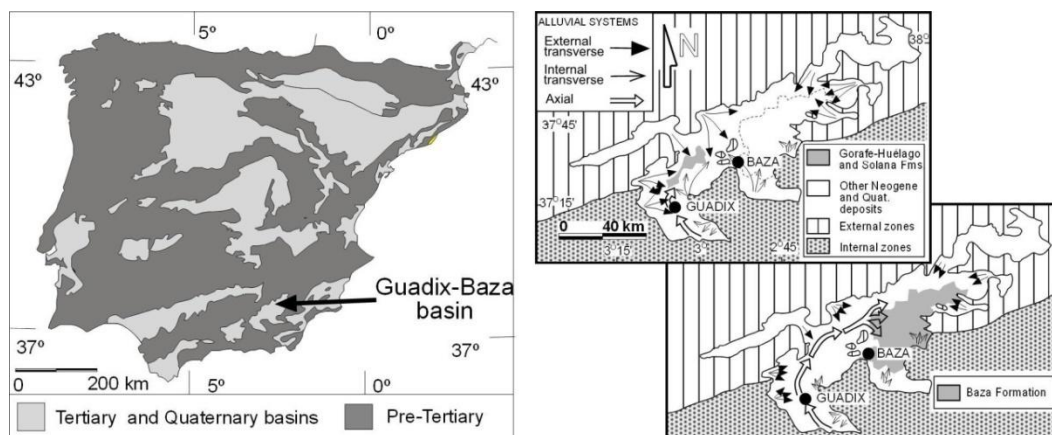
Figure 1. Left: the Guadix Baza Basin in the Context of Tertiary and Quaternary basins of the Iberian Peninsula. Right: extension of the lacustrine sedimentation (Gorafe-Huélago, Solana and Baza formations) according to the dominant alluvial system (after Viseras 1991).
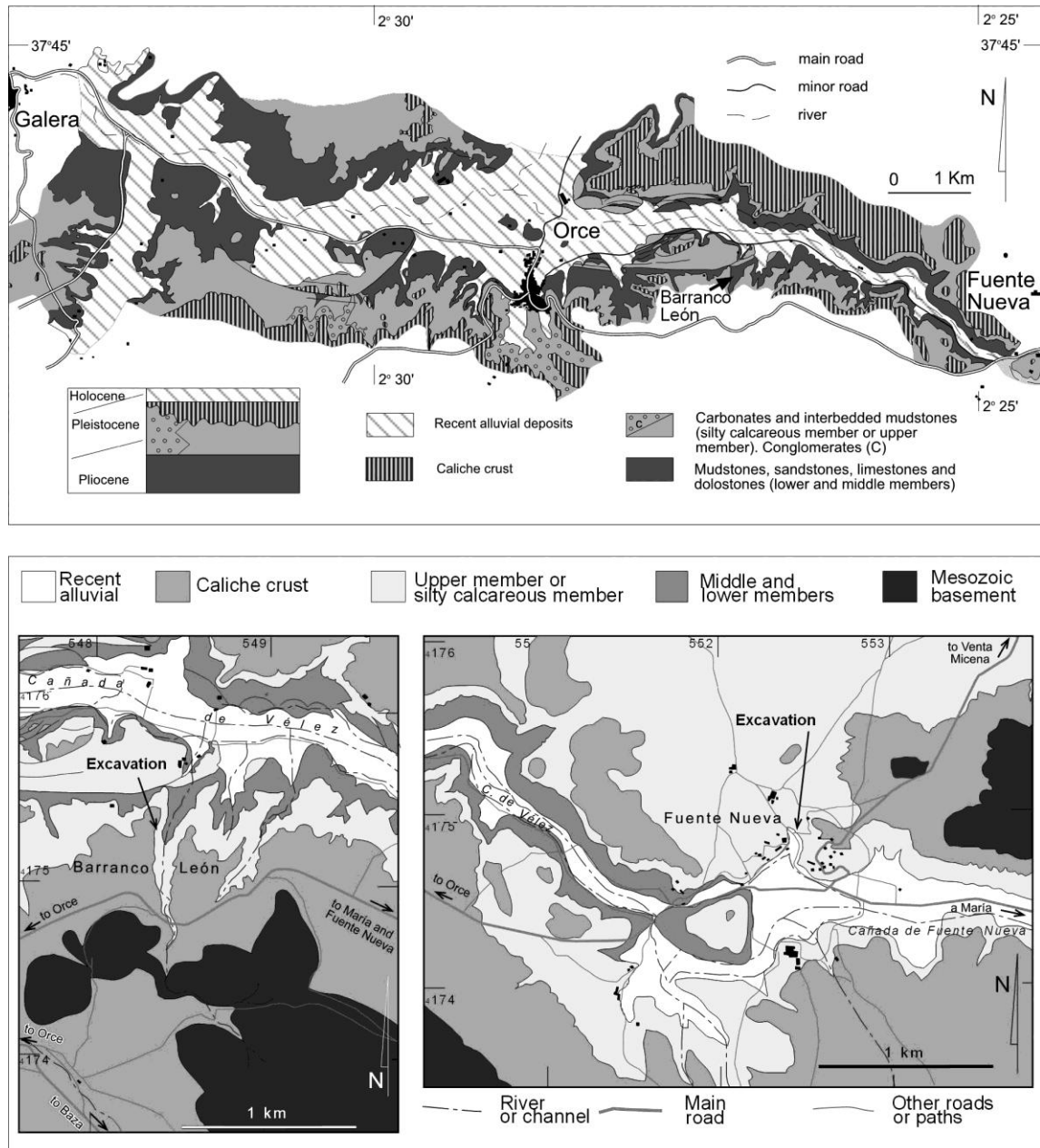
Figure 2. Up: Geological map of the Galera – Orce – Fuente Nueva sector (after Oms et al 2000a). Down: detailed geological location of the Barranco León and Fuente Nueva 3 sites (left and right, respectively).
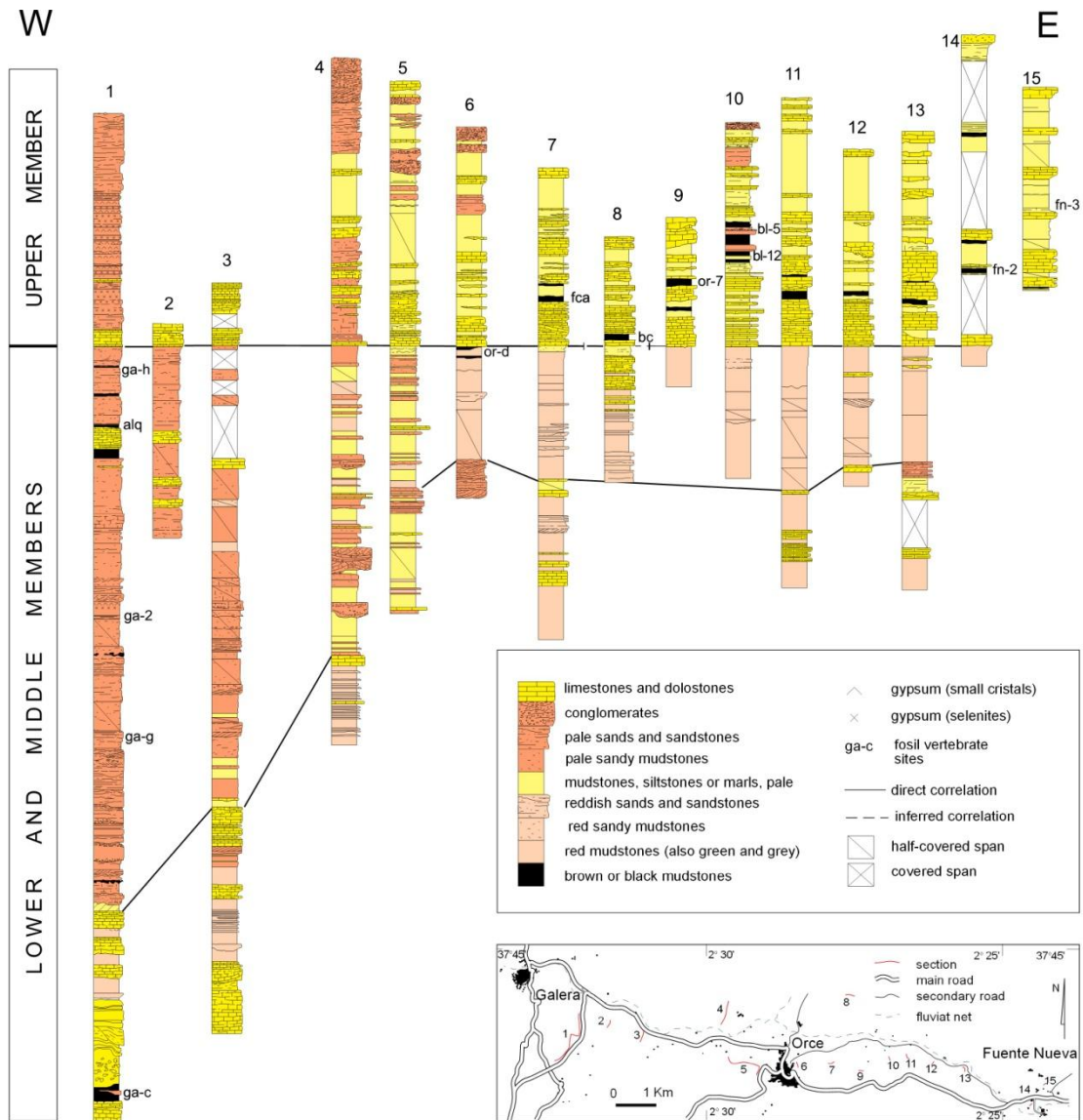
Figure 3. Selected stratigraphic section from the Galera – Orce – Fuente Nueva sector (adapted from Oms 1998, Oms et al., 1998 and Oms et al 2000a). Section 10 and 15 contain the Barranco León and Fuente Nueva 3 sites, respectively.
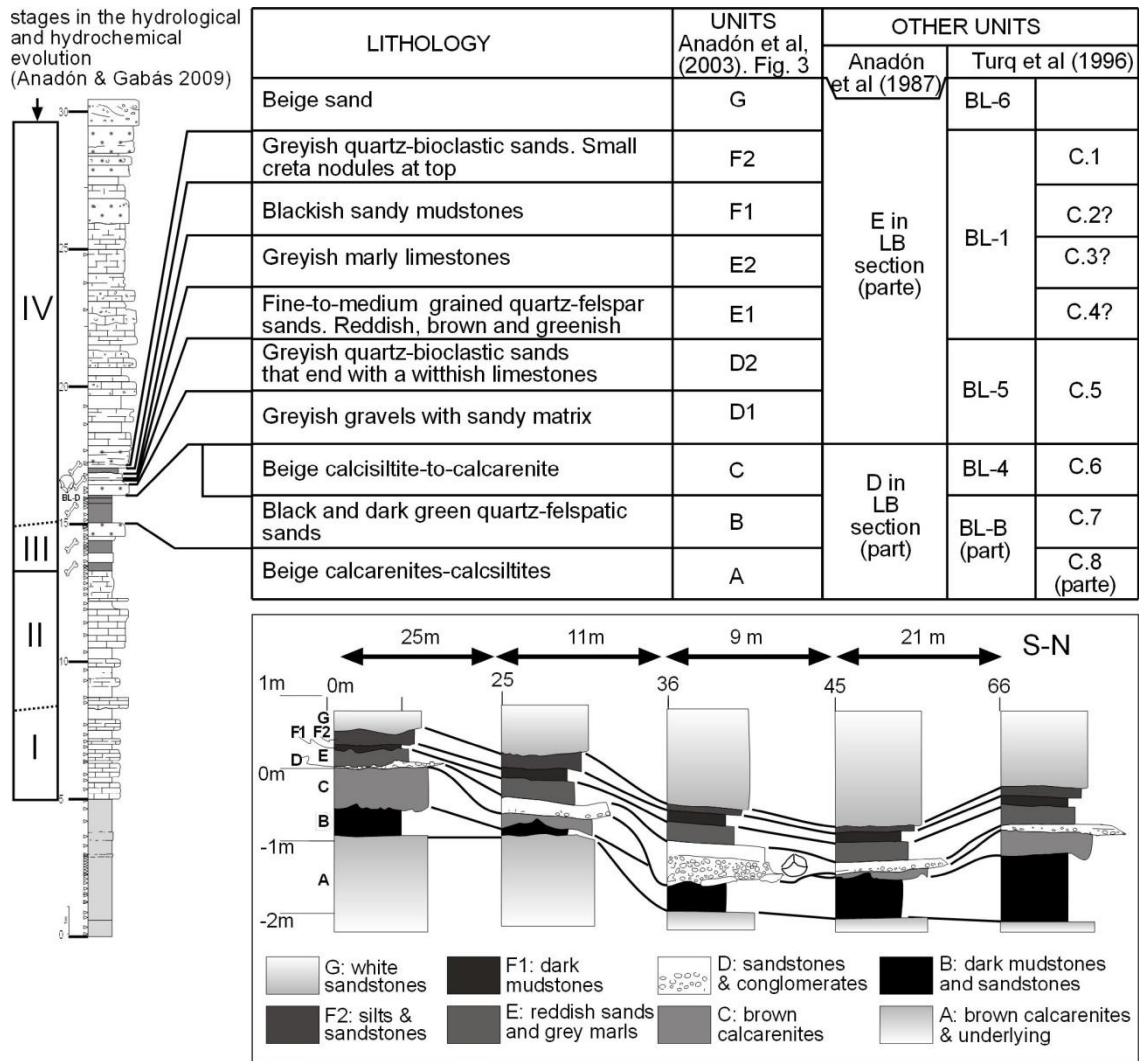
Figure 4. Vertical stratigraphy of the Barranco León section and site. From left to right: Stages in the hydrological hydrochemical evolution (Anadón and Gabàs, 2009), lithological section and nomenclature in several other works. The stages boundaries by Anadón and Gabàs (2009) are in solid (exact) or dashed lines (approximate), since these units are projected from a section studied some 100 meters to the south of the site.
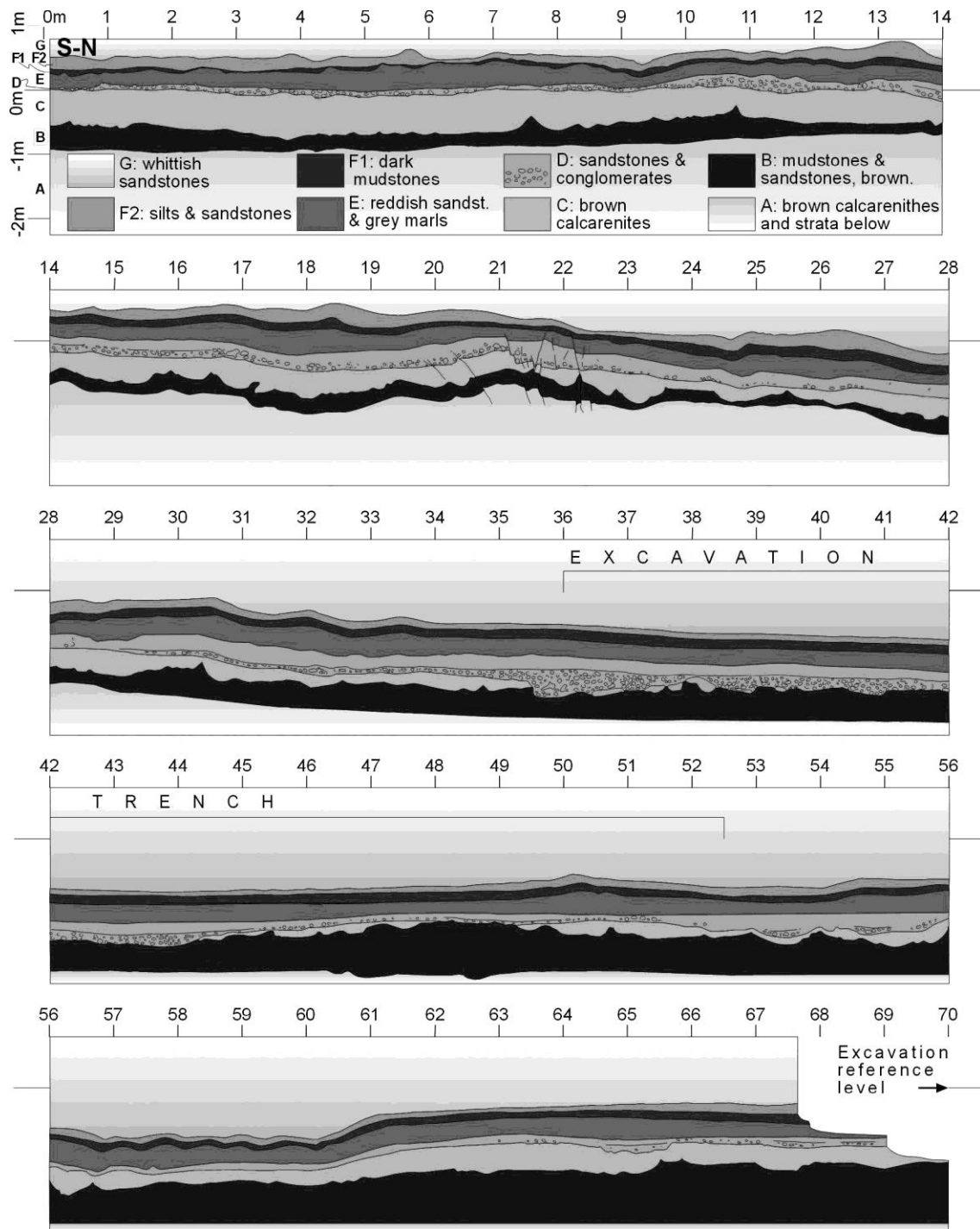
Figure 5. Geometry of BL-5 archaeological and paleontological site (level D) and stratigraphically related levels in a S-N section (adapted and improved from Anadón et al., 2003).
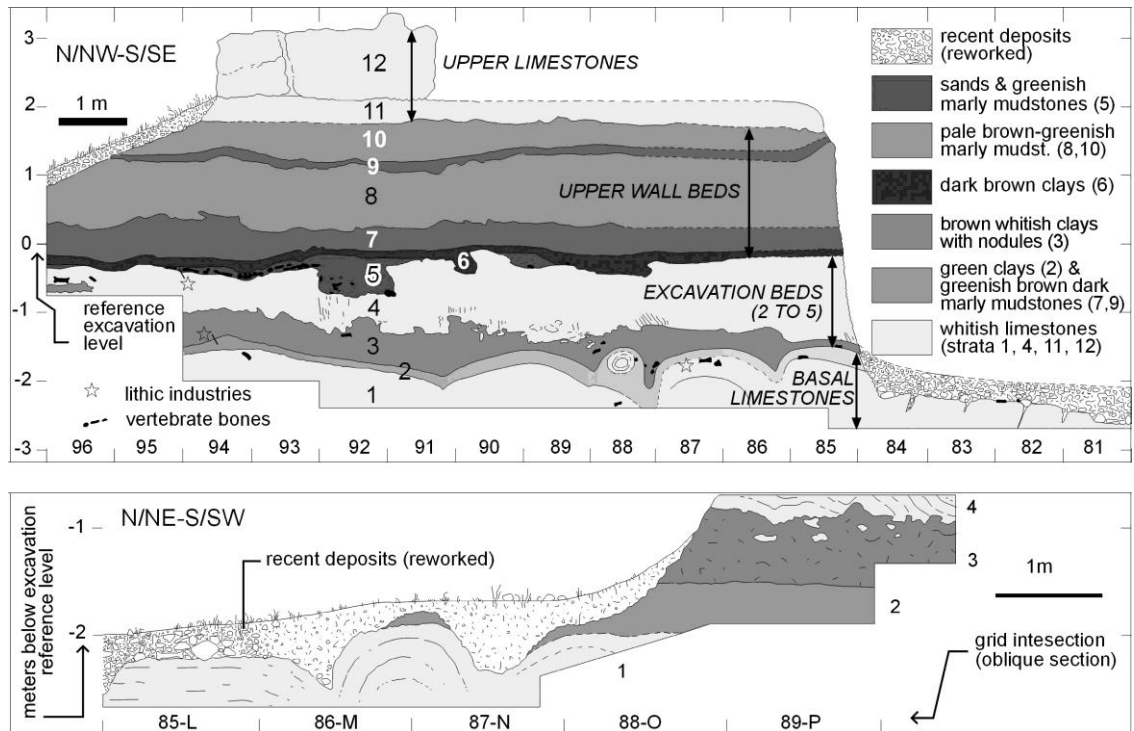
Figure 6. Stratigraphic units and lateral variations of Fuente Nueva 3 paleontological – archaeological level and section. Lower levels (basically from 1 to base of 4) are projected towards the rest of the section (see detailed description in Anadón et al., 2003).

		GUADIX-BAZA BASIN		NORTH-CENTRAL & EASTERN EUROPE
		SITE	RODENT SEQUENCE	RODENT SEQUENCE
P L E I S T O C E N E	EARLY	Cúllar C	*Terricola arvalidens* *Stenocranius gregaloides*	*Terricola arvalidens* *Stenocranius gregaloides*
		Huéscar Puerto Lobo	*Iberomys huescarensis* *Mimomys savini* (large)	*Stenocranius hintoni* *Microtus tenii* *A. nutiensis, A. burgondiae* *Mimomys savini, T. blanci*
		Barranco León 5 Fuente Nueva 3 Orce 3	*Allophaiomys* aff. *lavocati* *Mimomys savini* (small)	*Microtus praehintoni* *Mimomys savini*
		Venta Micena Orce 7	*Allophaiomys ruffoi*	*Allophaiomys pliocaenicus* *Prolagurus pannonicus*
		Barranco conejos Orce 2	*Tibericola vandermeuleni* *Tcharinomys oswaldoreigi* *Mimomys* n. sp.	*Allophaimoys deucalion* *Mimomys ostramosensis* *Tcharinomys tornensis* *Prolagurus ternopolitanus*
P L I O C E N E	LATE	Alqueria, Galera H	*Mimomys* cf. *reidi*	*Mimomys pliocaenicus* *Pusillomimus pusillus* *Mimomys reidi* *Mimomys pitymyoides*
		Galera 2 Zújar 14	*Kislangia gusii* *Mimomys medasensis*	
		Zújar 10	*Kislangia ischus* *Mimomys polonicus*	*Mimomys polonicus*
	MIDDLE	Tollo de Chiclana 1B	*Mimomys hassiacus*	*Mimomys hassiacus*
		Galera 1C	*Dolomys adroveri*	*Dolomys occitanus*
	EARLY	Gorafe A, 1	*Trilophomys*	*Trilophomys*
			Promimomys	*Promimomys*

Figure 7. Late Pliocene to Middle Pleistocene Biozonation of the Guadix-Baza Basin based on rodents.

THE EARLY PLEISTOCENE LARGE MAMMAL ASSEMBLAGES FROM VENTA MICENA, FUENTE NUEVA-3 AND BARRANCO LEÓN-5 (ORCE, SPAIN).

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INTRODUCTION:
The Geology of the intramontane lacustrine Guadix-Baza Basin (Figure 1), situated in the Betic chain, southeastern of the Iberian Peninsula, is dominated by two formations, Guadix Fm. (fluvial and alluvial sediments: conglomerates, sandstones and mudstones) and Baza Fm. (lacustrine sediments: limestones, gypsum and salt) (Vera,1970). The Basin has a complete continental sedimentological record from the late Miocene to the Middle Pleistocene, when it was captured by the Guadalquivir river.
The triangle Orce-Fuente Nueva-Venta Micena is dominated by the Baza Fm. (Figure 1). This area has yielded one of the highest densities of vertebrate fossil sites in the Basin from the late Pliocene to the late Early Pleistocene. This chronology is based on paleomagnetic readings, ESR data, and biostratigraphy of small and large mammals (Martínez-Navarro *et al.,* 1997, 2003; Oms *et al*., 2000; this volume; Duval 2008). This area is known in the literature as the Spanish Olduvai.
The oldest site of the Orce area is Fuente Nueva-1, with typical European fauna of the MN-17, including the presence of *Mimomys* cf. *reidi*, *Equus stenonis*, *Gazella borbonica*, and other mammals (Moyà-Solà *et al*., 1987).
The Early Pleistocene is very well recorded in the entire Orce region with several sites documented in the literature: Venta Micena, Fuente Nueva 2 and 3, Barranco de Orce (several levels), Barranco León (several levels), Barranco del Paso, and some other levels along the Vélez Gorge, that stretches from Fuente Nueva to Orce. In this fieldtrip we will visit the best-known three Early Pleistocene sites: Venta Micena, Fuente Nueva-3 and Barranco León.

Venta Micena:
The paleontological site of Venta Micena is an 80-120 cm thick horizontal stratum whose outcrop can be followed for more than 2.5 Km along the surface. It comprises more than 1 million square meters and is the best documented locality, and most thoroughly excavated, in the Orce region. The more than 17000 vertebrate specimens recovered from the 350 m^2 of excavated deposit, have revealed the presence of 21 species of fossil large mammals (see table 1) and other classes of vertebrates. It has a reverse paleomagnetic record (chron 1r.2r) and is situated in the biozone of the arvicolid *Allophaiomys ruffoi* (see Oms et al. in this volume). The large mammal assemblage (see table 1) is similar in several aspects to that of the Georgian site of Dmanisi, dated 1.8 Ma (Lordkipanidze et al. 2007). The most

characteristic large mammal *fossil directeur* present at Venta Micena and Dmanisi, is the brachyodont bovid *Soergelia minor* (Moyà-Solà, 1987; Vekua, 1995; Buhksianidze, 2005), which is also present at the Greek site of Apollonia-1 and named there *Soergelia brigittae* (Kostopoulos, 1997). We consider that the chronology of Venta Micena is approximately 1.5±0.1 Ma, slightly more recent than Dmanisi (Martínez-Navarro *et al.,* 2003; Duval, 2008).

Unfortunately, research in Venta Micena and in the entire Orce region has been involved in a more or less continuous polemic since the discovery in 1982 of the skull fragment VM-0, a small and problematic piece that was classified as *Homo* sp., thus representing the oldest human remains in Europe (Gibert *et al.,*1983). Since then, the piece has been the focus of numerous studies, ascribing it to a hominid or to an equid. But Martínez-Navarro (2002) suggests that it corresponds to a ruminant female without horn-cores. At the moment, no other clear human remains or other evidence of human activity have been found at the site of Venta Micena.

The stratigraphic position of the Venta Micena level, at the base of the Early Pleistocene in the Orce region, is situated below the archaeological sites of Fuente Nueva-3 and Barranco León-5 (Martínez-Navarro *et al.*, 2003; in press).

Fuente Nueva-3 and Barranco León-5:
The archaeological sites of Fuente Nueva-3 and Barranco León-5, with an excellent record of Oldowan lithic artefacts (see Toro in this volume), are situated in a reverse magnetic polarity (chron 1r.2r) below the subchron Jaramillo in the biozone of the arvicolid *Allophaiomys* aff. *lavocati* (see Oms et al. in this volume).

Martínez-Navarro *et al.* (2003; in press) revised and up-dated the large mammal lists of Barranco Leon-5 and Fuente Nueva-3 (see table 1). The faunal lists of both sites show practically the same faunal assemblage. This faunal association is similar to that of Venta Micena, but it is characterised by the presence of new immigrants of Asian origin, especially the hypsodont species *Equus sussenbornensis* (Alberdi, in press)*,* and the Caprini *Ammotragus europaeus,* that was described at the archaeological site of Vallonnet Cave (France) (Moullé *et al.* 2004), dated around 1.0 Ma and which lies within the normal magnetic subchron Jaramillo, chron 1r.1n (Lumley *et al.*, 1988; Moullé, 1992), and at the site of Cueva Victoria, Spain.

CONCLUSION**:**
The Guadix-Baza basin, especially the Orce region, has one of the best continental record for studying the Early Pleistocene faunal assemblages of Europe.

The best known site is Venta Micena, situated in the biozone of *Allophaiomys ruffoi*, with a typical faunal list of the early Early Pleistocene, marked by the presence of a small size brachyodont bovid *Soergelia*, *S. minor*, which is also present at the site of Dmanisi.

The sites of Fuente Nueva 3 and Barranco León 5, situated at the biozone of *Allophaiomys* aff. *labocati*, are stratigraphically located above Venta Micena, but are also below the Jaramillo normal paleomagnetic event. They are marked by the absence of the small size and brachydont *Soergelia*, and by the arrival of a large hypsodont *Ammotragus europaeus*. It is in these sites where the earliest evidences of human presence are found at Orce in the form of more than 2000 lithic artefacts.

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FIGURES AND TABLES
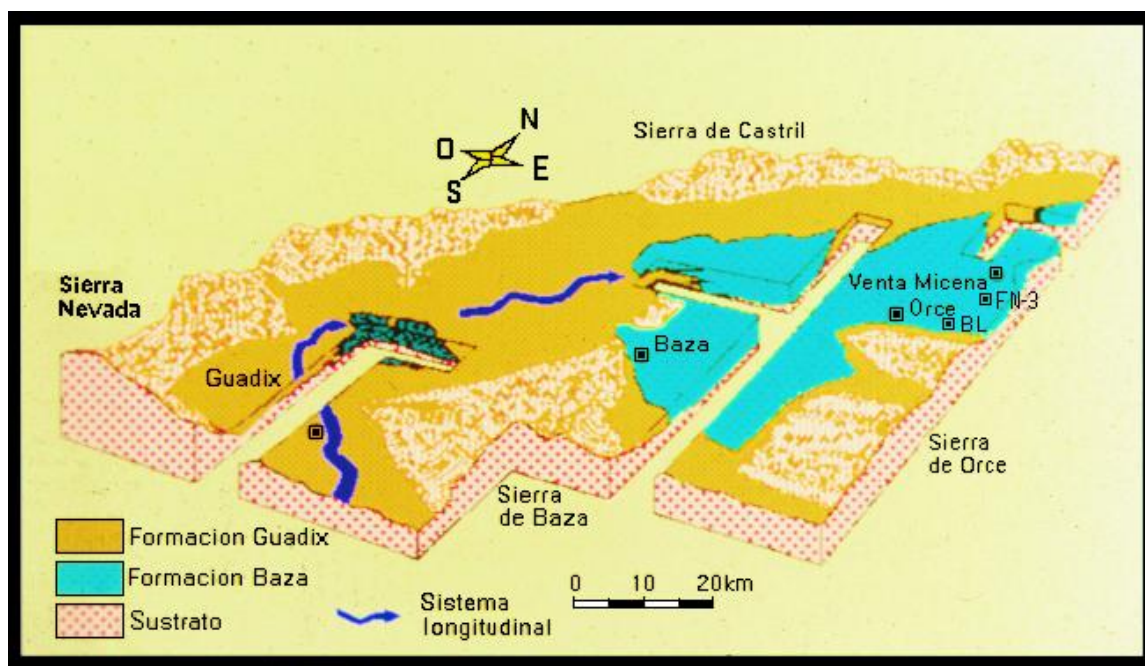
Figure 1.- The Guadix-Baza basin, adapted from Vera (1970) and Viseras (1991).

VENTA MICENA	FUENTE NUEVA-3	BARRANCO LEÓN-5
Allophaiomys ruffoi	*Allophaiomys* aff. *lavocati*	*Allophaiomys* aff. *lavocati*
	Homo sp. (only lithic artefacts)	*Homo* sp. (only lithic artefacts)
Ursus etruscus	*Ursus* sp.	*Ursus* sp.
Lycaon lycaonoides		
Canis mosbachensis	*Canis mosbachensis*	*Canis mosbachensis*
Vulpes praeglacialis	*Vulpes* sp. (cf. *V. Praeglacialis*)	*Vulpes* sp. (cf. *V. Praeglacialis*)
Pachycrocuta brevirostris	*Pachycrocuta brevirostris*	*Pachycrocuta brevirostris*
Megantereon whitei		
Homtherium latidens		
Panthera gombaszoegensis		
Lynx sp.		
Meles sp.	*Meles* sp.	*Meles* sp.
	Pannonictis cf. *nestii*	Cf. *Pannonictis* sp.
	Mustelidae gen.et sp. indet.	
Mammuthus meridionalis	*Mammuthus meridionalis*	*Mammuthus meridionalis*
Stephanorhinus aff. *hundsheimensis*	*Stephanorhinus hundsheimensis*	*Stephanorhinus hundsheimensis*
Equus altidens	*Equus altidens*	*Equus altidens*
	Equus sussenbornensis	*Equus sussenbornensis*
Hippopotamus antiquus	*Hippopotamus antiquus*	*Hippopotamus antiquus*
Bison sp.	*Bison* sp.	*Bison* sp.
Bovini gen. et sp. indet.		
Soergelia minor		
Praeovibos sp.		
	Ammotragus europaeus	
Hemitragus alba	*Hemitragus* cf. *alba*	*Hemitragus* cf. *alba*
Praemegaceros cf. *verticornis*	*Praemegaceros* cf. *verticornis*	*Praemegaceros* cf. *verticornis*
Metacervocerus rhenanus	*Metacervocerus rhenanus*	*Metacervocerus rhenanus*

Table 1: Faunal lists from Venta Micena, Fuente Nueva-3 and Barranco León-5 (after Alberdi & Ruiz-Bustos, 1985; Moyá-Solá, 1987; Pons-Moyà, 1987; Martínez-Navarro, 1991; Torres Pérez-Hidalgo, 1992; Martínez-Navarro & Palmqvist, 1995; Martínez-Navarro *et al.* 1997; Guerrero-Alba & Palmqvist, 1998; Cregut-Bonnoure, 1999; Eisenmann, 1999; Martínez-Navarro & Rook, 2003; Martínez-Navarro *et al.* 2003; Agustí & Madurell, 2003; Oms et al., this volume; Alberdi, in press; Abazzi in press; Lacombat in press; Martínez-Navarro et al. in press).

LES INDUSTRIES LITHIQUES DE BARRANCO LEON ET FUENTE NUEVA 3
D´ORCE (GRENADE, ANDALOUSIE, ESPAGNE). MATIERES PREMIERES,
CARACTERISTIQUES TCHNIQUES ET TYPOLOGIQUES.

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RESUME
Les sites de Barranco León et Fuente Nueva 3 à Orce, Grenade, contiennent
actuellement les plus anciennes industries lithiques de l'Europe, que témoigne la
occupation plus vieille de L'Europe Occidental.
L`etude magnétostratigraphique et récent ánalises pour ESR, comparée aux resultats de
l`etude des faunes, notamment la présence d`*Allophaiomys lavocati*, permet de les dater
d`un age d`environ 1,4-1,2 Ma.
Les matières premières sont d'origine local: silex, calcaire et quartzite, de qualité
différentes. D'un point de vue techno-typologique, les deux ensembles sont homogènes.
Touts les éléments des différentes processus de taille sont représentes, dominées pour
les produits de débitage (éclats et débris), les nucleus sont peut nombreuses, pierres
avec retouches irrégulières, et percuteurs, cette industrie révèle une stratégie de taille
avec des méthodes d'exploitation opportunistes mais relativement sophistiques.
Mots clés: Plus anciennes industries lithiques, Matières premieres, produits de débitage,
Stratégie de taille.

ABSTRACT
The archaeological localities of Barranco León and Fuente Nueva 3 in Orce, Grenade,
have, at the moment, the oldest lithic artifacts in Europe; they are the oldest evidence of
human occupation in eastern Europe.
When compared the magnetostratigraphic, ESR, and biochronologic data, notably
through the presence of`*Allophaiomys* aff. *lavocati* allow for a date of around 1.4-1,2
Ma.
The raw material used for developing these lithic industries are, basically limestone or
siliceous rocks, these, raw materials selected were smoothed down *in situ*. The
techniques used are knapping at raised with a hammerstone, and we can find all the
different elements of the "*chaine operatoire*". Both localities are charactericed by the
predominance of flakes and debris, cores, and some knapped cobbles sowing mediocre
aspect. The technical and typological features of both lithic assemblages have an
opportunist character but they are relative sophisticated too.
Keywords: Oldest evidence, Raw material, Flintknapping, "Chaine operatoire".

I. INTRODUCTION

Les sites de Barranco León et de Fuente Nueva 3, distants de 4,1 km l'un de l'autre, sont
situés à l´est de la ville d´Orce, province de Grenade, en Andalousie (Espagne), à environ
115 km au nord-est de las ville de Grenade et à 80 km, à vol d´oiseau, à l'ouest du rivage
de la Méditerranée.

Ils se trouvent, à environ 950 metres d´altitude, dans le bassin de Guadix-Baza, bordé
tout autour par des massifs montagneux notamment au nord et au sud . Deux vallées

encaissées, entaillent les formations plio-pléistocène de ce bassin sur plus de 100 m. de epaisseur et dìmportantes coupes stratigraphiques naturelles ont été laissées par l´erosion. Elle permettent de suivre l`evolution d`un acien lac, le paleolac de Baza, qui a occupé ce bassin depuis la fin du Miocène jusqu`au Pléistocène moyen, entre 7 millions d`années et 300.000 ans, avant d`être totalement asséché vers le milieu du Pléistocène moyen.

La séquence de Barranco León comprend une alternance de niveaux des graviers calcaires, sableux et marneux noirs, mais o moins carbonatés, localisés dans l´unité E de la stratigraphie régionale, dans la biozone à *Allophaiomys* Aff. *lavocati* . Le niveau à industrie lithique archéologique (couche D), épais de 22 à 30 cm., est constitué par de sables fins à galets, qui contient nombreux fragments de coquilles de mollusques d'eau douce. La faune est très abondante et de nombreuses pièces d´industrie lithique ont été mises au jour (Anadón y Juliá, 2003 ; García Aguilar, 2003, Oms et al.2003 ; Agustí et al. 2003 ; Martínez Navarro et al. 2003 ; et Toro et al. 2003, 2009).

La séquence à Fuente Nueva 3, consiste en une succession de lits calcaires et d´argiles limono-sableuses, assez riche en coquilles de gastéropodes lacustres, sur 5 metres d´epaisseur, situés dans l´unité F de la stratigraphie régionale, aussí dans la biozone à *Allophaiomys lavocati* . Parmi les 15 couches individualisées, deux niveaux ont livré des industries lithiques associeés à des faunes de grands mammifères. La couche archéologique supérieure, sablo-limoneuse à nodules carbonatés, de couleur gris verdâtre, de 5 à 15 cm. d´epaisseur, à livré un abondant matériel osseux et en particulier un squelette de *Mammuthus meridionalis* dont les ossements sont restés en connexion anatomique. La couche archéologique inférieure, de mêmme èpaisseur, constitué par des argiles limono-sableuses de couleur gris verdâtre, avec des passées d´oxydes de fer, à livré un matériel lithique abondant associé à une riche faune de grands mammifères (Anadón y Juliá, 2003 ; García Aguilar, 2003 ;Duval., 2008 Oms et al.2003 ; Agustí et al. 2003 ; Martínez Navarro et al. 2003 ; et Toro et al. 2003, 2009).

II. MATIÈRES PREMIÈRES. ETUDE TECHNOLOGIQUE ET TYPOLOGIQUE DE L´INDUSTRIE LITHIQUE

A Barranco León la serie recueillie jusq`a present comprend 1292 pièces et à Fuente Nueva 3 il comprend 932 pièces (Toro et al., in press).
Les séries lithiques récoltées sur les sites de Barranco León et Fuente Nueva 3 ont été fabriquées à partir de matières premières peu diversifiées. Il se composent principalement des matières premières d'origine locale silex, calcaire et en mineur proportion de quartzite. Pour confectionner leur outillage lithique les hominidés se procuraient, à la proximité immédiate de sites, des roches en calcaire (calcaire marneux, calcaire silicifié) ou en silex (silex vert, silex gris, silex gris à fossiles) sous forme de plaquettes, de rognons ou parfois de galets. Toutes ces roches pouvaient être ramassées dans un rayon de moins de 2 km autour du site et, en abondance, dans un rayon de 5 à 10 km. La calcaire a été presque exclusivement employé pour le façonnage des galets aménages, et alors que le silex ont surtout été sélectionnées comme nucléus pour la production des éclats (Toro et al., 2007).
À Barranco León, et à Fuente Nueva 3, les pièces non modifiés sont presque exclusivement en calcaire silicifié. Ces pièces se présentent sous la forme de galets ou blocs et représentent le 6,09% de l'assemblage lithique de Barranco León, et le 10,48%

et 10,10% des couches supérieure et inférieure de Fuente Nueva 3 respectivement. Les formes de ces pièces brut sont diverses, ovoïdes, circulaires, quadrangulaires polygonales et triangulaires.

Le calcaire est aussi dominante parmi les pièces peu modifiés de ces ensembles lithiques. Les galets et blocs fracturées, sont aussi très peut représentées dans les assemblages. Les éléments de percussion, son presque en sa totalité dans calcaire, un seul percuteur en quartzite à été répertorié à la couche inférieure de Fuente Nueva 3 ; ils ont plus abondants à Fuente Nueva 3 qu'à Barranco León. Les percuteurs sont présents dans les trois assemblages lithiques (BL et couches inférieur et supérierur de FN3), tandis que les enclumes sont absentes à Barranco León (Fajardo, 2008).

Les produits de débitage dominent les assemblages lithiques de Barranco León et Fuente Nueva 3, parmi ces produits on observe toutes les matières premières représentées dans l'assemblage, mais le silex est largement majoritaire. Ce catégorie inclus les galets aménagés, les fragments anguleux, les débris, les fragments d'éclats et les éclats entiers. Un total de 169 éclats entiers de Barranco León, et 231 á Fuente Nueva 3 (29 pièces de la couche supérieure et 202 de la couche inférieure) on été étudiées. Comme dans le cas des nucléus les éclats sont principalement en silex, et, dans général, les éclats sont de petites dimensions.

Des stratégies de débitage différentes étaient utilisées selon qu'il s'agissait de roche en calcaire ou de roche en silex, selon la morphologie du support ou selon le produit recherché.

- Les supports plats, en calcaire, étaient débités, à main levée, par des enlèvements unifaciaux entrecroisés ou centripètes.
- Les supports épais, en calcaire, de forme plus ou moins cubique ou subparallélépipédique, étaient débités, à main levée ou sur enclume, selon la forme du support ou la qualité de la roche, en utilisant au mieux les arêtes naturelles limitant les diverses surfaces du nucléus.
- Les supports plats, en silex, étaient débités à main levée, à l'aide d'un percuteur dur, par des enlèvements unifaciaux, parfois bifaciaux, qui pouvaient être unipolaires, bipolaires, entrecroisés et même, parfois, centripètes.
- Les supports épais, en silex, étaient débités soit à main levée, soit par percussion bipolaire sur enclume, au moyen d'un percuteur dur.

Le débitage à main levée était alors pratiqué par des enlèvements le plus souvent non récurrents avec de fréquents changements de direction, au moyen d'un percuteur dur et de coups violents. Le plan de frappe était alors le plus souvent un enlèvement antérieur. Les tailleurs s'adaptaient à la morphologie des blocs et utilisaient tous les plans de débitage disponibles au fur et à mesure de l'exploitation. Ce processus, poussé à l'extrême, jusqu'à épuisement du potentiel de matière première, a conduit à la réduction et à l'obtention de nucléus de petites tailles et de formes polyédriques.

Souvent, c'est un éclat qui servait de nucléus pour l'obtention d'autres éclats.

Le débitage sur enclume était fréquemment utilisé pour de petits blocs ou des plaquettes de forme cubique ou subparallélépipédique, qui étaient posés sur une enclume, pour l'extraction, au moyen d'un percuteur dur et de coups violents, d'une ou de plusieurs séries d'enlèvements unidirectionnels récurrents periphériques et, parfois, avec des rotations permettant une exploitation maximale du support. Cette percussion bipolaire sur

enclume produisait parfois des éclats à double point d'impact bipolaire ou de type
« pièces esquillées » ainsi que des débris de petites dimensions.

Ces stratégies de débitage, pratiquées sur les deux sites, avaient pour but d'obtenir des
éclats, de forme non standardisée et expliquent les petites dimensions et la forme
polyédrique de la plupart des nucléus résiduels laissés sur le site après l'abandon des
séquences de débitage.

Le but recherché, au moyen de ces stratégies de débitage, était l'obtention de petits
éclats, le plus souvent de 10 mm à 40 mm de longueur, généralement de contour plus ou
moins carré à bords tranchants.

Le débitage à main levée par coups violents avec un percuteur dur et celui par percussion
bipolaire sur enclume expliquent le grand nombre d'éclats > 20 mm cassés
(respectivement 39 % à Barranco León et 34,7 % à Fuente Nueva 3) et notamment les
fortes proportions d'éclats fracturés selon l'axe de débitage (accidents de Siret), selon un
axe parallèle à l'axe de débitage ou selon un axe perpendiculaire ou oblique par rapport à
l'axe de débitage.

Quelques enlèvements isolés, effectués à main levée, sur des galets ou des blocs en
calcaire, permettaient la production de choppers primaires (galets à enlèvement isolé
concave). Des galets fracturés, qui présentent le long d'une arête tranchante des
retouches irrégulières épaisses denticulées, ont vraisemblablement servi de chopper et
peuvent être considérés comme des choppers mal caractérisés. Les choppers bien
caractérisés, aménagés par plusieurs enlèvements contigus, sont rares

L'industrie de Barranco León, comme celle de Fuente Nueva 3, se caractérise par une
dominance des éclats de 1 à 6 cm maximum de longueur (respectivement 19,5 % et 32,2
% du matériel lithique et 22,5 % et 58,3 % de l'industrie) et des petits éclats inférieurs à
1 cm de long (respectivement 13,9 % et 8,5 % du matériel lithique et 16 % et 15,3 % de
l'industrie), ainsi que de débris et de petits débris (respectivement 6,2 % et 3,6 % du
matériel lithique et 7,1 % et 6,6 % de l'industrie pour les débris et 44,7 % du matériel
lithique et 7,1 % de l'industrie pour les petits débris de Barranco León), de nucléus
(respectivement 1,4 % et 2,3 % du matériel lithique et 1,6 % et 4,1 % de l'industrie), de
quelques galets aménagés de facture très médiocre, essentiellement des choppers
primaires et des choppers mal caractérisés (respectivement 0,5 % et 0,9 % du matériel
lithique et 0,6 % et 1,6 % de l'industrie).

Les galets fracturés sont assez nombreux (respectivement 0,9 % et 5,7 % du matériel
lithique).

Les galets entiers et les pierres apportés sur le site sous forme de manuports,
(respectivement 6,3 % et 10,9 % du matériel lithique pour les galets entiers ; 5,8 % et
28,1 % du matériel lithique pour les pierres), sont relativement abondants.

L'association du matériel lithique avec des ossements de grands mammifères, conservés
parfois en connexion anatomique, comme l'hippopotame à Barranco León et l'éléphant
méridional à Fuente Nueva 3, ainsi que des fracturations anthropiques volontaires
d'ossements et quelques traces de décarnisation, suggèrent que les pièces lithiques sont
en relation avec le traitement des carcasses de ces animaux.

La présence, autour des ossements en connexion anatomique de l'éléphant méridional de la couche supérieure de Fuente Nueva 3, de 15 petits éclats et de débris ainsi que de nombreux coprolithes d'hyène permet d'envisager qu'il y a eu autour de cette grande carcasse, une compétition de charognage entre l'homme et la hyène pour les petits fragments de viande encore attachés à la carcasse.

La présence de galets entiers ou fracturés, dont certains possèdent des stigmates de percussion, et dont les arêtes présentent des retouches irrégulières, ainsi que de nombreux ossements brisés par percussion violente ou qui montrent des stries de décarnisation, suggèrent que les homininés fracturaient les os longs pour récupérer et consommer la moelle.

La domination des éclats bruts de taille, le plus souvent de très petites dimensions suggère qu'ils servaient plutôt à la découpe et au raclage pour retirer la viande qui restait encore sur les carcasses d'animaux abandonnés par les grands carnivores.

Les arêtes de nombreuses pièces : pierres, galets fracturés, nucléus abandonnés après les séquences de débitage, éclats et débris, présentent souvent des retouches irrégulières d'utilisation : retouches irrégulières marginales, retouches irrégulières minces ou épaisses, retouches irrégulières serrées contiguës, parfois chevauchantes, mettent en évidence une utilisation intensive et appuyée de certains éclats.

Mises à part quelques rares différences sans grande signification, les caractéristiques techniques et typologiques des industries lithiques de Barranco León et de Fuente Nueva 3 présentent entre elles de grandes similitudes et permettent de les attribuer à un même complexe techno-culturel. Le débitage d`éclats est la caractéristique principale de ces industries. Ce sont les éclats et le nucléus le que caractérisent les industies archaïques de ces gisements (Toro et al., in press).

À Barranco León la bonne qualité de le silex nous à permis de faire un analyse préliminaire des traces d'utilisation. Après une première phase de sélection à la loupe binoculaire, un échantillon de douze pièces ont été choisies pour un analyse au microscope électronique de balayage dans le laboratoire su C.N.R.S. à Tautavel (France). Des stries et des polies on été identifiés sur quatre pièces (Toro et al., 2003). Sans doute, des analyses plus en profundis sont nécessaires pour un approche traceologique plus précise, mais la présence des marcs de découpage des oséments avec traces de dècoupage et de percussion, inclús veritables eclats dans os, dans un pourcentage encore à déterminer de l'assemblage faunique de Barranco León (Toro et al., 2003) appuie l'hypothèse de leur utilisation pour le traitement de la viande.

Aussí les études préliminaires à Barranco León montrent la présence d´un remontage de quatre pièces d'un même support en silex que remontent   .

III. COMPARAISONS ET CONCLUSION.

Par leurs caractéristiques techniques et typologiques, les industries lithiques de Barranco León et de Fuente Nueva 3, montrent des analogies avec d'autres assemblages industrielles Oldowayennes oú Mode I, d'Afrique, de Géorgie et d'Europe méridionale (Toro et al., 2009). Elles se caractérisent par l'utilisation d'un débitage opportuniste à main levée ou par un débitage bipolaire sur enclume, par une très forte dominance des éclats bruts de taille généralement de petites dimensions, par l'absence de petits outils retouchés standardisés sur éclat ou sur débris, par la présence de galets aménagés en proportion plus ou moins grandes selon les fonctionnalités du site et la disponibilité des galets ainsi que par la relative abondance d'outils de percussion (galets à enlèvement isolé convexe et galets entiers ou fracturés à stigmates de percussion).

Datés dans en 1,45 M.a. le site de Barranco León, et 1,26 Ma. Fuente Nueva 3 (Duval. , 2008), témoignent la précoce présence des hommes dans l´Europe occidentale, sur les

rivages de la Méditerranée après leur sortie d'Afrique et de leur installation à Dmanissi (Géorgie), aux portes de l'Europe, dans la transition Plio-pléistocène, il y a 1,81 Ma.,(Celiberti et al., 2004 ; Lumley et *all,* 2005) et de la continuité du peuplement humaine jusqu´a la Gran Dolina TD6 à Atapuerca (Burgos,Espagne) daté de 0,8 Ma. (Carbonell et al., 1995, 2001).

En ce qui concerne à l'interprétation des sites, la présence dans ses assemblages lithiques de remontages, des pièces de petite taille, même millimétriques, et abondants restes fauniques, ainsí que piecés lithiques avec de traces d´utilisation à Barranco León (Toro et al.. 2003), et des oséments avec traces de dècoupage et de percussion, inclús veritables eclats dans os, démontrent que la perturbation dans les sites est minimal. Ces associations spatio-temporelles de matériaux archéologiques et paléontologiques reflètent des activités d'approvisionnement de protéines animales dans un court période de temps.

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HUÉSCAR-1

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ABSTRACT

The earliest Middle Pleistocene site of Huéscar-1 is located in the eastern area of the Guadix-Baza basin. The bones were transported by fluvial currents and deposited in the fan deltas created when they flowed into a lacustrine area. When the deltas prograded over the already sedimented shoreline carbonates, materials and bones belonging to these were eroded and deposited at the same time with autochthonous remains, such as those from aquatic and semi-aquatic habitats, in an area located nearer the interior of the lake. The diachronic accumulation is indicated by the attritional mortality profile and the clear evidence of transport and fluvial selection of bones. There is an important representation of birds; most of them are aquatic forms. The most abundant fossils correspond to horses represented by two species: *Equus altidens altidens* and *Equus suessenbornensis*, the first is the latest form of the stenonoid horse lineage in Europe. There is a good representation of a large rhinoceros: *Stephanorhinus etruscus*, and elephant: *Elephas antiquus*. Despite the presence of a semi-aquatic form, *Hippopotamus major*, the artiodactyls are scarce and the diversity is also low. Only one bovid, *Capra* sp., and one cervid, *Praemegaceros* cf. *P. solilhacus,* are present. Carnivores: *Canis etruscus*, *Panthera gombaszoegensis*, *Homotherium* sp. and Hyaenidae indet. have been identified. The fauna of Huescar-1 documents the Galerian turnover pulse, the last major biotic event in the western Mediterranean area. This turnover, at around 1 Ma, represented a major community reorganisation that showed a total rejuvenation of the fauna. The taxonomic composition of Huéscar 1, with a low diversity of artiodactyl species, indicates an open, sparsely forested environment which could become quite dry in certain seasons, in agreement with the sedimentological data. The oxygen isotopic data obtained from the phosphate of horse bones and teeth indicate colder climatic condition in Huéscar-1 than in the late Villafranchian sites analysed. This climate and environmental conditions are consistent with the climatic deterioration at the beginning of the Middle Pleistocene ("Glacial Pleistocene").

INTRODUCCIÓN

Huéscar-1 is located in the eastern part of the Guadix-Baza basin. The continental sedimentary basin of Guadix-Baza is located in the SE of the Iberian Peninsula, within the range of the *Cordilleras Béticas*, and represents a broad geographical area of great paleontological and geological interest.

The special structural features of the Guadix-Baza Basin, situated in a tectonically active zone and with a significant subsidence rate, gave rise during the Pliocene and Pleistocene, to a centripetal and asymmetrical sedimentation from alluvial fan systems. Towards the lowermost areas, they were converted to successive palustrine-lacustrine environments. The sedimentary characteristics of these sedimentary environments and the rapid subsidence of the basin resulted in the formation and preservation of numerous localities with fossil vertebrates.

GEOGRAPHICAL LOCATION, GEOLOGY AND MICROSTRATIGRAPHY

The site of Huéscar is located in the eastern basin, about 4 km SE of Huéscar on the left bank of the Barranco de las Cañadas, at an altitude of 940 m (Figure 1). The levels of the site consist of an alternation of conglomerates, sands and alluvial-lacustrine carbonate silts (Figure 2). They belong to the Upper Member (Soria et al., 1987) of the Baza Formation (Vera, 1970). In the sector Orce-Huéscar-Galera, this formation corresponds to a lacustrine deposit, where detritic material intermittently accessed through the adjacent fluvial and alluvial systems (Soria et al., 1987).

This site has 5 differentiated levels that correspond to the following (Alonso et al., 2003):

Level 1. 0.6 m, grey marly silts loam, massive, with horizontal levels of accumulation of iron oxides.

Level 2. 0.6 m, erosive level above level 1, consists of overlapping lenses of sands and yellow conglomerates (5 cm centile); those lenses are massive and, sporadically, with small furrows. The sands show a progressive decrease in grain size toward the top, containing conglomerate lenses with an average size of 15 cm to 20 cm and a lateral continuity up to 2 m. This is the first fossiliferous level of the site. The clasts are mainly carbonates and flint, very sporadic "Jacinto de Compostela" quartz and conglomerates, in addition to the bones.

Level 3. 1.3 m, massive brown mottled carbonate silts and millimetrical plant debris, the degree of carbonation increases toward the top. It is a level almost sterile in the grid A but contains remains in B. At the top there are perforations and bioturbations filled with sand from level 4.

Level 4. 0.4 m, sand and yellow micro conglomerates with bone remains similar to those from level 2 (centile of 4 cm). It is the second fossiliferous level of the site.

Level 5. 1.0 m, white-grey carbonated silts with numerous root tubules toward the top. Abundant bands of iron oxides, associated with the fluctuations of the phreatic level, are observed at the base.

Another 2 m of alternating massive carbonated sand (40 cm) and conglomeratic sands (30 cm) similar to levels 2 and 4 of the deposit are accumulated above the levels of the site.

SURVEY AND EXCAVATION

The survey was made at the Barranco de Las Cañadas, a few meters downstream from its confluence with the Barranco de las Quebradas. Figure 1 specifies the most important outcrops for micro and macromammals. The systematic excavation, in 1986, was conducted in the locality named Huéscar-1, which is very rich in large and small mammals. Fossiliferous levels, being cut by the ravine appeared on the walls with variable extensions, the use of all of them forced us to raise two types of excavation: the grids themselves, and test-pits (Figure 2).

SEDIMENTARY ENVIRONMENT

The deposit was formed in a lake zone, at the mouth area of a channel system emitting a system of alluvial fans whose origin would be located toward the east (Alonso et al. 2003; Alberdi et al. 2001). In this area were formed successive "fan deltas" with levels of massive conglomerates and sands with a flat base, corresponding to the detrital levels 2 and 4. Classical structures of delta front are not recognized (avalanche front cross-stratification, negative granoclassification), probably due to the low ranking and

instability of the alluvial environment. In this mouth area the bone remains were preferentially accumulated (Figure 3). Ecosystem characteristics indicated by the fauna of aquatic birds (Sánchez Marco 1989) are consistent with the sedimentological interpretation. Most of these species need, besides water, dense vegetation on the banks and even inside the mass of water. The oscillations of the water level are reflected in the numerous paleolevels of stabilization of the phreatic level, which are recognized in the levels excavated, but also in the detrital levels close to the lake area (Alberdi et al. 2001; Alonso et al. 2003).

TAPHONOMIC CONSIDERATIONS

The results of sedimentological and taphonomic studies indicate that the anatomical composition was largely controlled by hydraulic factors (Alberdi et al., 2001). The mortality profile of *Equus altidens*, the most abundant species at the locality, is attritional, indicating that the accumulation of the skeletal remains was diachronic. This interpretation is consistent with the depositional environment.
The taxonomic composition is biased by the various factors that controlled the preservation in that environment. Huéscar-1 was deposited in sub aquatic environments where autochthonous fauna has been found (hippopotamus, aquatic birds).
Comparing with the data from Behrensmeyer (1975 a, b) it is possible to conclude that the taxonomic composition mainly reflects the habitat preferences of the taxa and, therefore, is indicative of the habitats surrounding the site.

FAUNAL CONSIDERATIONS

Continental molluscs from the Huéscar series can be separated into two associations of different meaning (Robles, 1989). The first is characterized by the predominance of species typical of hard substrates, like *Melanopsis* and *Theodoxus*; and the second, associates one or more of those species with *Melanoides*, living on vegetation or on soft or muddy substrates, which implies a mixture of molluscs from different environments.

The association of vertebrate fauna from Huéscar-1 is represented by Emydidae indet., a significant presence of fossil birds with: cf. *Tachybaptus ruficollis*, *Anas crecca/A. querquedula*, *Anas platyrhynchos*, *Anas clypeata*, *Anas strepera*, *Anas* sp., *Netta rufina*, *Aythya ferina*, *Aythya nyroca*, *Aythya fuligula*, *Aythya* sp., *Perdix perdix*, *Crex crex*, *Bubo bubo*; mammals are represented by Soricidae indet., *Eliomys quercinus*, *Apodemus* sp., *Castillomys crusafonti* ssp., *Mimomys savini*, *Microtus (Pitymys) gregaloides*, *Microtus (Microtus) brecciensis*, *Oryctolagus* sp., *Lepus* cf. *L. granatensis*, Leporidae indet., *Canis etruscus*, Hyaenidae indet., *Panthera gombaszoegensis, Homotherium* sp*., Elephas antiquus, Hippopotamus major*, *Equus altidens altidens, Equus suessenbornensis, Stephanorhinus etruscus*, *Capra* sp*.* and *Praemegaceros* cf. *P. solilhacus* (Mazo et al., 1985; Aberdi *et al.*, 1989, 1998; Alberdi & Ruiz Bustos, 1989; Alcalá & Morales, 1989; Azanza & Morales, 1989; Cerdeño, 1989, 1993; Mazo, 1989 a, b; Sesé, 1989).
The association of micromammals is characterized by the presence of the arvicolids *Microtus* (*Microtus*) *brecciensis* and *Microtus* (*Pitymys*) *gregaloides* that allow correlating the Huescar-1 fauna with lower levels of Gran Dolina at Atapuerca, Villany-6 and 8, Nagyharsanyhegy, Süssenborn and Westbury-2 and 3 (Sesé, 1989).

CONCLUDING REMARKS

The mammal fauna of the basal Galerian of Huéscar-1 offers a high interest for documenting the last major biotic event in the Mediterranean region, the "Galerian turnover" (Alberdi et al., 1997; Azanza et al. 1999, 2000), which represented the establishment of the extant fauna, not only at the taxonomic level but also in the size structure of the large mammal communities. This event coincides with a major global climate change amply documented at the beginning of the Middle Pleistocene or lower Galerian. Approximately 1 Ma ago, a change occurred in the periodicity of 41 ka to 100 ka in the overall scheme of glacial-interglacial fluctuations already started at the end of Villafranchian, accompanied by a significant decrease in temperature (Shackleton, 1995, Suc et al., 1995).

The climatic and environmental conditions suggested by the fauna at Huéscar-1 are in agreement with this climatic deterioration. At Huéscar-1, the number of species of artiodactyls is considerably lower than at Huélago-carretera, despite the record of amphibious forms, suggesting that the surrounding vegetation was more open and the climate was drier, especially in certain seasons, as also suggested by the sedimentological data (Alberdi et al., 2001). The oxygen isotope composition results from horse teeth and bones from Huéscar-1 indicate a climatic deterioration in comparison to what was recorded in the upper Villafranchian, although those temperatures did not reach the minima found during the glacial Pleistocene (Sánchez *et al*., 1994).

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FIGURES
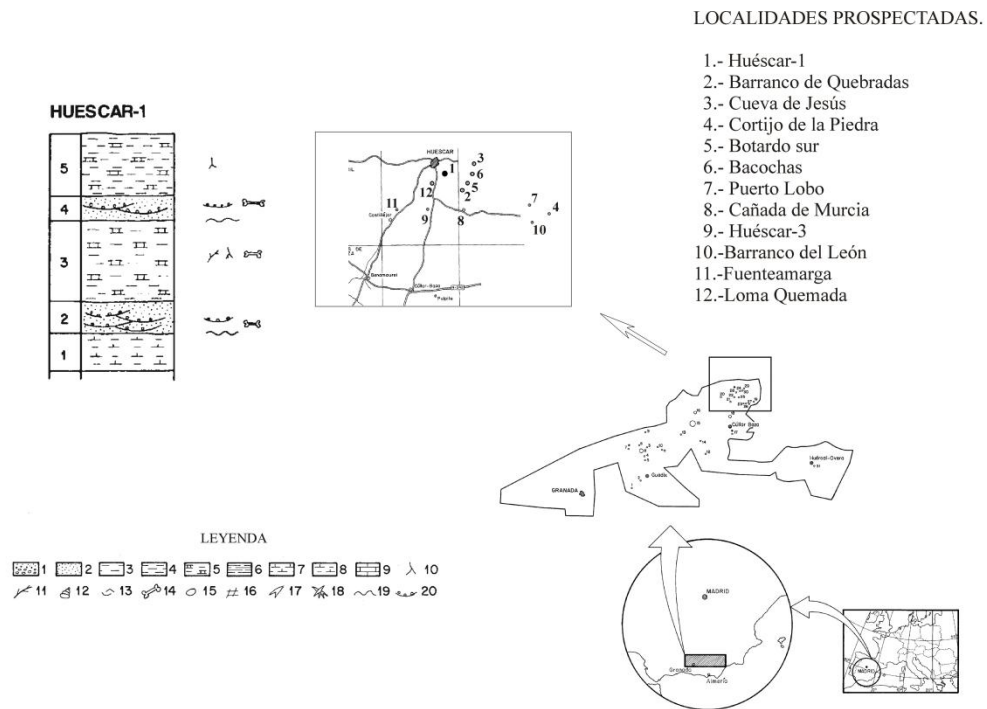
Figure 1.- Location of the prospected localities with micromammals in the area around Huéscar-1 and stratigraphy of the deposits at Huéscar-1. Legend: **1**.- Conglomerates and sand; **2**.- Sand; **3**.- Coarse sand; **4**.- Alluvial sediment; **5**.- Carbonated sand; **6**.- Clay; **7**.- Marl; **8**.- Marly clay; **9**.- Limestone; **10**.- Roots; **11**.- Fragments of plants; **12**.- Gastropods; **13**.- Ostracods; **14**.- Level of preferential accumulation of bones; **15**.- Calcareous concretion; **16**.- Carbonates; **17**.- Lenticular gypsum; **18**.- Gypsum concretions; **19**.- Surface of erosion; **20**.- Channels.
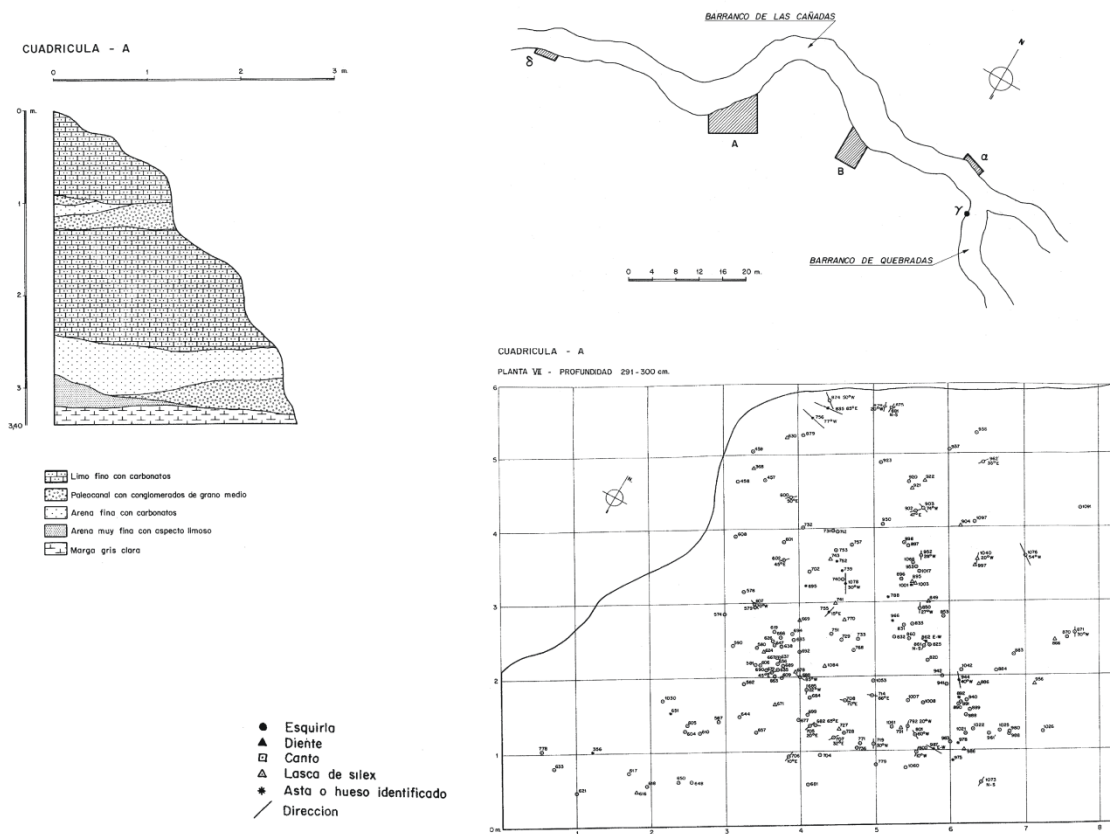
Figure 2.- Relative position of the grids (A and B) and the test-pits (α, β, τ and δ) at the site of Huéscar-1 along the Barranco de las Cañadas. Profile 3 corresponding to the grid A and graphical representation of the layer VII (291-300 cm depth) brought to light during the excavation of grid A at Huéscar-1 in the 1986 season.
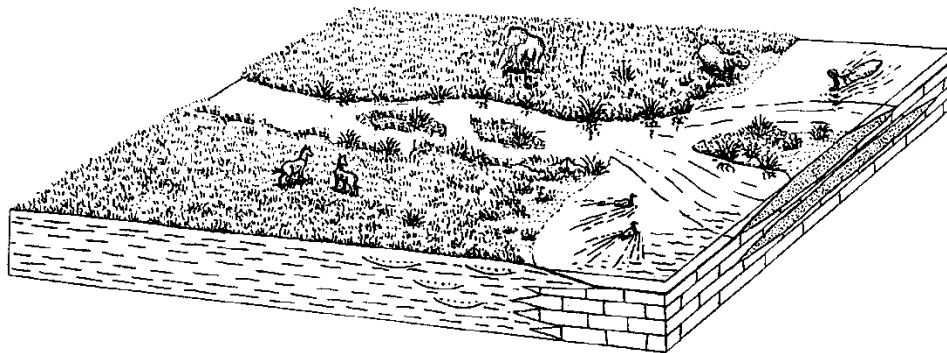
Figure 3.- Sedimentary model and formation conditions of the site Huéscar-1 (modified from Alberdi et al., 2001).

CÚLLAR DE BAZA-1

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ABSTRACT

The middle Pleistocene locality of Cúllar de Baza-1 is located in the eastern area of the Guadix-Baza basin. The bones were accumulated in a swampy mud flat that fringed a lacustrine area, but without edaphic processes because of the lack of drying. The scavengers and predators action, including hominids, must have been an important factor in the primary generation of the accumulation of bones. This was diachronic and could be seasonal because the bones dispersed on the surface were buried in the times of flooding. Hydraulics factors greatly controlled the selective skeletal composition. The horses are represented by two species: *Equus altidens altidens* and *Equus suessenbornensis*, the first is the latest of the stenonoid horse lineage in Europe. There is a good representation of a large rhinoceros: *Stephanorhinus etruscus*, and elephant: *Mammuthus trogontherii*. Artiodactyls are represented by scarce remains. The cervids are only represented by *Dolichodoryceros savini* while the bovids are represented by *Capra* sp. and *Bison* sp. There is also a canine that belongs to *Sus* cf. *S. scrofa*. Among the Carnivora, only *Canis etruscus* and *Crocuta crocuta* were indentified. The fauna of Cúllar de Baza-1 documents the Galerian turnover pulse, the last major biotic event in the western Mediterranean area. This turnover, at around 1 Ma, represented a major community reorganisation. At that moment, a great part of the lineages appear that constitute the present mammal communities, including humans. The low diversity of artiodactyl species indicates an open, sparsely forested environment while the low diversity of rodent species indicates that the climatic conditions had to be cool. The oxygen isotopic data obtained from the phosphate of horse bones and teeth, indicate colder climatic condition than in the late Villafranchian sites analysed, but the temperature increases respect to the climatic deterioration at the beginning of the Middle Pleistocene.

INTRODUCTION

This locality was excavated in the 70's (Ruiz Bustos, 1976) and on the same outcrop we organized the new excavation in 1987. This site is located in the eastern part of the Guadix-Baza basin (Figure 1). This wide basin is of important interest, not only paleontological but also geological.
Alberdi *et al*. (1989b) raise two hypotheses on the geodynamic evolution of the area. The first one suggests that the oriental area is related to the Pliocene transgression lasting until the Quaternary. The second one considers the Pliocene tectonic as responsible of the separation of the central and oriental zones, the latter remaining uplifted and, therefore, isolating the central part from the sea.

GEOGRAPHIC LOCATION, GEOLOGIC SETTING AND MICROSTRATIGRAPHY

The site of Cúllar de Baza-1 is located at 1 km southeast of the town of the same name, at an altitude of 960 m (Figure 1). The levels are constituted by an alternation of carbonates and silt, and belong to the most southeastern outcrops of the Upper Carbonated Section "*Tramo Carbonatado Superior*" (Alonso, 1991).

This section overlies the conglomerates and alluvial-fluvial sands of the Section of Conglomerates and Red Sands, and shows a general trend towards the development of lake and marsh sequences of Pleistocene age that outcrop in the vicinity of Cúllar de Baza (Alonso, 1991). In unconformity on that level, and culminating the series, we find the Unit of terminal fans and glacis (Alonso, 1991).

For consistency, we followed the nomenclature proposed by Ruiz Bustos in its excavation of the 70s. From the base to the top, the following levels were differentiated (Alonso 1991, Alonso et al., 2001):

Level B. 0.20 to 0.30 m. Conglomerate at the base, gray with clasts of marble, mica-schists and quartzite, which changes towards the top to green silt with traces of plants.
Level D1. 0.20 to 0.80 m. Brown silt, more or less carbonated, lens shaped, massive, with scattered gastropods or with cross-stratification of front avalanche of small-medium scale with fragments of gastropods at the basis of the sets. The base of the level consists of an accumulation of fragmented gastropods and small pieces of carbonized plants with "Flaser" laminated type.
Level D2. 0.15 to 0.25 m. Lens of white limestone with fenestral porosity and recrystallizations. It contains very scarce vertebrate remains.
Level C. 0.03 to 0.10 m. Silts and black or dark brown-green clays wedged sideways. It has large plastic deformations and contains vertebrate remains, abundant gastropods and organic matter.
Level D. 0.30 to 0.80 m. White sandy marls and calcareous marls. Towards the top, the carbonatation increases and the percentage of silt and sand decreases. It has plastic deformations and a strongly cemented limestone lens of 15 to 20 cm called D2'. It contains vertebrate remains and complete gastropods scattered in the level.
Level C'. 0.05 to 0.20 m. Black clayey silt, massive, with the same characteristics as those of the underlying level C.
Level D1'. 0.30 to 0.60 m. Dark brown sandy silts, massive and carbonated, similar to the underlying level D1.
Level F. 0.25 m. Green silts with cemented carbonates, generally massive appearance but in some places appears horizontal laminations slightly wavy. It contains abundant ostracods.
Level H. 1.70 m. Yellowish-green silty sands with wavy laminations and oscillation ripples. It contains abundant ostracods.

EXPLORATION AND EXCAVATION

During the 1987 season, it was carried out a field work of systematic excavation at the site of Cúllar de Baza-1 and several outcrops were prospected for obtaining various micromammals in the vicinity of the town (Alberdi & Bonadonna, 1989). The excavation was made on the area that was left after the excavation works of 1973 and 1975 by Ruiz Bustos (1976), so that, the new data could be correlated with the old data (Figure 2).

SEDIMENTARY ENVIRONMENTS

The bone fragments were accumulated almost "in situ" in a very shallow flooded area situated on the banks of a lake system with carbonate sedimentation (Figure 3). The area was subjected to several cycles of expansion-retroaction in relation to the layer of water that caused the change of the sedimentation of silt marsh (times of low water) to another of carbonates (times of high water). At least, three cycles are recognized (see Alonso et al., 2001; Alberdi et al., 2001).
Neither the sedimentary characteristics nor the fauna indicate a strongly saline environment in the area around the site, but we can not rule out a certain salinity, always low, marked by the presence of certain species of ostracods (Civis, 1989) and pseudomorphs of lenticular gypsum, though the latter could be related also to the decomposition of plants (Cody, 1979).

TAPHONOMIC CONSIDERATIONS

The remains were not accumulated or transported by alluvial or fluvial currents. The responsible main agents for the accumulation and fracturation of the remains were biological, either by the accumulation of animals by natural death, prevalent in marshy areas, either by the action of predators-scavengers (the evidence of their activity are clear, Alonso et al., 2001) or by trampling of the remains scattered around the marshy area. Moreover, the mortality profile of *Equus altidens*, the most abundant species, is catastrophic; however, other taphonomic features observed on skeletal remains indicate a diachronic accumulation (Alberdi et al., 2001). This could be explained by selective predation and/or a seasonal accumulation of bones. The latter interpretation is consistent with the depositional environment, since the sedimentation was controlled by variations in water level of the lake. It was not possible to assess the possible contribution of human action in the accumulation (Alberdi et al., 2001). The burial was rapid with a majority of very low weathered remains.

FAUNAL CONSIDERATIONS

Gastropods associations are formed by hygrophilous and mesophilic species: very hygrophilous gastropods living on the edge of water bodies or in their vicinity, and gastropods that inhabit open habitats without tree cover, with broad tolerance to changes in humidity and temperature (Robles, 1989).
The faunal association of vertebrates from the site of Cúllar de Baza-1 known so far is: *Leuciscus pyrenaicus*, *Acanthodactylus* cf. *A. erythrurus*, *Lacerta* cf. *L. lepida*, *Lacerta* (*Podarcis*) indet., Lacertidae gen. sp. indet., *Chalcides* cf. *C. bedriagai*, *Chalcides* indet., Scindidae gen. sp. indet., *Blanus cinereus, Testudo* sp., *Sorex* sp., *Neomys* sp., *Crocidura* sp., *Cricetulus* (*Allocricetus*) *bursae, Eliomys quercinus, Apodemus* aff. *A. sylvaticus, Microtus* (*Microtus*) *brecciensis, Arvicola mosbachensis, Lepus* cf. *L. granatensis, Canis etruscus, Crocuta crocuta, Mammuthus trogontherii, Equus altidens altidens, Equus suessenbornensis, Stephanorhinus etruscus, Sus* cf. *S. scrofa, Bison* sp., and *Dolichodoryceros savini* (Alberdi & Ruiz Bustos, 1989; Alberdi *et al.*, 1989a, 1998; Alcalá & Morales, 1989; Azanza & Morales, 1989; Cerdeño, 1989, 1993; Mazo, 1989; Sesé, 1989). The Testudinidae of thick plates found in the area of Cúllar de Baza indicate warm summers and the presence of immature individuals also supports it (Jimenez-Fuentes & Martin de Jesus, 1989).

ARCHEOLOGY

The remains attributed to human activity at Cúllar de Baza-1 are scarce. In 1973 two worked nodules in quartzite and dolomite were found with five manuports (some with fractures) weighing slightly more than 1,000 g and of calcareous nature. Their presence in a clay package could only be explained by anthropic transport, because the environment did not have enough power to justify its appearance next to the bone remains (Ruiz Bustos, 1984). In 1987, many more manuports were found in similar conditions with two exceptionally fresh flint flakes (CU-87-A83 and CU-87-B175). Both have flat butts and they are unretouched but, as they are third-order products, it indicates that their origin is a reduction sequence and not the configuration of a tool on nodule. Very little can be said from these pieces but its archaic attributes could fit with the typical characteristics of a Lower Palaeolithic industry with a similar chronology (Vega, 1989).

CONCLUDING REMARKS

The middle Pleistocene mammal fauna from Cúllar de Baza-1 documents the last major biotic event in the Mediterranean region, the Galerian turnover (Alberdi et al., 1997, Azanza et al. 1999, 2000) that led to the installation of the extant fauna, not only at the taxonomic level, but also in the size structure of the communities of large mammals. This event coincides with a major global climate change largely documented at the beginning of Middle Pleistocene or lower Galerian. Approximately 1 Ma ago, a change occurred in the periodicity of 41 ka to 100 ka in the overall scheme of glacial-interglacial fluctuations already started at the end of Villafranchian, accompanied by a significant decrease in temperature (Shackleton, 1995, Suc et al., 1995). The climatic and environmental conditions observed at Cúllar de Baza-1 are in agreement with this climatic deterioration. An open environment can be detected at Cúllar de Baza-1, where the low diversity of rodents indicates a colder climate (Alberdi et al., 2001). The oxygen isotope composition of phosphate from horse teeth and bones confirmed that the temperature during the Pleistocene shows important oscillations (Sanchez et al., 1994). The data obtained by these authors indicate lower temperatures at Cúllar de Baza-1 than those for the end of the Villafranchian (Venta Micena). Although those temperatures are not as low as in other localities from the base of the middle Pleistocene, and in any case they did not reach the minima found during the middle Villafranchian (El Rincón, Albacete: Alberdi et al., 1982).
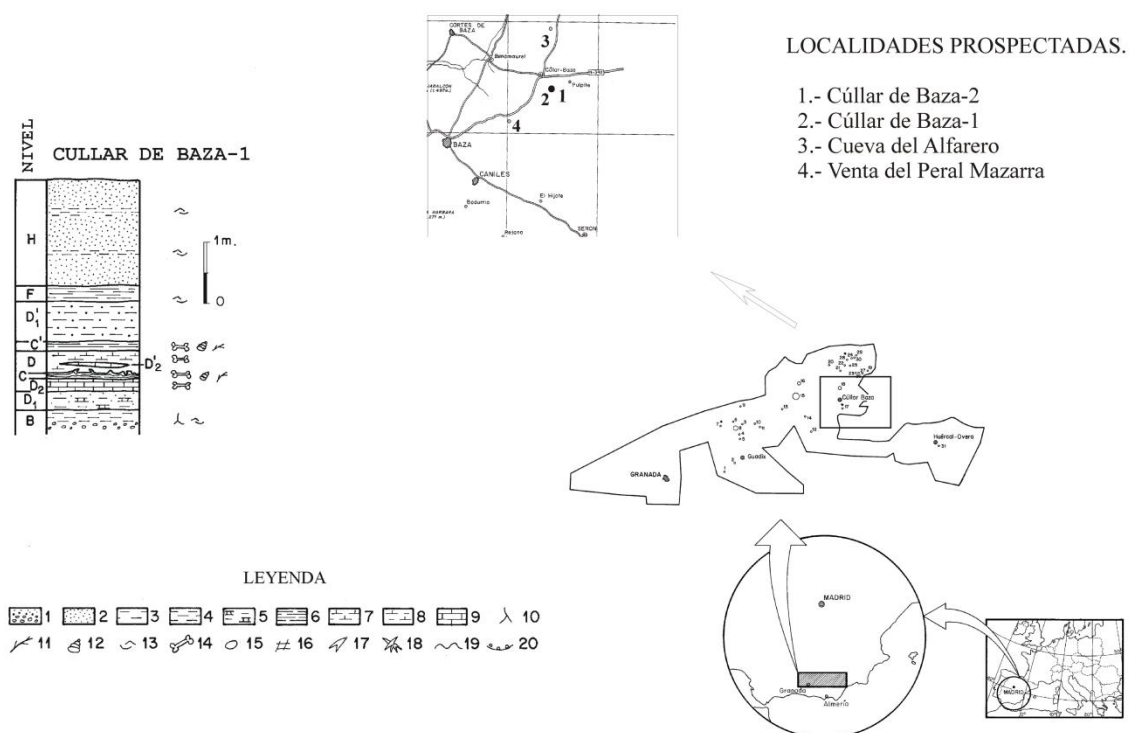
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FIGURES

Figure 1.- Location of the prospected localities with micromammals in the area around Cúllar de Baza and stratigraphy of the deposits at Cúllar de Baza-1. Legend: 1.- Conglomerates and sand; 2.- Sand; 3.- Coarse sand; 4.- Alluvial sediment; 5.- Carbonated sand; 6.- Clay; 7.- Marl; 8.- Marly clay; 9.- Limestone; 10.- Roots; 11.- Fragments of plants; 12.- Gastropods; 13.- Ostracods; 14.- Level of preferential accumulation of bones; 15.- Calcareous concretion; 16.- Carbonates; 17.- Lenticular gypsum; 18.- Gypsum concretions; 19.- Surface of erosion; 20.- Channels.

Figure 2.- Graphical representation of the excavated area at Cúllar de Baza-1 by Ruiz Bustos (1973-75) in relation to that excavated by Alberdi and collaborators in 1987. Graphical representation of the layer II (51-100 cm deep) brought to light during the excavation in the area B at Cúllar de Baza-1.
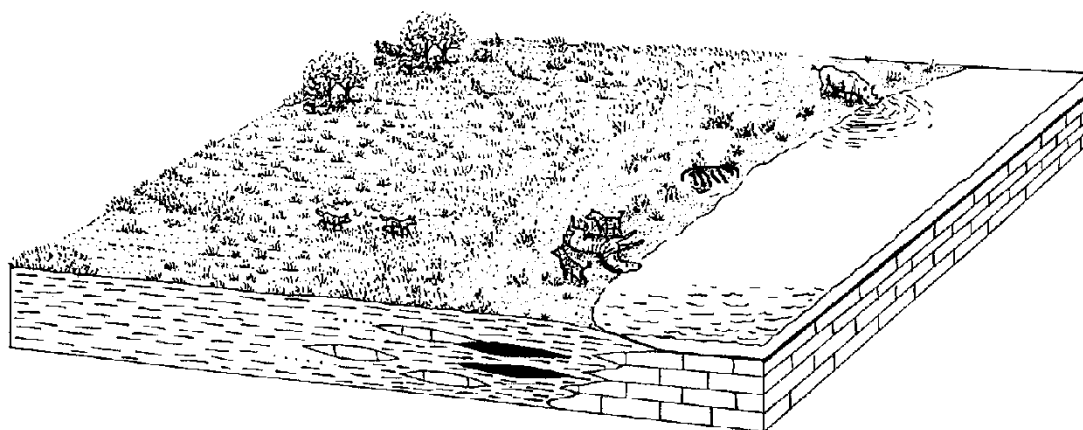
Figure 3.- Sedimentary model and formation conditions of the site Cúllar de Baza-1 (modified from Alberdi et al., 2001).

FIELDTRIP 2, 2nd OCTOBER

VISIT TO FONELAS P-1 SITE

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THE GUADIX BASIN
<u>Geological general features</u>

The Guadix Basin is located in the central sector of the Betic Cordillera and occupies some 4600 km^2 on the contact between the Internal and External Zones. The basin's sedimentary filling has been divided into six genetic units whose boundary unconformities are related to both tectonic events and eustatic changes. The two lower units (Units I and II) are Late Tortonian, corresponding to a stage of marine sedimentation, the third (Unit III) includes sediments deposited during sea retreat from the central sector of the Betic Cordillera at the end of the Tortonian and the three most modern (Units IV, V and VI) cover the Late Turolian to the Late Pleistocene, which was a period of exclusively continental sedimentation in an endorheic (a basin with internal drainage, where no surface drainage reaching the ocean can be detected) basin context.

This sedimentary stage was interrupted in the Late Pleistocene, when a geomorphological inversion of the basin took place and it was captured in its entirety by the drainage network of the Guadalquivir River, becoming an exorheic domain mainly subjected to erosion. The Fonelas P-1 large mammals site is dated to 2,000,000 year B.P. and forms part of the continental sediments of Unit V (Upper Pliocene).

<u>Palaeogeography and local sedimentary context</u>
Using both the origin of the sediment supply and analysis of sedimentary facies during the continental filling of the basin, two sectors with different depositional characteristics have been differentiated: the eastern sector, mostly occupied by a large shallow lake acting as base level for the whole basin, and the western sector, dominated by alluvial fans and fluvial plains, draining towards the eastern lake. Three main drainage systems have been distinguished in this western sector, where the Fonelas P-1 site is located.

Lying approximately parallel to the axis of the basin, the Axial System is represented by a broad fluvial valley through which the main drainage to the eastern lake took place. In its proximal zone this system connects with alluvial fans lying at the foot of the Sierra Nevada reliefs. The rest of it consists of a flood plain crossed by high sinuosity channels (meandering rivers) and occasionally occupied by shallow ephemeral lakes and palustrine areas. The Fonelas P-1 site is located palaeogeographically on the flood plain of this Axial System, near the mouth of a channel in one of the shallow lakes
The Axial or Longitudinal System was fed transversally by two other drainage systems made up of coalescing alluvial fans and named the Internal and External Transverse Systems, as their source areas were installed on the reliefs of the Internal Zones (Sierra Nevada and Sierra de Baza) to the South, and the External Zones (Sierra Arana, Montes Orientales, Sierra del Pozo and Sierra de Cazorla) to the North. In the case of the top of Unit V (Upper Pliocene) and in Unit VI (Lower Pleistocene), the Axial System was

located closer to the reliefs of the External Zones. This meant that the fans of the External Transverse System had a short radius (less than 3-4 km) and a wide sweep angle, whereas the fans of the Internal Transverse System had a 10-12 km radius and less sweep angle, coalescing to form a bajada system.

Progradation of the transverse systems led to local obstruction of axial drainage in the basin, which explains why some sectors of the main valley were temporarily occupied by small shallow lakes. Their shallowness and small size in relation to their alluvial feeder systems affected their ephemeral nature, subjecting them to frequent changes in depth and displacement of coastline.

The literature contains numerous examples of vertebrate sites in sediments of the axial system of continental basins with this paleogeographic pattern, such as the Pliocene in the Awash River basin in Ethiopia, the Miocene of the Siwalik Group in Pakistan or the Paleogene of the Bighorn Basin in Wyoming.

The stratigraphic series of Units V and VI at the Fonelas P-1 site is 70 m thick. There is alternation of detrital and carbonate sediments in fining-upward cycles 2 to 6 m thick. As described in detail in previous studies of this basin, this vertical succession of lithofacies with upward decreasing energy characterizes sedimentation of a meandering dominated flood plain, similar to what occurs in many other examples.

FONELAS P-1 SITE
<u>Facies associations related to the Fonelas P-1 site</u>
The Fonelas P-1 site lies on the intermediate part of one of the fining-upward cycles characterizing sedimentation in this sector of the basin. Palaeontological excavation of the site (Trench B) has identified several sections of different orientation distributed over approximately 30 m^2. It has therefore been possible to draw up several detailed stratigraphic logs lying very close together, establish a direct correlation between them and identify the lithofacies and 3-D geometry of the sedimentary bodies where the accumulation of large mammal fossils is found.

Five facies associations at the site (A-E) have been described, and facies association E contains the bone association (the significance of facies C, D and E are discussed in terms of subenvironments and sedimentary processes).

- *Facies association C (abandoned channel)*
This overlies association A by means of a gradual change. It consists of alternating layers of sand and lutite from 5 to 25 cm thick and several metres wide, but no bigger than the channel where association A developed. In the sandy layers, grain size is medium and current ripples can be distinguished (lithofacies Sr) indicating flow towards the NNE and horizontal lamination (Sh). The lutite intervals present parallel or slightly wavy lamination (lithofacies Fl) with a base adapted to the top of the underlying association A sigmoids and a top tilting less than the bottom, developing a spoon shape in vertical section. Their southeastern part is thicker and base and top are concave upwards. Site excavation has exposed several square metres of the top of one of these lutite layers, showing both current marks indicating northeastwardly flow and ichnites caused by passage of large mammals on a substratum consisting of lutitic mud beneath a shallow layer of water. The top of this layer, of which 18 m^2 have been mapped, also shows desiccation cracks at several points.

According to its types of lithofacies and the shapes of the sedimentary bodies they form, facies association C can be interpreted, as in other examples as the filling of a channel in a stage of gradual abandonment. During this process, periods of low energy traction flow (development of sandy layers with current ripples) alternated with periods of lack

of flow, when fine sediments settled and clay plugs developed that gradually filled and softened the topographical depression of the old channel.

- Facies association D (flood plain)

This is located in gradual transition above facies association C. It is a series of cycles with two intervals: a lower one of horizontally laminated lutite (lithofacies Fl) and calcium carbonate nodules, occasionally beginning with medium to fine sand with ripples (lithofacies Sr); and an upper interval of nodulous limestone or marly limestone and abundant root traces (lithofacies Mr). These elementary lutite-carbonate cycles recur four times with remarkable (tens of metres) extension. Disperse large mammal fossils are found, although no ichnites can be detected, unlike the case of the lutite layers in facies association C.

Because of the similarity between these sediments and other examples described in the literature, we interpret this facies association as distal flood plain deposits. By comparison with other outcrops in the basin, where this facies association can be traced by direct correlation to the channel whose overflow produced it, we can estimate a distance of around one hundred metres from the sinuous active channel.

- Facies association E (bioturbation)

This occupies the same stratigraphic position as facies association C (abandoned channel) and is separated from it by a highly irregular net surface. Facies association E is a ribbon-shaped body 25 to 40 cm thick and tens of centimetres wide mainly oriented SW-NE. The base has a very irregular morphology, while the top is flat-horizontal. Seen in cross-section, the boundary surface of this body has vertical walls with scalloped morphology (small saw-toothed cavities) tens of centimetres thick. The most characteristic lithofacies of this body are sub-angular, very irregularly sized fragments of lutite strata from association C held in a matrix of sand, clay and silt. It has no internal organization (massive or chaotic structure) and there are some rather narrow levels of sand not more than 3 cm thick with ripples similar to the sandy intervals in facies association C (Sr). It should be pointed out that there is often lateral coincidence between the lutite levels of association C and stratiform lutite fragments in facies association E. The importance of association E is that it contains the large mammal fossil concentration with most elements and highest diversity of species at the Fonelas P-1 site (Trench B).

We interpret this facies to be the result of animal bioturbation of the sediments of association C (abandoned channel) exposed to weathering and whose original features were completely destroyed by the effects of mammal passage, since we take the site, linked with facies association E, to be a hyena den where these animals were active. The excavating action of these animals' feet on a soft substratum (clay plugs) was the main cause of the massive or chaotic structure of association E. This interpretation is supported by two main pieces of evidence: 1) the presence of large mammal ichnites in the lutite interval of facies association C, immediately prior to association E and on which the latter lies at several places of the site and 2) the concentration of the most abundant accumulation of bones in the bioturbated lithofacies, as there is a direct relation between this lithofacies and the fossil record. Similar examples of deformation of soft sediments by passage of large vertebrates have been described in both modern and ancient fluvial and marginal lacustrine flood plain environments.

<u>Sedimentological/taphonomical production of the site</u>
The largest concentrations of bone remains at the Fonelas P-1 site (Trench B) appear in what we have described as facies association E, located in a very specific position in one of the characteristic cycles of the succession in Unit V of this sector of the basin. The simple lithofacies making up associations A to D, as well as the spatial relation between facies associations were explained in 2006. The sedimentological evidence indicates that the area was crossed by a sinuous fluvial channel flowing north-eastwards which at this point made a convex curve towards the East. The reconstruction of this channel in the area excavated suggests its sinuous nature, as is corroborated by the continuation of the sedimentary body to the North, where, several hundred metres from the site, another curve of the same channel can be reconstructed, in this case convex towards the West.

Unfortunately, neither the base of the channel nor the accretion margin during maximum fluvial activity outcrop sufficiently well for observation. However, the grain size of the sediment and the size of the bars and other bedforms suggest that this was not the main channel of the Axial System, but rather one of the many meandering secondary channels crossing the distal plain of the system and connected to the main channel. Taking the data available from the outcropping part of this channel and by comparison with other well exposed examples in this sector of the basin, we can estimate a size for this channel in bankfull state of 6-8 m wide and around 1.5 m deep. The remarkable facies association E (bioturbated) is clearly unlinked to this evolution of purely fluvial processes. Moreover, it does not appear in the other cycles of the succession. The fact that it is coetaneous with association C (abandoned channel) means we can genetically link the animal bioturbation with the last stages of the channel's evolution. Thus, the slight depression formed by the residual channel in the stage of abandonment (ox-bow lake), occasionally ponded by both rainwater and overflow from the nearby active channel, would have been a relatively protected area, with easy access to water for the animals, probably used by some (carnivorous scavengers) as feeding place and den. This hypothesis of a hyena den is also based on data, which show intensive feeding on bones by scavenging carnivores, as well as the fact that the animals did not die at the site (with the possible exception of *Pachycrocuta brevirostris* cubs). Passage of animals over such a depression with a very soft substratum would have caused a very dense pattern of tracks, creating narrow corridors with an intensely bioturbated bottom, coinciding approximately in orientation with the abandoned channel). After complete filling of this residual channel, the topography would have been homogenized at the level of the flood plain. This is why the particular location of the site ceased to be a preferential occupation zone for the animals, just at the beginning of the development of facies association D (flood plain). At this point, the main animal occupation must have transferred to another place providing the topographical conditions described above (probably to Fonelas SCC-1 paleontological site, one kilometre to the North). The high sedimentation rate in the abandoned channel, resulting from both the local concentration of sediment from rainfall and detrital supply from overflow of the active channel in its new position (about a hundred metres from its previous position), and from chemical precipitation of the flood plain, led to the burial of the fossil accumulations. This genetic context characterizing the site remained outside the erosive influence of fluvial channels, which were displaced tens or hundreds of metres from the abandoned channel. Consequently, the position of this site in the context of the local evolution of an alluvial channel abandoned by avulsion coincides with that of other vertebrate sites described in the literature.

The main results of the stratigraphic and sedimentological study are the following:
- On the scale of the general palaeogeography of the basin, the Fonelas P-1 site is located on the distal stretch of the axial drainage system of the Guadix Basin, near its connection to a shallow lake, occupying a palaeogeographic situation similar to that of many other vertebrate sites.
- The site is located in a sedimentary cycle typical of a meandering fluvial system. This cycle consists of four facies associations related to fluvial processes: (A) gravel and/or sand in layers with sigmoidal geometry, caused by the lateral accretion natural to the filling of a sinuous channel, (B) sand and lutite in wedge-shaped bodies abutting onto the erosion bank of the channel, interpreted as levee deposits, (C) fine sand and lutite in sigmoidal laminae, gradually overlying the A facies and representing progressive channel abandonment deposits, (D) lutite and carbonate in extensive horizontal layers lying directly on the C facies and recording typical flood plain sedimentation.
- The main accumulation of large mammal fossils (Trench B) is found in a facies genetically independent of those described above, as it is unconnected with purely fluvial processes. This facies (E) consists of very angular fragments of lutite of the C facies (channel abandonment) with no internal organization, held in a matrix of sand, silt and clay and is interpreted as the result of bioturbation of a soft substratum by continuous passage of large mammals (carnivorous scavengers, specifically hyaenids) in an occupation space.
- The detailed palaeogeographic context inferred for facies E is that of an abandoned meander. This would have described a slight topographic depression that was periodically flooded, either by rainfall or by small overflow from the distant active channel, and occupied by large mammals.
- The type of facies represented by association E has never before been identified and described in continental basin filling. Its sedimentological and palaeobiological importance is due to the fact that these are biogenetic facies characteristic of the biological activity of large scavenging carnivores on fluvial substrata. Whether they present fossil content or not, they are predictive, as they indicate sedimentary interruption, subaerial exposure and biological occupation wherever they may be identified in the geological record. Recognition of this facies association can be used as a sedimentological criterion for prospecting large mammal activity in future palaeontological research.

FOSSIL RECORD AT FONELAS P-1 (Trench B)
The Fonelas P-1 site contains a vertebrate fossil assemblage consisting mainly of large mammal fossil remains - as well as small minority of amphibians, reptiles, small mammals and birds - by which it can be dated to the Late Upper Pliocene (in the top of Unit V of the Guadix Basin), near the Pleistocene boundary (Late Villafranchian, ca 2,0 Ma).
In four seasons of systematic excavation, almost three thousand bone fragments were recovered. Many are anatomically complete to a high degree (allowing their taxonomic classification), which leads us to consider this as the most important large mammals site from the end of the Pliocene in the entire Iberian Peninsula.

Analysis of first and last appearance data (FAD and LAD) of the species identified to date, and new palaeomagnetic results, corroborates the hypothesis of the time-scale being on the Late Upper Pliocene (2,0 Ma) in zone MNQ18.
The faunal assemblage to date identified at this site consists of 32 species of mammals (Mammalia). Four groups of large mammals have been identified according to their

paleobiogeographic origin and the time-scale of their incorporation into the Iberian paleomastocenosis: i) a group of animals typical of the Late Pliocene in Europe, some of which extended from Asia into these ecosystems around 2,6-2,5 Ma; ii) a second mammal association of Asian origin reaching these latitudes during the Late Upper Pliocene; iii) a third group native to Africa which also reached the Iberian Peninsula during the Late Upper Pliocene; iv) a fourth set of endemic taxa. There is also a fifth group of animals at Fonelas P-1 of uncertain origin (either Asian or African) that reached Atlantic Europe in the same brief interval. Thanks to the quality of the paleontological remains, their extraordinary state of preservation and the abundance of skeletal elements, advanced taxonomic study has led to verification of the presence of new species or subspecies of the genera *Meles*, *Canis*, *Megantereon*, *Gazellospira*, *Croizetoceros, Capra* and *Potamochoerus*.

As this is the only known paleontological record with such a variety of species of such diverse origin, the large mammals assemblage at Fonelas P-1 holds extremely interesting information for the reconstruction of the main migratory routes and the interrelations between African and Eurasian species. In addition, the high scientific interest in this site is due to the fact that, because of the time-scale and combined presence of African and Caucasian species, it is the only site in western Europe similar to the Caucasian site at Dmanisi. Fonelas P-1 is, therefore, the first evidence in Europe to allow definition of the paleoenvironmental framework of the Late Upper Pliocene, when the first humans spread beyond Africa. As such, therefore, attention should be drawn to the enormous similarities between the sedimentary environment of Fonelas P-1 and the recently reconstructed context of the sites of the earliest stone tool makers in the Awash River Basin, Ethiopia.

The provisional assemblage of this site is heterogeneous as regards the palaeobiogeographic significance of the identified taxa and also their biochronological significance. In view of the foregoing, the taxonomic study of Fonelas P-1 will lead to interesting paleontological discoveries regarding faunal turnover and distribution in time of different groups across the European Pliocene-Pleistocene boundary.

Out of all the new sites located by our team since 2001 in this area of the Guadix basin (62 locations with large mammal records), the Fonelas P-1 site has proved to be especially rich in number and diversity of large mammal remains. It is significant that most of the taxa identified at this location are represented by both cranial elements (mainly complete crania, half maxillas and half lower jaws) and parts of the postcranial skeleton (bones of the spine and limbs) that in many cases can be identified as belonging to the same individual. Isolated teeth are rare in this record. They represent only 10% of the total sample and often appear either fragmented with traces of gastric dissolution (teeth belonging to grazing animals such as *Equus*, *Gazellospira* or *Leptobos*), or complete, in a site position vertical to the alveolar region of their corresponding crania (belonging to carnivores such as *Canis* and *Hyaena*).

Vertebrate association of Fonelas P-1 (Trench B).
REPTILIA
Lacertidae gen. indet.
Anguidae gen. indet.
Rhinechis scalaris (Schinz, 1822)
Viperidae gen. indet.

AVES
Aves gen. indet.
MAMMALS (LAGOMORPHA)
Prolagus cf. *calpensis* Major, 1905
** *Oryctolagus* sp.
MAMMALS (INSECTIVORA)
** Erinaceidae gen. indet.
MAMMALS (RODENTIA)
Eliomys sp.
Mimomys sp.
Apodemus cf. *atavus* Heller, 1936
Castillomys sp. gr. *C. crusafonti* Michaux, 1969-*C. rivas* Martín Suárez y Mein, 1991
Stephanomys sp.
MAMMALS (CARNIVORA)
* *Meles iberica* Arribas y Garrido, 2007
Vulpes alopecoides (Forsyth-Major, 1877)
* *Canis accitanus* Garrido y Arribas, 2008
Canis etruscus Forsyth-Major, 1877
Canis cf. *falconeri* Forsyth-Major, 1877
Pachycrocuta brevirostris (Aymard, 1846)
Hyaena brunnea Thunberg, 1820
Lynx issiodorensis valdarnensis Werdelin, 1981
Acinonyx pardinensis (Croizet y Jobert, 1828)
* *Megantereon cultridens roderici* Arribas y Garrido, 2008
Homotherium latidens (Owen, 1846)
MAMMALS (ARTIODACTYLA)
* *Potamochoerus magnus* Arribas y Garrido, 2008
* *Croizetoceros ramosus fonelensis* Garrido, 2008
Metacervoceros rhenanus philisi (Schaub, 1941)
Eucladoceros sp.
** *Mitilanotherium* sp.
* *Gazellospira torticornis hispanica* Garrido, 2008
* *Capra baetica* Arribas y Garrido, 2008
** *Praeovibos* sp.
Leptobos etruscus (Falconer, 1868)
MAMMALS (PERISSODACTYLA)
Equus cf. *major* Depéret, 1893
Stephanorhinus etruscus (Falconer, 1859)
MAMMALS (PROBOSCIDEA)
Mammuthus meridionalis (Nesti, 1825)

(*) singular taxa at Fonelas P-1.
(**) in study.

Other taxa (unpublished):
Eurotestudo sp. (fossils).
Hystrix sp. (taphonomical evidence: toothmarks).

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Note: during the visit to the site (Fonelas P-1) copy of an article will be delivered to the assistants, with the most recent information of the research.

THE ARCHAEOLOGICAL SITE OF SOLANA DEL ZAMBORINO

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1. LOCATION AND HISTORY OF THE RESEARCH

The archaeological site of Solana del Zamborino is located on the western region of the Guadix Basin. It is located in the property of Cortijo Guájar Viejo, around 7 km far from the village of Fonelas.

The site is located at 992 m above the sea level and precisely at the boundary between the depression of Guadix and the beginning of the cliffs and steep areas (also called badlands), which is the characteristic landscape of this region of Granada (Botella López 1975).

The deposit was discovered during the construction of a road between Hernán Valle village and the Cortijo de Guájar, which uncovered a fossil and stone artifacts deposit. During the following years, the site was visited several times by fossil collectors. In 1970, Carlos Asenjo Sedano and Eduardo Lao Beas, after several visits to the site and the discovery of several faunal remains and lithic industry, contacted the Department of Prehistory at the University of Granada.

Finally, given the importance of the findings, a team of researchers was organized, leaded by Miguel C. Botella López, director of the excavation and the study of the archaeological material, and J.A. Vera (Geology), J. Porta (Paleontology), and N. Solé (Palinology) (Botella López 1975; Botella López, Porta et al. 1976).

The first dig season, in 1972, was conducted in the slope of the road, 9 m^3 of materials were dug above the fertile levels. Once the excavation area was exposed, three sections were done: two of 6x2 m and other of 5x3 m with a depth of 4 m in all outcrops, so in total about 39 m^2 were dug (Botella López 1975; Botella López, Porta et al. 1976; Penela 1988).

In the second dig season, in 1973, withdrew the overlying sterile archaeological levels in an area about 400 m^2, and four new sections were opened: one 7x3 m E-W oriented (located northeast of the surface of the excavation), two of 6x2 m E-W oriented (parallel to those made in the previous season), and one of 5x2 N-S oriented, located East of the above, leaving a 1-m T-shaped core sample between the last three sections. The excavation was finished to reach about 4 m deep above the level of limestone that limit the archaeological deposit (Botella López 1975; Botella López, Porta et al. 1976).

On 1975 Prof. Botella expanded the excavated area, digging another new 27 m^2 during this year. And more than 58 m^2 were dug in the following year. Thus, in total, about 180 m^2 were dug during these four years (Martín-Penela 1988; Santonja Gómez 1992). In the following two dig seasons (1977-1978) there is no detailed information.

2. STRATIGRAPHY AND GEOLOGICAL CONTEXT

The site is located in the western sector of the Guadix basin, where two geological formations are recorded, the Guadix and the Gorafe-Huélago formations. The Guadix Fm. occupies most of the sector, corresponding to a fluvial deposit, while the second corresponds to a lacustrine deposit. The fossiliferous levels that constitute the site represent a swamp-lacustrine episode developed on the above materials (Botella López, Porta et al. 1976; Penela 1988).

The context of the findings correspond to a small lake, with wide seasonal variations of water flows (Díez Fernández-Lomana 1992).

Six stratigraphic levels were identified (A, B, C, D, E and F), of which only 3 have archaeological remains (Botella López, Porta et al. 1976). Thus, the level A (also called Lower Level) is composed of clay, silt and very fine sands. Here few faunal remains and stone industry were recovered. Level B (also called Central Level), is the richest one in terms of faunal remains and stone artifacts, and it is composed of black clays and other lighter color, but also of sandy loam. Level C (also called Upper Level), has less stone tools and faunal remains than the lower ones, it is composed by clay, very fine sands and silts. These three levels correspond to an initial sedimentation of fluvial origin that gradually becomes a lake, with an episode through local water-logging and mounds of vegetation, which has the largest accumulation of fauna and lithics (Botella López, Porta et al. 1976).

Level D is composed of limestone and seals earlier archaeological levels. Level E is composed of clays with interbedded conglomerates. Level F, is the only one which doesn't belong to the Guadix Formation and corresponds to the level of filling of the basin (Botella López, Porta et al. 1976).

3. PALEONTOLOGY AND TAPHONOMY

About 8000 faunal remains were recovered, with a great diversity of herbivores, few remains and small diversity of carnivores. The most abundant remains correspond to large bovids and horses, followed by red deer and fallow deer. Also, other megaherbivores are recorded but in a small number of specimens, especially rhinos and elephants (Penela 1976; Penela 1987). The remains of pigs, monkeys and hippos are vestigial (Díez Fernández-Lomana 1992). The complete faunal list is:

Sorex sp.
Crocidura sp.
Lepus sp.
Oryctolagus cf. *Cuniculus*
Allocricetus bursae colombierensis
Arvicola sapidus
Microtu brecciensis
Apodemus cf. *flavicollis*
Eliomys quercinus cf. *quercinus*
Eliomys quercinus cf. l*usitanicus*
Canis cf. l*upus*
Felis sylvestris
Lynx cf. p*ardina*
Panthera (Leo) spelaea
Equus caballus torralbae
Dicerorhinus hemitoechus
Sus scrofa
Palaeoloxodon antiquus
Mammuthus trogontherii
Hippotamus sp.
Cervus elaphus
Dama sp.
Capreolus capreolus
Bos (bos) primigenius
Bos (Bison) priscus

Table 1- The Macromamals List (from Martín-Penela, 1988)

Although most of the species belong to forest environments, the species associated with grassland habitats are nearly 60% of the recovered remains (Penela 1988; Díez Fernández-Lomana 1992; Díez Fernández-Lomana 1993). The faunal data indicate that the site is more recent than the locality of Cúllar-Baza I and it is earlier than other late Middle and Late Pleistocene karstic archaeological sites bordering Guadix Depression, such as Cueva Horá and Cueva de la Carigüela (Santonja Gómez 1992).
Taphonomic studies by Díez Fernández-Lomana (1992) indicate that most of the recorded anatomical parts mostly represent complete skeletons, suggesting that the death of the animals were directly on the site, and then, the autochthonous character of the taphocenosis. Moreover, the age profiles suggest a non-selective mortality, with early access to the spoils. Furthermore, the different conservation of the remains, indicates the existence of post-mortem differential treatments that are more linked to natural processes that man-made. The exception is found in horse and bovid remains that have similarities in post-mortem processes, which may suggest the action of hominids.

4. MICROMAMALS

The set of small mammals recovered from the excavation was studied by Ruiz Bustos (1975, 1982) and subsequently, by C. García García (García García 1977; García García

and Rosino 1983). The faunal list indicates the presence of *Apodemus* cf. *flavicolis* (58 specimens), which is found in large forests environments. Furthermore, its presence suggests a transition from a temperate climate to a cold stage (Ruiz Bustos, Toro Moyano et al. 1982). The other identified species of rodents, were *Allocricetus bursae*; *Eliomys quercinus* cf. *quercinus* (also recorded at Cullar-Baza I) *Eliomys quercinus* cf. *lusitanicus*; *Microtus brecciensis* and *Arvicola sapidus*. The presence of these species suggests that the archaeological site can be placed at the end of the Mindel-Riss interglacial, at one stage of the onset of climate change and ecological conditions (Ruiz Bustos, Toro Moyano et al. 1982). Metric comparisons with specimens of Cúllar-Baza I are very similar but nevertheless it presents characteristics to include them in the second half of the Middle Pleistocene (Ruiz Bustos, Toro Moyano et al. 1982).

5. PALAEOENVIRONMENTAL RECONSTRUCTION

The study of preferential habitats of certain species, together with the stratigraphy, sedimentology and paleogeography, allowed to estimate the paleoecological and paleoclimatic conditions of the region at the time of formation of the archaeological deposits (Penela 1988).
According to the paleoenvironmental interpretation, it is estimated that during this period the region had a mild and humid climate, with the predominance of large and abundant grassy flooded areas, near wooded areas (Penela 1988; Díez Fernández-Lomana 1992; Díez Fernández-Lomana 1993). These weather conditions could correspond to the Riss II-III Central Europe (Penela 1988; Díez Fernández-Lomana 1992).

6. LITHIC TECHNOLOGY

The recovered lithic assemblage, amounting up to 1,500 pieces, was never subjected to a detailed study, hardly any small references in various publications of the site. The used raw materials are quartz, quartzite and flint, in order of use. The quartz and quartzite could be found in the beds of ancient rivers of the Guadix basin (Botella López, Porta et al. 1976; Díez Fernández-Lomana 1992), while the siliceous materials appear to come from both, the Sierra de Arana (to West) and the Sierra del Mencal (to North), both further away from the archaeological area (Botella López, Porta et al. 1976; López Reyes 1998).
The choppers as the cores are abundant (Martínez Fernández and López Reyes 1998), especially the ones with unifacial knapping (Díez Fernández-Lomana 1992). Most of these objects are also made on quartz and quartzite, possibly due to the ease access and quality of the raw material (Díez Fernández-Lomana 1992). On the other hand, the flint cores are less numerous, but show the preparations of the striking platform and have a more intense knapping work.
Most objects are retouched flint and the most abundant are racloir, denticulate and notches. A few number of handaxes, scrappers and cleavers made of quartz and flint were identified (Botella López, Porta et al. 1976). The Levallois technique is very scarce (Díez Fernández-Lomana 1992; Martínez Fernández and López Reyes 1998). The observed diversity in the knapping method of the different raw materials, especially between the flint and quartz, has made difficult to classify the lithic assemblage inside a technological mode. However, according to Prof. Miguel Botella, the assemblage exhibits all features to be included in the called "Achelense Final Mediterráneo" (Latest Mediterranean Acheulean), within the set of Acheulean industries that mark the

transition between the Middle Pleistocene, and the Late Pleistocene (Botella López, Porta et al. 1976; Díez Fernández-Lomana 1992).

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FIGURES
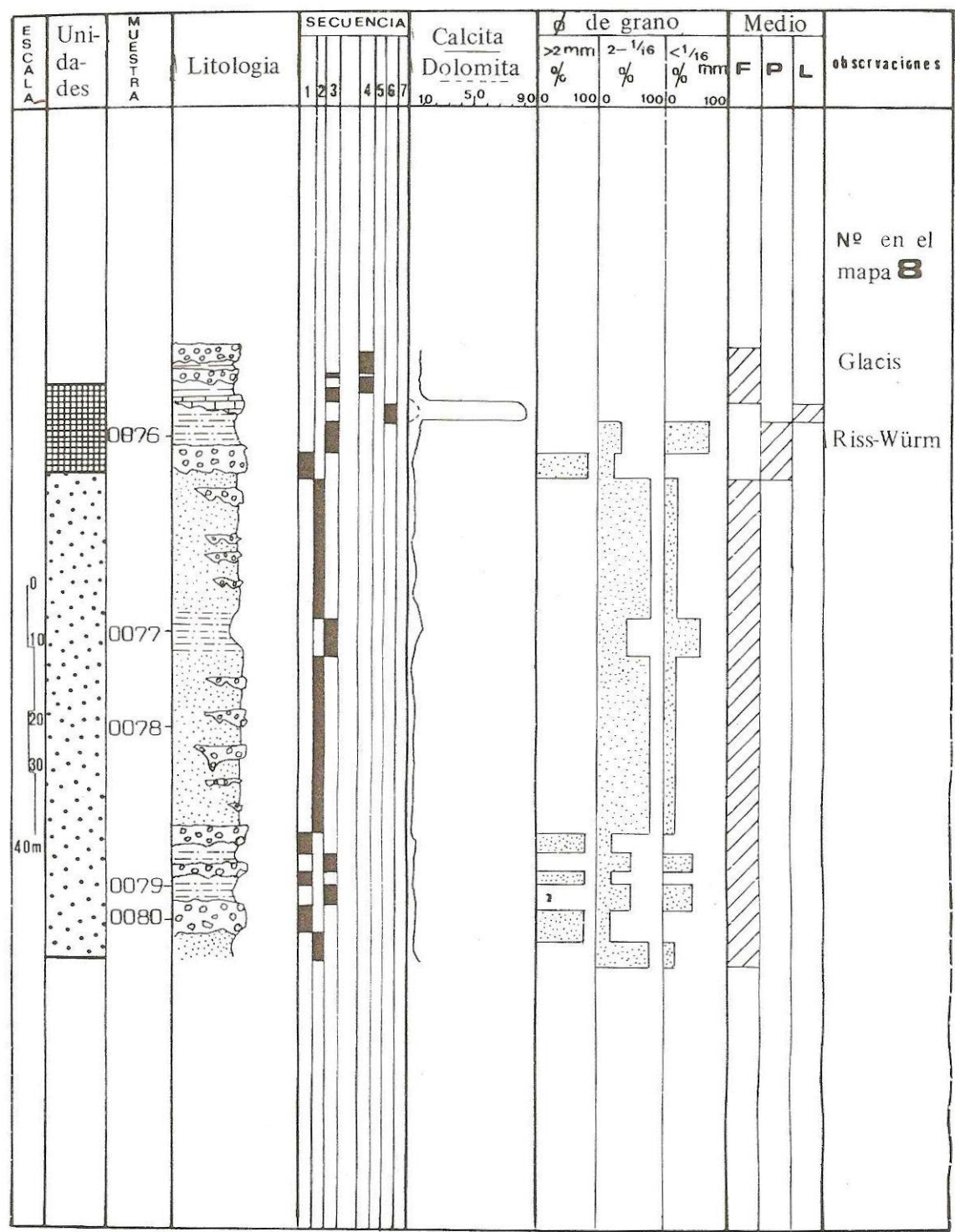

Figure 1. Stratgraphic series of the archaeological site of Solana del Zamborino (from Peña 1975).

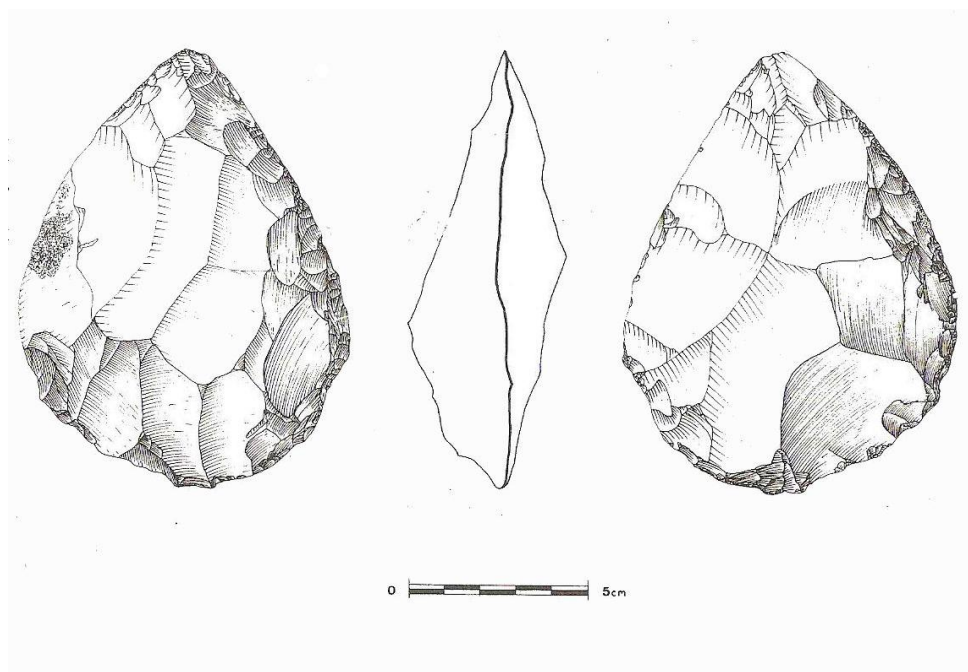Figure 2. Handaxe recovered from surface (from Botella López, Porta et al. 1976).
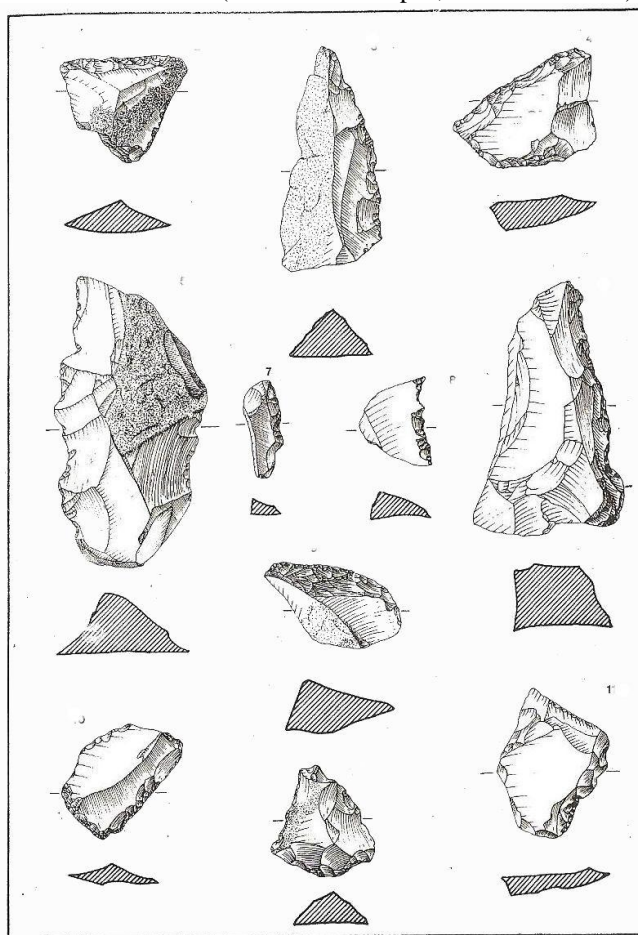

Figure 3. Stone artifacts recovered from surface (from Botella López, Porta et al. 1976).
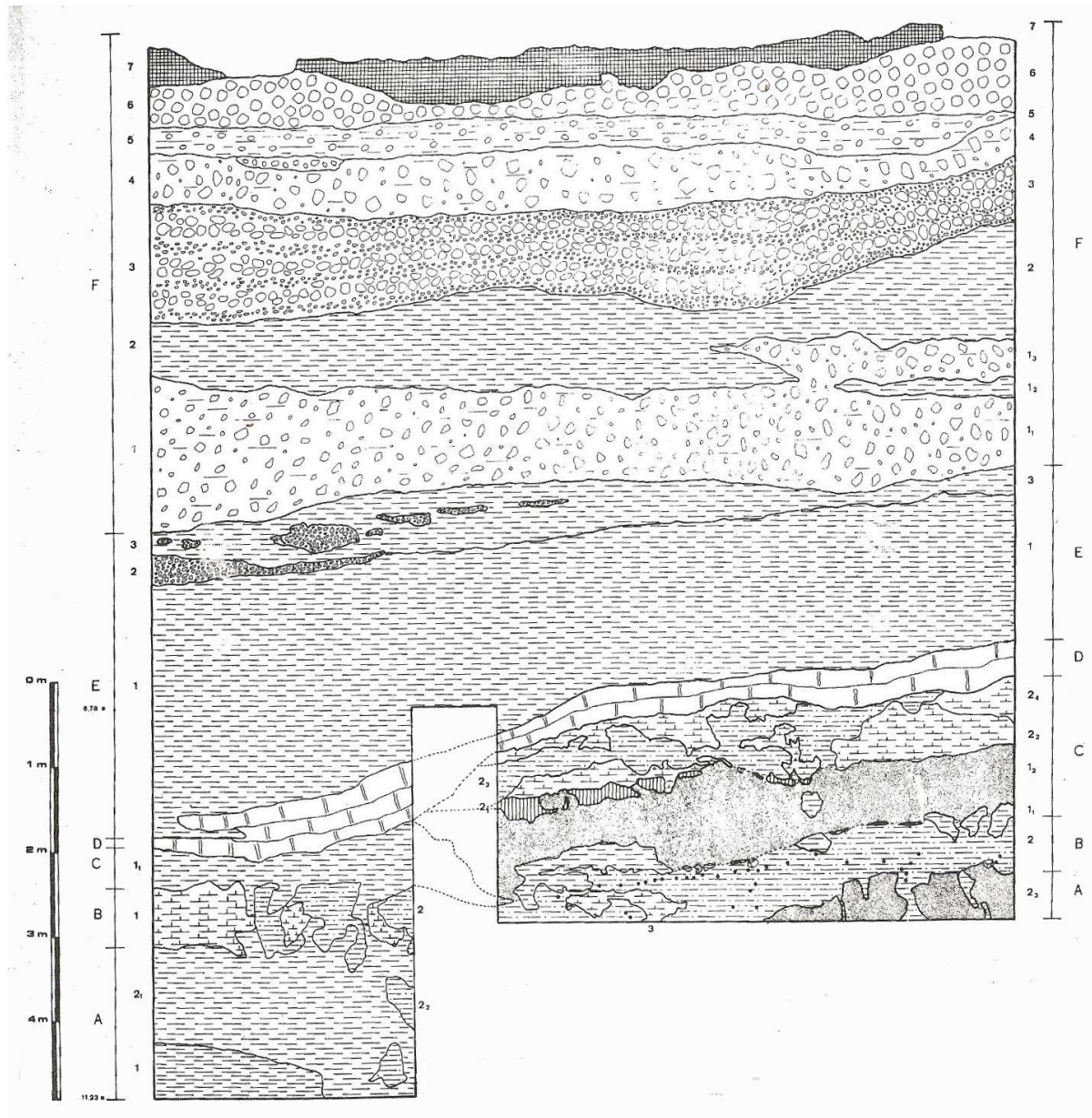
Figure 4. Stratigraphic column from two of the sections (number 1 and 3) of the site. The fossil remains are represented by black points and the quartzite stone artifacts are drowned at scale (from Botella López, Porta et al. 1976).

THE SITE OF PADUL (GRANADA, SPAIN): ONE OF THE LONGEST
PLEISTOCENE PALEOENVIRONMENTAL RECORDS FROM SOUTHERN
EUROPE

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1. INTRODUCTION

Long paleoenvironmental records are necessary in order to understand recurrent
climatic or paleoenvironmental changes occurring with a certain periodicity (e.g.,
glacial-interglacial cycles). The advantage of these records is that they offer constant
background site characteristics; secure chronostratigraphical positions and minimal
differences in species' immigration rates (Tzedakis and Bennett, 1995). In this respect,
Padul peat bog, located in the Granada province, in the southern part of the Iberian
Peninsula (Fig. 1), has one of the best available records of Pleistocene sediments in
Southern Europe. The sedimentary sequence is more than 100 m thick and has been
used to study palaeoenvironmental change. Several cores have already been taken from
this basin and previous papers on its stratigraphy and palynology have been published:
Menéndez Amor and Florschütz (1962, 1964), Florschütz et al. (1971), Pons and Reille
(1988) and Valle et al. (2003), who noted oscillations in the pollen curves related to
palaeoclimatic changes. Another core retrieving the whole sequence was taken in 1997
(Nestares and Torres, 1998) in which Ortiz et al. (2004) studied the organic
geochemistry. These results were interpreted as paleoenvironmental and
paleohydrological changes (Ortiz et al., 2004). More recently, Alvarez-Lao et al. (2009)
published the occurrence of wooly mammoth remains in some of the peat horizons from
Padul, revealing the additional importance of this site with respect to mammal
biogeography.
In this paper, a review of the above mentioned information available from this very
interesting site is provided.

2. GEOGRAPHIC LOCATION AND GEOLOGICAL SETTING

The Padul peat bog is an endorrheic asymmetric basin situated in the southernmost part
of the Granada Basin, around 20 km south of the city of Granada (SE Spain) at
37°01′01″N, 03°36′07″W and 700–800 m above sea level (Fig. 1a). The Granada Basin
itself is a NW–SE orientated Miocene to Pleistocene intramontane basin of the Betic
Cordillera, bounded by two fault systems limited by the Sierra Nevada range to the
north and the Sierra de Albuñuelas to the south (Fig. 1b). The bedrock consists mainly
of faulted Mesozoic dolostones that caused the basin to sink gradually. In the Padul
Basin, which was subsiding during the Quaternary, two alluvial fan systems of erosional
debris were deposited. These coarse sedimentary fans, originated from the Sierra
Nevada, distally evolved into lacustrine and peat deposits that emerge in the NW area of
the basin. The northwestern part of the Padul Basin subsided the most during the
Quaternary and therefore acted as the depocenter of a former lake, which initiated the
peat formation. The resulting peat bog covered an area of about 4 km^2. The sediment
filling of the Padul Basin reaches a thickness of at least 107 m (Ortiz et al., 2004).
The today artificially drained Padul Basin is a discharge area for the groundwater flow

of the surrounding aquifers (Ortiz et al., 2004). The flow directions change from sub-horizontal, in the Mesozoic aquifers adjacent to the basin, to essentially upwards discharge inside the peat-containing depression (Cañada, 1984). Present rainfall in the area is a minor factor in the water balance of the peat deposit and run-off input of water is estimated to contribute only about 8% of the total (Cañada, 1984). Consequently, changes in the water table in the peat are controlled indirectly by infiltration of water from the surrounding mountains, occasioned by accumulation of snow during colder phases and its subsequent melting (Ortiz et al., 2004).

In this area the climate is typically Mediterranean (summer drought) and vegetation around Padul Basin is characterized by a series of vegetation belts (Rivas Martínez, 1987) comprising from low- to high-altitude: a thermomediterranean belt between 0-800 m characterized by the presence of several steppe elements and *Olea europaea*, *Quercus coccifera* and *Pistacia lentiscus*; a mesomediterranean belt, from 800-1400 m, with *Quercus rotundifolia-ilex* y *Q. coccifera*; a supramediterranean belt, from around 1400-1900 m, with deciduous *Quercus* (*Quercus pyrenica*, *Q. faginea*, etc.); an oromediterranean belt between 1900-2200 m with cushion-like *Juniperus*, *Pinus nigra* and *P. sylvestris* and higher up a crioromediterranean belt with tundra vegetation.

3. LITHOLOGY

The lithology of the Padul sedimentary sequence as observed in the ′97 core (latitude: 37º01′01″N; longitude: 3º36′07″W; elevation: 714.20 m; Ortiz et al., 2004) is shown in Fig. 2. The bottom of the sequence, from 107-97 m, is characterized by abundant gravels and interbedded marls. From 97-78 m mainly lutites occur. From 78-69 m these lutites are interrupted by four main gravel horizons at 78, 76, 75 and 70 m depth. Sedimentation became characterized by peaty lutites from 69-52. Peat characterizes the rest of the sequence, from 52 m to the top, with occurrences of about 3 m of marls at ca. 35 m and sands at ca. 32, 7, 6 and 5 m depth. Peaty lutites again occur at around 2.5 and 1 m depth.

The main lithological change that occurs at around 60 m with the change from lutites to peat sedimentation has been interpreted as an environmental change from an open lake environment to a peat bog (Fig. 2; Ortiz et al., 2004).

4. CHRONOLOGY

The age constrain from the Padul sedimentary sequence comes from radiocarbon and U/Th dating, amino acid racemization dating and paleomagnetism. Age uncertainties increase with time and the top 10 meters (>30 cal ka BP) are obviously better dated using ^{14}C than the rest of the sequence (Florschütz et al., 1971; Pons and Reille, 1988; Valle-Hernández et al., 2003; Ortiz et al., 2004). As different cores have been drilled in this basin, different age models have been built. However, they seem to agree in that the geological age of the Padul Basin sequence ranges from late Early Pleistocene (ca. 1 Ma) to middle Holocene (ca. 5.1 cal ka BP; Ortiz et al., 2004; Pons and Reille, 1988). Because of the limitations of the ^{14}C dating method to the last ca. 50 ka, pollen changes, previously correlated to climatic events (e.g., mostly glacial-interglacial cycles), have been used in order to date the sequence. However, the different authors seem to disagree (see below) and different correlations have been proposed (see Florschütz et al., 1971 and Pons and Reille, 1988).

The paleomagnetic data of the uppermost ca. 98 m of the borehole revealed normal magnetic polarity, agreeing with the rest of the dates, and can be assigned to the

Bruhnes Magnetozone (Upper and Middle Pleistocene). For the bottom of the borehole (>97 m), negative polarity was observed and this part was interpreted as belonging to the Matuyama Magnetozone (Lower Pleistocene) (Fig. 2; Ortiz et al., 2004). These results corroborate the amino acid racemization dating of horizon SPD-9710 (885 ± 150 ka) and information obtained from a palynological study from Menéndez Amor and Florschütz (1962) that noted the presence of "old" exotic taxa such as *Liquidambar* or *Carya*.

5. PALEONTOLOGY

Throughout the Padul sequence macrofloral remains are abundant: well-preserved tree wood and bark, branches and leaves. In some horizons mollusk shells were found: Pelecypoda (*Pisidium* sp.) and Gastropoda (*Radix* sp., *Planorbis* sp. and *Succinea* sp.). Ostracod valves have been recovered from marly beds: *Herpetocypris reptans* (Baird), *Candona angulata* Müller and *Candona negleta* Sars.

Padul is very well known between palynologists as it is one of the longest Pleistocene pollen sequences found in the arid Southern Europe. Pollen studies started early in the 60′s and continued until recently (Menendez Amor and Florschütz, 1962, 1964; Florschüz et al., 1971; Pons and Reille, 1988; Valle-Hernández et al., 2003). The different pollen analyses agree in that changes on the vegetation from *Artemisia*-Chenopodiaceae steppe environments (cold-dry periods) to forested vegetation (warm-wet periods) from the last glacial (Würm glaciation) to the Holocene are found. These studies also found vegetation changes related to millennial-scale climate variability such as the Oldest and Younger Dryas cold events, that is reflected in the pollen by increase in steppic elements. Discrepancies between these studies are due to different interpretations of the pollen records due to poor age control lower in the sequence, when dating becomes a problem. For example, Florschütz et al. (1971) who studied a 70 m-long core, interpreted the upper 20 m of the section representing the Holocene and Weichselian (last Glacial) and the part below 20 m was believed to represent the Eemian (last Interglacial), the Saalian (Riss glaciation) and part of the Holsteinian Interglacial. These interpretations differ from Pons and Reille (1988), who studied the first ca. 24 m of the sequence, in that they attribute a warm period at the bottom of their core to the first Prewürm Interstadial and not to the Eemian Interglacial and that no interglacial at Padul is recorded (Pons and Reille, 1988).

Fossil remains of at least four mature to old mature male individuals of *Mammuthus primigenius* have been discovered in the Padul peat-bog (Alvarez-Lao et al., 2009). These mammoth remains appeared associated to remains of steppe bison (*Bison priscus*), red deer (*Cervus elaphus*) and a medium sized horse (*Equus* sp.). Radiocarbon dates indicate their presence in this area between 40.4–30.6 cal ka BP, a time span corresponding with the later part of MIS 3. In their study, Alvarez-Lao et al. (2009) show that the Padul mammoths represent the westernmost portion of an extended and continuous Holarctic belt of mammoth distribution. The southernmost extent of Iberian woolly mammoths seem to correlate with periods of particularly dry and cold climatic conditions during the last glaciation such as Heinrich Stadial 4, where they are documented in terrestrial and marine sediment sequences of the region, paralleling the distribution of suitable steppe- or tundra-steppe like environments.

6. ORGANIC GEOCHEMISTRY AND HYDROLOGY

The elemental (concentration of organic carbon, atomic H/C and C/N ratios), isotopic

(δ^{13}C values of organic matter) and molecular (predominant n-alkane chain length and carbon preference index (CPI)) organic components were measured from a 107-m long core from the Padul Basin (Fig. 2; Ortiz et al., 2004). Two markedly different hydrogeological scenarios were interpreted: (1) From ca. 1 Ma to ca. 400 ka run-off recharge was significant and water depths were greater (lacustrine scenario). From ca. 400 to 4.5 ka, the Padul Basin became a peat bog s.s. with the major water input coming from groundwater inflow. From ca. 400 to ca. 180 ka alternating episodes with either predominant grasses, trees or aquatic macrophytes, which were linked to wet/dry phases, took place. An important deglaciation episode has been interpreted to occur between ca. 180 and 170 ka B.P. The global climatic changes occurring from ca. 170 to 25 ka B.P. were not recorded in the proxies, though they do show important variations linked to the Last Glacial Maximum and the beginning of the Holocene (ca. 25–10 ka B.P.): (2) Cold phases coexisting with dry periods produced the recession of forests and the development of grasses. After these periods, as both temperature and precipitation increased, forests expanded and the water level, linked to thaw, rose, especially at ca. 20 ka B.P. Few changes occurred during the Holocene, although there were short alternations between wet and dry episodes (Ortiz et al., 2004).

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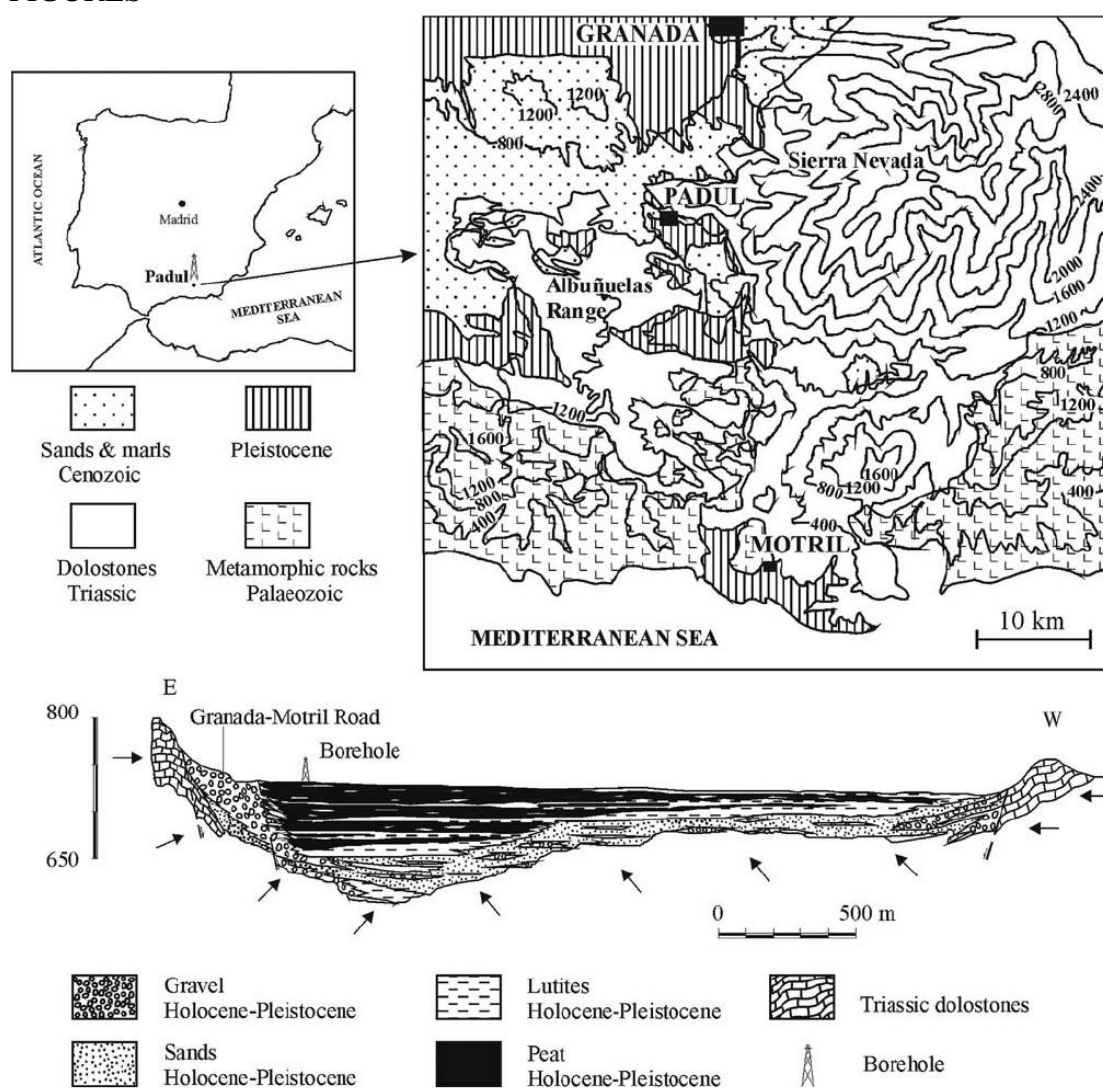
FIGURES

Fig. 1. Geographical and geological setting and cross-section of Padul peat bog. Groundwater flow directions are represented with arrows (from Ortiz et al., 2004).
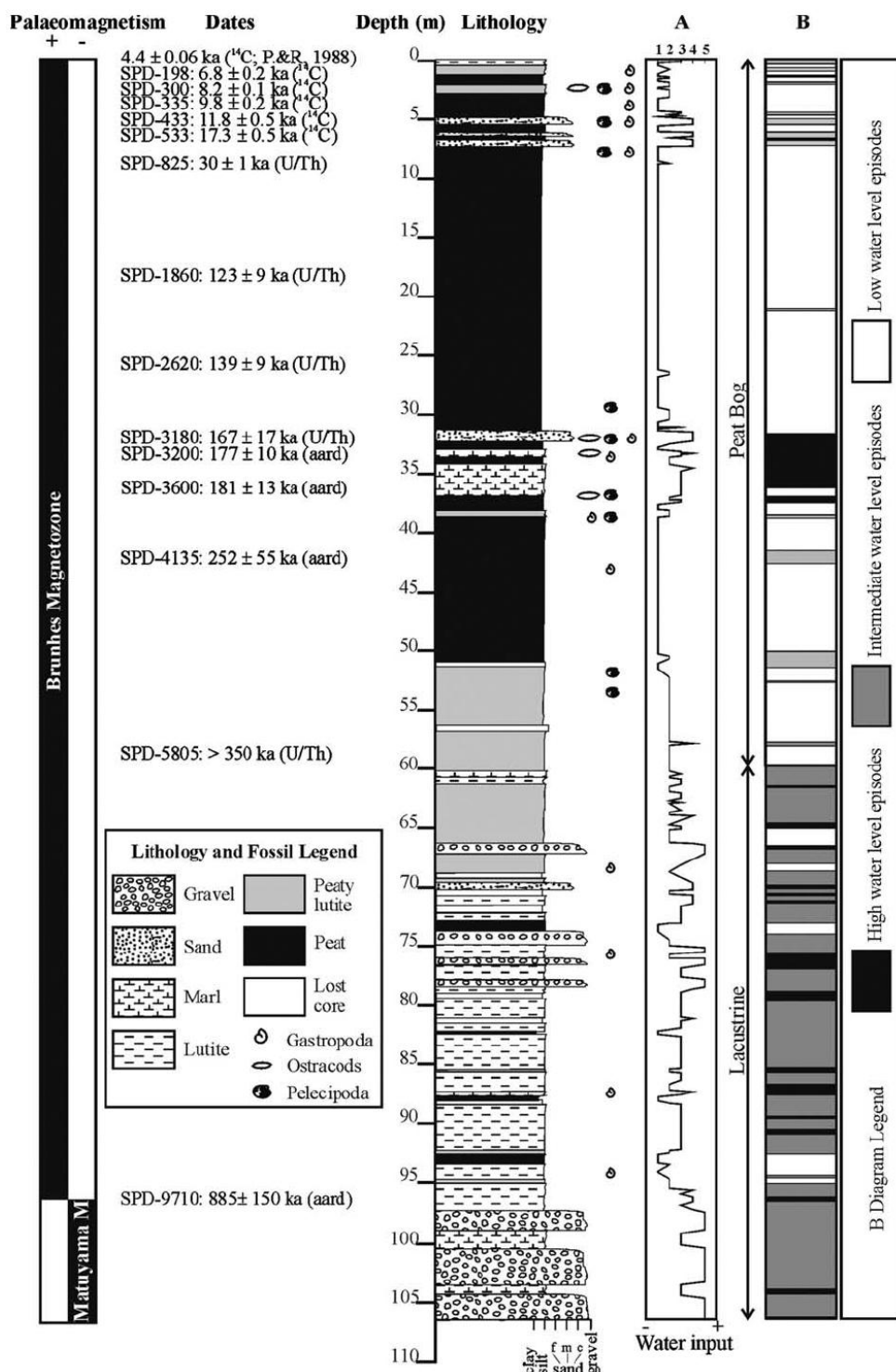
Fig. 2. Stratigraphy and chronology of the Padul peat bog core. Datings are followed by the method used for their calculation: 14C, U/Th, aard (amino acid racemization). Owing to drawing limitations, some 14C results have not been represented (SPD-0213, 7220 ± 190 ka; SPD-0335, 9019 ± 241; SPD-0345, 9021 ± 245, SPD-0407, 11329 ± 213). Pons and Reille (1988) dated the top of the Padul record at 4450 ± 60 ka. Diagram A reflects the water-input of Padul Basin based on the lithology (1, massive peat; 2, peaty lutite and lutitic peat; 3, lutites and marls; 4, sands and sandy lutites; 5, gravels); 1 represents low water level episodes and 5 high water level episodes. Diagram B shows low (white rectangles), intermediate (grey) and high (black rectangles) water level episodes according to the information provided by the palaeoenvironmental proxies. From 107 to 60 m a lacustrine conditions prevailed while at the uppermost 60 m Padul Basin became a peat bog. Taken from Ortiz et al. (2004).

FIELDTRIP 3, 3rd OCTOBER

CUEVA DEL ÁNGEL (LUCENA, CÓRDOBA), A MIDDLE AND LATE
PLEISTOCENE SITE IN THE SOUTH OF THE IBERIAN PENINSULA

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1. INTRODUCTION

Cueva del Angel is situated near the town of Lucena, south of the Cordoba province, at the geographical centre of Andalusia. The site is located in the Sierra de Aras, at 620 meters above sea level and its coordinates: lat. 37 ° 24 '22" and long. 4 ° 24 '59" sheet 989 (IGME 1991).
Until 2009, six dig seasons were carried out, authorized by the *Dirección General de Bienes Culturales de la Consejería de Cultura de la Junta de Andalucía* and financially supported by both, the *Consejería de Cultura de la Junta* and by the *Town Hall of Lucena*.

2. GEOLOGY OF THE CAVE
2.1. Description

The site is located in what was once a karstic cavity. Nowadays, both the walls and the roof of the cave are missing due to a collapse of the cavity that probably occurred during the Late Pleistocene. The name of Cueva del Angel comes from the existence of a small gallery in this cavity, which still exists today. The Angel complex was formed in the dolomitic limestone, light gray or white, of the Lias. These are presented as banks dipping towards NNW.
Nowadays, the karstic complex presents three well differentiated parts (Felgueroso and Coma 1964; Martínez Gallego 1970; López Chicano 1985; Molina Cámara 1987):

     1. Sedimentary infilling located on an outside platform of 300 m^2 with a strong dip toward the south, and large blocks of breccias, limestone, and speleothems. This platform is the remnant of an older cave, which for reasons not yet known, lost its roof and walls.

     2. In the northeast of this platform it is a small cavity of about 18 m long by 3 m wide which is the only remnant of the original cavity. This gallery presents blocks from the collapse. It shows the breakdown of sedimentary infilling, and its total disappearance.

     3. Under the floor of this cavity develops a vertical pit about 100 m deep on the basis of which was formed a washout cone about 70 m high, composed by falling blocks, clasts, clay, bones, and many remains of lithic industry.

2.2. Stratigraphy of the infilling
Twenty stratigraphical units were observed with an infilling of 5 meters of thickness.

3. MACROFAUNA

During the excavations, from 1995 to 2008, more than 20,000 bone fragments were recovered, from which about 7,000 remains have a correct stratigraphic position, while the other come from an upper level of mixed material.

The fossil material from this karst system has a number of characteristics consistent with it. Thus, about 80% of the bones have a strong mineralization. The presence of oxides on the cortical part of the bones is very frequent, for almost all the levels. Manganese oxides are more abundant than iron oxides. Water loggings were quite common during the formation of the paleostratigraphical record.

In general, fossils are found in good preservation state, although we find many elements with dissolution damages on the cortical surface associated with diagenetic processes of the karst system. However, there are few evidences of vermiculation, actions of bacteria, fungi or lichens. The state of weathering and abrasion is very low. We can say that they have little transport and the subaerial exposure is almost inexistent.

About bone breakage, we can observe orthogonal and staggered breaks produced by processes of sediment compaction. These occur mostly where the bone accumulation is greater, and especially in the areas of contact between bone remains, or even lithic industry. On the other hand, evidences of trampling are minimal.

Most of the bone remains from Cueva del Angel consists on difficult to identify fragments of long bone shafts. The size of these unidentified fragments is predominantly small, between 2 and 10 cm. In 90% of the long bones, the circumference does not reach 180º. This gives us an idea of the strong and advanced process of fracturing that has suffered the material. The most abundant type of fracture is the longitudinal-pointed, followed by the spiral. The surfaces of the fractures are usually smooth, straight or oblique. These features together with a large number of notches of percussion on the cortex are evidences of the anthropic character of the fracturing processes. All the anatomical elements are represented in these processes, both cranial and postcranial. Long bones are broken from the center of the shaft toward the epiphyses with numerous impacts to reduce them to small fragments, including many short bones and longitudinally sectioned first phalanges. For some of the ribs, processes of fracturing by flexion have been documented. On the cranial skeleton we can see a high fracturing of the neurocranium to access to the brain and a weaker for the splanchnocranium where there are fewer nutrients. For most of the specimens the jaws

are found, especially those of larger size, that are longitudinally fractured at the basal part of the horizontal ramus.

The fracturation degree of the fossils is high, indicating a maximal utilization of the available nutrients and resources.

Furthermore, we find frequent examples of striations produced by tools. Cutmarks are predominant over the scraping marks. Cutmarks usually appear in clusters showing a repeated action on a particular area. The most distinctive anatomical elements with these marks are the ribs and vertebrae. On the long bones they can be found on the metadiaphysis. The direction of these marks is oblique and with the same direction, although sometimes overlapping in opposite directions.

So far, the most common cut marks are related to defleshing, but also there are evidences of dismembering. It is worth mentioning the presence of two unidentified skeletal elements with many overlapping cut marks which were certainly made after the defleshing process.

We observed that 85% of the fossils are burned; and 50% on the total surface. The degree of thermal alteration is quite high. The color of burning occupies the spectrum from dark brown to white in the late stage of combustion.

The identified taxa at the site are the following:

O. Perissodactyla: *Equus sp., Equus cf. hydruntinus, Dicerorhinus cf. hemitoechus.*

O. Artiodactyla: *Bos primigenius, Bos/Bison sp., Cervus elaphus, Sus scrofa.*

O. Proboscidea: *Elephas sp.*

O. Carnivora: *Ursus sp., Lynx cf. pardina.*

O. Lagomorfa: *Oryctolagus cuniculus.*

The horse remains are, by far, the most aboundant within the indentified material. Teeth are more abundant than the remains belonging to the postcranial skeleton.

Fragments belonging to equids come from all the excavated levels. Some teeth belonging to adult individuals, but of small size, may indicate the presence of *Equus hydruntinus*.

The presence of rhinoceros is primarily based on the identification of fragments of jaws, both adults and young individuals, some fragments of metapodials, and other long bones.

Besides equids, bovids are the other most recorded animals at the site. They are represented by *Bos primigenius* and bison. Jaws, phalanges and some horncores are dominant in the assemblage. The patterns of butchery and burning are the same as those observed for the equids.

The red deer is well recorded, although not in the same proportions as the equids and bovids.

The remains of wild boar are scarce and present throughout the whole stratigraphic sequence.

The elephants are represented by a metacarpal of a young individual and a fragment of tusk.

The carnivores are exceptionally rare, because Cueva del Angel was never used as a refuge for these animals. Their presence in the cave is due to their consumption by the hominids, limiting themselves to bears, canids, and lynx.

The remains of rabbits are scarce, postcranial bones are predominant.

5. LITHIC INDUSTRY

The raw materials are largely dominated by flint, few quartzite, and very rare limestone.

Flints are extremely diversified in their structures, their colors and their fossils.
The raw material is in the form of pebbles for the quartzite and for most of the flint, although in this group may also occur platelet and cobbles.
Six different types of raw material were identified:

> T1. Jurassic flint (Bayocian), very thin, opaque and in various colors. Gray, beige, olive green, pink, caramel, red jasper and pink with white areas. Total or partial white patinas, and sometimes without patina, sometimes punctually, sometimes with carbonated inclusions, and often fissured. Most of the pieces come from pebbles of the Genil River terraces.

> T2. Translucent brown flint, very fine and homogenous, sometimes gray, from the Jurassic (Oxfordian), often with white patina, contains cracks. The pieces can come from pebbles of the terraces of the river Genil, or the outcrop of the Iznajar reservoir.

> T3. Oolitic flint, often patinated with numerous inclusions. It comes from the Bayocia-Bathonian levels in an area south of Lucena. Also occurs in the form of pebbles at the alluvium of the river Genil.

> T4. Chert, black with oxidation patinas, of unknown provenance.

> T5. Quartzite. Very fine grained, gray, beige or pink to red, in pebbles with neocortex. They come from the terraces of the Guadalquivir river.

> T6. Beige to white limestone, frequently altered. Ubiquitous origin around the site.

The lithic assemblage has a very fresh aspect and the preservation of the cutting edges is optimal. Only some small fractures, due to the excavation have partially altered the series, because of the nature of the sediment in breccias.
The desilification could be important on some flint (T3). Fire played an important role in this site. All grades of temperature changes are present: rubefaction, craquelation, termic breakage, and fractures. It seems that in the first half of the infilling, the evidences for fire are more abundant than in the last phase.
A surface damage in the form of a thick white patina has been frequently observed on flint artifacts. Sometimes a double patina on the pieces testifies the reuse.
The knappig methods are largely dominant by direct hand percusión, both hard and soft. Some presion retouches are also present, they are leading to microdenticulates.
The *chaîne opératoire* is partial because the initial phases are absent at the site. The first phase consisting in locating and obtaining raw material, either in blocks, pebbles, or platelets. Then, their initial configuration as cores is transferred to the Acheulean habitat inside the cave, where they proceed to debitaje for extracting flakes and subsequent retouching.
The products of debitaje are of medium size and fairly uniform, with abundance of *débordant* flakes, which illustrate a willingness of systematic maintenance of the convex surface.
The scrapers largely dominate, especially the lateral ones. The double and convergent scrapers are rare, and the points very rare. Some tools with knotches have been identified, among them are two Tayac points.
Scrapers, burins and protolimaces are present. The scrapers are carenated, the burins are dihedral and simple, worked from fractures or of preconfigured edges. One of the protolimaces evokes an Aurignacian scraper.
Finally we record the presence, in stratigraphy, of a trihedral pick, made on a quartzite pebble; of a large series of different types of handaxes (cordiform, lanceolated, subtriangular) and several cleavers made in quartzite.

The thinning, the most frequent of Kostienki type, are systematically associated with the retouched tools, and can be simple or multiple.

The thin and flat retouches are dominant, however, thick, escaled, and Quina retouches are present.

All the objects larger than two centimeters show macroscopic use damage. The entire series seems relatively homogeneous from the base to the top of the stratigraphical sequence.

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FIGURES

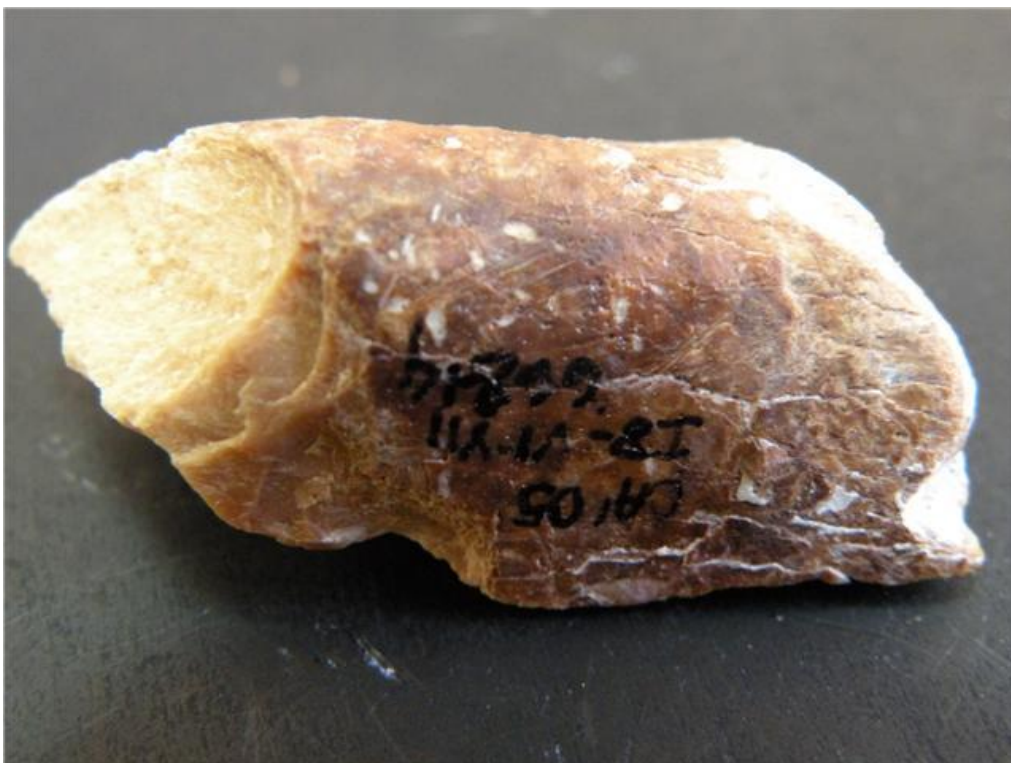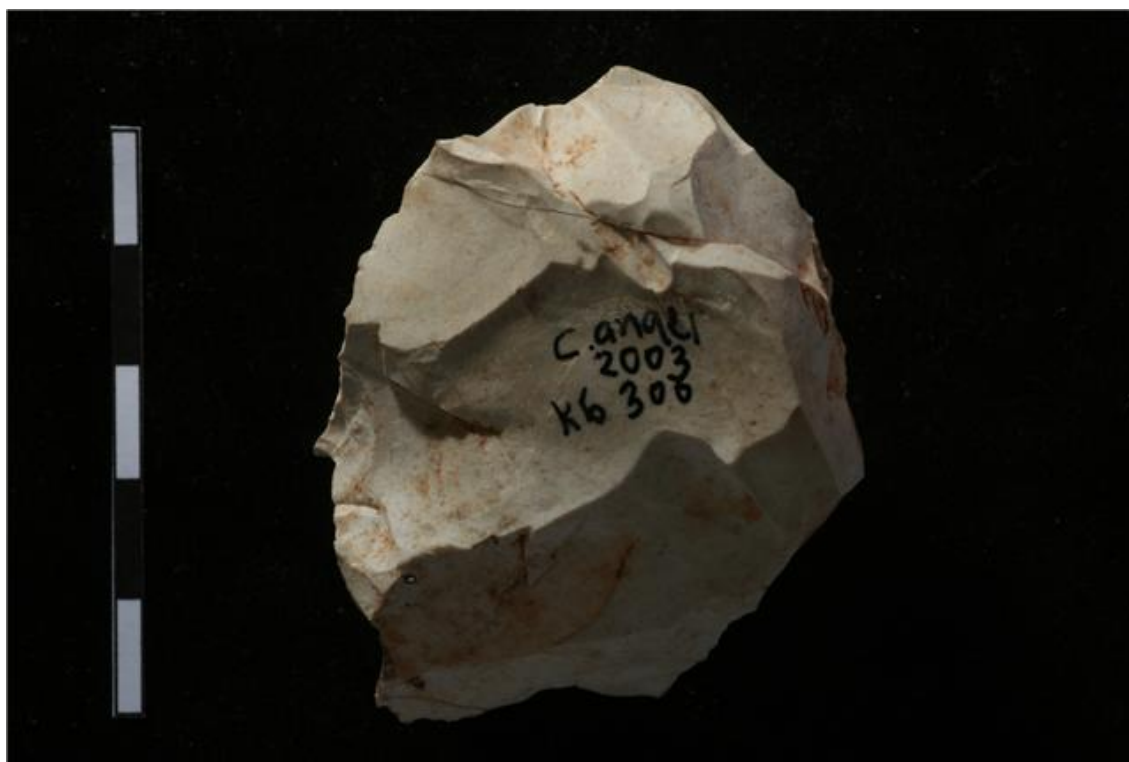Fig. 1 Fragment of *Equus* mandible

Fig. 2 Cut Marks

Fig. 3 Lithic Artifact

Fig. 4 Lithic Artifact

BOQUETE DE ZAFARRAYA CAVE: A REFERENCE SITE FOR THE UNDERSTANDING OF THE NEANDERTHALS IN THE SOUTH OF THE IBERIAN PENINSULA.

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Boquete Zafarraya cave is located in the town of Alcaucín (prov. of Malaga, Andalusia, Spain). It opens to 400 m southwest of the mountain pass of Zafarraya, which borders the province of Granada.
The cavity is located at 1020 m a.s.l. and oriented toward the southeast, at the foot of a limestone cliff 70 meters high. From here, it is possible to see a magnificent landscape of the entire region up to the Mediterranean Sea.
The archaeological site was discovered by Cecilio Barroso Ruiz in 1979. The first excavations were organized and directed by C.B.R. and F. Medina Lara, between 1981 and 1983, leading to the discovery of a Neanderthal femur (Zafarraya 1) and a Neanderthal jaw (Zafarraya 2), associated with a rich Mousterian industry and a diversified fauna with carnivores and herbivores.
Since 1983 the main subjet was to report the initial results of research carried out at the site. (Barroso Ruiz, C. et *al* 1983; Barroso Ruiz, C. et al 1984; Medina Lara, F. 1984; García Sánchez, M. 1986; Medina Lara, F. et al. 1986; Medina Lara, F. et al 1986; Barroso Ruiz, C. et al 1989)
In 1987 the *Junta de Andalucía* purchased the cave, allowing further excavations, from 1990 to 1994, with the discovery of new Neanderthal remains and Mousterian industry and a rich fauna. (Barroso Ruiz, C., et al 1993; Barroso Ruiz, C. et al 1994)

In 1996 at the CERP in Tautavel, and with the coordination of Professor H. Lumley and Cecilio Barroso Ruiz, a large multidisciplinary team was constituted, consisting of about 80 researchers of different nationalities (Spanish, French, English, Algerians, Moroccans, etc.) aiming to a comprehensive study of the deposit and its publication in a monography. (Cecilio Barroso Ruiz, 2003; Cecilio Barroso Ruiz & Henry de Lumley, 2006).

THE DATES

In the last datings performed on bone material and wood charcoal collected in the Boquete de Zafarraya cave, we used different methods (C-14, U-Th, ESR). They have failed to accurately determine the age of the Mousterian levels, nor the precise age of the human fossils. These results lead us to a range of ages from 30 to 45 ka. (Michel, V. et al. 2003; Michel, V. et al. 2006). However, we needed new datings based on the technical innovations.

LARGE MAMMALS

The fauna of large herbivores from the site of Zafarraya is numerically very important, and among all the skeletal remains the most abundant are those of *Capra pyrenaica*, followed by *Cervus elaphus, Rupicapra pyrenaica, Bos primigenius, Equus caballus, Equus hydruntinus* and *Sus scrofa*.

Carnivores can account, in some levels, for up to 30%. They are represented by *Panthera pardus, Cuon alpinus, Lynx pardina, Felis silvestris, Ursus arctos and Crocuta crocuta*. (Barroso Ruiz, C. et al. 2003e; Barroso Ruiz, C. et al. 2006e)

The species represented by very young animals (*Capra pyrenaica, Cervus elaphus, Bos primigenius* and *Ursus arctos*) indicate a mortality in early summer.

Interestingly, the species of large herbivores hunted either by Neanderthals or by carnivores correspond to distinct ecological niches: animals from rocky areas like *Capra pyrenaica*, forest such as *Cervus elaphus* and *Sus scrofa*, open spaces such as *Equus caballus*, and boundaries between forest and rocky areas, typical of *Rupicapra pyrenaica*.

The taphonomic analysis realized on the herbivore remains, show carnivore marks as well as anthropogenic, and sometimes both on the same pieces.

Tooth marks of carnivores are common. Long bones have a cylindrical state and digested bones are numerous.

Levels with the most important human activities, show, on the surfaces of the bones of herbivores, cutmarks left by the use of flint tools in the process of defleshing. Also, we observed several spiral fractures associated with an intentional breakage on fresh bone for deer, aurochs or horse.

Herbivores from Zafarraya were killed by hominids, when they were young and possibly died between late spring and early autumn.

The bone assemblage from Boquete de Zafarraya cave indicates occupations by hominids and carnivores in a site at high altitude, with particular species such as dholes and panthers. This site corresponds to a wild goat hunting camp, where hominids have consumed carcasses of females and young individuals.

PALEOECOLOGY, PALEOCLIMATOLOGY AND PALEOGEOGRAPHY.

Based on the data from sedimentological, palynological, anthropological, paleontological (macrofauna, micromamífereos, birds, reptiles and amphibians) studies and applying new methods for studying the paleoecology of a site (cenograms, climatogram and semi-quantification of palaeoclimates) it was possible to improve the knowledge of the environment of the Neanderthal hunters at the Boquete de Zafarraya cave and the evolution of its landscapes. (Barroso Ruiz, C. et al. 2003c; Barroso Ruiz, C. et. al. 2006c)

It was established that the landscape appears as a mosaic, i.e. characterized by different ecological niches, still present nowadays in the region.

The presence of forest complexes is evidenced by the various woodland taxa. Its extent on the landscape seems to have undergone some changes through time. During the drier phases, located in the stratigraphic sublevels Ic and Ia, its extension should be limited to the surface of the polje. During more humid phases present in the stratigraphic sublevels Id and Ib, its surface should cover a large part of the hills around the polje. The Mediterranean character of the region is attested by the presence of plant and animal species with Mediterranean climatic affinities.

THE NEANDERTHAL FOSSILS

Excavations at the site between 1981 and 1994 have provided 46 Neanderthal remains attributed to at least 9 individuals and formed by 2 jaws, 5 isolated teeth and 9 postcranial bones, all of them associated with a Mousterian industry and belonging to the isotopic stage 3. (Barroso Ruiz, C. et al 2003a; Barroso Ruiz, C. et. Al. 2006a)

The jaws belong to the so-called classic Neanderthals. However, the association of mandibular and dental features suggests that the fossils from the Boquete de Zafarraya are at an earlier stage than the Mediterranean gracile Neanderthals from Hortus.
It was possible to estimate the individual age at the time of death: 2 children of 14 months and 12 years, 6 adults of 19 and 30 years, and an adult of indeterminate age.
The comparison with the histogram obtained from the Hortus population reveals common characteristics: a very low percentage of children under 15 years and a high mortality between 18 and 30.
Part of human fossil remains have suffered anthropic activity, such as the fragmentation of long and fresh bones, together with multiple cutmarks produced by lithic tools for cutting and defleshing processes. Inside a small hearth, were found several fragments of herbivore bones together with human bones of a woman (two femurs and a tibia). The burning of human remains is a unique testimony to the behaviour of this group of Neanderthals with the other. (Barroso Ruiz, C. et al 2003b; Barroso Ruiz, C. et. al. 2006b)

THE MOUSTERIAN INDUSTRY

In the various Mousterian levels of the site, 813 pieces were recovered, and except for some made in quartzite, the rest have been knapped on flint of good quality. Flint comes mainly from outcrops in Alcolea and Llano de Alfarnate, located at 7 and 12 km respectively, but they also collected flint in closer places, located between 800 m and 4 km, but the quality is mediocre to bad, and its use rather opportunistic.
The low number of cores, the rarity of debris and the low proportion of cortical flakes, allow to propose the hypothesis that Neanderthal have introduced into the cave prefigured cores, and even flakes and tools already knapped.
The Levallois method has been widely applied and is attested in all the levels of the stratigraphy. A study of the flakes and cores shows that the centripetal recurrent Levallois method was the most used.
Among the different tools, the scrapers are dominant and its retouched edges are usually convex. The Quina retouch is almost absent. The Upper Paleolithic -type tools such as burins, becs, and scrapers are scarce and of not very good quality.
The lithic assemblage corresponds to a typical Mousterian. (Barroso Ruiz, C. et al 2003d; Barroso Ruiz, C. et. Al. 2006d)

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