

Abstracts – Resúmenes

Las Hoyas Publications – Publicaciones de Las Hoyas

The abstracts in alphabetical order by first author's last name.

Los resúmenes por orden alfabético del apellido del primer autor.

**Anurans from the early cretaceous lagerstätte of Las Hoyas, Spain:
New evidence on the mesozoic diversification of crown-clade Anura.**

Báez, A.M.

Cretaceous Research **41**: 90-106
2013

Abstract

The late Barremian laminated limestones of Las Hoyas in eastern Spain are famous for the large number, diversity, and quality of the fossils that they have yielded. Herein, anuran remains from these beds representing two new taxa are thoroughly described. *Iberobatrachus angelae* gen. et sp. nov. is characterized by a skull nearly as long as it is wide, a narrow neurocranium, frontoparietals fused at least along the posterior half of the orbital length, a distinct palatine process on maxilla, and moderately expanded sacral diapophyses. In turn, *Gracilibatrachus avallei* gen. et sp. nov. is characterized by a combination of characters that includes an azygous frontoparietal, eight presacral vertebrae, a monovertebral sacrum bearing narrow diapophyses, a bicondylar sacro-urostyler articulation, highly elongate metacarpals, and long distal manual phalanges. The anatomical evidence retrieved in this study is used to explore the taxonomic positions of the new taxa through a maximum parsimony analysis. This analysis supports the placement of *I. angelae* within Costata close to the extant genus *Discoglossus*, whereas *G. avallei* is nested within Xenoanura, as a basal pipimorph. These records corroborate that diversification of costatan and xenoanuran “archaeobatrachian” lineages were already well underway by the Early Cretaceous.

Palaeohistology and preservation of tetrapods from Las Hoyas (Lower Cretaceous, Spain).

Bailleul, A., Ségalen, L., Buscalioni, A.D., Cambra-Moo, O. y Cubo, J.

Comptes Rendus Palevol **10**: 367-80
2011

Abstract

The Upper Barremian (Lower Cretaceous) site of Las Hoyas (Spain) is an important Konservat Lagerstätte that has yielded well-preserved biota. Both the palaeohistology and the preservation of six tetrapods were investigated in this study. Chemical analysis (Ca/P ratio, fluorine, strontium, barium and REE amounts) reveals an alteration of the original apatite of the bone in fluoroapatite by postmortem substitutions, a late Sr incorporation during fossilization, and a rather moderate postmortem REE incorporation in the freshwater environment of Las Hoyas. However, the conditions of fossilization have limited the dissolution-recrystallisation processes and preserved the microstructure of the bones. Bone growth rate estimations have been made according to Amprino's rule. The Discoglossidae indet., the Centrocryptodira indet. and *Scandensia ciervensis* are characterized by low growth rates and an ectothermic metabolism. *Concornis lacustris*, *Pelecanimimus polyodon* and the Archosauria indet. are characterized by a faster growth and probably higher resting metabolic rate. All of the specimens are adults of small-sized species. This leads to the hypothesis of an ecological filter favoring small-sized species in this ecosystem, strengthening the taphonomical results. The combination of geochemical and histological studies seems to offer a more precise overlook of life history traits and preservation of these fossils from Las Hoyas.

Description d'une nouvelle paléoflore dans le Crétacé inférieur du Nord de l'Espagne. Description of a new flora in the Lower Cretaceous in the North of Spain.

Barale, G. y Viera, L.I.

Natur zientziak **43**: 21-35
1991

Resumen

Se describe una nueva paleoflora en el Cretácico inferior (Valanginiense-Hauteriviense) de la provincia de La Rioja en el N. de España. Esta paleoflora esta formada por helechos arborescentes (*Tempskya riojana* Barale) y coníferas: *Dadoxylon* (*Araucarioxylon*) *riojense* nov. sp. Los detalles de la organización anatómica de esta conífera son determinados estudiando láminas delgadas así como por observaciones con Microscopio Electrónico de Barrido. La paleoecología de esta flora a menudo asociada a huellas de Dinosaurios es discutida.

Leaf architecture and ecophysiology of an early basal eudicot from the Early Cretaceous of Spain.

Barral, A., Gomez, B., Feild, T.S., Coiffard, C. y Daviero-Gomez, V.

Botanical Journal of the Linnean Society **173**: 594-605
2013

Iterophyllum lobatum gen. et sp. nov. is reported from the late Barremian lithographic limestones of Las Hoyas, Spain. It consists of a simple, petiolate leaf, with a pinnately lobed lamina. The dentate thickened margin bears chloranthoid-like glands at lobe apices and sinuses. The venation is pinnate and craspedodromous, with three discernible vein orders. Based on the low regularity of vein course and angles and the low leaf rank, such a venation pattern may represent an early evolved leaf archetype in early basal eudicots. An acropetal leaf development mode in *I. lobatum* is similar to that in several living Papaveraceae. The leaf architecture and ecophysiology, particularly the vein widths and the glands, indicate that *I. lobatum* leaves were aerial. The plant grew close to water in the wetland terrestrial ecosystem of Las Hoyas. *Iterophyllum lobatum* might have been an opportunist species in early ecological succession stages after wildfires.

Two new fungus gnats (Insecta, Diptera, Mycetophilidae) from the Lower Cretaceous of Spain.

Blagoderov, V. y Martínez-Delclós, X.

Geobios **34**: 63-67
2001

Abstract

Two new species of Diptera Mycetophilidae are described based on two imagos found in the Lower Cretaceous La Cabrúa fossil-site (Montsec Range, Lleida Province, Spain). One belongs to the genus *Palaeodocosia* described from Baltic amber and known from Recent Fauna, and the other, to a recent genus *Synapha*. *Palaeodocosia cabruae* sp. nov. and *Synapha rubiesensis* sp. nov. are the first described and named dipteran adult specimens from the Mesozoic compression fossil-sites of Spain.

A new lizard from the Early Cretaceous of Catalonia (Spain), and the Mesozoic lizards of the Iberian Peninsula.

Bolet, A. y Evans S.E.

Cretaceous Research **31**: 447-57
2010

Abstract

The Early Cretaceous (late Berriasian-early Valanginian) locality of La Pedrera de Meià (Montsec, Catalonia, Spain) has yielded remains of at least two genera of lizards: *Meyasaurus* (including its synonym *Ilerdaesaurus* and possibly *Rubiessaurus*) and *Eichstaettisaurus*. A new lizard specimen is described and named here as *Pedrerasaurus latifrontalis* gen. et sp. nov., being sufficiently distinct from other known genera to warrant the erection of a new taxon. The results of phylogenetic analysis are equivocal but support the placement of the new genus within Scincogekkonomorpha. The new taxon resembles *Meyasaurus*, a genus widely distributed in the Lower Cretaceous of the Iberian Peninsula, in having bicuspid teeth but differs in lacking the characteristic fusion and constriction of the frontals. *Pedrerasaurus* and *Meyasaurus* may be related, but the support for this is not strong. Recognition of a clearly distinct form with bicuspid teeth is significant in terms of attribution of fragmentary material recovered from other Jurassic-Cretaceous localities.

**The mineralization of dinosaur soft tissue in the Lower Cretaceous
of Las Hoyas, Spain.**

Briggs, D.E.G., Wilby, P.R.W., Pérez-Moreno, B.P., Sanz, J.L. y
Fregenal-Martínez, M.

Journal of the Geological Society **154**: 587-588
1997

Abstract

The mineralized soft tissue of a dinosaur, only the second discovery of its kind is reported from the Lower Cretaceous of Las Hoyas, Spain. Cellular details of mineralized skin and muscle of *Pelecanimimus* are replicated in an iron carbonate. The outline of this ornithomimosaur is preserved by a phosphatized microbial mat that enshrouded the carcass. It confirms the existence of either a throat pouch or dewlap, and soft occipital crest. This study confirms the importance of microbial mats in the fossilization of soft tissues and emphasises the need for careful monitoring of vertebrate remains for mineralized soft tissues prior to acid preparation.

Applications of ichnology in lacustrine sequence stratigraphy: Potential and limitations.

Buatois, L.A. y Mángano, M.G.

Palaeogeography, Palaeoclimatology, Palaeoecology **272**: 127-42
2009

Abstract

In comparison with their marine counterparts, lacustrine ichnofaunas have not been extensively used in sequence stratigraphy. Application of trace fossils in continental sequence stratigraphy cannot be based simply on the extrapolation of marine sequence stratigraphy. Marine substrate-controlled ichnofacies, in particular the firmground *Glossifungites* ichnofacies, develop in stable and cohesive substrates, reflecting erosive exhumation of the sediment. In contrast, in lacustrine sequences, substrate-controlled ichnofossils only rarely indicate erosional exhumation because they are commonly related to desiccation of water bodies. The tripartite division of overfilled, balanced-fill, and underfilled lakes provides a comprehensive framework to evaluate the potential and limitations of lacustrine ichnofaunas in sequence stratigraphy. Based on a number of case studies spanning the three lake-basin types, a model of trace-fossil distribution in overfilled, balanced-fill, and underfilled basins is proposed.

Overfilled lake basins contain well-developed softground trace fossils (*Mermia* and *Skolithos* ichnofacies, and the softground suite of the *Scoyenia* ichnofacies) that are useful to delineate parasequences and parasequence sets. Fluvial discharge into overfilled lakes usually generates density currents that oxygenate lake bottoms, allowing the establishment of epifaunal and infaunal communities. Additionally, these are freshwater lakes where no stress due to hypersalinity occurs, leading to the development of a relatively diverse benthos. Land-plant derived organic matter is the prime source of nutrients, favoring the development of a deposit-feeding benthic fauna in permanently subaqueous, low-energy zones. Firmground suites are rare because such large lakes usually do not experience desiccation.

Abundant firmground trace-fossil suites of the *Scoyenia* ichnofacies occur in balanced-fill lakes, but softground assemblages are usually depauperate. Lowstand deposits contain abundant and widespread ichnofaunas, commonly meniscate trace fossils and arthropod trackways of the *Scoyenia* ichnofacies. Lake hydrology is closed during lowstands and salinity usually increases, imposing a stress factor on the lake biota and, therefore, softground ichnofaunas are depauperate. Ichnofaunas from turbidite systems in balanced-fill lakes are less abundant and diverse than those from overfilled lacustrine turbidites. Freshwater conditions are common during transgression, but dysaerobic conditions

may prevail, imparting a stress factor on the benthic biota. In hydrologically closed lakes, the *Scoyenia* ichnofacies is widespread, but the *Mermia* ichnofacies is commonly absent or impoverished.

The *Scoyenia* ichnofacies is associated with lowstand desiccated substrates in underfilled lakes. The density of arthropod trackways may be high, forming tracked omission surfaces. Some of these omission surfaces may represent sequence boundaries expressed by co-planar surfaces of lowstand and subsequent flooding. Rapid changes in depositional conditions reflecting desiccation during vertical aggradation can lead to the formation of composite ichnofabrics that reflect successive bioturbation events.

Short-term colonization trace-fossil assemblages in a carbonate lacustrine Konservat-Lagerstätte (Las Hoyas fossil site, Lower Cretaceous, Cuenca, Central Spain).

Buatois, L.A., Mángano, M.G., Fregenal-Martínez, M.A. y de Gibert, J.M.

Facies **43**: 145-156
2000

Abstract

Rhythmically laminated fine-grained lacustrine carbonates of the Cretaceous La Huérguina Limestone Formation at Las Hoyas fossil site, central Spain, contain not only a spectacular body fossil fauna, but also vertebrate and invertebrate trace fossils. The study of the Las Hoyas invertebrate ichnofauna provides valuable taphonomic, paleoecological and paleoenvironmental information and represents one of the first attempts to study in detail a lacustrine trace-fossil assemblage in carbonate rocks. The Las Hoyas ichnofauna includes *Cruziana problematica*, *Helminthoidichnites tenuis*, *Lockeia* isp., *Palaeophycus tubularis*, and *Treptichnus pollardi*. This assemblage is characterized by low ichnodiversity and small burrow size, and it is dominated by surface trails and extremely shallow burrows produced mostly by detritus feeders. The Las Hoyas ichnofauna indicates low to moderately low energy, permanently submerged, shallow-lacustrine areas. The ichnofauna is suggestive of environmental stress, most likely oxygen-depleted conditions in interstitial waters. Occurrence of traces in event beds indicates opportunistic colonization by epifauna and very shallow infauna during brief periods of improved oxygenation related to the passage of density underflows and dilute turbidity currents. The Las Hoyas ichnofauna resembles other shallow lacustrine trace-fossil assemblages of the archetypal *Mermia* ichnofacies and differs significantly from the archetypal *Scoyenia* ichnofacies. It is therefore best regarded as a proximal, depauperate example of the *Mermia* ichnofacies. The Las Hoyas assemblage is similar to the slightly older lacustrine Montsec ichnofauna, but it is remarkably different from marine ichnocoenoses of other Mesozoic *konservat-lagerstätten* in lithographic limestones such as those of Cerin, Solnhofen and Nusplingen.

Tetrapods from the Late Jurassic and Early Cretaceous lithographic limestones of Europe: A comparative review.

Buffetaut, E.

Geobios 27(Supplement 1): 259-265
1994

Abstract

Comparison of the tetrapod assemblages from Late Jurassic (Franconia, Cerin, Canjuers) and Early Cretaceous (Montsec, Las Hoyas) lithographic limestone localities in Germany, France and Spain, reveals both important resemblances and striking differences. The latter are explainable by different collecting histories, taphonomic biases, different depositional environments, and differences in geological age. The tetrapod assemblages from the lithographic limestones of Europe are unbalanced and the reasons for this are worthy of further investigation.

The vertebrate assemblage of Buenache de la Sierra (Upper Barremian of Serranía de Cuenca, Spain) with insights into its taphonomy and palaeoecology.

Buscalioni, A.D., Fregenal, M.A., Bravo, A., Poyato-Ariza, F.J., Sanchíz, B., Báez, A.M., Cambra Moo, O., Martín Closas, C., Evans, S.E. y Marugán Lobón, J.

Cretaceous Research **29**: 687-710
2008

Abstract

The Upper Barremian deposits of La Huérguina Limestone Formation in the Serranía de Cuenca (Iberian Ranges, Spain) contain rich continental fossil associations preserved under a great diversity of taphonomic conditions in alluvial and lacustrine deposits. The vertebrate association retrieved from the Buenache de la Sierra Subbasin is described in detail and compared to other localities of La Huérguina Formation (Uña and Las Hoyas). The association was found at El Inglés Quarry, in a level composed of grey to ochre slabby marly siltstones, sometimes slightly sandy, with abundant plant macroremains sedimented in a small stagnant pond. The pond was part of a complex and mixed (siliciclastic and carbonatic) depositional system, controlled by a seasonal subtropical climate. It consisted of distal alluvial plains grooved by narrow channels with scattered ponds, small shallow lakes and palustrine marshy areas, fed by superficial water and groundwater. These underwent seasonal floods followed by slow draining and evaporation and finally a seasonal period of desiccation.

Three different points from the same level were sampled in the quarry. Microfossils were extracted with a sieving table and pressurized water, yielding more than 2000 fossil specimens. The assemblage is composed of anatomically identifiable elements of charophytes, ostracods, molluscs, fish, albanerpetontids, anurans, lepidosauromorphs, chelonians, a pterosaur?, theropods, crocodyliformes, eggshells and a mammaliaforms?, as well as bone splinters, shell fragments and plant remains. Charophyte utriculi, ostracods, isolated teeth and eggshells are the most abundant elements. The association has yielded Allocaudata remains as well as an unidentified family of Anura (based on a maxilla fragment) and an unidentified family of Neosuchia (based on isolated teeth). The Buenache assemblage shows a sound demy (i.e. fossils found in their original habitat) of an aquatic freshwater ecosystem, as is natural for a wetland ecosystem. The wide variety of microhabitats linked to water availability in wetlands gives rise to a complex faunal assemblage in which four categories of species can be recognized as in extant wetlands: obligate, amphibious, facultative and incidental. Despite

the taphonomic differences between Buenache, Uña and Las Hoyas, a common palaeoecological structure is documented.

Biostratinomic patterns in archosaur fossils: influence of morphological organization on dispersal.

Cambra-Moo, O. y Buscalioni, A. D.

Journal of Taphonomy 1: 247-297.
2003

Abstract

The dispersal of 122 specimens of fossil archosaurs and lepidosaurians from different localities throughout the world, catalogued as fossil-lagerstätten, has been characterized. The analysis is based on the quantification of dispersal by the evaluation of burial position, anatomical disarticulation, overlap and significant absences of bony elements. Our goal is to identify commonalities of morphological organization, and to reveal dispersal patterns. First, we explore a theoretical space of burial positions, and seek logical alignments of variables in order to understand the sequence of the earliest biostratinomic phenomena. Dinosauria and the basal avian specimens (Archaeopteryx-like organisms) are biased towards lateral burials with crossed forelimbs or hindlimbs. Pterosauria and Ornithuromorpha have ambivalent burial positions, while Enantiornithes and Confuciusornithidae adopt preferentially dorso-ventral burial positions. There is a significantly negative regression coefficient relating overlap and disarticulation-absence. A high percentage overlap corresponds to a high percentage articulation and completeness of body elements, particularly in laterally lying fossils. Conversely, overlap and disarticulation are not significantly related in specimens with a dorso-ventral burial position. Ambivalence in burial positions is associated with singularities in disarticulation patterns. Aves and Pterosauria both diverge from the general disarticulation sequence of diapsids. The results indicate that dispersal has a strong biological component at least in the initial steps of the biostratinomic process.

Histological observations on Enantiornithine bone (Saurischia, Aves) from the Lower Cretaceous of Las Hoyas (Spain).

Cambra-Moo, O., Buscalioni, A.D., Cubo, J., Castanet, J., Loth, M.M., de Magerie, E., y Ricqlès, A.

Comptes Rendus Palevol **5**: 685-691
2006

Abstract

New material from a small, presumably adult enantiornithine bird (Saurischia: Aves) from the Lower Cretaceous of Las Hoyas (Spain) provides new data on the bone histology of those Mesozoic birds, which became extinct at the Cretaceous–Tertiary boundary. The material is referred to *cf. Concornis lacustris*. The outer cortex of the studied long bones is formed of a rather typical parallel-fibered bone tissue, with sparse flattened osteocyte lacunae, evidence of lines of arrested growth (LAGs) and no vascularization. This structure matches the outer circumferential layer (OCL) of many extant mature, small to tiny birds and also agrees with earlier descriptions of enantiornithine cortical bone. The deeper cortex progressively contains a much more plentiful component of osteocyte lacunae, which are more plump than flat. This region is also permeated by a few vascular canals surrounded by bone lamellae that form osteonal structures. The relationship of the osteonal material to the neighbouring primary tissue strongly suggests that the osteons are secondary. In some sections, it is possible to follow those osteons as formed by outward extensions from the endosteal bone tissue into the deep primary cortex. This specimen shows more histodiversity than the few enantiornithine samples previously reported. This further suggests that although growth may have been slow when the adult size was approached, it was more rapid at earlier stages. Even if as yet not enough is known of those early stages to document just how rapid early growth may have been, and whether enantiornithines grew differently from the basal avian models known from other early birds, the new data do not necessarily suggest that they had growth regimes quite distinct from extant birds of similar body sizes nor, by implication, completely different metabolic patterns or regimes.

Juvenile enantiornithine birds from the Lower Cretaceous of Las Hoyas (Spain).

Chiappe, L.M., Sanz, J.L y Ortega, F.

Sixth international meeting of the Society of Avian Paleontology and Evolution.
2004

Abstract

Discoveries of exquisite avian remains contained in the Lower Cretaceous lacustrine limestones of Las Hoyas, central Spain, have provided critical information for understanding the diversity and evolution of early birds. Among these fossils is a bone aggregate of at least four similarly ossified individuals, that was previously interpreted as a pellet. The presence of open neurocentral sutures and the lack of fusion of several elements forming compound bones (i.e., carpometacarpus, tibiotarsus, tarsometatarsus) indicates an early juvenile age for these individuals. Qualitative and quantitative characters of the skeletons contained in this aggregate indicate the presence of three different types of birds, all of which show synapomorphies of Enantiornithes. One of these skeletons displays several unique characters—primarily in the tail—that indicate that it belongs to a new enantiornithine species. The remaining two types of birds are less easily identifiable and whether or not they correspond to early juveniles of any of the previously identified enantiornithines from Las Hoyas (*Iberomesornis romerali*, *Concornis lacustris*, and *Eoalulavis hoyasi*) remains unclear. The anatomy of the fossils contained in the bone aggregate is discussed in this paper. These juvenile enantiornithines provide evidence of new morphologies for the group and anatomical information relevant to the understanding of the evolutionary origin of the avian pygostyle.

Early cretaceous fish trails from La Rioja, Spain.

Costeur, L. y Ezquerro, R.

Cretaceous Research **30**: 1027-1030
2009

Abstract

We report a new find of the fish trail *Undichna unisulca* in fluvial sediments of the Lower Cretaceous Oliván Group of the Cameros Basin (Aptian-Albian; Valtrujal, La Rioja, northern Spain). It is the second Mesozoic record of *Undichna unisulca* after the first discovery in the Lower Cretaceous of central Spain (Las Hoyas, Cuenca, central Spain). The trails are characterized by single sinusoidal waves which in this case are often surrounded by well-preserved lateral levees that rule out an undertrail hypothesis.

The continental depositional setting, a floodplain fluvial system, reflects the known broad palaeoenvironmental distribution of *Undichna* and confirms its occurrences in freshwater settings.

Uncommon branching pattern within conifers: *Frenelopsis turolensis*, a Spanish Early Cretaceous Cheirolepidiaceae.

Daviero, V., Gomez, B. y Philippe, M.

Canadian Journal of Botany **79**: 1400-1408
2001

Abstract

The fossil plant *Frenelopsis turolensis* Gomez from the Lower to Middle Albian of the Escucha Formation (Iberian Ranges, Spain) displays a combination of leaf and branch arrangements unknown in extant conifers. Detailed architectural analyses allow for elucidation of the branching pattern of this species. Branching occurs above a leaf of the whorl but at some distance from the node, within the internodal region. This event may be the result of adnation or hypomerithallus formation. We point out a new type of branching pattern for *Frenelopsis* based on *F. turolensis*, with no discontinuity in the leaf sequence. This unusual ontogeny of the branches asserts that branching is more diverse in the fossil cheirolepidiaceous genus *Frenelopsis* than previously supposed.

The fish trace fossil *Undichna* from the Cretaceous of Spain.

De Gibert, J.M., Buatois, L.A., Fregenal-Martínez, M.A., Mángano, M.G., Ortega, F., Poyato-Ariza, F.J. y Wenz, S.

Palaeontology **42**: 409-427
1999

Abstract

The Early Cretaceous Spanish localities of El Montsec and Las Hoyas have yielded the fish trails *Undichna britannica* and *Undichna unisulca* ichnosp. nov. respectively. The former consists of two intertwined waves, and was probably produced by the elopiform *Ichthyemidion vidali*. *Undichna unisulca* is characterized by having only a single sinusoidal wave, and was most probably produced by the pycnodontiforms *Eomesodon* and/or *Macromesodon*. Reliable criteria that distinguish this ichnospecies from the putative single-waved undertrails of more complex trails include the presence of hyporeliefs below undisturbed lamination and the preservation of epireliefs with lateral levees. The Spanish occurrences represent the first mention of this ichnogenus in post-Palaeozoic strata, and demonstrate that *Undichna* is not restricted to the Carboniferous–Permian, as previously thought. The lacustrine depositional setting of the two Cretaceous localities is consistent with the known palaeoenvironmental distribution of this ichnotaxon. The disparity between the stratigraphical record of *Undichna* and the broad temporal and palaeoenvironmental distribution of fishes capable of producing similar sinusoidal structures presumably reflects a taphonomic filter. Preservation of *Undichna* is favoured by: absence or scarcity of infaunal burrowers; presence of a very fine-grained, plastic, semiconsolidated substrate; low-energy bottom conditions; and relatively rapid burial with no associated erosion. Freshwater settings present these taphonomic constraints more frequently than other environments; thus preservation of *Undichna* is favoured in lakes, alluvial swamps and inner regions of estuaries.

Trace fossils and their palaeoecological significance in Lower Cretaceous lacustrine conservation deposits, El Montsec, Spain.

De Gibert, J.M., Fregenal-Martínez, M.A., Buatois, L.A. y Mángano, M.G.

Palaeogeography, Palaeoclimatology, Palaeoecology **156**: 89-101
2000

Abstract

La Pedrera and La Cabrúa at El Montsec, Spain, are two Lower Cretaceous lacustrine conservation deposits (Konservat-Lagerstätten) that have provided a rich, diverse, and well-preserved faunal and floral fossil record. Although the lithographic limestones where the body fossils are found are finely laminated and essentially undisturbed by bioturbation, epigenic trace fossils occur on the surface of certain laminae. Trace fossils at La Pedrera include the fish trail *Undichna britannica* and the arthropod trackway *Hamipes didactylus*, while the ichnospecies found at La Cabrúa are *Steinsfjordichnus brutoni*, *Gordia arcuata*, *Cochlichnus anguineus* and *Undichna britannica*, all but the last corresponding to the activity of small invertebrates. The trace fossil occurrences record short-term events in a lake bottom that did not support any benthic life for most of its history. Differences in the trace fossil assemblages for the two localities agree with sedimentological data in attributing a more distal position for La Pedrera.

Fossil-insect taphonomy: their preservation in carbonate rocks.

X. Delclòs

Abstracts: 3rd International Congress of Palaeoentomology, with 2nd International Meeting on Palaeoarthropodology and 2nd World Congress on Amber and its Inclusions
2005

Abstract

Insects are usually considered as soft-bodied terrestrial invertebrates with few possibilities of becoming fossilized. However, insects may remain in oxygenated aquatic media, without disarticulation, for more than one year on quiet bottoms, and in anoxic environments for the same time without decaying or disarticulation. Insects are rarely fossilised because their tissues are non-biomineralized and prone to decay, but when conditions are suitable for preservation, a lot of individuals are found.

Some insect groups have higher preservation potential due to their hardened sclerotization; plane structures, such as wings, also have higher preservation potential due to their rapid burial and slow degradation. Insects with a wider range of sizes are recorded in carbonates in comparison to amber. In carbonate rocks, insects related with aquatic or adjacent environments are mainly found, whereas in amber, insects are related with wooded environments.

Before being fossilized in aquatic ecosystems, insects need to surpass several barriers: predators, water surface tension, chemical composition of water (conditioned eutrophy/oligotrophy), currents, clines, etc. Floating time due to water surface tension varies even within the same insect taxon, and with the presence or absence of a pilose body. Biological (fungal and algae developments, insect wingspan, etc.), physical (water temperature, raining periods, etc.) and chemical (oligotrophy/eutrophy) agents control carcass articulation and sinking.

Rapid burial favours exceptional insect preservation, prevents scavengers, and promotes anaerobic conditions that inhibit necrophages. Low rates of decay are indispensable to allow authigenic minerals to form quickly enough to preserve the most labile soft-tissues.

Taphonomic processes that rule taphonomic bias and organism preservation in carbonate rocks usually favor insect preservation in two dimensions; complete three-dimensional insect preservation is rare. In carbonate rocks, fossil insects are usually preserved as organic remains of the original cuticle, or as a mould where the cuticle has been lost during fossil diagenesis. The most ancient insect cuticle with chitin and protein has been found in Oligocene deposits.

Insects are preserved in carbonate rocks in six major ways that usually represent particular environmental conditions and genesis: a) as an organic film remain, product of the original cuticle, usually not

preserved, b) preserved in an authigenic mineral, c) as a mould of the insect exoskeleton, d) as a cast, replicate in a secondary mineral, e) in a travertine, f) in a concretion.

The aquatic Lower Cretaceous ecosystem of Las Hoyas (Spain): ecological interactions.

X. Delclòs, C. Martín-Closas and C. Soriano

*Abstracts: 3rd International Congress of Palaeoentomology, with 2nd
International Meeting on Palaeoarthropodology and 2nd World Congress
on Amber and its Inclusions
2005*

Abstract

The aquatic ecosystem of Las Hoyas (Lower Cretaceous, Barremian) is characterised by highly diverse benthos and nekton, but poorly diverse plankton and pleuston. The benthonic community was mainly formed by several species of charophytes (which indicates a low trophism for the lacustrine system), early aquatic angiosperms, aquatic insects, crayfishes and molluscs, whilst the nekton was mainly composed of small adult fishes and freshwater shrimps. The normal status of the aquatic system was oligotrophy, but punctual eutrophication events have been recorded, which may produce the destruction of the charophyte and plant cover and the subsequent mass mortality of benthic animals.

Aquatic arthropods are represented by ostracods, pericarids (isopods and speleogriphaceans), decapods, and insects (ephemeropterans, odonatans, heteropterans, phasmatodeans, dipterans and coleopterans). The studies on arthropod and plant communities of the Las Hoyas palaeolake suggest the presence of several relationships between arthropods and the palaeoenvironment and between the other organisms that live in the aquatic ecosystem that suggest not only a complex trophic chain in the ecosystem, but also plant-insect, plantcrustacean, and fish-insect interactions.

The charophyte *Clavatoraxis robustus* bore a heavy coat of spine cell-rosettes suggesting an adaptation against herbivory, most probably by coleopterans.

Planktonic inhabitants (Chaoboridae-like pupae) are supposed to be the usual food for other insects and fishes, like *Gordichthys*, a teleostean fish that had a body remarkably similar to recent *Gambusia*. *Chresmoda* was a pleustonic representative; its long and serrate female ovopositor suggests endophytic oviposition. Epipleustonic beetles are represented by coptoclavids; these beetles would feed on insects on the water surface, or diving into the water.

Spanish Mesozoic amber localities

X. Delclòs, E. Peñalver Mollá, A. Arillo, V. Ortuño, R. López Del Valle and C. Soriano

Abstracts: 3rd International Congress of Palaeoentomology, with 2nd International Meeting on Palaeoarthropodology and 2nd World Congress on Amber and its Inclusions.

2005

Abstract

The most ancient mention of the existence of amber in Spain was published by Gaspar-Casal in 1762. During the XIXth century and at the beginning of the XXth, quite a lot of general publications about Spanish coals and minerals included new references about the occurrence of amber in different localities and mines.

Nevertheless, until 1996 no palaeobiological inclusions in these ambers were recorded. This amber (for the first time including palaeobiological specimens) was found in Peñacerrada and Moraza, in Álava and Burgos Provinces respectively, and until today it has yielded about 1500 specimens of insects and other arthropods, mainly arachnids and hexapods.

The scientific research carried out during the last five years in Spain have shown the existence of more than 110 fossil sites with amber, mainly located in the northern and eastern regions. This area corresponds to a Lower Cretaceous palaeogeographic limit of the Iberian Plate, and the majority of amber deposits are associated with deltaic coal-rich palaeoenvironments.

Although the majority of these amber fossil sites are Aptian - Albian in age, several Triassic, Upper Cretaceous and Tertiary amber-bearing deposits are also documented. Nevertheless, only in 7 amber localities from the Lower Cretaceous have recognizable insect inclusions been found. These are: Moraza (Burgos Province), Peñacerrada (Álava Province), El Caleyú and Pola de Siero (both in the Asturias Principate), Rubielos de Mora and San Just (both in the Teruel Province), and La-Hoya (Castellón Province). In these localities 21 orders of arthropods (17 of insects) are known.

**Early Cretaceous ferns from lacustrine limestones at Las Hoyas,
Cuenca province, Spain.**

Diéguez, C. y Meléndez, N.

Palaeontology **43**: 1113-1141
2000

Abstract

A brief outline is presented of the geological conditions prevailing in the hard-water lake that produced the Las Hoyas fossiliferous site in the Serranía de Cuenca (north-east central Spain). The corresponding Barremian laminated limestones contain varied fossil remains including plants. The fern component of the assemblage is described in the present paper. Ten taxa are referable to the families Matoniaceae, Dicksoniaceae and Schizaeaceae, whilst eight are unclassified. A new species of Dicksoniaceae is described: *Coniopteris laciniata*. Three species, *Pelletixia valdensis*, *Cladophlebis albertsii*, and *Sphenopteris fontainei*, are recorded here for the first time outside the English Wealden; one species, *Acrostichopteris foliosa*, is new to the Barremian of Europe. The fern assemblage from the Las Hoyas site is most similar to that of the English Wealden. The xeromorph character of some species is noted. Although the specimens from Las Hoyas are generally small, even tiny, most are still identifiable leaf fragments preserved as imprints on platy limestone. Epidermal detail has been obtained from a few impressions. Some rather delicate remains, such as indusia, a crozier with pinnules, and fragments of *Pelletixia valdensis* occur, thus suggesting limited residence time in water.

Floristic and vegetational changes in the Iberian Peninsula during Jurassic and Cretaceous.

Diéguez, C., Peyrot, D. y Barrón, E.

Review of Palaeobotany and Palynology **162**: 325-340
2010

Abstract

The successive vegetations inhabiting the Iberian Peninsula from the Triassic/Jurassic boundary to the Cretaceous/Tertiary Boundary is reviewed based on published palynological and macrofloral data, and the vegetational changes set in a palaeogeographical and climate context. Xerophytic microphyllous coniferous forests and pteridophyte communities of arid environments dominated the Jurassic and earliest Cretaceous vegetation. This vegetation was replaced in the mid Early Cretaceous by mixed forests of pteridophytes, gymnosperms and angiosperms. The composition of the successive plant assemblages suggests that a subtropical arid climate generally prevailed in the Iberian Peninsula during Jurassic–Cretaceous, although palaeobotanical and sedimentological evidences suggest that the climate was not uniform through the whole interval and that there were two episodes in the Tithonian–Berriasian and Aptian–Albian periods of pronounced dry and/or arid environmental conditions. The composition and structure of the vegetation was not only affected by evolutionary changes but also by successive global geographical and climate changes. Hence, significant changes in the distribution of continental areas during the Mesozoic resulted in the latitudinal or sublatitudinal extensions of the climatic belts.

Patrimonio Geológico: Una panorámica de los últimos 30 años en España.

Durán Valsero, J.J., Carcavilla Urqui, L. y López-Martínez, J.

Boletín de la Real Sociedad Española de Historia Natural
Sección Geológica 100: 277-287
2005

Resumen

En las últimas décadas se ha producido un cambio importante en España en relación con el estudio, la valoración y la conservación de los lugares de interés geológico, es decir con el patrimonio geológico. Tras unos momentos iniciales, a principios del siglo XX, de reconocimiento de la necesidad de proteger algunos enclaves emblemáticos por sus peculiares características geológicas y paisajísticas, la geoconservación cayó en un profundo letargo. No fue sino hasta finales de los años 1970 y principios de los 80 cuando se desencadenaron una serie de acciones – fundamentalmente en torno al Instituto Geológico y Minero de España, aunque no en exclusiva– que impulsaron los trabajos de inventario del patrimonio geológico de una parte del territorio español. Apartir de ese momento se han sucedido numerosas actuaciones: creación de comisiones y sociedades científicas específicas, generalización de inventarios a distintas escalas, publicación de síntesis del patrimonio geológico de buena parte del territorio español, toma de conciencia de las administraciones públicas (en particular las autonómicas) del valor del patrimonio geológico, participación de investigadores españoles en grupos internacionales de trabajo, declaraciones internacionales y nacionales sobre geoconservación, protección de lugares de interés geológico mediante figuras contempladas en la legislación de espacios naturales protegidos, creación de parques geológicos, inclusión de asignaturas específicas en los planes de estudios universitarios y la celebración de gran número de reuniones y congresos temáticos, con una ingente cantidad de trabajos publicados como resultado de los mismos.

Un konservat-Lagerstätte del Cretácico Inferior de Europa: Las Hoyas.

Escaso, F., Sanz, J.L. y Ortega, F.

Boletín de la Real Sociedad Española de Historia Natural
Sección Geológica **100**: 221-233
2005

Resumen

Desde su descubrimiento, en el año 1984, el yacimiento de Las Hoyas ha ido paulatinamente convirtiéndose en una referencia obligada en la comprensión de los ecosistemas continentales del Cretácico Inferior (hace unos 120 millones de años) y en la interpretación de la transición de floras y faunas no marinas durante el Mesozoico. El yacimiento se encuentra en la Serranía de Cuenca, en el término municipal de La Cierva. Los niveles actualmente en estudio son las calizas litográficas resultantes de la sedimentación en la zona más profunda de un lago somero. En esta zona el rápido enterramiento y la ausencia de organismos que alterasen los restos han permitido preservar fósiles que representan, con gran fiabilidad, la forma de los animales y plantas que se depositaron en el fondo del lago. Los restos de flora reconocidos en el yacimiento abarcan todos los grandes grupos de vegetales reconocidos en el Mesozoico. Entre otros, en Las Hoyas han podido registrarse los primeros pasos de uno de los eventos más importantes de la historia evolutiva de los vegetales: la sustitución de los grupos florísticos dominantes durante el Mesozoico, las gimnospermas, por plantas con flores (angiospermas). En Las Hoyas se ha recogido también una inusualmente rica colección de invertebrados, pertenecientes tanto a medios acuáticos, como crustáceos y ciertos grupos de insectos, como a medios terrestres. En cuanto a los vertebrados existe un amplio rango de diversidad, abarcando desde varios grupos de peces, entre los que podría destacarse la presencia de celacantos, hasta varios grupos de anfibios (ranas y salamandras), pequeñas tortugas, lagartos, cocodrilos y dinosaurios, entre los que destacan las aves.

At the feet of the dinosaurs: the early history and radiation of lizards.

Evans, S.E.

Biological Reviews **78**: 513-551
2003

Abstract

Lizards, snakes and amphisbaenians together constitute the Squamata, the largest and most diverse group of living reptiles. Despite their current success, the early squamate fossil record is extremely patchy. The last major survey of squamate palaeontology and evolution was published 20 years ago. Since then, there have been major changes in systematic theory and methodology, as well as a steady trickle of new fossil finds. This review examines our current understanding of the first 150 million years of squamate evolution in the light of the new data and changing ideas. Contrary to previous reports, no squamate fossils are currently documented before the Jurassic. Nonetheless, indirect evidence predicts that squamates had evolved by at least the middle Triassic, and had diversified into existing major lineages before the end of this period. There is thus a major gap in the squamate record at a time when key morphological features were evolving. With the exception of fragmentary remains from Africa and India, Jurassic squamates are known only from localities in northern continents (Laurasia). The situation improves in the Early Cretaceous, but the southern (Gondwanan) record remains extremely poor. This constrains palaeobiogeographic discussion and makes it difficult to predict centres of origin for major squamate clades on the basis of fossil evidence alone. Preliminary mapping of morphological characters onto a consensus tree demonstrates stages in the sequence of acquisition for some characters of the skull and postcranial skeleton, but many crucial stages – most notably those relating to the acquisition of squamate skull kinesis – remain unclear.

The Early Cretaceous lizards of Montsec (Catalonia, Spain).

Evans, S.E. y Barbadillo, L.J.

Treballs del Museu de Geologia de Barcelona 5: 5-13
1996

Resumen

Los depósitos del Cretácico Inferior del Montsec (Cataluña, España) han proporcionado restos pertenecientes a dos ejemplares de lagartos. El primero está representado por un esqueleto postcraneal incompleto que fue descrito por Vidal (1915) como *Meyasaurus fauræ*. El segundo, representado por un cráneo, fue descrito como *Ilerdaesaurus crusafonti* por Hoffstetter (1966). Hasta la fecha, debido a la inexistencia de materiales craneales y postcraneales asociados, no había podido determinarse si ambos restos podían ser atribuidos al mismo género. Sin embargo, el descubrimiento de nuevos restos de lagartos procedentes de los depósitos lacustres del Cretácico Inferior de las Hoyas en Cuenca (Castilla-La Mancha, España) han dado respuesta a dicha cuestión. Los lagartos de Las Hoyas permiten asociar el cráneo de *Ilerdaesaurus* con el esqueleto postcraneal de *Meyasaurus*. *Meyasaurus* Vidal 1915 tiene clara prioridad sobre *Ilerdaesaurus* Hoffstetter 1966, convirtiéndose así éste en un sinónimo de aquel.

Abstract

The Lower Cretaceous deposits of Montsec (Catalonia, Spain) have yielded two lizard specimens. One, a partial postcranial skeleton, was named *Meyasaurus fauræ* by Vidal (1915). The second, a skull, was named *Ilerdaesaurus crusafonti* by Hoffstetter (1966). There has always been the possibility that the skull and postcranial skeleton belonged to a single genus, but without associated material, the question remained open. New lizard material from the Lower Cretaceous (Late Barremian) lacustrine deposits at Las Hoyas, near Cuenca (Castilla-La Mancha, Spain), provides the answer. The Las Hoyas lizards combine the skull of *Ilerdaesaurus* with the postcranial skeleton of *Meyasaurus*. *Meyasaurus* Vidal 1915 clearly has priority over *Ilerdaesaurus* Hoffstetter 1966, and the latter becomes a junior synonym.

Early Cretaceous lizards from Las Hoyas, Spain.

Evans, S.E. y Barbadillo, J.

Zoological Journal of the Linnean Society **119**: 23-49
1997

Abstract

The Lower Cretaceous lithographic limestone locality of Las Hoyas (Cuenca Province, Spain) has yielded a rich terrestrial and freshwater assemblage including early angiosperms, insects, birds, crocodiles, a dinosaur, amphibians and lizards. The Las Hoyas lizards are represented by three distinct taxa, of which one, *Meyasaurus* Vidal 1915, has been described from other Spanish localities of similar age. The Las Hoyas specimens provide the first complete examples of *Meyasaurus*, permitting both a detailed morphological description and a comprehensive analysis of phylogenetic position. *Meyasaurus* is shown to be a lacertoid scincomorph related to teioids. Furthermore, in providing an association between the skull and postcranium, the Las Hoyas specimens of *Meyasaurus* show that the Montsec genus *IUrdaesaurus* Hoffstetter 1966 is a junior synonym of *Meyasaurus* Vidal 1915.

An unusual lizard (Reptilia: Squamata) from the Early Cretaceous of Las Hoyas, Spain.

Evans, S.E. y Barbadillo, L.J.

Zoological Journal of the Linnean Society **124**: 235-265
1998

Abstract

The Early Cretaceous (Barremian) lepidosaurian assemblage of Las Hoyas (Cuenca Province, Castilla-La Mancha), Spain, resembles that of roughly contemporaneous localities at Montsec (Catalonia), Una (Castilla-La Mancha) and Galve (Aragon) in being dominated by the scincomorph lizard *Meyasaums* (*Ilerdaesaurus*). It differs in the presence of two previously unknown taxa, one of which, described here, shows a strikingly unusual morphology in its ribs and distal limb skeleton suggestive of climbing specialization. This form is sufficiently distinct from other known taxa to warrant the erection of a new genus and species, *Scandensia ciervensis* gen. et sp. nov. Cladistic analysis of *Scandensia* suggests that it forms a sister taxon to living squamates (Iguania + Scleroglossa and all descendants of their most recent common ancestor).

A short-limbed lizard from the Lower Cretaceous of Spain.

Evans, S.E. y Barbadillo, L.J.

Special Papers in Palaeontology 60: 73-85
1999

Abstract

The Early Cretaceous (Barremian) locality of Las Hoyas (Cuenca Province, Castilla-La Mancha), Spain, has yielded a relatively diverse lizard assemblage dominated by the scincomorph genus *Meyasaurus*, but including at least two further taxa: one with long limbs and the other with relatively short limbs. The short-limbed lizard is described here. It resembles *Meyasaurus* in having a waisted frontal, but differs in many other features including the absence of sculpture on the skull bones, the presence of simple conical rather than bicuspid teeth, and the relative proportions of the limbs to the presacral body length. Comparison with other Jurassic and Early Cretaceous lizards supports the erection of a new taxon, here named *Hoyalacerta sanzi* gen. et sp. nov. Parsimony analysis suggests that *Hoyalacerta* is a primitive stem-group lizard, lying outside crown-group Squamata (Iguania + Scleroglossa).

A Metamorphosed Salamander from the Early Cretaceous of Las Hoyas, Spain.

Evans, S.E. y Milner, A.R.

Philosophical Transactions of the Royal Society B: Biological Sciences
351: 627-646
1996

A salamander, *Valdotriton gracilis* gen. et sp. nov., is described on the basis of six articulated skeletons of small metamorphosed individuals from the early Barremian (Early Cretaceous) La Huerguina Formation at the locality of Las Hoyas, Cuenca Province, Castilla La Mancha, Spain. *Valdotriton* is a relatively plesiomorphic member of the Urodela (crown-group salamanders), but more derived than the Sirenidae and Cryptobranchoidea, in that it possesses a single ossification in place of the prearticular and angular, and it has intravertebral spinal foramina on the anterior caudal vertebrae. It represents a plesion on the stem of the 'internally fertilizing salamander clade' comprising the Plethodontidae, Amphiumidae, Rhyacotritonidae, Proteidae, Dicamptodontidae, Ambystomatidae and Salamandridae.

Phylogeny and classification of the Stenophlebioptera (Odonata: Epiproctophora).

Fleck, G., Bechly, G., Martínez-Delclòs, X., Jarzembowski, E., Coram, R. y Nel, A.

Annales de la Société Entomologique de France **39**: 55-93
2003

Abstract

The Juraheterophlebiidae, new family of the “heterophlebioid” lineage, the Henrotayiidae, new family of the “anisopteroid” lineage, the Prostenophlebiidae and the Liassostenophlebiidae, new families of the Stenophlebioptera, and three new genera and species of the Stenophlebiidae are described from the Mesozoic of Germany, Spain, England, Kazakhstan, and Mongolia. The phylogenetic positions of the families Erichschmidiidae and Gondvanogomphidae are discussed. A tentative phylogenetic analysis of the Anisopteromorpha is proposed. This significantly extends our knowledge on the palaeogeographical distribution of the Stenophlebioptera and the Epiproctophora (“dragondamselflies”).

A revision of the Upper Jurassic-Lower Cretaceous dragonfly family Tarsophlebiidae, with a discussion on the phylogenetic positions of the Tarsophlebiidae and Sieblossidae (Insecta, Odonatoptera, Panodonata).

Fleck, G., Bechly, G., Martínez-Delclòs, X., Jarzembowski, E.A. y Nel, A.

Geodiversitas 26, 33-60
2004

Abstract

The Upper Jurassic-Lower Cretaceous dragonfly family Tarsophlebiidae is revised. The type species of the type genus *Tarsophlebia* Hagen, 1866, *T. eximia* (Hagen, 1862) from the Upper Jurassic Solnhofen Limestones, is redescribed, including important new information on its head, legs, wings, anal appendages and male secondary genital apparatus. The type specimen of *Tarsophlebiopsis mayi* Tillyard, 1923 is regarded as an aberrant or unusually preserved *Tarsophlebia eximia*. One new species of *Tarsophlebia* and three new species of *Turanophlebia* are described, i.e. *Tarsophlebia minor* n. sp., *Turanophlebia anglicana* n. sp., *T. mongolica* n. sp., and *T. vitimensis* n. sp. A new combination is proposed for *Turanophlebia neckini* (Martynov, 1927) n. comb. The phylogenetic relationships of the Mesozoic Tarsophlebiidae are discussed on the basis of new body and wing venation characters. The present analysis supports a rather derived position for the Tarsophlebiidae, as sister group of the the Epiproctophora rather than of (Zygoptera + Epiproctophora). Also, through the present discussion, the Oligo-Miocene family Sieblosiidae seems to be more closely related to the Epiproctophora than to the Zygoptera. But the present study and previous analyses suffer of the lack of informations concerning the more inclusive groups of Odonatoptera, viz. Protozygoptera, Triadophlebiomorpha, Protanisoptera, etc. The significance of the tarsophlebiid secondary male genital apparatus for the reconstruction of the evolution of odonate copulation is discussed.

**Análisis de la cubeta sedimentaria de Las Hoyas y su entorno paleogeográfico (Cretácico Inferior, Serranía de Cuenca).
Sedimentología y aspectos tafonómicos del yacimiento de Las Hoyas.**

Fregenal-Martínez, M.A.

Tesis Doctoral
Universidad Complutense de Madrid
1998

Resumen

Esta tesis aborda el estudio de algunas de las diversas facetas implicadas en la formación del yacimiento de Las Hoyas (Cretácico Inferior, Serranía de Cuenca), así como la evolución paleogeográfica de la Cubeta de Las Hoyas, en la que el yacimiento se encuentra, y de las cubetas contemporáneas y circundantes. El relleno sedimentario de la Cubeta de Las Hoyas ha sido dividido en cuatro secuencias de depósito formadas por sedimentos aluviales y lacustres calcáreos y siliciclásticos. El yacimiento se encuentra en la segunda secuencia, formada por sedimentos depositados en un lago carbonatado somero y permanente en cuyo fondo se formaron las calizas finamente laminadas que constituyen el yacimiento. El estudio sedimentológico de estas calizas ha llevado a diferenciar ocho microfacies diferentes cuyo ordenamiento secuencial responde a factores autocíclicos y alocíclicos, fundamentalmente climáticos (alternancia de etapas húmedas y más áridas). La tectónica fue el control alocíclico que determinó la configuración paleogeográfica de las cubetas y su evolución. La sedimentación tuvo lugar en un contexto tectónico distensivo de rifting intracontinental y el yacimiento se formó en uno de los momentos de máxima subsidencia coincidiendo con el clímax de rifting y el momento de máxima expansión regional de los sistemas lacustres. El yacimiento, considerado como un Konservat-Lagerstätten, está compuesto por una diversa y abundante flora y fauna (moluscos, crustáceos, insectos, peces, anfibios, tortugas, lagartos, cocodrilos, dinosaurios y aves) excepcionalmente conservada. El estudio tafonómico general del yacimiento ha revelado la existencia de al menos dos tafofacies diferentes que contienen sendas asociaciones conservadas. Cada asociación muestra un conjunto de caracteres tafonómicos diferentes producto de la alteración tafonómica. El estudio prueba que la conservación de información paleobiológica no es incompatible con la alteración tafonómica y la adquisición de caracteres tafonómicos durante la fosilización. Las conclusiones obtenidas a partir del estudio a distintas escalas de aspectos puramente geológicos y aspectos paleontológicos, realizada de forma independiente, sobre los principales factores que concurrieron en la formación del yacimiento de Las Hoyas han resultado

coherentes y complementarias. Por tanto la metodología de enfoque múltiple y contrastación continua que se ha desarrollado constituye una fructífera vía en la aproximación a una problemática como la que plantea el yacimiento de Las Hoyas.

A holistic approach to the palaeoecology of Las Hoyas Konservat-Lagerstätte (La Huérguina Formation, Lower Cretaceous, Iberian Ranges, Spain).

Fregenal-Martínez, M.A. y Buscalioni A.D.

Journal of Iberian Geology **36** (2): 297-326
2010

Abstract

The Las Hoyas fossil site (Lower Cretaceous, Iberian Ranges, Spain) is a classic lacustrine Fossil-Lagerstätte that exemplifies the features predicted by the original concept of Konservat Lagerstätten in relation to the quantity of remains, quality of preservation, completeness, and preservation by a combination of obrution, stagnation and, in this case, mainly bacterial sealing. Fossils are preserved in rhythmically laminated limestones deposited in a environment that underwent strong, climatically driven cyclical oscillations in water level within the framework of a seasonal, subtropical, regional-scale wetland. Extensive systematic layer-by-layer excavation and geological research have resulted in a comprehensive understanding of the stratigraphy and sedimentology of the locality and its regional palaeogeography. Two approaches have allowed the palaeoecology of the fossil association to be reconstructed. Firstly, autoecological reconstructions of the fossil groups are supplemented by palaeoenvironmental reconstructions based on the sedimentology. This considers taphonomic features and the ecological structure of the whole association, including vegetation and animals. The organization of the ecosystem resembles that of extant lentic ecosystems. It is dominated by obligate aquatic and amphibious organisms; facultative terrestrial organisms are scarce. Several lines of evidence from flora and fauna indicate strong seasonality and water stress. The second approach is dynamic and aims to unravel the information transferred to the fossil record about ecological dynamics and evolution by combining stratigraphical and palaeontological information and integrating this in a spatial and temporal framework. This analysis illustrates that Las Hoyas has a significant facies bias, reflecting alternating wet and dry climatically controlled periods. The biotic response these wet and dry cycles produced a coupling of taphonomic and sedimentary processes that resulted in the characteristic cyclical arrangement of the stratigraphic and palaeontological record. Las Hoyas therefore represents a subtropical seasonal wetland impacted by cyclicity and ecological stress. This stress impeded shortterm ecological evolution and resulted in a stable ecosystem that lasted for thousands of years. The results of this study also have implications for the concept of Konservat-Lagerstätten and its limitations. Whereas the former approach considers Las Hoyas as a canon of minimally biased information (as it is

a Konservat-Lagerstätte), the latter approach reveals the biased characteristics of the association. The study illustrates that although all Konservat-Lagerstätten share similar preservational mechanisms, the paleoecological information that contain may differ.

Resumen

El yacimiento de Las Hoyas (Cretácico Inferior, Cordillera Ibérica, España) es un clásico Fossil-Lagerstätte lacustre que encaja perfectamente con los rasgos que predice el concepto de Konservat-Lagerstätte en lo relativo a la abundancia de restos, calidad de conservación, completitud y génesis del depósito debido a la combinación de factores relacionados con el enterramiento rápido, el estancamiento y, en el caso particular de Las Hoyas, el sellado bacteriano. Los fósiles se conservan en calizas finamente laminadas que fueron depositadas en un ambiente que estuvo sujeto a fuertes oscilaciones cíclicas en el nivel de agua, climáticamente reguladas, en el marco de un humedal estacional y subtropical de escala regional. Las profusas excavaciones sistemáticas realizadas capa a capa, y la investigación geológica han dado lugar a un profundo conocimiento de la estratigrafía y sedimentología de la localidad y de su paleogeografía regional. Una doble aproximación a la interpretación de las asociaciones fósiles ha permitido la reconstrucción paleoecológica de la localidad. La primera parte de las reconstrucciones autoecológicas de los grupos fósiles retroalimentadas por la reconstrucción paleoambiental basada en la sedimentología. En esta aproximación se consideran las características tafonómicas y la estructura ecológica de la asociación completa, incluyendo la ecología vegetal y animal. La organización del ecosistema sigue un patrón semejante al de los ecosistemas lénticos actuales. Este ecosistema se caracteriza por la dominancia de organismos acuáticos obligados y de categorías anfibias y por la escasez de formas facultativas terrestres. Hay evidencias diversas, en la flora y en la fauna, de estrategias ecológicas vinculadas a la fuerte estacionalidad y al estrés hídrico. La segunda aproximación es dinámica, y pretende desvelar la información transferida al registro fósil en cuanto a la dinámica ecológica y su evolución mediante la combinación de información proporcionada por datos estratigráficos y paleontológicos, de modo que los datos son interpretados en términos de su marco y significado espacial y temporal. Este análisis muestra que Las Hoyas tiene un sesgo significativo de facies (facies bias), reflejando la alternancia de periodos húmedos y áridos controlados climáticamente. La respuesta biótica a estos ciclos húmedos y áridos produjo un acoplamiento entre los procesos tafonómicos y sedimentarios que da lugar a una estructura cíclica del registro estratigráfico y paleontológico de Las Hoyas. Por consiguiente, Las Hoyas representa un humedal subtropical estacional regido por la ciclicidad y por el estrés ecológico. Dicho estrés impide una evolución ecológica a corta escala dando lugar a

un ecosistema estable que debió durar miles de años. El resultado de este estudio tiene algunas implicaciones en el concepto de Konservat-Lagerstätten y en sus limitaciones. Mientras que bajo la primera aproximación Las Hoyas se consideraría canon de información con un sesgo mínimo, puesto que es un depósito de conservación excepcional, la segunda aproximación pone de manifiesto el sesgo presente en la asociación. Este estudio ilustra que aunque todos los Konservat-Lagerstätten comparten mecanismos de conservación similares, la información paleoecológica que contienen difiere entre ellos.

Sedimentología y evolución paleogeográfica de la cubeta de Las Hoyas (Cretácico inferior, Serranía de Cuenca).

Fregenal-Martínez, M.A. y Meléndez, N.

Cuadernos de Geología Ibérica 17: 231-256
1993

Resumen

La cubeta de Las Hoyas (Serranía de Cuenca, Cordillera Ibérica) sufrió un relleno sedimentario complejo durante el Cretácico inferior. En un contexto de rift intracontinental, la cubeta de Las Hoyas se encontraba localizada sobre un bloque subsidente controlado por directrices tectónicas ONO-ESE y NO-SE. La variación a lo largo del tiempo del equilibrio entre la tasa de sedimentación y la tectónica sinsedimentaria activa, en interacción con una serie de factores intra y extracuencales (producción de carbonatos, llegada de aportes siliciclásticos, clima...) determinó una historia sedimentaria en tres episodios en los que la paleogeografía de esta cubeta estuvo dominada por diferentes ambientes. En un primer Episodio se instaló una llanura aluvial distal. Un segundo Episodio está definido por la instalación en todo el área de un ambiente lacustre abierto. El tercer y último Episodio está representado por un ambiente de llanura aluvial distal con áreas lacustres marginales dominantes.

Abstract

Las Hoyas sub-basin (Serranía de Cuenca, Iberian Ranges) had a very complex sedimentary infilling during the Lower Cretaceous. This basin was settled on a subsident block, in an intracontinental rift context. This block was controlled by WNW-ESE and NW-SE tectonic lineations. Its sedimentary history was developed in three stages and was outlined by the interaction and the equilibrium among several factors: sedimentation rate, differential subsidence, carbonate production, siliciclastic supply, climate... During the three stages the paleogeography was dominated by different environments. During the first one a distal alluvial plain was installed in the area. A lacustrine environment was developed during the second stage. The third stage is represented by the installation of a distal alluvial plain dominated by marginal lacustrine areas.

Sedimentological analysis of the Lower Cretaceous lithographic limestones of the "Las Hoyas" fossil site (Serrania de Cuenca, Iberian Range, Spain).

Fregenal-Martinez, M.-A. y Melendez, N.

Geobios 27(Supplement 1): 185-193
1994

Abstract

The lithographic limestones of the Las Hoyas fossil site (Lower Cretaceous) were deposited in a meromictic lake. The climate (subtropical), the active synsedimentary tectonics, the high organic productivity and the high sedimentation rate were the main controls on lake dynamics. The variety of microfacies recognized reflects a complex behaviour of the lake that produced the exceptional fossil record at this site. The main factors and processes that favoured the exceptional preservation of the fossils seem to be: the morphology of the lacustrine basin, the anoxia of the bottom of the lake, the very fast burial of the rests by turbidity deposits, the development of microbial mats, as well as, the early diagenetic mineralization of the rests, that were buried in carbonate sediments.

**Carbonate and coal deposition in an alluvial-lacustrine setting:
Lower Cretaceous (Weald) in the Iberian Range (East-Central Spain).**

Gierlowski-Kordesch, E.H., Gómez-Fernández, J.C. y Meléndez, N.

Lacustrine Facies Analysis
International Association of Sedimentologists
Special Publication 13: 109-125.
1991

Abstract

Lower Cretaceous (Upper Hauterivian? to Lower Barremian) carbonate and clastic rocks interbedded with coal from the Weald of the Serranía de Cuenca (Cuenca Province, Iberian Range, Spain) were analysed. The study area centred around Uña (north of the capital of Cuenca), where a lignite deposit exists; it is completely enclosed in carbonates and contains a vertebrate fauna including mammals. From six measured sections and other data, four facies associations containing 14 separate facies were identified: coal–limestones (association A), charophyte-micrites–silty-marls (association B), clayey-marls–limestones–sandstones (association C), and coal–clastics (association D). Based on evidence from tectonics, fossils, and regional geology, a continental palaeoenvironment comprising a carbonate–clastic alluvial plain transitional to a marginal lacustrine setting adjacent to a large lacustrine delta was envisaged.

The sediments of the carbonate floodplain were deposited and constantly recycled as bedload and as physico-chemical and biochemical precipitates. The continual recycling of the carbonates was attributed to early diagenetic processes including karstification, calichification, marmorization, micritization, nodularization, and illuviation. Algal morphologies within oncolites, as well as diagenetic patterns, suggest alternating wet and dry periods on the floodplain.

The limnic coal deposit (lignite) is interpreted to have developed within a prograding lake delta. Evidence includes facies geometry and lack of exposure features. From climatological and sedimentological arguments, a seasonal, warm and semi-arid climate was established for the Weald at Uña. Subsidence, sediment supply, and hydrology, not climate, were named as important factors in coal preservation. The Jurassic karst substratum was deemed sufficient to control the hydrology (water levels) and carbonate sedimentation in the Uña Basin for maintenance of constant water cover for coal formation and preservation.

A new species of *Mirovia* (Coniferales, Miroviaceae) from the Lower Cretaceous of the Iberian Ranges (Spain).

Gomez, B.

Cretaceous Research **23**: 761-773
2002

Abstract

The Lower–Middle Albian coaly clay bed of the Escucha Formation, which is exposed at Rubielos de Mora (eastern Iberian Ranges, Spain), contains a diverse fossil plant assemblage. Among the taxa present in this layer, *Mirovia gothanii* Gomez sp. nov. differs from other species of the genus by its greater leaf length, margins typically overhanging the depressed stomatal groove, a single short, blunt, papilla borne by each subsidiary cell, non-stomatal cells inside the groove and margins, and a higher number of resin ducts in the mesophyll. Morphological study of the well-preserved cuticles demonstrates that the species also occurs in Lower Cretaceous coals of Santa Maria de Meià (Pyrenees, Spain) where Gothan (1954) described it as *Sciadopitytes* sp. Both localities constitute the southernmost extent of the genus in Laurasia when the family was likely to have reached its climax in terms of abundance and diversity.

Rhythmically laminated lacustrine carbonates in the Lower Cretaceous of La Serranía de Cuenca Basin (Iberian Ranges, Spain).

Gómez Fernández, J.C. y Meléndez, N.

Lacustrine Facies Analysis
International Association of Sedimentologists
Special Publication 13: 245-256
1991

Abstract

Lacustrine carbonate deposits are well represented in the Lower Cretaceous of the Iberian Ranges, eastern Spain. Previously, only shallow lacustrine carbonate deposits have been described from the Iberian Basin, and interpreted as deposits of hard water, shallow lakes and wide, ponded alluvial plains. This paper deals with some of these carbonates located in La Serranía de Cuenca, in the northwestern part of the Iberian Ranges.

A notable feature of the lacustrine Upper Hauterivian? to Lower Barremian La Huerguina Formation, in La Serranía de Cuenca Basin, is the presence of rhythmically laminated limestones interpreted as lacustrine varves. The existence of these lacustrine varves and the preservation of different organisms (especially fish), suggest that thermal stratification of an open lake produced anoxic bottom conditions. Other evidence to support this interpretation includes the absence of bioturbation and high organic matter content. Irregular slabby limestones were deposited below the euphotic zone. Calcarenite beds and algal limestones represent shallower areas of the lake. This lake was surrounded by palustrine areas and a distal alluvial carbonate plain.

**Plant taphonomy and palaeoecology in the lacustrine Uña delta
(Late Barremian, Iberian Ranges, Spain).**

Gomez, B., Martín-Closas, C., Méon, H., Thévenard, F. y Berale, G.

Palaeogeography, Palaeoclimatology, Palaeoecology **170**: 133-148
2001

Abstract

Plant cuticle compressions and sporomorphs were studied in coaly clays belonging to the Upper Barremian La Huérguina Formation in Uña (South-western Iberian Ranges, Cuenca, Spain). Cuticle assemblages are extremely monotonous and formed by the genera *Frenelopsis* Schenk emend. Watson, *Classostrobus* Alvin et al. and *Glenrosa* Watson and Fisher. Sporomorphs are dominated by *Classopollis* Pflug emend. Srivastava. The genus *Glenrosa* is described for the first time in Europe. Sedimentological and taphonomical analyses show that these assemblages originated by fragmentation and size-selection during residence in the leaf-litter and by fluvial transport. Final deposition occurred in crevasse-splay, deltaic front and pro-deltaic environments. Our results indicate that the Uña delta was fed almost exclusively by remains of cheirolepidiaceous conifers living in the upper deltaic plain of a lacustrine delta. A comparison with the flora found in the open lacustrine facies of Las Hoyas, which is laterally equivalent of the beds studied, shows that land-plant assemblages of Las Hoyas are more diverse. The parautochthonous matoniaceous tree-fern *Weichselia reticulata* dominated the lakeshore vegetation of Las Hoyas in contrast to the vegetation of the upper delta plain of Uña, which was dominated by *Frenelopsis*. The habitats of *Frenelopsis* and *Glenrosa* from the Upper Barremian oligohaline basin of Uña–Las Hoyas contrast with the habitats commonly hypothesized for both taxa in coastal marine environments or on saline edaphic profiles. In conclusion *Frenelopsis* appears to have a wider tolerance to salinities than previously thought and their adaptations to saline edaphic conditions should be considered species-specific rather than genus-specific.

***Frenelopsis* (Coniferales: Cheirolepidiaceae) and related male organ genera from the Lower Cretaceous of Spain.**

Gomez, B., Martín-Closas, C., Barale, G., Solé de Porta, N., Thévenard, F. y Guignard, G.

Palaeontology **45**: 997-1036
2002

Abstract

Vegetative plant remains and microsporangiate cones, related to the fossil genera *Frenelopsis* and *Classostrobus* respectively, were studied in three localities from the Lower Cretaceous of the Pyrenees and Iberian Ranges (Spain). Sterile remains belong to three different species: *F. Rubiesensis* Barale, *F. Uгнаensis* sp. nov. and *F. Turolensis* sp. nov. The male cones *Classostrobus uгнаensis* sp. nov. and *C. Turolensis* sp. nov. are associated with the two latter species respectively, and *C. Turolensis* is found in connection with *F. Turolensis*. Internodes of *F. Uгнаensis* display small hemispherical papillae and long conical hairs covering the entire cuticle surface, while *F. Turolensis* has a strip of hairs near the leaf margin, in addition to more massive outer stomatal papillae and higher stomatal density. The tiny cones of *C. Uгнаensis* bear microsporophyll cuticles capped with vermiculate flattened papillae and a fringe of marginal hairs, while *C. Turolensis* has a central area of microsporophylls covered by long conical hairs. Sedimentological and taphonomic analyses show that the assemblages studied belong to a wide spectrum of habitats. These indicate that Spanish Lower Cretaceous frenelopsids were xeromorphic plants, able to adapt to helophytic and riparian habitats, and grew in brackish coastal marshes and fluvio-lacustrine freshwater environments.

The conifer *Glenrosa falcata* sp. nov. from the Lower Cretaceous of Spain and its palaeoecology.

Gomez, B., Ewin, T.A.M. y Daviero-Gomez, V.

Review of Palaeobotany and Palynology **172**: 21-32
2012

Abstract

Based on short shoots and isolated leaves collected from the upper Barremian coaly clays of the La Huérguina Formation (Uña–Las Hoyas basin, Iberian Ranges, Spain) a new species of the fossil conifer genus *Glenrosa* Watson et Fisher emend. Srinivasan is here described for the first time in Europe. *Glenrosa falcata* sp. nov. displays the characteristic stomatal crypts and papillae projecting into the crypt neck, however it is differentiated from other *Glenrosa* species by its falcate leaf morphology with a long free part (over 50% of the leaf length), an acute and recurved leaf tip and robust epidermal cell papillae. Based on comparisons with living angiosperms possessing stomatal crypts (*Nerium* Linnaeus (Apocynaceae) and *Blossfeldia* Werdermann (Cactaceae)) and an assessment of the palaeoenvironment we conclude that *G. falcata* was a xerophytic shrub, that grew on well drained substrates in a seasonally dry and warm climate and formed a minor part of a vegetation dominated by the Cheirolepid *Frenelopsis* (Schenk) emend. Watson. This habitat was alkaline and oligohaline and therefore expands the previously reported environmental tolerances of *Glenrosa*.

Phylogenetic relationships of fossil and Recent gonorynchiform fishes (Teleostei: Ostariophysii).

Grande, T. y Poyato-Ariza, F.J.

Zoological Journal of the Linnean Society **125**: 197-238
1999

Abstract

This paper represents the first cladistic analysis of the interrelationships of all nominal fossil and living gonorynchiform genera. Gonorynchiformes is the basal group of the superorder Ostariophysii, and is confirmed as monophyletic on the basis of 12 synapomorphies. The Gonorynchiformes is to be subdivided into two monophyletic suborders, Chanoidei and Gonorynchoidei. The Chanoidei includes the family Chanidae, which in turn includes the Recent *Chanos* plus five fossil genera, grouped in two subfamilies: Chaninae ((*Chanos*+† *Tharrhiai*) +†*Parachanos*+†*Dastilbe*) and †*Rubiesichthyinae* (†*Rubiesichthys*+†*Gordichthys*). †*Aethalionopsis* is the sister-group to the Chanidae. Gonorynchoidei includes two families Gonorynchidae and Kneriidae. Gonorynchidae is formed by (*Gonorynchus*,†*Notogoneus*) and four fossil taxa of uncertain definition and interrelationships: †*Charitosomus*,†*Charitopsis*,†*Ramallichthys*, and †*Judeichthys*. The last four genera were previously included in the families †Charitosomidae and †Judeichthyidae, which could not be supported as monophyletic in this analysis. Kneriidae consists of two subfamilies Phractolaeminae with one genus *Phractolaemus*, and Kneriinae which includes ((*Kneria* + *Parakneria*) + (*Grasseichthys* + *Cromeria*)), the latter two being paedomorphic forms. The Phractolaeminae and the Kneriinae are freshwater African taxa with no known fossil record. The order Gonorynchiformes is represented herein by 18 genera, extending back to the Early Cretaceous. More work is required to clarify the interrelationships of the Gonorynchidae and the paedomorphic characters that apparently played an important role in the evolution of this morphologically diverse group of fishes.

Molecular taphonomy of macrofossils from the Cretaceous Las Hoyas Formation, Spain.

Gupta, N.S., Cambre-Moo, O., Briggs, D.E.G., Love, G.D., Fregenal-Martinez, M.A. y Summons, R.E.

Cretaceous Research **29**: 1-8
2008

Abstract

Macromolecular analysis of fossil fish scales from the Cretaceous Las Hoyas Formation (using pyrolysis-gas chromatography-mass spectrometry) revealed a dominant aliphatic composition (C8 to C22) whereas modern fish scale is proteinaceous (largely collagenous). Structural analysis of the aliphatic polymer using thermochemolysis revealed the importance of ester linkages; saturated fatty acids C14 to C18 (particularly C16) are the most abundant. These acid components and their unsaturated counterparts are evident in the lipid composition of modern fish scales. Thus, the aliphatic composition of the fossil scales is probably a result of the incorporation of lipids (including a C19 aromatic hydrocarbon) from the original indicating preservation by in situ polymerization of labile aliphatic components. Fossil arthropods and plants from the same deposit also show a dominant aliphatic macromolecular component, likely derived predominantly by crosslinking of free lipid precursors. Differences in the relative distribution of molecular components indicate likely chemosystematic differences between different fossil groups.

Preliminary phylogenetic analysis of the Protanisoptera (Insecta: Odonatoptera).

Huguet, A., Nel, A., Martínez-Delclòs, X., Bechly, G. y Martins-Neto, R.

Geobios **35**: 537-560
2002

Abstract

The Permian suborder Protanisoptera (Insecta: Odonatoptera) is revised and a new phylogenetic hypothesis proposed after analyses based on wing venation and different outgroups. After our study the families Camptotaxineuridae and Kaltanoneuridae are excluded from the Protanisoptera. After a new phylogenetic analysis, the family Permaeschnidae is redefined and the families Pholidoptilidae, Polytaxineuridae, Callimokaltaniidae and Hemizygopteridae are restored, as already proposed for the latter three families by Bechly (1996). The new genus *Proditaxineura* is described. The genus *Gondvanoptilon* RÖSLER et al., 1981 is excluded from the Meganisoptera: Erasipteridae and re-included in the Permaeschnidae, as already proposed by Bechly (1998). *Permaeschna proxima* MARTYNOV, 1931 is considered as a junior synonym of *Permaeschna dolloi* MARTYNOV, 1931. *Pholidoptilon camense* ZALESSKY, 1931 is excluded from *Permaeschna* MARTYNOV, 1931 and the genus *Pholidoptilon* ZALESSKY, 1931 is restored. *Ditaxineurella stigmalis* MARTYNOV, 1940 is excluded from the Hemizygopteridae and considered as a Protanisoptera Incertae sedis.

Involvement of microbial mats in delayed decay: an experimental essay on fish preservation.

Iniesto, M., Lopez-Archilla, A.I., Fregenal-Martínez, M., Buscalioni, A.D. y Guerrero, M.C.

Palaios **28**: 56-66

2013

Abstract

Microbial mats have been implicated in exceptional fossil preservation. Few analyses have addressed how these complex-multilayered biofilms promote fossil preservation. The sequence of changes during decay of neon tetra fish were tracked up to 27 months, and their decomposition in mats was compared against nonmat sediments (control fish). Statistically significant differences in quantitative variables (length, width, and thickness) are provided (ANOVA test, in all cases, $P < 0.001$). Changes in the qualitative features (body-head, fins, scale connection, and eye and body coloration) were phenetically analyzed resulting in two clusters and highlighting that notable differences in decay began at day 15. Mat fish show a delayed decomposition maintaining the external and internal body integrity, in which soft organs were preserved after 27 months as shown by Magnetic Resonance Imaging. We discuss how the organization, structure, and activity of this community are interrelated, favoring exceptional preservation. Microbial mats entomb the fish from the earliest stages, forming a Ca-rich coat over the carcass while embedding it in an anoxic condition. This quick entombment provides important protection against abiotic and/or biotic agents.

A phylogenetic system of Clavatoraceae (fossil Charophyta).

Martín-Closas, C.

Review of Palaeobotany and Palynology **94**: 259-293
1996

Abstract

Using the cladistic method of Hennig a phylogenetic system of Clavatoraceae (fossil Charophyta) is proposed. A number of new combinations arise from this study.

The family Clavatoraceae is composed of three monophyla: (1) the Atopocharoidae, which are defined by presenting a utricle with a radial symmetry formed by the superposition of two whorls of spine-shaped bracts and includes traditional members plus traditional Echinocharoideae; (2) the Dictyoclavatoroidae, a monotypic taxon formed by *Dictyoclavator fierii*, which includes all traditional species of the genus and is defined by a utricle composed of a dense tissue of sub-polygonal cells; and (3) the Clavatoroidae, defined by showing a "Ringstruktur" calcification and a gyrogonite surrounded by a nodular layer, includes traditional members of the subfamily without *Dictyoclavator*.

Atopocharoidae include five taxa: *Diectochara andica*, *Echinochara spinosa*, *E. peckii*, *Globator maillardii* and *Atopochara trivolvii*. Traditional systematics created a large number of anagenetic taxa within some of these species. Although these traditional taxa are biostratigraphically useful, they are by no means equivalent to evolutionary species. The ancestral species of the subfamily is at present unknown. *D. andica*, *E. spinosa*, *E. peckii* and *A. trivolvii* are considered as terminal taxa of the stem line. *E. peckii* is proposed as the ancestral species of *G. maillardii*.

Clavatoroidae include an ancestral species (*Nodosoclavator bradleyi*) and four genera each one with a different utricle architecture (Bauplan): (1) *Clavator* is defined by the apomorphy "bracts adjacent to the phylloid bearing fans of spine cells". It is formed by six species plus the ancestral species and includes traditional members of *Clavator*, *Flabellochara*, *Clypeator*, *Triclypella*, *Lucernella* and *Septorella*. (2) *Ascidiella* is defined by the apomorphies "external layer of utricle constituted by two nodes of the phylloid" and "bracts bearing rosettes of petal-shaped cells". It is formed by four species plus the ancestral species and includes the traditional genera *Ascidiella* and *Embergerella*. (3) *Hemiclavator* is defined by the apomorphy "external layer of utricle consisting of one or two whorls of triangular-shaped cells directly attached to the phylloid". The genus contains one species and its ancestor and includes the traditional genus *Hemiclavator* and the species *Nodosoclavator adnatus*. (4) *Pseudoglobator* is defined by the apomorphy "external layer of utricle constituted of filiform cells radiating from the basal node". It contains one species and its surviving ancestor

and includes the traditional taxa *Pseudoglobator fourcadei* and *P. paucibracteatus*.

Epiphytic Overgrowth of Charophyte Thalli by Stromatolite-like Structures and Fungi in the Lower Cretaceous of the Iberian Ranges (Spain).

Martín-Closas, C.

Australian Journal of Botany **47**: 305-313
1999

Abstract

The Lower Cretaceous (113 million years old) lacustrine deposits of Las Hoyas (Iberian Ranges, Cuenca, Spain) yield an epiphytic assemblage formed by the charophyte species *Clavatoraxis diaz-romeralii* Martín-Closas & Diéguez overgrown by a muddy, laminated stromatolite-like structure. Fossil charophyte thalli coated with biogenic laminations were previously unknown from the fossil record. Within this stromatolite-like structure, filaments are found which correspond to thalli of another charophyte, *Palaeonitella vermicularis* Martín-Closas & Diéguez, and to septate hyphae of fungi (Ascomycetes). The distribution pattern of the biogenic lamination and its selective growth only on the strongest thalli of *Clavatoraxis diaz-romeralii* suggests that it occurred when these macrophytes were still alive, standing upright on the lake bottom. From this point of view the stromatolite-like structures are reminiscent of extant overgrowths of charophyte thalli by epiphytic, filamentous cyanobacteria, eucaryotic algae and fungi. These assemblages appear to develop after eutrophication of nutrient-poor environments, which are more suitable for charophyte growth.

The fossil record and evolution of freshwater plants: A review.

Martín-Closas, C.

Geologica Acta 1: 315-338
2003

Abstract

Palaeobotany applied to freshwater plants is an emerging field of palaeontology. Hydrophytic plants reveal evolutionary trends of their own, clearly distinct from those of the terrestrial and marine flora. During the Precambrian, two groups stand out in the fossil record of freshwater plants: the Cyanobacteria (stromatolites) in benthic environments and the prasinophytes (leiosphaeridian acritarchs) in transitional planktonic environments. During the Palaeozoic, green algae (Chlorococcales, Zygnematales, charophytes and some extinct groups) radiated and developed the widest range of morphostructural patterns known for these groups. Between the Permian and Early Cretaceous, charophytes dominated macrophytic associations, with the consequence that over tens of millions of years, freshwater flora bypassed the dominance of vascular plants on land. During the Early Cretaceous, global extension of the freshwater environments is associated with diversification of the flora, including new charophyte families and the appearance of aquatic angiosperms and ferns for the first time. Mesozoic planktonic assemblages retained their ancestral composition that was dominated by coenobial Chlorococcales, until the appearance of freshwater dinoflagellates in the Early Cretaceous. In the Late Cretaceous, freshwater angiosperms dominated almost all macrophytic communities worldwide. The Tertiary was characterised by the diversification of additional angiosperm and aquatic fern lineages, which resulted in the first differentiation of aquatic plant biogeoprovinces. Phytoplankton also diversified during the Eocene with the development of freshwater diatoms and chrysophytes. Diatoms, which were exclusively marine during tens of millions of years, were dominant over the Chlorococcales during Neogene and in later assemblages. During the Quaternary, aquatic plant communities suffered from the effects of eutrophication, paludification and acidification, which were the result of the combined impact of glaciation and anthropogenic disturbance.

Taphonomie des plantes et interprétations paléoécologiques. Une synthèse.

Martín-Closas, C. y Gomez, B.

Geobios **37**: 65-88
2004

Abstract

The taphonomy is a powerful and requisite tool for environmental reconstructions of ancient plant communities. Necrobiotic processes, which lead to the production of plant fragments, inform us on fossil plant physiology. Among the processes that can be drawn from necrobiotic studies is the retention of leaf organs on plants, the relative quantity of pollen grains produced by different fossil species or the significance of wildfire dynamics in ancient plant communities. Biostratigraphy examination is a fundamental tool for elucidating fossil plant habitats. Numerous experimental data allow paleobotanists for evaluating the role of transport in the origin of fossil assemblages. Autochthonous plant assemblages, which are characterised by the preservation of fossil rooting structures, are relatively rare in the nature. In consequence, the search for palaeoecological information from parautochthonous to allochthonous assemblages has been a priority in taphonomy. As a result, taphonomic models have been elaborated in well-known sedimentological contexts, such as small lacustrine deltas, which allow for the distinction between riparian or perideltaic plant remains. Lithospheric processes modify plant debris after burial. The differences in the degrees of transformations (or alterations) during the diagenesis provide for information about the original morphology and biochemical composition of the plant tissues, which are also paleoecologically useful. Thus, amber diagenesis modifies resin biochemistry into new molecules that are still informative from the chemotaxonomical point of view.

**Blátidos (Insecta, Blattodea) del Cretácico Inferior de España.
Familias Mesoblattinidae, Blattulidae y Poliphagidae.**

Martínez-Delclòs, X.

Boletín Geológico y Minero **104**: 52-74
1993

Resumen

Se describen siete especies de blátidos (Insecta, Blattodea), entre un amplio número de formas de este orden, encontradas en los yacimientos de calizas litográficas del Cretácico Inferior de España. De estas siete formas, cinco son géneros y especies nuevas y dos son especies que se redescubren. Han sido reconocidas tres familias: Mesoblattinidae, en la cual se ha emplazado cinco especies y Blattulidae y Poliphagidae, con una especie cada una. Es la primera vez que se reconoce la familia Poliphagidae en el registro fósil. Con anterioridad individuos fósiles de la familia Blattulidae se habían encontrado en otros yacimientos de Europa pero nunca en España.

El registro fósil de los insectos.

Martínez-Delclòs, X.

Boletín de la Asociación Española de Entomología **20**: 9-30
1996

Resumen

En el presente trabajo se ha realizado un breve repaso a alguno de los aspectos más conocidos de los insectos fósiles como pueden ser: a) los diversos factores que condicionan la fosilización de los insectos terrestres y acuáticos como: su habitat, la presencia de un exoesqueleto esclerotizado, la tensión superficial, la envergadura alar, el tamaño, el grado de descomposición, entre otros; b) el tipo de rocas en el que se encuentran fosilizados los insectos son las rocas sedimentarias pero existen otros tipos de matriz como el ámbar, asfalto o cineritas donde también se hallan insectos; c) en que momento aparecieron y como eran los primeros insectos; se ha citado que los restos más antiguos datan del Devónico inferior y que no es hasta el Carbonífero superior que se encuentran frecuentemente en el registro fósil; y d) aquellos ejemplos de comportamiento de los insectos que se han preservado o inferido del registro geológico como son, entre otros, la simbiosis, el parasitismo y la vida social.

**Les insectes des calcaires lithographiques du Crétacé inférieur
d'Espagne. Faune et taphonomie.**

Martínez-Delclós, X. y Ruiz de Loizaga, M.J.

Geobios 27(Supplement 1): 195-201
1994

Abstract

There are two Spanish Lower Cretaceous fossil sites with an insect fauna. One of them is in the Serra del Montsec, and presents three outcrops dated as Berriasian-Valanginian. The other one is in the Serranía de Cuenca, with one outcrop of Barremian age. Thirteen fossil insect orders in the Serra del Montsec and fourteen in the Serranía de Cuenca have been recognized. Only small differences between the insects of the three Montsec out-crops are recognized, but the differences with the Cuenca insects are more obvious. Nevertheless, the remaining fauna and the flora in both areas are very similar. Taphonomic studies on the fossil insects have been made, and the results have been complemented with experimental observation on Recent insects in aquaria. The comparison suggests a short floating time with exposure to surface predators and necrophagous, an anoxic bottom lacking predators, rapid sedimentation and early diagenetic mineralisation.

Systematics and functional morphology of *Iberonepa romerali* n. gen. and sp., Belostomatidae from the Spanish Lower Cretaceous (Insecta, Heteroptera).

Martinez-Delclos, X., Nel, A. y Popov, Y.A.

Journal of Paleontology **69**: 496-508
1995

Abstract

Iberonepa romerali n. gen. and sp. is the most abundant insect species found in Lower Cretaceous (Barremian) lithographic limestones at "Las Hoyas," Spain. External features of this species indicate that it should be assigned to the family Belostomatidae, with a similarity to the species *Stygeonepa foersteri* Popov, 1971, which was found in the Upper Jurassic (Tithonian) lithographic limestones of Solnhofen. This article discusses the relation between these two species and subfamilies of the Recent Belostomatidae. The new "Las Hoyas" species is described from adult specimens and from molts of nymphs, these differing only slightly from one another. The abundant number of specimens and the generally exceptional preservation have allowed interpretation of its probable natatory behavior on the basis of the functional morphology of the insect's legs.

Taphonomy of insects in carbonates and amber.

Martínez-Delclòs, X., Briggs, D.E.G. y Peñalver, E.

Palaeogeography Palaeoclimatology Palaeoecology **203**: 19-64.
2004

Abstract

The major taphonomic processes that control insect preservation in carbonate rocks (limestones, travertines and nodules) are biological: insect size and wingspan, degree of decomposition, presence of microbial mats, predation and scavenging; environmental: water surface tension, water temperature, density and salinity, current activity; and diagenetic: authigenic mineralisation, flattening, deformation, carbonisation. The major taphonomic processes that control the preservation of insects in fossil resins (amber and copal) are different, but can be considered under the same headings – biological: presence of resin producers, size and behaviour of insects; environmental: latitude, climate, seasonality, resin viscosity, effects of storms and fires, soil composition; and diagenetic: resin composition, insect dehydration, pressure, carbonisation, thermal maturation, reworking, oxidation. These taphonomic processes are geographically and temporally restricted, and generate biases in the fossil record. Nevertheless, where insects occur they may be abundant and very diverse. Taphonomic processes may impact on phylogenetic and palaeobiogeographic studies, in determining the timing of the origin and extinction of insect groups, and in identifying radiations and major extinctions. Taphonomic studies are an essential prerequisite to the reconstruction of fossil insect assemblages, to interpreting the sedimentary and environmental conditions where insects lived and died, and to the investigation of interactions between insects and other organisms.

Feather diversity in the Barremian (Early Cretaceous) of Las Hoyas, Spain.

Marugán-Lobón J. y Vullo, R.

Comptes Rendus Palevol **10**: 219-23
2011

Abstract

The preservation of feathers is a rare phenomenon in the fossil record. In this study, we report 11 isolated feathers from the Early Cretaceous of the Konservat-Lagerstätte of Las Hoyas, Spain. Most of them are preserved as a carbonised thin layer, but there are also imprints. The specimens are relatively small, and unambiguously correspond to body contour feathers, although it is very difficult to match them to a particular taxon (among avian or non-avian theropods). Among the fossils, there is an almost complete remige, a well-preserved fragment of a possible ornamental rectrice feather, and possibly a semiplume. Furthermore, some specimens appear to have different colour patterns, such as stripes or patches.

El Cretácico basal «Weald» de la Cordillera Ibérica suroccidental (NW. de la provincia de Valencia y E. De la de Cuenca).

Mas, J.R., Alonso, A. y Meléndez, N.

Cuadernos de Geología Ibérica, 8: 309-335
1982

Resumen

Dentro del Cretácico basal, que en el Sistema Ibérico suroccidental ha venido siendo denominado «Weald», se han diferenciado cuatro Formaciones con edades que comprenden desde el Valanginiense/Hauteriviense al Aptiense inferior.

El análisis de la distribución, relaciones y edad de estas Formaciones, de sus Asociaciones de Facies y de la distribución de ambientes sedimentarios, pone de manifiesto que en el área estudiada la sedimentación wealdense se desarrolló en tres ciclos sedimentarios.

El Ciclo I comprende la Formación Arcillas y areniscas de Cortés. Tiene carácter regresivo (lagoon-llanura de marea-llanura deltaica) y se desarrolló durante el Valanginiense/Hauteriviense.

El Ciclo II comprende las Formaciones Arenas y arcillas de El Collado y Calizas de La Huérguina. Sólo al principio presenta carácter transgresivo para pasar posteriormente a tener en su mayor parte carácter regresivo (fluvial-llanura deltaica y marismas-lagos carbonatados). Este ciclo se desarrolló durante ¿la parte alta del Hauteriviense-?Barremiense inferior.

La Formación Arcillas de Contreras de edad Barremiense superior-Aptiense inferior representa el inicio (desde llanuras costeras a llanuras de marea) del Ciclo III transgresivo-regresivo, en el cual tiene lugar la instalación de una primera plataforma urgoniana en parte de esta región.

Abstract

In the lowest part of the Lower Cretaceous in the southwestern Iberian Ranges, named by different authors «Weald», have been differentiated four Formations, comprising from a Valanginian/Hauterivian age to a Lower Aptian age.

The analysis of the distribution, relationships and age of these Formations, their Facies Associations and distribution of sedimentary environments, proves that in the studied area the wealdian sedimentation was developed into three sedimentary cycles.

Cycle I comprises the Clays and sandstones of Cortés Fm. It has regressive character (lagoon-tidal flats-deltaic plain) and was developed during a Valanginian/Hauterivian age.

Cycle II comprises the Sands and clays of El Collado Fm. and the Limestones of La Huérguina Fm. Only at the beginning it has a transgressive character but it is essentially regressive (fluvial-deltaic plain

and marshes-carbonated lakes). This Cycle was developed probably during the upper part of Hauterivian and during Lower Barremian.

The Clays of Contreras Fm., represents the beginning (from coastal plains to tidal flats) of a transgressive-regressive Cycle III during which took place the installation of a first urgonian shelf lagoon in a part of this region.

Frontals as Diagnostic Indicators in Fossil Albanerpetontid Amphibians.

McGowan, G.

Bulletin of the National Science Museum, Series C **24**: 185-194
1998

Abstract

Albanerpetontids are an extinct group of amphibians known from deposits of Middle Jurassic to Miocene age from Euramerica and central Asia. Recent analyses have suggested they are most probably a sister group of frogs and salamanders. Throughout their long history they retain a very conservative body form and are difficult to distinguish from isolated specimens. However, they can be easily diagnosed as albanerpetontids from a collection of unique character states which includes an interdigitating mandibular symphysis; polygonal sculpturing on dermal roofing bones-related to its dermal ossification pattern-; tricuspedate, non-pedicellate teeth; and a unique atlas-axis complex. A comprehensive comparison of material from different European localities has revealed that the shape of the fused frontal may be a good indicator of genus and even species.

Albanerpetontid amphibians from the Cretaceous of Spain.

McGowan, G. y Evans, S.E.

Nature **373**: 143-145
1995

Abstract

Albanerpetontids are a group of enigmatic salamander-like fossil amphibians known from deposits of middle Jurassic to Miocene age across Euramerica and Central Asia. Throughout a long history they remained remarkably conservative but can be diagnosed by a suite of unique derived character states, including an anterior peg-and-socket joint between the mandibles, non-pedicellate tricuspid teeth, a distinctive polygonal dermal sculpture pattern, and a two-part craniovertebral joint analogous to that of amniotes. Previous interpretations have placed albanerpetontids within salamanders or as a separate amphibian group. We report here on the recovery of the first complete albanerpetontid specimens (including traces of skin and possible male courtship glands) from the early Cretaceous of Spain. The new material supports the interpretation of albanerpetontids as predominantly terrestrial animals. Albanerpetontids resemble salamanders only in retaining an unspecialized tailed body form; cladistic analysis suggests they represent a distinct lissamphibian lineage.

On the aerodynamics of leading-edge high-lift devices of avian wings.

Meseguer, J., Franchini, S., Pérez-Grande, I. y Sanz, J.L.

*Proceedings of the Institution of Mechanical Engineers, Part G,
Journal of Aerospace Engineering* **219**: 63-68
2005

Abstract

The alula is a high-lift device located at the leading edge of bird wings that allows these animals to fly at large angles of attack and low speeds without wing stalling. The influence of the alula in the wing aerodynamics seems to be similar to that of leading-edge slats in aircraft wings. Aiming to clarify the role of the alula in the aerodynamics of the bird wings, the aerodynamic forces generated by a model simulating the wing of a pigeon equipped with different alulae were measured in a wind tunnel. Experimental results show that alula deflection causes the boundary layer to remain attached at large values of the angle of attack (at least in the wing area protected by this device: from the alula position to the wing root), so that lift forces can be up to 22 per cent higher than those measured at the same angle of attack without alula deflection.

A preliminary note on the first tetrapod trackways from the lithographic limestones of Las Hoyas (Lower Cretaceous, Cuenca, Spain).

Moratalla, J.J., Lockley, M.G., Buscalioni, A.D., Fregenal-Martinez, M.A., Meléndez, N., Ortega, F., Pérez-Moreno, B.P., Pérez-Asensio, E., Sanz, J.L. y Schultz, R.J.

Geobios **28**: 777-782
1995

Abstract

Although famous as a fossil lagerstätte that has produced numerous well-preserved vertebrates, recent discoveries indicate that the lithographic limestones of Las Hoyas (Calizas de la Huérguina Formation) also contain vertebrate trackways. We herein report on at least two distinctive tetrapod track types tentatively assigned to crocodylians and to turtles. Turtle tracks are isolated while the crocodile ones are forming a trackway showing an animal walking with a very regular step and stride length on an emergent surface. It is interesting to note the similarity between the inferred turtle tracks from Las Hoyas and those from the Late Jurassic lithographic limestones of Cerin, France. The occurrence of tracks in both environments suggests that the ichnofaunas are similar.

New Nemestrinoidea (Diptera: Brachycera) from the Upper Jurassic-Lower Cretaceous of Eurasia, taxonomy and palaeobiology.

Mostovski, M.B. y Martínez-Delclòs, X.

Entomological Problems **31**: 137-148
2000

Abstract

New nemestrinoids belonging to the families Rhagionemestriidae and Nemestrinidae from the Jurassic deposits of the Southern Kazakhstan and Germany and Lower Cretaceous deposits of Spain, Russia, and Mongolia are described. The authors argued including the Heterostominae in the Rhagionemestriidae; and the latter is considered as a connecting link between Xylophagidae and Nemestrinidae. The Nemestrinoidea and Nemestrinidae themselves demonstrate high taxonomic diversity since the Middle - Upper Jurassic although members of the families Rhagionemestriidae and Nemestrinidae appeared in the Lower Jurassic for the first time. Both extinct Archinemestriinae and extant Hirmonneurinae are known since the Jurassic, while Nemestrininae came into palaeontological record in the Lower Cretaceous. Fossil nemestrinids, at least those with long proboscis, are postulated to be connected with bennettites or angiosperms as nectar-feeders and possibly pollinators.

Nuevos Zygoptera y Anisoptera (Insecta: Odonata) en el Cretacico inferior de España.

Nel, A. y Delclòs Martínez, X.

Estudios Geológicos **49**: 351-359
1993

Resumen

El estudio de nuevos insectos cretácicos hallados en los yacimientos de calizas litográficas españoles ha dado como resultado el reconocimiento de tres nuevas formas de odonatos (Insecta, üdonata). Se han encontrado larvas de Zygoptera del género-tipo *Samarura*, ya reconocidas en otros yacimientos mundiales, y larvas de anisópteros Libelluloidea en los yacimientos mesozoicos españoles. Se describe *Hoyaeshna cretacica* n. gen y n. sp. (Aeshnidae Gomphaeschninae). Esta nueva especie presenta una vena psScP que nace en el nodo y recorre parcialmente el campo postnodal supliendo el recorrido que en algunos grupos de odonatos realiza la ScP, por ejemplo, en los Zygoptera Sieblosidae y en los Anisoptera Aeschnidiidae.

**Mesozoic Chrysopid-like Planipennia: A phylogenetic approach
(Insecta, Neuroptera).**

Nel, A., Delclòs, X. y Hutin, A.

Annales de la Société Entomologique de France **41**: 29-69.
2005

Abstract

The Mesozoic chrysopid-like Planipennia are revised and several new genera and species are described. The new superfamily Chrysopoidea is proposed for the extant and fossil Chrysopidae, and the fossil families Liassochrysidae n. fam., Allopteridae Zhang 1991 n. sensu, Mesochrysopidae Handlirsch, 1906 n. sensu, Tachinymphidae n. fam., and Limaiidae Martins-Neto and Vulcano 1989 n. sensu. A phylogenetic analysis of the Chrysopoidea is proposed, based on the wing venation characters. With at least the four families Allopteridae, Mesochrysopidae, Tachinymphidae, and Chrysopidae, showing different wing venation patterns, the systematic diversity and morphological disparity of the Chrysopoidea are maximal during the Late Jurassic and Early Cretaceous. The Mesozoic family Limaiidae was still present during the Paleocene/Eocene suggesting a minimal impact on the Chrysopoidea of the crisis of the diversity at the K-T boundary. Other Cenozoic Chrysopoidea can be attributed to the Chrysopidae sensu stricto.

New mesozoic protomyrmeleontidae (Insecta: Odonatoptera: Archizygoptera) from Asia with a new phylogenetic analysis.

Nel, A., Petrulevicius, J.F. y Martínez-Delclòs, X.

Journal of Systematic Palaeontology **3**: 1-15
2005

Abstract

The following damselfly-like protomyrmeleontid Odonatoptera are described from the Mesozoic of Eurasia: *Ferganagrion kirghiziensis* gen. et sp. nov., *Paraobotritagrion* gen. nov. for *Paraobotritagrion tenuiformis* (Zessin, 1991), *Mongolagrion shartegensis* gen. et sp. nov., *Protomyrmeleon pumilio* sp. nov., *Protomyrmeleon kazakhstanensis* sp. nov., *Protomyrmeleon karatauensis* sp. nov., *Protomyrmeleon grandis* sp. nov. The wing venations of protomyrmeleontid genera are homologised and the high morphological disparity in this family suggests that the Protomyrmeleontidae had very different modes of flight and consequently occupied a wide range of palaeoenvironments. A new phylogenetic analysis suggests that the fossil record is too scarce and incomplete to solve the phylogeny of the Protomyrmeleontidae. In particular, the current division of Protomyrmeleontidae in Triassagrioninae and Protomyrmeleontinae is only weakly supported.

***Chresmoda*, an enigmatic Mesozoic insect that is finally placed.**

A. Nel, X. Delclòs, O. Béthoux & D. Azar

Abstracts: 3rd International Congress of Palaeoentomology, with 2nd International Meeting on Palaeoarthropodology and 2nd World Congress on Amber and its Inclusions.

2005

Abstract

The genus *Chresmoda* (= *Pygolampis*) was named in 1839 by E.F. Germar for an insect found in the Upper Jurassic lithographic limestones of Solnhofen, in Germany. Handlirsch in 1906-08 erected for the species *Chresmoda obscura* the family Chresmodidae. Today the genus is also known and reported from China, Spain, Mongolia, Lebanon and Brazil, and ranges from the Upper Jurassic to the Upper Cretaceous. The genus is not infrequent and diverse semaphoronts, larvae, females and usually males, are found. Larvae and males are apterous, whereas females are winged; unfortunately the wing characters are not well known because wings usually rest folded above the abdomen. The lack of information has prevented any positive placement among several insect groups. The general habitus is similar to that of recent water striders, in relation with a similar life habit, but with mandibles instead of a sucking mouth. The recent discovery of a specimen with fore- and hindwings not folded, in the Lower Cretaceous of El Montsec (Spain), and several specimens with well preserved ultra-articulated tarsi (> 40) in the Upper Cretaceous of Namoura (Lebanon), Solnhofen (Germany) and Las Hoyas (Spain), suggest that *Chresmoda* was a member of Phasmatodea (but not related to the Recent order Phasmida), possibly with carnivorous/insectivorous alimentary habits, and with very specialized leg structures indicating a water-surface skating locomotion mode.

Dinosaurios de la Península Ibérica.

Ortega, F., Escaso, F., Gasulla, J., Dantas, P. y Sanz, J.

Estudios geológicos 62: 219-40
2006

Resumen

El registro de restos directos de dinosaurios en la Península Ibérica ha mostrado, en los últimos años, que puede ser muy relevante para el conocimiento de distintos aspectos de la historia evolutiva del grupo y, dada la posición de la Península Ibérica, para la interpretación de la distribución de muchos de sus componentes. El registro ibérico cuenta con representantes de casi todos los grandes grupos de dinosaurios: ornitópodos, tireóforos, terópodos y saurópodos, que están bien representados, sobre todo en el tránsito Jurásico-Cretácico (Kimmeridgiense-Berriasiewe), en parte del Cretácico Inferior (Barremiense-Aptiense) y en el final del Cretácico Superior (Campaniense-Maastrichtiense). El conjunto de ornitisquios está compuesto por tireóforos, de los que se han identificado dos estegosaurios (*Dacentrurus* y *Stegosaurus*) y tres anquilosaurios (*Dracopelta*, *Polacanthus* y *Struthiosaurus*) y ornitópodos: hipsilofodóntidos, iguanodontia basales (*Rhabdodon*); driosáuridos, camptosáuridos (*Draconyx* y *Camptosaurus*), iguanodontoides (*Iguanodon*) y hadrosáuridos (*Pararhabdodon*). Además existe un gran número de formas de asignación dudosa o aún por describir. El registro de saurópodos está fundamentalmente compuesto por formas cercanas al nodo Neosauropoda (*Lourinhasaurus*, *Dinheirosaurus*, *Galveosaurus* y *Losillasaurus*) y titanosauriformes (*Aragosaurus*, *Lusotitan* y *Lirainosaurus*), además de una serie de formas nuevas en fase de descripción, como los saurópodos de Riodeva (Teruel), Peñarroya de Tastavins (Teruel) y Morella (Castellón). El conjunto de géneros de terópodos ibéricos está constituido por el ceratosaurio *Ceratosaurus*, el espinosauroide *Torvosaurus*, los carnosaurios *Lourinhanosaurus* y *Allosaurus*, el tiranosauroide *Aviatyrannis*, el ornitomimosaurio *Pelecanimimus*, y los terópodos avianos *Iberomesornis*, *Concornis*, *Eoalulavis* y *Noguerornis*. Sin embargo, la diversidad de terópodos es mucho mayor, como muestra la abundante colección de morfotipos dentarios identificados.

A bizarre, humped carcharodontosauria (theropoda) from the lower cretaceous of Spain.

Ortega, F., Escaso, F. y Sanz, J.L.

Nature **467**: 203-206
2010

Abstract

Carcharodontosaurs were the largest predatory dinosaurs, and their early evolutionary history seems to be more intricate than was previously thought. Until recently, carcharodontosaurs were restricted to a group of large theropods inhabiting the Late Cretaceous Gondwanan land masses, but in the last few years Laurasian evidence has been causing a reevaluation of their initial diversification. Here we describe an almost complete and exquisitely preserved skeleton of a medium-sized (roughly six metres long) theropod from the Lower Cretaceous series (Barremian stage) Konservat-Lagerstätte of Las Hoyas in Cuenca, Spain. Cladistic analysis supports the idea that the new taxon *Concavenator corcovatus* is a primitive member of Carcharodontosauria, exhibiting two unusual features: elongation of the neurapophyses of two presacral vertebrae forming a pointed, hump-like structure and a series of small bumps on the ulna. We think that these bumps are homologous to quill knobs present on some modern birds; the knobs are related to the insertion area of follicular ligaments that anchor the roots of the flight feathers (remiges) to the arm. We propose that *Concavenator* has integumentary follicular structures inserted on the ulna, as in modern birds. Because scales do not have follicles, we consider the structures anchored to the *Concavenator* arms to be non-scale skin appendages homologous to the feathers of modern birds. If this is true, then the phylogenetic bracket for the presence of non-scale skin structures homologous to feathers in theropod dinosaurs would be extended to the Neotetanurae, enlarging the scope for explaining the origin of feathers in theropods.

Yacimientos con insectos fósiles en España.

Peñalver, E., Martínez-Delclós, X. y Arillo, A.

Revista Española de Paleontología **14**: 231-245
1999

Resumen

Este artículo es una puesta al día de los yacimientos con insectos fósiles en España, algunos de los cuales son inéditos. Todos se presentan ordenados de acuerdo con su edad geológica. Para cada yacimiento se incluye una relación taxonómica de los insectos citados en la bibliografía. En España no existen muchos yacimientos con insectos fósiles y sólo se ha estudiado con detalle un pequeño número de ellos. La mayoría de las 41 localidades conocidas están todavía por muestrear ya que únicamente han proporcionado algunos ejemplares aislados. De hecho, únicamente en once yacimientos ya habían sido citados insectos fósiles en la bibliografía con anterioridad a la década de los 80. En la actualidad, los estudios paleoentomológicos prácticamente se centran en el Cretácico y en el Neógeno. Los yacimientos en conjunto se localizan en varios tipos de substratos: en carbón, en calizas litográficas, en ritmitas bituminosas, en diatomitas, en nódulos calcáreos y en ámbar. En cuanto al tipo de restos que se hallan, comprenden restos directos (individuos completos o partes desarticuladas) y una amplia muestra icnológica -ya sean galerías o nidos en substrato inorgánico (sedimentos)- u originalmente en substrato orgánico (hojas o troncos). Geográficamente los yacimientos se concentran en su mayoría en la parte norte y este de la Península Ibérica.

New beetles (Insecta: Coleoptera) from the Lower Cretaceous of Spain.

Ponomarenko, A. y Martínez-Delclòs, X.

Acta geologica hispánica **35**: 47-52
2000

Abstract

Three beetles remains from the Lower Cretaceous lithographic limestones of Spain are described. We classified them into two new genus and three new species. One specimen named *Tetraphalerus brevicapitis* n.sp. was placed in the Cupedidae, and both *Megacoptoclava longiurogomphia* n.gen., n.sp. and *Bolbonectus lithographicus* n.gen., n.sp. in Coptoclavidae.

**A new Early Cretaceous gonorynchiform fish (*Teleostei*:
Ostariophysii) from Las Hoyas (Cuenca, Spain).**

Poyato-Ariza, F.J.

Occasional Papers of the Museum of Natural History
The University of Kansas 164: 1-37
1994

Abstract

Gordichthys conquensis nov. gen. nov. sp. is a small gonorynchiform teleost only known from the recently discovered Early Cretaceous outcrop of Las Hoyas (Cuenca, Spain), which is Late Hauterivian-Early Barremian in age. This new fish is characterized by the following features: a short, triangular head; a mouth cleft that is directed dorsally; edentulous premaxilla, maxilla, and mandible, but toothed parasphenoid and vomer; a moderately deep body; a short-based, high dorsal fin; a robust caudal peduncle; an unforked caudal fin that is higher than long; last hypural in contact with U2, and neural spine of PU2. epurals, uroneurals, and last four hypurals in contact with each other. The supraoccipital bone partially separates the parietals; this condition is termed "mesoparietal." In addition, *Gordichthys* possesses the synapomorphies of the superorder Ostariophysii and of the order Gonorynchiformes in most of the characters that can be verified. It is similar to the members of the family Chanidae in several cranial and caudal endoskeletal features. However, it is considered as a gonorynchiform incertae sedis until a cladistic analysis is attempted. *Gordichthys conquensis* strikingly resembles the other Spanish Early Cretaceous ostariophysan teleost, *Ruhiesichthys gregalis* Wenz, 1984, but the taxa can be distinguished on the basis of morphometric features of the body, head, and caudal fin. and by several anatomical characters.

**A revision of *Rubiesichthys gregalis* Wenz 1984 (Ostariophysi,
Chanidae), from the Early Cretaceous of Spain.**

Poyato-Ariza, F.J.

Mesozoic Fishes: Systematics and Paleoecology
1996

The small fish *Rubiesichthys gregalis*, from the Early Cretaceous of Montsec and Las Hoyas (Spain), is redescribed on the basis of abundant new material; complementary anatomical information is now available, mostly concerning the anteriormost vertebrae. A modified diagnosis of the genus and the species, as well as new restorations, are presented. This revision confirms the similarities of *Rubiesichthys gregalis* with *Gordichthys conquensis* and other gonorynchiform fishes traditionally considered chanids.

The phylogenetic relationships of *Rubiesichthys gregalis* and *Gordichthys conquensis* (Teleostei, Ostariophysii), from the Early Cretaceous of Spain.

Poyato-Ariza, F.J.

Mesozoic Fishes: Systematics and Paleoecology
1996

Abstract

Two small teleostean fishes from the Early Cretaceous of Spain, *Rubiesichthys gregalis* and *Gordichthys conquensis* were considered related to the gonorynchiform family Chanidae when first described. Here, a cladistic analysis was carried out to establish their phylogenetic relationships. The ingroup included living and fossil forms traditionally assigned to the Chanidae, as well as other otophysans. A set of 55 characters of six genera was polarized by outgroup comparison with *Elops* and *Diplomystus*. The results confirm that the Otophysi (represented by the cyprinid *Opsariichthys*) is the sister group to the Gonorynchiformes, which are monophyletic. Within the order Gonorynchiformes, *Chanos* is the sister group to [*Tharrhias* + [*Rubiesichthys* + *Gordichthys*]]. This set of relationships shows that the family Chanidae is a clade; its monophyly is supported by 11 synapomorphies, eight of which are uniquely derived characters. *Rubiesichthys gregalis* and *Gordichthys conquensis* are, therefore, chanid fishes, as previously assigned; in addition, they are sister taxa. This analysis also indicates that some fossil forms are included with the Recent *Chanos* in the family Chanidae. This hypothesis of relationships also implies that fusion within the caudal endoskeleton arose independently in the Chanidae. In addition, the resultant interrelationships present temporal incongruences. These problems reveal the need to re-examine other fossil forms that have been traditionally considered chanids. Such a re-examination would allow clarification of the diagnosis of the family, as well as the phylogenetic relationships within the family, and with other gonorynchiforms.

A revision of the ostariophysan fish family Chanidae, with special reference to the Mesozoic forms.

Poyato-Ariza, F.J.

Palaeo Ichthyologica **6**: 1-52
1996

Abstract

The diagnosis, composition, and phylogenetic relationships of the Chanidae, an ostariophysan fish family of the order Gonorynchiformes, are revised. A cladistic analysis is carried out in order to test previous phylogenetic hypotheses and the monophyly of this family. The material examined consists on several Mesozoic taxa traditionally assigned to the Chanidae and several living Gonorynchiformes, including *Chanos chanos*. The results provide new synapomorphies of the order Gonorynchiformes, and reject some previously proposed synapomorphies. The monophyly of the Chanidae is confirmed on the basis of fourteen synapomorphies, nine of which are uniquely derived characters. These synapomorphies provide the basis for the new diagnosis of this family. *Chanos* is not the sole member of the family Chanidae. The analysis confirms that the fossil taxa considered in the study (*Aethalionopsis*, *Dastilbe*, *Gordichthys*, *Parachanos*, *Rubiesichthys*, and *Tharrhias*) must also be included within the chanids. This implies independent evolution of the caudal endoskeleton in *Chanos* and in the other Recent gonorynchiforms.

The Spanish Early Cretaceous forms *Rubiesichthys gregalis* and *Gordichthys conquensis* are sister-taxa, forming the subfamily Rubiesichthyinae n. subfam. This clade is the sister-group to all other chanids, which form the subfamily Chaninae n. subfam. *Rubiesichthys* and *Gordichthys* are the oldest fossil record of the family Chanidae and of the order Gonorynchiformes.

**A new assemblage of Spanish Early Cretaceous teleostean fishes,
formerly considered "leptolepids": phylogenetic relevance.**

Poyato-Ariza, F.J.

*Comptes Rendus de l'Académie des Sciences, Series IIA, Earth and
Planetary Science* **325**: 373-379
1997

Abstract

Several relevant cranial and caudal endoskeleton characters show that the Early Cretaceous teleosts from Montsec and Las Hoyas previously reported as *Leptolepis* and *Ascalabos* are clearly different from these genera, and more diversified than previously thought. The Spanish fishes present a unique combination of characters, suggesting that they may represent a new assemblage of primitive teleosts. The study of other unrevised fishes traditionally identified as "leptolepids" may show that they are not closely related to *Leptolepis sensu stricto*. The study of these forms is of great relevance to the understanding of the origin and early diversification of the teleostean fishes, especially since the traditional diagnoses and phylogenetic relationships of the major basal teleostean clades are questionable today.

**A new pycnodontiform fish from the Early Cretaceous of Las Hoyas
(Cuenca, Spain).**

Poyato-Ariza, F.J. y Wenz, S.

Bulletin de la Societe Geologique de France, **171**: 251-258
2000

Abstract

Stenamara mia is a new genus and species of a rare pycnodontiform fish from the Barremian, early Cretaceous, lacustrine beds of Las Hoyas, province of Cuenca, Spain. It was previously considered *Eomesodon* sp., but a number of characters clearly separates it from the genus *Eomesodon*: lack of prognathism; absence of nuchal plates; presence of a parietal process and of only two rows of teeth in the prearticular; and peltate pattern of ossification and distribution of scales, that is, scales are present only before the level of the unpaired fins, and are complete only in the ventralmost abdominal area. The unique combination of these and other characters, plus the following autopomorphies, diagnoses the new taxon: presence of a strongly curved dorsal prominence that results in an ovoid shape of the contour of the body; body deeper than long, with maximum body height near 125% of standard length; and narrow, high cloaca formed by only two differentiated scales, the posterior one considerably longer than the anterior one. *Stenamara mia* nov. gen. nov. sp. is considered a primitive Pycnodontidae, pending a cladistic analysis to determine precisely its phylogenetic relationships.

A new insight into pycnodontiform fishes.

Poyato-Ariza, F.J. y Wenz, S.

Geodiversitas **24**: 139-248
2002

Abstract

The present paper provides a revision of the pycnodontiform fish genera that are based on articulated material. The results of the first cladistic analysis on the interrelationships of the order Pycnodontiformes Berg, 1937 are also presented: it is based on 105 characters for 33 taxa. The monophyly of the order, of the suborder Pycnodontoidei Nursall, 1996, and of the family Pycnodontidae Agassiz, 1833 sensu Nursall 1996b (in large sense) are confirmed; the "suborder Gyrodontoidei" appears, in contrast, as a paraphyletic group. The revision of the historic nomenclatural problems and the hypothesis of phylogenetic relationships show that the genera *Eomesodon* Woodward, 1918, *Coelodus* Heckel, 1854, and *Palaeobalistum* Blainville, 1818, as previously recognized, were not natural assemblages. The new genera *Apomesodon* n. gen., *Ocloedus* n. gen., *Oropycnodus* n. gen., and *Abdobalistum* n. gen., together with two new species (*Apomesodon surgens* n. gen., n. sp. And *Abdobalistum thyrsus* n. gen., n. sp.), are erected to locate former species of those non-monophyletic genera. The subfamilies Proscinetinae n. rank, Pycnodontinae n. rank, and Nursalliinae n. rank, are also proposed, together with the superfamily Pycnodontoidea n. rank, which gathers the sister-groups Coccodontidae and Pycnodontidae. A completely revised systematic palaeontology of the Pycnodontiformes is provided.

The new pycnodontid fish genus *Turbomesodon*, and a revision of *Macromesodon* based on Lower Cretaceous new material from Las Hoyas, Cuenca, Spain.

Poyato-Ariza, F.J. y Wenz, S.

Mesozoic Fishes 3: Systematics, Palaeoenvironment and Biodiversity,
2004

Abstract

The nicely preserved new material of a pycnodontid fish previously reported as *Macromesodon* aff. *M. Bernissartensis* has triggered a revision of this genus. As a result, it is evident that the holotype of the type species, *M. macropterus*, is quite different from all of the butterfly fish-like specimens that have been called this for over a century. *Turbomesodon* gen. nov. is created for these fishes. The type species is the one from the Solnhofen area, *T. relegans* gen. et sp. nov.; the Las Hoyas material is assigned to another new species, *T. praeclarus*; and *T. bernissartensis* is the third species of this new, monophyletic genus. The presence of a nasal bone in pycnodontiforms is confirmed for the first time. The occurrence of a dermosphenotic bone that is interpreted as partially independent and partially fused to the dermopterotic is an unusual feature described for the first time in pycnodonts. The new genus *Turbomesodon* has one autapomorphic character, the presence of a supracloacal scale, a differentiated scale of the cloacal region that is defined herein. A juvenile specimen of *T. praeclarus* gen. et sp. nov. is one of the smallest specimens of pycnodontiform fish currently known.

First isotopic and multidisciplinary evidence for nonmarine coelacanths and pycnodontiform fishes: palaeoenvironmental implications.

Poyato-Ariza, F.J., Talbot, M.R., Fregenal Martínez M.A., Meléndez, N. Y Wenz, S.

Palaeogeography, Palaeoclimatology, Palaeoecology **144**: 65-84
1998

Abstract

The Recent coelacanth *Latimeria chalumnae*, one of the best known 'living fossils', dwells in deep marine water. Fossil coelacanths have been globally related to marine environments, specially after the Triassic, an association that has led to a general belief that they have always been marine. Previous reports of fossil coelacanths in continental deposits have been largely neglected. Prior to this report, uncontested Cretaceous freshwater coelacanths were unknown. In turn, the pycnodontiform fishes have always been considered exclusively marine, apart from a few controversial exceptions. Here we present the first multidisciplinary evidence for nonmarine coelacanths and pycnodonts. Our conclusions are based upon palaeogeographic, sedimentologic, taphonomic, and palaeoecologic criteria, strongly supported by strontium (^{87}Sr – ^{86}Sr) and stable carbon and oxygen isotopic studies. The coelacanth, provisionally attributed to the genus 'Holophagus', and the pycnodontiforms *Eomesodon* sp. and *Macromesodon* aff. *bernissartensis* were unearthed at the Early Cretaceous locality of Las Hoyas (Cuenca, Spain), where they grew in and inhabited a freshwater environment without marine influence. Fossil coelacanths and pycnodonts cannot, therefore, be used as unambiguous indicators of a marine environment. Caution is needed when using a single or a few taxa as palaeoenvironmental indicators, especially fish; in this sense, communities are much more reliable. Arguments based on actualism or taxonomic uniformitarianism, morphologic convergence and functional morphology are truly significant only within the framework of a sound multidisciplinary approach to the study of the palaeoenvironment.

The Mesozoic record of osteichthyan fishes from Spain.

Poyato-Ariza, F.J., Buscalioni, A.D. y Cartanyà, J.

Mesozoic Fishes 2: Systematics and Fossil Record
1999

Abstract

The record of Mesozoic osteichthyan fishes from Spain is evaluated: the faunas of 51 localities are revised and catalogued, updating their age. This record is analysed from an integrative multidisciplinary perspective.

The Mesozoic localities of Spain are mostly restricted to the north and central eastern half of the Iberian Peninsula, being most of them Cretaceous in age. The osteichthyan record, as retrieved from literature, comprises 50 genera grouped into 29 families, together with 25 incertae sedis or undetermined taxa. The record is patchy; 53 % of the entire generic diversity is provided by three fossil-Lagerstätten only (Mont-ral, Middle Triassic; Las Hoyas and El Montsec, both Early Cretaceous), which have yielded abundant complete and articulated remains. The other 48 localities have yielded only relatively diverse isolated remains. The most extensively cited actinopterygian genus is *Lepidotes*, followed by *Coelodus* and other pycnodonts, most of them being unreliably identified on the basis of isolate remains. The Sarcopterygii are represented by a scarce record of the family Coelacanthidae only.

The metric completeness analysis at family level and series-stages reveals that the Mesozoic fossil record of osteichthyans from Spain presents a 54 % of completeness. Three major groups of Actinopterygii have been analysed to approach their completeness: 1) the non-halecostome Actinopterygii are restricted to the Triassic, associated to the Mont-ral fauna; 2) the record of non-teleostean Halecostomi is affected by the poorly informative beds from the Jurassic, thus showing the lowest values of completeness: 48 %; against 100 % of non-halecostome Actinopterygii and 70 % of Teleostei. The non-teleostean Halecostomi include the most extended Lazarus taxa; 3) finally, the Teleostei families are distributed throughout the Early Cretaceous and Late Cretaceous, with an unexpected lack of record in the Aptian-Albian.

The worst documented records correspond to the Jurassic stages, in which the number of localities, the diversity, and the completeness of the stratigraphic record are quite poor.

Crustáceos decápodos de Las Hoyas (Cuenca) y del Montsec de Rúbies (Lleida). Calizas litográficas del Cretácico inferior de España.

Rabadà i Vives, D.

Acta geologica hispanica **25**: 299-311
1990

Resumen

Se han diferenciado tres formas de decápodos: un astacideo (*Pseudastacus llopisi*) y dos carideos, definiéndose para estos últimos un nuevo género para ambos (*Delclosia*) y una nueva especie para la forma de Las Hoyas (*Delclosia martinelli*). Ambos yacimientos (El Montsec de Lleida y Las Hoyas en Cuenca) configuran los afloramientos existentes de calizas litográficas del Cretácico inferior de España. El astacideo está presente en ambos yacimientos; los dos carideos se hallan adscritos por separado, uno en cada yacimiento. *Delclosia roselli* para el Montsec y *Delclosia martinelli* para Las Hoyas. La excepcional preservación y su alto grado de articulación y conexión segmentaria son signos inequívocos de unas condiciones de fosilización excelentes: un medio acuático tranquilo que evitó su desarticulación y unas condiciones de enterramiento rápido con una diagénesis temprana que mineralizó con celeridad su exosqueleto.

Crustáceos decápodos lacustres de las calizas litográficas del Cretácico inferior de España: Las Hoyas (Cuenca) y el Montsec de Rúbies (Lleida).

Rabadá i Vives, D.

Cuadernos de Geología Ibérica **17**: 345-370
1993

Resumen

Se estudian tres formas de decápodos pertenecientes a los infraórdenes Caridea y Astacidea. Se describe y figura un nuevo género (*Delclosia*), una nueva especie (*Delclosia martinelli*), y se comentan y figuran dos especies ya conocidas (*Delclosia roselli* y *Pseudastacus llopisi*). Los fósiles estudiados proceden de los yacimientos de calizas litográficas de la Pedrera de Meiá, El Reguer, La Cabrua (Montsec de Rúbies, Lleida) y de Las Hoyas (La Cierva, Cuenca). Estos yacimientos constituyen en su totalidad el registro de calizas litográficas en el Cretácico inferior español. La excepcional conservación del material permite realizar observaciones tafonómicas y paleoecológicas que indican: un medio lacustre de fondo anóxico tranquilo, más unas condiciones de enterramiento rápido con una diagénesis muy temprana.

New Cretaceous Scoliidae (Vespida=Hymenoptera) from the Lower Cretaceous of Spain and Brazil.

Rasnitsyn, A.P. y Martínez-Delclòs, X.

Cretaceous Research **20**: 767-772
1999

Abstract

A new genus, *Cretaproscolia*, and three new species of scoliid wasps, *Archaeoscolia hispanica*, *Cretoscolia montsecana* and *Cretaproscolia josai*, are described from the Lower Cretaceous of Spain and Brazil. The species representing the new genus is attributed to the plesiomorphic extant subfamily Proscoliinae, while the two other new species are assigned to two previously described genera in the extinct, archaic subfamily Archaeoscoliinae. The Brazilian species is the first Mesozoic scoliidid to have been described from the New World.

Wasps (Insecta: Vespida=Hymenoptera) from the Early Cretaceous of Spain.

Rasnitsyn, A.P. y Martínez-Delclòs, X.

Acta Geologica Hispanica **35**: 65–95
2000

Abstract

Wasps and their relatives from the Lower Cretaceous lithographic limestones of Spain have been studied. Thirty specimens representing 30 species (4 of them with undetermined placement), at least 21 genera and 11 families are recorded. We erect 1 new family - Andrenelidae-, 6 new genera and 11 new species: *Meiaghilarella cretacica* n.gen., n.sp. (Sepulcidae Ghilarellinae), *Eosyntexis catalonicus* n.sp., *Cretosyntexis montsecensis* n.gen., n.sp. (Anaxyelidae Syntexinae), *Montsecephialtites zherikhini* n.gen., n.sp. (Ephialtitidae Ephialtitinae), *Karataus hispanicus* n.sp. (Ephialtitidae Symphyopterinae), *Manlaya ansorgei* n.sp. (Gasteruptiidae Baissinae), *Andrenelia pennata* n.gen., n.sp. (Andrenelidae n. fam.), *Cretoserphus gomezi* n.gen., n.sp. (Mesoserphidae), *Montsecosphex jarzembow skii* n.gen., n.sp., *Angarosphex penyalveri* n.sp., *Pompilopterus (?) noguerensis* n.sp. (Sphecidae Angarospheciniae), *Cretoscolia conquensis* n.sp. (Scoliidae Archaeoscoliinae). The Mesozoic family Ephialtitidae is revisited based on the restudy of the type-species. We compare these Spanish Cretaceous assemblages with other ones from various parts of the world: Central and Eastern Asia, England, Australia, and Brazil. The number of genera and families identified in the Spanish fossil-sites is almost the same as in the English Purbeck and Wealden. The absence of some hymenopteran groups as Xyelidae, is consistent with the warm climate known to exist in Spain during the Early Cretaceous. We conclude that both La Cabrúa and La Pedrera assemblages - the two sites that have yielded the greatest number of species- correspond to the Lower Cretaceous "Baissin type" (sensu Rasnitsyn et al., 1998), but including some Jurassic "survivors". La Pedrera assemblage fits equally well in the "angarosphecine subtype", while La Cabrúa roughly corresponds to the "proctotrupid" one, although shows a comparatively high proportion of angarosphecins. This fact may suggest: a) possibly asynchrony between these two fossil-sites, b) environmental differences not reflected in the lithological record, c) different taphonomic processes and/or, d) insufficient sample size - to reflect the reality of the source populations-. La Pedrera assemblage is very similar to those from Weald Clay (England), Bon Tsagan (Mongolia) and Santana (Brazil). La Cabrúa approaches to a some extent, though not quite agrees with the Purbeck (UK), Koonwarra (Australia), and most Lower Cretaceous Asian assemblages.

Exceptional fossil preservation during CO₂ greenhouse crises?

Retallack, G.J.

Palaeogeography , Palaeoclimatology , Palaeoecology **307**: 59-74.
2011

Abstract

Exceptional fossil preservation may require not only exceptional places, but exceptional times, as demonstrated here by two distinct types of analysis. First, irregular stratigraphic spacing of horizons yielding articulated Triassic fishes and Cambrian trilobites is highly correlated in sequences in different parts of the world, as if there were short temporal intervals of exceptional preservation globally. Second, compilations of ages of well-dated fossil localities show spikes of abundance which coincide with stage boundaries, mass extinctions, oceanic anoxic events, carbon isotope anomalies, spikes of high atmospheric carbon dioxide, and transient warm-wet paleoclimates. Exceptional fossil preservation may have been promoted during unusual times, comparable with the present: CO₂ greenhouse crises of expanding marine dead zones, oceanic acidification, coral bleaching, wetland eutrophication, sea level rise, ice-cap melting, and biotic invasions.

Mesozoic extensional tectonics, stratigraphy and crustal evolution during the Alpine cycle of the eastern Iberian basin.

Salas, R. y Casas, A.

Tectonophysics **228**: 33-55
1993

Abstract

Sequence stratigraphy, subsidence analysis and the integration of the basin fill data allow to the identification of four successive evolutionary stages in the basins of the eastern Iberian margin during Mesozoic extension: (1) Triassic rift (Late Permian-Hettangian); (2) Early and Middle Jurassic postrift (Sinemurian-Oxfordian); (3) Late Jurassic and Early Cretaceous rift (Kimmeridgian-middle Albian); and (4) Late Cretaceous postrift (late Albian-Maastrichtian).

The present-day crustal structure of the eastern Iberian Range and evidence of its evolution are deduced from the analysis of a new gravity map and other geophysical data. A regional gravity low along the Iberian Range is interpreted in terms of crustal thickening beneath the orogen as a result of the collision between the Ebro block and the Iberian plate during the Paleogene. The boundary between these blocks coincides with a magnetic lineament that is interpreted as an inherited signature of the thinning that occurred during Mesozoic extension.

A geodynamic scenario for the crustal evolution of the eastern part of the Iberian Peninsula, based on the evaluation of Mesozoic extensional tectonics and an analysis of the available geophysical data, includes three main successive evolutionary stages:

1. Mesozoic crustal thinning;
2. Paleogene crustal thickening;
3. Neogene crustal thinning.

Based on new geological and geophysical arguments, this study offers an alternative and a more complete geodynamic history of the eastern Iberian basins related to the evolution of the Iberian plate and the Central-North Atlantic.

An isolated bird foot from the Barremian (Lower Cretaceous) of Las Hoyas (Cuenca, Spain).

Sanz, J.L. y Buscalioni, A.D.

Geobios 27(Supplement 1): 213-217
1994

Abstract

The Early Cretaceous (Barremian) Las Hoyas outcrop (Cuenca, Spain) has yielded several bird remains. Two newavian genera (*Iberomesornis*, *Concornis*) have been already proposed. A new bird specimen consists of an isolated pedal skeleton, not well preserved. The metatarsus is 14 mm in length, close to that of *Iberomesornis*, with three verifiable character states: an unfused metatarsus; an unexpanded distal metatarsal region; and a slender first phalanx of the first digit, similar in length to that of the ungual. It is difficult to relate the new material to other primitive avian taxa, since most of the visible traits seem to be plesiomorphic. It lacks a true tarsometatarsus, and this trait indicates that it does not belong to the Ornithurae. It is probable that the isolated avian foot from Las Hoyas could be close to that of *Iberomesornis*, and its identification is proposed as cf. *Iberomesornis* sp.

The birds from Las Hoyas.

Sanz, J.L. y Ortega, F.

Science Progress **85**: 113-130
2002

Abstract

Information on the first steps of the avian evolutionary history has dramatically increased during the last few years. The fossil record provides a general view of the morphological changes of the avian flight apparatus from nonvolant ancestors (non-avian theropod dinosaurs) to the first derived fliers of the Early Cretaceous. The Las Hoyas bird record includes three genera: *Iberomesornis*, *Concornis* and *Eoalulavis*. This fossil material has yielded information about the early avian evolutionary history. These Early Cretaceous birds (some 120 Myr old) had a wingbeat cycle and breathing devices similar to those of extant birds. The function of the rectricial fan was also similar. In the evolutionary transition from cursorial ancestors to derived fliers it is possible to verify a trend to increase lift. Primitive wing aspect ratio morphotypes were elliptical ones, other derived morphotypes appeared, for example, in the Neornithes (extant birds). Some primitive fliers, like the Las Hoyas genus *Eoalulavis*, had an alula (feathers attached to the first digit of the hand) similar to that of present day birds, indicating braking and manoeuvring skills similar to those of their extant relatives. Primitive avian life habits are poorly understood. Some evidence from the Las Hoyas bird record indicates that Early Cretaceous birds were present in the trophic chains.

Unusual Early Cretaceous birds from Spain.

Sanz, J.L., Bonapartet, J.F. y Lacasa, A.

Nature **331**: 433-435
1988

Abstract

The Neocomian Spanish outcrops of Montsec (province of Lérida) and the new one of Las Hoyas (province of Cuenca) have yielded several avian remains in the last few years. Several isolated feathers have been reported from Montsec, and a specimen of some feathered wing bones has recently been found. Las Hoyas has yielded an isolated feather and a nearly articulated small fossil bird that lacks the skull. This new specimen, reported here, presents a combination of derived (strut-like coracoids, pygostyle) and primitive (pelvic girdle, sacrum, hind limb) character states. If one considers Archaeopteryx, Ornithurae and the new Spanish fossil bird, it seems clear that the latter taxon is the sister group of Ornithurae (extant birds and all other fossil birds that are closer to recent forms than is Archaeopteryx).

An Early Cretaceous faunal and floral continental assemblage: Las Hoyas fossil site (Cuenca, Spain).

Sanz, J.L.

Geobios **21**: 611-635
1988

Abstract

The fossiliferous beds of Las Hoyas (province of Cuenca, Spain) are composed of limestones (probably Late Hauterivian). The main fossiliferous facies consists of laminated limestone from a lake-basin plain with bottom waters perennially anoxic. The floral and faunal assemblage is similar to that of Montsec (prov. of Lérida, Spain), with divergences especially in the insects and some tetrapods. Bottom-dwelling invertebrates are scarce. Most of invertebrates are arthropods: three crustaceans and a relatively diversified entomofauna. The fishes are the main component of the vertebrate fauna both in number of individuals and diversity (13 different taxa). Among tetrapods the most abundant is a new genus of Caudata. Reptiles are represented by a chelonian, a little lizard and an atoposaurid crocodile. Finally, a new bird is reported from Las Hoyas, with an intermediate phylogenetic position between Archaeopteryx and Ornithurae.

The osteology of *Concornis lacustris* (Aves: Enantiornithes) from the Lower Cretaceous of Spain and a reexamination of its phylogenetic relationships.

Sanz, J.L., Chiappe, L.M. y Buscalioni, A.D.

American Museum Novitates **3133**: 1-23
1995

Abstract

Additional preparation of the holotype of *Concornis lacustris* from the Lower Cretaceous (Barremian) deposits of Las Hoyas (Spain) has provided abundant new osteological data. This specimen is superbly preserved and anatomical details are available for most skeletal regions except the skull and neck. The forelimb has "modern" proportions but it retains large claws. The sternum is carinate and deeply notched. The carina, however, does not reach the cranial margin but is developed in the caudal half of the sternum. The dorsal, synsacral and caudal vertebrae are amphicoelous. The dorsal vertebrae have deep lateral grooves and parapophyses in a central position. The ischium has large obturator and dorsal processes; the pubes form a distal symphysis. The hind limb is gracile, elongate, and longer than the forelimb. Cladistic analysis of various ornithothoracine taxa supports the allocation of *Concornis lacustris* within the Enantiornithes, a major clade of Cretaceous birds mostly recognized from continental deposits. This new interpretation is substantially supported by 12 synapomorphies shared by *C. lacustris* and the remaining enantiornithines.

An Early Cretaceous bird from Spain and its implications for the evolution of avian flight.

Sanz, J.L., Chiappe, L.M., Pérez-Moreno, B.P., Buscalioni, A.D., Moratalla, J.J., Ortega, F. y Poyato-Ariza, F.J.

Nature **382**: 442-445
1996

Abstract

Avian flight is one of the most remarkable achievements of vertebrate evolution, yet there is little evidence of its early phases. Specimens of Archaeopteryx shed important (albeit controversial) light on this evolutionary phenomenon, but large morphological (and almost certainly functional) gap between Archaeopteryx and modern avians remain virtually empty until recently. Here we report a new, exquisitely preserved, bird from the Lower Cretaceous Konservat-Lagerstätte of Las Hoyas (Cuenca, Spain) which provides evidence for the oldest known alula (bastard wing). Crustacean remains found inside its belly also provide the oldest direct evidence of feeding habits in birds. The new specimen has numerous synapomorphies with the Enantiornithes, but its unique sternal morphology, along with other autopomorphies in the furcula and vertebral centra, support the recognition of a new enantiornithine taxon, *Eoalulavis hoyasi*. The combination in *Eoalulavis* of a decisive aerodynamic feature, such as the alula, with the basic structures of the modern flight apparatus indicates that as early as 115 million years ago, birds had evolved a sophisticated structural system that enabled them to fly at low speeds and to attain high manoeuvrability.

**A Nestling Bird from the Lower Cretaceous of Spain: Implications
for Avian Skull and Neck Evolution.**

Sanz, J.L., Chiappe, L.M., Pérez-Moreno, B.P., Moratalla, J.J.,
Hernández-Carrasquilla, F., Buscalioni, A.D., Ortega, F., Poyato-Ariza,
F.J., Rasskin-Gutman, D. y Martínez-Delclòs, X.

Science 276: 1543-1546
1997

Abstract

A feathered skeleton of a Lower Cretaceous enantiornithine bird from Spain indicates that the modified diapsid skull of modern birds did not evolve until late in their evolution: Basal birds retained an essentially primitive diapsid design. The fossil provides data clarifying long-standing debates on the cranial morphology of the basalmost bird, *Archaeopteryx*. It also reemphasizes the notion that the early morphological transformations of birds were focused on the flight apparatus. This fossil was a nestling and suggests that early postnatal developments in the Cretaceous enantiornithine birds and those in their extant counterparts are comparable.

New cupedid beetles from the Lower Cretaceous of Spain and the palaeogeography of the family.

Soriano, C. y Delclòs, X.

Acta Palaeontologica Polonica **51**: 185–200
2006

Abstract

Thirteen new species of the family Cupedidae (Coleoptera: Archostemata) from Las Hoyas (Cuenca province) and El Montsec (Lleida province) fossil sites from the Barremian (Lower Cretaceous) of Spain are described. Ten of them belong to subfamily Ommatinae: *Tetraphalerus ponomarenkoi*, *Tetraphalerus penalveri*, *Cionocoleus longicapitis*, *Brochocoleus indibili*, *Zygadenia viridis*, *Zygadenia oculata*, *Zygadenia martinclousas*, *Zygadenia longicoxa*, and *Zygadenia siniestri*. Three of them are assigned to subfamily Cupedinae: *Priacma sanzii*, *Anaglyphites zherikhini*, and *Anaglyphites pluricavus*. Placement of genus *Cionocoleus* among subfamily Ommatinae is proposed. These new species extend the record of genera *Zygadenia*, *Cionocoleus*, *Brochocoleus*, *Priacma*, and *Anaglyphites* to the western part of Barremian European deposits. Nowadays the family Cupedidae is considered to be a relic group, restricted to few genera and species on Asia, Africa, Australia, and America, with limited geographical distribution, while during the Mesozoic the cupedids were distributed all over Laurasia. The Mesozoic cupedid-bearing localities are mostly interpreted as warm temperate to subtropical environments.

New cupedids (Coleoptera: Cupedidae) from the Lower Cretaceous of Spain

C. Soriano, A.G. Ponomarenko & X. Delclòs

Abstracts: 3rd International Congress of Palaeoentomology, with 2nd International Meeting on Palaeoarthropodology and 2nd World Congress on Amber and its Inclusions
2005

Abstract

The fossil sites of Las Hoyas and El Montsec are formed by lithographic limestones, the result of sedimentation in shallow lakes during the Lower Cretaceous (Late Barremian). The entomofauna registered in these sites includes 15 orders of insects. The coleopterans are composed of families belonging to three suborders: Archostemata (Cupedidae), Adephaga (Coptoclavidae, ?Trachipachidae, Dytiscidae, and ?Gyrinidae) and Polyphaga (Buprestidae, Elateridae, Peltidae, Parandrexidae, Ptilodactylidae, ?Hydrophyllidae, Scarabaeidae, Staphylinidae, Mordellidae, Nemochynidae, Eccoptarthridae, Belidae, and Anthribidae).

The record of the family Cupedidae is mainly Mesozoic, with about 35 recent species and more than 500 fossil species. At the moment the only species of this group recognized in the Lower Cretaceous of Spain was *Tetraphalerus brevicapitis* Ponomarenko & Martínez-Delclòs, 2000. Recent studies have yielded the presence in Las Hoyas and El Montsec of at least 14 species of the family Cupedidae, belonging to 6 genera and 2 subfamilies.

The diversity of this family in the Spanish fossil sites is comparatively higher than in other European Mesozoic sites, such as Sohlnofen (Germany) or the English Weald. Moreover, the exceptional degree of preservation in most of the Spanish material allows us to study not only the external features in detail, but even to study some internal structures.

The best-recorded subfamily is Ommatinae, represented by the genera *Notocupes* (6 new species), followed by *Tetraphalerus* (2 new species), *Cionocoleus* (2 new species) and *Brochocoleus* (1 new species). The subfamily Cupedinae is recorded by the presence of the genera *Anaglyphites* (2 new species) and *Priacma* (1 new species).

**The Mesozoic laurasian family Parandrexidae (Insecta: Coleoptera),
new species from the Lower Cretaceous of Spain.**

Soriano, C., Kirejtshuk, A.G. y Delclòs, X.

Comptes Rendus Palevol 5: 779-84
2006

Abstract

Martynopsis laticollis gen. n., sp. n. of the Laurasian Mesozoic beetle family Parandrexidae from the Barremian (Lower Cretaceous) of Spain, is described. The diagnosis of the family is revised and emended, and a new synonymy for the generic names *Parandrexia* Martynov, 1926 and *Parandrexia* Hong, 1983 is proposed. *Martynopsis laticollis* gen. n., sp. n. enlarges the palaeogeographic distribution of the family from Asia to western Europe, and amplifies the fossil record of the family from the Middle–Upper Jurassic to the Lower Cretaceous.

Coptoclauid Beetles (Coleoptera: Adephaga) from the lower Cretaceous of Spain: a new feeding strategy in beetles.

Soriano, C., Ponomarenko, A.G. y Delclòs, X.

Palaeontology 50: 525-536
2007

Abstract

Currently the beetle family Coptoclavidae consists of four subfamilies known from the Upper Triassic–Lower Cretaceous (Aptian). We describe two new subfamilies, three new genera and five new species from the Las Hoyas (Cuenca Province) and El Montsec (Lleida Province) localities of Barremian (Early Cretaceous) age from Spain: the first new subfamily, Hispanoclavinae, is from Las Hoyas and comprises one new genus, *Hispanoclavina*, and two new species, *H. diazromerali* and *H. gratshevi*; the second, Coptoclaviscinae, is represented at El Montsec by one new species of *Coptoclavella* (*C. inexpecta*). In addition, at Las Hoyas the subfamilies Necronectinae and Coptoclavinae are each represented by one new genus and species: *Ovonectes pilosum* and *Hoyaclava buscalionae*, respectively. All beetles previously assigned to the family Coptoclavidae have been interpreted as active hunters. However, we consider *Hispanoclavina* and *Hoyaclava* to be filter-feeding, with forelegs adapted for filtering plankton (probably zooplankton because other members of the family are carnivorous) on and beneath the water surface. This represents a new feeding strategy in beetles (extant and extinct). The five new species extend the known geographical distribution of the Coptoclavidae into the western part of European Barremian deposits. The Las Hoyas locality now has the highest known diversity of coptoclauid species.

New data on spinosaurid dinosaurs from the Early Cretaceous of the Sahara.

Taquet, P. y Russell, D.A.

Comptes Rendus de l'Académie des Sciences, Series IIA, Earth and Planetary Science **327**: 347-53
1998

Abstract

New occurrences of spinosaurid dinosaurs from the Aptian of Niger and Albian of Algeria augment our knowledge of *Spinosaurus maroccanus* and permit the description of a new taxon: *Cristatusaurus lapparenti* from the Gadoufaoua locality (Niger). Spinosaurids may be separated into two distinct groups: one with longirostrine muzzles and premaxillae which are rounded in cross-section, and a second with brevirostrine muzzles possessing a dorsoposteriorly expanded crest. The Spanish genus *Pelecanimimus* may be related to spinosaurids, rendering spinosaurids a more diversified group than previously thought.

Xeromorphic adaptations of some Mesozoic gymnosperms. A review with palaeoclimatological implications.

Thévenard, F., Gomez, B. y Daviero-Gomez, V.

Comptes Rendus Palevol 4: 67-77
2005

Abstract

Plant cuticles have proved to be a high-resolution proxy of palaeo- p_{CO_2} variation. Mesozoic gymnosperms, however, show a wider range of xeromorphic adaptations than their living relatives, and these may explain stomatal density/stomatal index differences between taxa within the same fossil assemblage. Four main adaptive responses to water loss are pointed out: reduction of solar radiation, reduction of drought-air circulation, reduction of evapotranspiration, and trapping of surface external water. In conclusion, we recommend supplementing quantitative estimates of stomatal density and index by qualitative observations of cuticular adaptive macro- and microstructures.

Lower Cretaceous charophytes from the Serrania de Cuenca, Iberian chain: Taxonomy, biostratigraphy and palaeoecology.

Vicente, A. y Martín-Closas, C.

Cretaceous Research **40**: 227-242
2013

Abstract

The assemblages of fossil charophyte fructifications from the La Huérguina Formation at the La Huérguina stratotype and the Las Hoyas section, along with some other samples from isolated outcrops are composed of *Atopochara trivolis* var. *triquetra*, *Globator maillardii* var. *trochiliscoides*, *Globator maillardii* var. *biutricularis* var. nov., *Clavator harrisii* var. *reyi*, *Ascidiella cruciata* and *Mesochara harrisii*. Some reworked utricles of *Ascidiella iberica* var. *iberica* were also found. The in situ assemblage belongs to the Cruciate-Paucibracteatus Biozone, which is Late Barremian–Early Aptian in age. These results confirm that the entire deposition of the La Huérguina Formation took place within this biozone and not earlier, as previously thought. The top of the unit can be limited to the uppermost Barremian with biostratigraphic data from ostracods. *Globator maillardii* var. *biutricularis* var. nov. is defined as the end form for the *Globator* lineage according to present knowledge. It is characterised by its unique utricle morphology, showing a basal ring representing a second, external utricular layer. This layer shows a primitive structure, reminiscent of *G. maillardii* var. *mutabilis*, in contrast to the internal utricle, which is more derived and similar to *G. maillardii* var. *trochiliscoides*. In comparison with other non-marine formations of the same age in the Iberian Chain and in Europe, the charophyte assemblages from the La Huérguina Formation appear to be relatively poor and monotonous, suggesting that some of the species found elsewhere never reached this part of the basin owing to the brief development of non-marine facies there. The main differences in composition between the samples studied are indicative of the palaeoecological conditions. *Atopochara trivolis* *triquetra* was found to be dominant in shallow lacustrine facies and *Globator maillardii* var. *trochiliscoides* and var. *biutricularis* are associated with temporary lakes from a well-drained palustrine area. *Clavator harrisii* and *Mesochara harrisii* thrived on floodplains whereas *Ascidiella cruciata* grew in palustrine environments with significant edaphic activity.

First pterosaur remains from the Early Cretaceous Lagerstätte of Las Hoyas, Spain: Palaeoecological significance.

Vullo, R., Buscalioni, A.D., Marugán-Lobón, J. y Moratalla, J.J.

Geological Magazine **146**: 931-936
2009

Abstract

Pterosaur teeth from the Early Cretaceous Lagerstätte of Las Hoyas (Spain) are described. We reassess the track from this site previously ascribed to a pterosaur, concluding that it is a theropod footprint. The teeth belong to two pterodactyloid taxa: a basal Istiodactylidae similar to *Haopterus* and an indeterminate Ornithocheiridae. From a palaeoecological point of view, the occurrence of such pterosaurs in the freshwater wetland palaeobiota of Las Hoyas strengthens the evidence of the similarity of this Spanish locality to the famous Early Cretaceous Lagerstätten of Liaoning in China.

A New crested pterosaur from the Early Cretaceous of Spain: The first european tapejarid (Pterodactyloidea: Azhdarchoidea).

Vullo, R., Marugán-Lobón, J., Kellner, A.W.A., Buscalioni, A.D., Gomez, B., de la Fuente, M. y Mratalla, J.J.

PLoS ONE
2012

Abstract

Background

The Tapejaridae is a group of unusual toothless pterosaurs characterized by bizarre cranial crests. From a paleoecological point of view, frugivorous feeding habits have often been suggested for one of its included clades, the Tapejarinae. So far, the presence of these intriguing flying reptiles has been unambiguously documented from Early Cretaceous sites in China and Brazil, where pterosaur fossils are less rare and fragmentary than in similarly-aged European strata.

Methodology/Principal Findings

Europejara olcadesorum gen. et sp. nov. is diagnosed by a unique combination of characters including an unusual caudally recurved dentary crest. It represents the oldest known member of Tapejaridae and the oldest known toothless pterosaur. The new taxon documents the earliest stage of the acquisition of this anatomical feature during the evolutionary history of the Pterodactyloidea. This innovation may have been linked to the development of new feeding strategies.

Conclusion/Significance

The discovery of *Europejara* in the Barremian of the Iberian Peninsula reveals an earlier and broader global distribution of tapejarids, suggesting a Eurasian origin of this group. It adds to the poorly known pterosaur fauna of the Las Hoyas locality and contributes to a better understanding of the paleoecology of this Konservat-Lagerstätte. Finally, the significance of a probable contribution of tapejarine tapejarids to the early angiosperm dispersal is discussed.

Les amiidés du Crétacé inférieur du Montsec (province de Lleida, Espagne): *Urocles sauvagei* (Vidal, 1915) synonyme de *Vidalamia catalunica* (Sauvage, 1903).

Wenz, S.

Treballs del Museu de Geologia de Barcelona 1995: 5-13
1995

Abstract

The Amiids from the Lower Cretaceous of Montsec (Lleida, Spain): *Urocles sauvagei* (Vidal, 1915) as a synonym of *Vidalamia catalunica* (Sauvage, 1903). - The new find of juvenile specimens coming from the Lower Cretaceous continental deposits of Montsec and Las Hoyas (Spain), which are identified as *Vidalamia catalunica* according to the pattern of the caudal endoskeleton, the vertebral formula, the characters of the dorsal (i. E. Long-based dorsal fin and high number of dorsal finrays), allows us to establish the synonymy between *Urocles sauvagei* and *Vidalamia catalunica*, species respectively based on juvenile and adult individuals of the same genus.

Les Lepidotes (Actinopterygii, Semionotiformes) du Crétacé inférieur (Barrémien) de Las Hoyas (Province de Cuenca, Espagne).

Wenz, S.

Geodiversitas **25**: 481-499
2003

Abstract

Two new *Lepidotes* Agassiz, 1832 species are described from the Early Cretaceous (Barremian) lacustrine beds from Las Hoyas (Cuenca Province, Spain). *Lepidotes microrhis* n. sp. and *Lepidotes tanyrhis* n. sp. are represented by articulated specimens. They are defined by the coexistence of characters either unknown in *Lepidotes* (infraorbitals at the posteroventral corner of the orbit posteriorly extended, reaching the preoperculum only in *L. Microrhis* n. sp.), exceptional (extrascapular commissure passing through the parietal, two suborbitals, edentulous maxillary) or variously distributed (lack of tritoral teeth, unpaired vomer). *Lepidotes* is frequent at Las Hoyas. It differs from the rare specimens described at Montsec (Province of Lérida, Spain), a usually Berriasian-Valanginian locality that presents numerous elements in common with Las Hoyas.

Les Actinoptérygiens juvéniles du Crétacé inférieur du montsec et de Las Hoyas (Espagne).

Wenz, S. y Poyato-Ariza, F.J.

Geobios 27 (Supplement 1): 203-212
1994

Abstract

Juvenile actinopterygians are numerous and varied in the Early Cretaceous continental deposits at Las Hoyas and Montsec (Spain). We explore the validity of various characters in these juveniles as diagnostic at different levels of the systematic hierarchy, showing that some are constant from their first appearance in ontogeny, and others appear at different times in different lineages. The relative abundance of juveniles and adults of actinopterygian species at Montsec and Las Hoyas are relevant to the environment of deposition, implying the proximity of spawning grounds and the temporary occurrence of conditions inimical to juveniles.

Resumen

Las formas juveniles de peces son numerosas y variadas en los yacimientos continentales del Cretácico inferior de Las Hoyas y Montsec (España). La presencia de algunos rasgos estables desde fases tempranas del crecimiento y el momento en el que determinadas estructuras aparecen permiten comprobar como diagnósticos ciertos caracteres, aplicables a distintos niveles jerárquicos y cuyo valor varía en función del taxon considerado. El análisis de la abundancia relativa de las diferentes especies de actinopterigios del Montsec y de Las Hoyas permite suponer ciertas condiciones ambientales, como la proximidad de áreas de reproducción ó la aparición temporal de condiciones desfavorables para la vida de determinadas formas juveniles.