CERAMIC CLAYS OF MORELLA AND THEIR RELATION TO HERITAGE: THE DINOSAUR SITES



José Miguel Gasulla Asensio

Palaeontologist Technician of the firm Vega del Moll, S.A. Castellón, Spain

Graduate in Geography and History (Archaeology) from the University of Valencia.

Doctoring in the Interuniversitary Palaeontology Doctorate of the Autonomous University of Madrid.

Technician for the permanent archaeological and palaeontological monitoring of the Clay Mine at Mas de la Parreta in Morella.

Ex-director, creator and co-ordinator of the network of Morella Museums (Castellón).

Director of several excavations and archaeological and palaeontological monitorings and municipal ex-archaeologist of the Morella City Council.

Member of the Spanish Society of Palaeontology.

Author of over 25 popular and research papers, organiser of several exhibitions of Morellan cultural heritage, besides delivering over 12 conferences and communications.

INTRODUCTION

The year 2000 brought with it the opening of a clay mine for ceramic use located in the municipal area of Morella, in Castellón province. This event, which at first seemed of no great significance, however gave rise to some issues of considerable importance regarding the compatibility of questions so far apart and seemingly unrelated as how to run a mine for the ceramic industry and the recovery of items of cultural interest.

In this context, what relationships are there between the mining industry and heritage? The red clavs of the central part of the so-called, geologically speaking, Clay Formation of Morella exhibit some very suitable characteristics for use in the production of bodies for ceramic compositions. These Morella clays have in a short time become an important ingredient in the formulations of red bodies for their fluxing properties, good compaction and good deflocculation. But this type of clay also presents another characteristic that has to do with heritage value, and that is of being able to preserve, among its strata, fossil remains of an extraordinary palaeontological importance. The firm Arcillas de Morella, formerly known as Capas Rojas de Morella, is found in a sedimentary sequence whose chronology dates back to the lower Cretaceous, approximately 110 -115 million years ago. The sedimentary materials, that is to say the clays, were of continental origin and were deposited in a palaeoenvironment dominated by a deltaic plain. At that time, on the surface of the earth the dominant fauna was the dinosaur. Their skeletal remains, together with those of other animals such as crocodiles, turtles, amphibians or fish were fossilised in the clay sediments of Morella, evidencing their presence in a singular way. Not in vain, the dinosaur sites of Morella, for their quality and quantity, stand among the best in Europe. Therefore these clays present a symbiosis between industrial resources and heritage resources; and although it may seem contradictory, there is an example of mutual support.

The possible imbalance between the industrial exploitation of these clays and the preservation of the rich palaeontological heritage that they contribute was solved in a very satisfactory way at the Mine of Mas de la Parreta of Morella, without a doubt owing to the sensitivity and readiness of the organisations involved: on one hand, the company owning the Mine, Vega del Moll, S.A., and which administers the resource; on the other, the public institutions that watch over compliance with regulations and the preservation of heritage, which are the Head Office for Heritage of the Authority for Culture and Education of the Autonomous Government of Valencia and the Morella City Council.



Figure 1. Panoramic view of the Mine at Mas de la Parreta of Morella.

The innovative approach adopted, reached by consensus, has been positively valued by the most noted researchers and has set a precedent to be followed by mining exploitations with heritage resources at peril. The approach involves the planning and implementation of permanent palaeontological monitoring of the mining extractions by a competent technician. On one hand, the company Vega del Moll, with previous planning, works several banks or sufficiently wide extractive terraces, and this allows the located sites to be delimited without disturbing the continuity of the extraction. On the other hand, the palaeontologist carries out his monitoring functions and he studies, sets off and digs out the excavations at the fastest speed and with the appropriate means for each occasion. It has thus enabled running the mining exploitation of the clays without delays or prejudice for the company, while also locating, recovering and investigating important fossil materials, discovered moreover in different sites.

The dinosaur remains of the Morella sites, known since the XIXth century, have been considered as mentioned before, among the best and most important, not just in Spain, but also in a European context. These important fossil records are at present being increased in a spectacular way by the sites of the Mine at Mas de la Parreta. Furthermore, these sites are driving the recent investigations carried out by several scientists, specialists in different geologic and palaeontological disciplines, thus increasing the prestige of Morellan fossil records and making Morella at the moment the hub or centre of research on dinosaurs in Spain.

THE CLAY FORMATION OF MORELLA

Morella and the District of Els Ports are located in the north and interior of Castellón province, in the Valencia Region, bounded by the south-east of Aragón and the south of Catalonia. From the point of view of the great geologic structural units of the Iberian Peninsula they are fully integrated in the so-called Connection Area, located between the eastern branch of the Iberian Chain and the Catalan Coastal Chain. The Connection Area corresponds to the palaeogenic inversion of a great Jurassic lower higher-Cretaceous sedimentary basin, called the Maestrazgo Basin.

During the Mesozoic a great sedimentation occurred of mainly marine influence, which reached a thickness of up to 6500 metres, divided in four depositional super-sequences. One of these super-sequences was that of the lower Cretaceous, more than 2400 metres thick, which in turn was also divided in ten depositional sequences. In the area of Morella, buried deep in the sub-basin Morella-Forcall-TorreMiró, the deposit sequence of the lower Aptian is about 350 metres thick. This sequence consists of five lithostratigraphic units: the clay formations of Morella, marls of Cervera, limestones and marls of Xert, marls of Forcall and the basal part of the calcareous formation of Villarroya.

At the beginning of the Aptian a brief marine regression took place with the entry of terrigenous sediments that were deposited in a fluviodeltaic environment from the North-NW and produced the Clay Formation of Morella (Salas *et al.*, 1995), also known previously in an informal way as the Red Layers of Morella. The age of the Morella Formation probably dates back to the basal Aptian. It is difficult to be more precise since the fauna and the flora that it contains, have quite a wide range of scatter. In some places the thickness of the formation can reach 100 metres.

The stratigraphic series of the Morella Clay Formation show similar characteristics in all the outcroppings in the Morella area. The central part of the stratigraphic series is defined at the base and ceiling by thick sandstone facies with parallel horizontal stratification. Between them lie the great facies of red clay limolites, broken by more or less thick layers of various subfacies, among which to be noted are the clayey and sandy green limolites and the conglomerate subfacies.



Figure 2. Palaeogeography and distribution of facies of the deltaic system of the basal Aptian. 1, Areas without sedimentation and/or erosion. 2, Upper deltaic plain (fluvial). 3, Lower deltaic plain (tidal). 4, Prodelta. According to Salas et al., 1995.

The Morella Clay Formation is interpreted as a deltaic fluvial system with the presence of lagoons and distribution channels and with a prevalence of hydromorphous soils generated by successive floods, in an area of great plains with fluvial currents of little energy but large flow. The vegetation was abundant and basically composed of conifers, cycads and ferns. The proximity of the coastline also conditioned the palaeoenvironment by the influence of tidal currents and their intrusion into this system.

DINOSAURS OF MORELLA: RESEARCH HISTORY

THE FOSSILS

A fossil is a rest of a vegetable or animal organism, or of its activity. The organism belonged to past geologic times and a fossilisation process replaced the organic matter of its composition by mineral matter, or captured or left the imprint of its vital activity in the stratum. Generally, only the most resistant parts of the organisms fossilised, i.e., direct evidence of these organisms (bones, teeth, shells, etc.). Some indications or indirect evidence of the vital activity also fossilised (coprolites or fossil faeces, marks and prints, eggs, etc.).

Con - 6



Figure 3. Iguanodon remains arranged in the same position in which they appeared at the site in Bernissart (Belgium). Museum of the Institut Royal des Sciences Naturelles de Belgique.

For a fossil to form it is necessary for the dead organism or the indirect evidence to be buried quickly by some type of sediment and thus avoid their degradation, disappearance or decomposition. Such events can be caused by meteorological phenomena, chemical alterations or by other live organisms such as bacterias, carrion-eating animal, plants, etc. Subsequently, mainly in the skeletal elements, addition or substitution processes can begin of mineral components (permineralisation, recrystallisation, inversion or mineralogical replacement). Dissolution processes can also commence and subsequent creation of moulds. Dinosaurs and other terrestrial animals fossilised when their bodies were buried at the bottoms of channels, lagoons, lakes or in flooded soils. They could be dragged or float there from distant or very nearby places or be overcome by death in situ.

THE DINOSAURS

A dinosaur can be defined as a tetrapod vertebrate animal, that is to say with two pairs of pentadactyl extremities, amniote that is to say with an internal epithelial layer in the embryonic sack, diapsid that is to say with two lateral openings in the rear part of the skull, and archosaur, that is to say belonging to the reigning or dominant reptiles. The hypothetical ancestral dinosaur could be a carnivorous small size biped animal.



Con - 7

The parentage or phylogenetic relationships of the dinosaurs divide them into two big monophyletic groups: the saurischian and the ornithischian. In the saurischian dinosaurs, although their name comes from the arrangement of the hip, the features that define and group them are found mainly in the vertebras and the hand. The saurischian consists of two related groups: the Sauropodomorpha and the Theropoda. The former are generally herbivores of great size and quadrupeds, with a relatively small skull and long neck and tail. They are divided in turn in prosauropods and sauropods; among these last ones are found the brachiosaurians whose presence has been encountered in the fossil records of Morella. The theropods are mostly carnivorous and generally biped with different forms and sizes, with relatively big skulls and nailed phalanxes of the curved extremities, and of great size. This group is the only one that has lasted through an evolutionary process, leading to the current birds. In the fossil records of Morella remains appear, mainly teeth, of different types of theropods of small and great size, such as the Megalosaurus or Coelurus, and some form close to the dromeosaurids and Carcharodontosaurus. This last one is a theropod located in the north of Africa, with a similar size to Tyrannosaurus rex but of greater weight.



The ornithischian dinosaurs are characterised by an arrangement of the hip like that of the birds and also by a series of characteristics relating to their herbivore feed. The ornithischians include various groups that are also highly diversified, with quadruped and biped forms. Among these, there are the ceratopsians and pachycephalosaurians with heads bearing horns or augmented, and also the stegosaurians and anchilosaurians featuring large dorsal plates and tail thorns in some and protecting the backs of others. These last animals appear scattered in the Morellan sites with remains of the Nodosauridae family. Another of the important groups of ornithischians is that of the ornithopods with generally biped forms, with extremities in the form of a bird foot. Among these to be noted are the hypsylophodontids, found in the Morellan records, hadrosaurians or dinosaurs with a duck beak and the iguanodontids. These are, without any doubt, the most widely found at the Morella sites through the species *Iguanodon bernissartensis* and possibly some species or new subspecies of iguanodontid.

The main dinosaur sites, by direct evidence (remains of animal bodies) and by indirect evidence (remains of vital activity) of the lower Cretaceous in Spain are located in the Eastern Iberian Mountain range: Las Hoyas in Cuenca, the district of Los Serranos in Valencia, Galve in Teruel or Morella in Castellón. There are also sites in the north of the province of Burgos and in Soria, in places such as Salas de los Infantes or the whole Sierra de Cameros of La Rioja and Soria.

HISTORY OF THE RESEARCHES INTO DINOSAURS IN MORELLA

Sites with direct evidence of dinosaur remains have been known since the second half of the XIXth century. The first information on discoveries of fossil remains, possibly related to dinosaurs, comes from the local historian José Segura y Barreda. In his book "Morella and its villages", in a footnote he mentions that in August of 1868, the naturalist and professor of Valencian medicine Nicolás Ferrer y Julve, follower of the research tradition of the well-known Valencian naturalistic Antonio José Cavanilles found:

"... some deformed bones in the proximities of Morella, which not only conserve the outer figure, but even the fossilised marrow." (Segura, J. "Morella and its villages" Morella, 1868. Vol. II, p. 280).

The first citation on dinosaur remains comes from Juan Vilanova y Piera, first professor of Geology and Palaeontology of the Central University of Madrid. In 1873, he communicates the finding of *Iguanodon* remains at Utrillas and Morella.

However, the pioneer in the study of Spanish dinosaurs, largely carried out at Morellan sites, was the Castellón researcher and politician, José Royo y Gómez. Between 1914 and 1929 he conducted a fertile investigation in Morella, establishing a numerous collection of dinosaur remains and presenting numerous communications in national and international environments. His most extensive work is entitled "The discoveries of gigantic reptiles in Levant", and it is Royo's only work that includes figures of dinosaurs, while he also complains in it about the use of fossil remains for the construction of a bridge on the road from Morella to Cinctorres.



Figure 4. Photographic record belonging to Royo. Bridge on the Cinctorres road. Archives Museo Nacional de Ciencias Naturales.

Both Vilanova and Royo deposited the materials of their investigations in the Archives of the Museo Nacional de Ciencias Naturales in Madrid.

Research on dinosaurs stopped until the 60s and 70s. In those two decades a local amateur, Francisco Yeste López found several sites of great importance. His work alerted the City Council of Morella, who requested the collaboration of the Miquel Crusafont Institute of Palaeontology in Sabadell. From 1978 to 1980, the Institute, under the technical supervision of José Vicente Santafé and Lourdes Casanovas carried out several excavation campaigns.

With the materials from the excavations and those contributed by Francisco Yeste, in 1982, Santafé and Casanovas, together with the geologist Sebastián Calzada, of the Museo del Seminario Conciliar of Barcelona and the palaeontologist José Luís Sanz, of the Department of Zoology of the Autonomous University of Madrid, presented several communications and published the first monograph in Spain on dinosaurs, entitled "Geology and Palaeontology (Dinosaurs) of the red Layers of Morella (Castellón, Spain)". In their conclusions they affirm:

"At the level of current knowledge the Dinosaur fauna of Morella consists of two Theropods (Coelurosauridae und. and a Megalosauridae undet.), a Sauropod (Brachiosaurinae undet.), an Anchylosaurian (? Nodosauridae undet.) and an Ornithopod (Iguanodon bernissartensis, VAN BENEDEN, 1881). (Santafé et al., 1982. p. 143).

In 1983, the same researchers presented a publication on the remains of the ornithopod Hypsilophodon dinosaur from the site at Tejería Milián. Francisco Yeste continued with the fieldwork, locating more sites and making very important finds.

In 1994, at the initiative of the City Council of Morella, with an important part of the conserved fossil remains, a Museum on the single theme "Time of dinosaurs. The Cretaceous in Morella" was established. The Museum is located in the Towers of San Miguel in the medieval walled enclosure of the city. With more than 20,000 annual visitors, it is one of the most visited museums in the Valencia Region. In the same year, the association Friends of Palaeontology of Morella was also founded.



Figure 5. Museum Temps de Dinosaures. Room of the femur y sacrum of Iguanodon.

In 1997, a child playing at searching for fossil dinosaur tracks, accidentally discovered the site of theropod ichnites at Vallivana, first indirect evidence of the presence of dinosaurs in Morella. At some 20 kilometres from Morella, near national highway 232, the site lies on the surface of a grey calcareous rock, in the north-south direction, which is part of a succession of table levels whose age dates back to the lower Cretaceous, and more concretely to the Hauterivian-Barremian. It contains a compound trail made up of four tridactyl ichnites and several isolated ichnites of a theropod dinosaur.



Figure 6. Trail of theropod dinosaur ichnites at the Vallivana site.

In 1998 a large fragment was discovered of the right humerus of an iguanodontid in the area of Mas de Romeu, one of the well-known sites in Morella. The material was deposited at the Nature Centre "El Termet" of Vila-real. It was studied by José Ignacio Ruiz-Omeñaca of the University of Zaragoza.

With the opening of the clay mine at Mas de la Parreta in 2000, the palaeontological investigation of the sites in Morella was given new drive. The localisation up to the year 2001 of six different sites inside the mine itself with the recovery of a high number of remains, as well as their quality, has allowed starting up various research lines and increased the importance of the Morellan fossil records. The best specialists in palaeontological matters are carrying out stratigraphic, taphonomic, palinological or palaeobiological studies of the sites, to find further details and upgrade their knowledge.

Although not directly in relation to field research, the year 2001 has meant a step forward in the dissemination of knowledge regarding the fossil sites of Morella. The Museum "Temps of Dinosaures", which had organised a travelling exhibition with part of its fossil collection, visiting cities like Lisbon and Toma in Portugal, or Castellón, Onda, Almassora and Les Coves de Vinromà in the province itself, for the first time, is joining the Museo Nacional de Ciencias Naturales of Madrid in an outstanding exhibition on the dinosaurs of Morella, held at the Museum in Madrid.



Figure 7. Full-scale model of an Iguanodon from the exhibition Dinosaurs of Morella.

Lastly, it is interesting to note the enormous importance of the study of the remains of sauropods at the Morella sites conducted by the researchers Pilar Yagüe, José Luís Sanz and José Miguel Gasulla from the Autonomous University of Madrid and Paul Upchurch from the University of Cambridge. The conclusions of the study were presented, in September 2001, as a poster at the Congress of Palaeontology of York in Great Britain. The remains correspond to a new taxon of the Brachiosauridae family called Morellasaurus royoi.

THE DINOSAUR SITES OF MORELLA: MINE AT MAS DE LA PARRETA

The Morella Clay Formation is widely found in the whole district of Els Ports. There are outcroppings in several towns such as: Vallibona, Cinctorres, Olocau del Rey, Villores, Zorita, Herbés, Castell de Cabres and Herbesset. In most of these outcroppings it has been possible to encounter more or less interesting fossil remains, though Vallibona is possibly to date the best known, with the greatest number of remains, most of which are on show in the private museographic collection of Juan Cano Forner at the town of San Mateo.

However, the greatest outcroppings of the Formation are in the municipal area of Morella, a direct consequence of the fluvial erosion of the rivers Bergantes and Caldes. Three main bands can be defined that cross the area in an east-west direction:

- The first one is located to the north of the city in the "Denas" (traditional territorial division of Morella) or Partidas de la Roca and Morella la Vella. This outcropping is the result of the ravines made by the tributaries on the right bank of the river Bergantes. The most prominent sites are: Mas de Eroles and Mas de Romeu.
- The second is located to the south-west of the city, in the 1st and 2nd Denas of the River. This band is a result of the river Bergantes and its sub-tributaries on the left riverbank. The most noteworthy sites are: Tejería Milián, Beltrán-Azuvi and Canteret.



Figure 8. "El Beltrán" site. Photograph collection of José Royo y Gómez. Archives of the Museo Nacional de Ciencias Naturales.

- The third is located more to the south of the city in the valley dug out by the river Caldes, in the Denas of Coll i Moll and Vespa. The most noteworthy sites are: Mas de Querol and the Mine at Mas de la Parreta.

THE SITES OF THE MINE AT MAS DE LA PARRETA

The mine at Mas de la Parreta is located four kilometres from Morella, to the south-west of the city, on the southern slope of the Aguila mountains, a mountain range that separates the beds of the river Bergantes and the river Caldes, both with an east-west direction. The southern slope of this mountain range descends toward a wide valley formed by the river Caldés, called Vega del Moll, in the Denas of Vespa and Coll i Moll.

Mine exploitation is planned by intervention in several phases. In the first phases, the total extraction area involves about 30,000 square metres, lying in the Masía Querol property. Even before 50% of these first phases have been executed, six different sites with an extraordinary quantity of remains have already been located.

2002 QUALI 2002

Mas de la Parreta Mine site 1 was located toward the west of the exploitation area, near the surface in a subfacies of clayey grey-green limolites. The removal of land by machinery did not allow locating the remains in the clay matrix, however it is almost certain that a concentrated deposit was involved, with well-conserved fossil materials. 89 pieces or fragments were encountered, mainly of a very large iguanodontid, even larger than the holotype of Iguanodon bernissartensis. Remains of other animals also appeared: a possible theropod astragalus, remains of crocodiles and turtles and small coprolites.



Figure 9. Site 1. Iguanodontid femur. Measuring almost 1.20 m, it is the largest found to date in the world.

Mas de la Parreta Mine site 2 was located to the east of the exploitation area under a terraced farmland area, in greenish-red and motley coloured clays. It presented different characteristics from the previous location, since the recovered fossil material was of smaller size and more broken up. It had therefore possibly been a distribution channel through which the material had been dragged and deposited. A research dig was made measuring 7x6 metres, which yielded small remains across almost the whole extension: of these to be highlighted are the teeth of several types of animals, from ornithopod and theropod dinosaurs to two different types of crocodiles such as *Bernissartia* and *Goniopholis*. A concentration deposit appeared in which several bones of an iguanodontid were located. Other interesting remains were breastplates and bones of turtles, a vertebra of a scaly animal, ostheodermic plates of crocodiles and anuran bones.

Mas de la Parreta Mine site 3 was located in the subfacies of bluish-grey limolites found under the sandstone bar in the north-eastern part of the exploitation area. This site forms a kind of lens more than a metre high, and about 20 metres wide. It was probably a considerable channel with moments of certain energy. An important quantity of fossilised plant remains has been discovered. Also to be noted is the discovery of numerous skeletal remains, mostly in fragments, of several types of dinosaurs. There are also crocodile remains and many moulds of gastropod molluscs.



Figure 10. Site 4. Concentration deposit. Ischion fragments and tibia and tail vertebra of an iguanodontid.

Mas de la Parreta Mine site 4 was located on the eastern boundary of the exploitation area, 3 metres below the party wall between the farmhouses of Querol and Parreta. It appeared in some red marbled (motley coloured) clays, indicating hydromorphous soil, possibly a lagoon bottom with aquatic vegetation, in the same stratigraphic level as site CMP-1. The most important remains are all of the *Iguanodon* genus. Taphonomically, some elements, especially the vertebras, present vertical squashing as a result of fossildiagenetic compression.

Mas de la Parreta Mine site 5 was located toward the centre of the extraction area in a stratigraphic level near the wall (end of the stratigraphic series) and therefore quite deep. The lithology is a little different from the rest of sites, since it consists of limolites with an important sandy component, which causes strong compaction. This subfacies was probably related to a channel with a water stream of little energy. Taphonomically, it is

clearly a concentration deposit owing to the good conservation of the fossils, as well as their great abundance: in less than 15 square metres more than 60 complete pieces or big fragments of a single individual of the Iguanodon genus were found, besides other remains such as moulds of bivalves or gastropods, scales of Lepidotes or crocodile bones. A few metres away, another concentration deposit also appeared, possibly of the same individual.

Mas de la Parreta Mine site 6 was located in a subfacies of red and greenish limolites near the ceiling of the stratigraphic



Figure 11. Site 5. Concentration deposit of remains of an iguanodontid.



Figure 12. Site 6. Femur of an undetermined dinosaur.

series of the red clays and spatially near site 3. Very few remains appeared in this site although quite a complete femur of 70 centimetres of a dinosaur is to be noted, at the moment undetermined, together with fragments of ribs and other undetermined remains.

EPILOGUE

Although as we have seen, the history of the dinosaur sites of Morella is long and interesting, there is without a doubt a before and after in heritage protection in general, and in palaeontological research in particular, after the opening of the Mine at Mas de la Parreta.

There is no doubt that mining in general has always disregarded protection of natural and cultural heritage, without worrying much about it, the basic concern being extraction of the resource. This has had negative repercussions for this type of industry, creating a very poor image in society in general, and continuous conflicts with public administrations. Society at present is demanding more and more strongly that natural and cultural heritage be preserved, and this gradually being supported by less permissive regulations, obliging implementation of corrective and protective measures for the environment.

The company Vega del Moll, owner of the Mine at Mas de la Parreta has started putting in place the necessary corrective mechanisms to protect natural and cultural heritage. Evidently, these mechanisms are carried out partly in compliance with legislation and under pressure of public institutions, but also, and this is the especially significant point, because of the sensitivity of the company in heritage issues and in actions aimed at supporting and collaborating in the sustainable development of the area. This contribution has led to fostering archaeological, palaeontological and even ethnological research outside its exploitation scope, with collaborations in cultural acts of the area, sponsorship of the exhibitions at the Museum Temps de Dinosaures of Morella (as a significant example, financing the building of the full-scale Iguanodon dinosaur) and, naturally, with the new jobs, in the keeping employment in the district.

Arcillas Vega del Moll

Figure 13. Anagram of the firm Vega del Moll

It is important to highlight athat the recovery, study, conservation and exhibition

of heritage, in this case, mainly palaeontological, is an issue that should not be the sole concern of a mining company but of all, public and private organisations. The example of the Mine at Mas de la Parreta is a precedent to be followed in the future. Possibly in a short time, we will be a European reference in dinosaur palaeontology and this will raise our scientific prestige in the international environment. Of course, this will not increase mining or ceramic industry production, nor will it save the economy of the rural areas of the interior, but our knowledge of the past can increase, of a part of the history of the Earth in which, we as mammals, have only occupied a tiny corner in an ecological space dominated by the dinosaurs.

REFERENCES

- [1] BULTYNCK, P. Bernissart et les Iguanodons. Institut Royal des Sciencies Naturelles de Belgique. Bruxelles, 1989.
- [2] CZERKAS, S. and CZERKAS, S. Dinosaurios. Origen, evolución y extinción. Editorial Planeta. Barcelona, 1991.
- [3] LOPEZ MARTINEZ, N. Guía de Campo de los Fósiles de España. Editorial Pirámide. Madrid, 1988.
- [4] NORMAN, D. Enciclopedia ilustrada de los Dinosaurios. Editorial Susaeta, 1992.
- [5] RUIZ-OMEÑACA, J.I. and SANTOS CUBEDO, A. Un húmero de iguanodóntido (Ornithischia: Ornithopoda) del Cretácico inferior (Aptiense) de Morella (Castellón, España). Geogaceta, 24. 1998.
- [6] SALAS, R. and MARTIN-CLOSAS, C. El Cretácico inferior del Nordeste de Iberia. Publicacions Universitat de Barcelona. Barcelona, 1995.
- [7] SANTAFÉ, J.V., CASANOVAS, M.L., SANZ, J.L. and CALZADA, S. Los Dinosaurios de Morella (Nota preliminar). Acta geológica hispánica nº 5, tomo 13, 1978.
- [8] SANTAFÉ, J.V., CASANOVAS, M.L., SANZ, J.L. and CALZADA, S. Geología y Paleontología (Dinosaurios) de las Capas Rojas de Morella (Castellón, España). Diputación Prov. De Castellón y Barcelona. Castellón-Barna, 1982
- [9] SANZ, J.L., SANTAFÉ, J.V. and CASANOVAS, L. Wealden Ornithopod dinosaur Hypsilophodon from the Capas rojas Formation (Lower Aptian, lower Cretaceous) of Morella, Castellón, Spain. Journal of Vertebrate Palaeontology 3, University of Oklahoma, 1983. Pags. 39-42.
- [10] SANZ, J.L. and BUSCALIONI, A.D. Los Dinosaurios y su entorno biótico. Instituto Juan de Valdés. Cuenca, 1992.
- [11] WEISHAMPEL, D., DODSON, P. and OSMÓLSKA, H. The Dinosauria. University of California Press. 1990.