



CONFERENCES PLENIERES / *PLENARY LECTURES*



L'ORIGINE DES VERTEBRES ET LES PREMIERES ETAPES DE LEUR HISTOIRE EVOLUTIVE

JANVIER Philippe

Centre de recherches sur la Paléobiodiversité et les Paléoenvironnements (CR2P), UMR 7207 du CNRS, Muséum National d'Histoire Naturelle, 8 rue Buffon, 75231 Paris Cedex 05 Paris, France. janvier@mnhn.fr

Les vertébrés partagent avec quelques grands groupes, comme les plantes vasculaires et les arthropodes, une remarquable capacité d'illustrer par les fossiles et la hiérarchie de nombreux caractères morphologiques, le processus historique de l'évolution. Leur structure est complexe mais bien documentée par une grande diversité actuelle et, surtout, leur registre fossile est abondant et leur squelette conserve des traces précises des fonctions et adaptations. De plus, la diversification de leurs grands clades a été relativement tardive, étalée dans le temps depuis le Cambrien inférieur. Enfin, de nouvelles sources de données issues de la génétique du développement viennent éclairer les mécanismes qui régissent la construction de leur forme. Indirectement, elles éclairent d'une nouvelle lumière l'origine des innovations morpho-anatomiques dont les fossiles gardent la trace. L'arbre des vertébrés depuis son origine a été émondé par diverses extinctions, progressives ou brutales, et la diversité actuelle du groupe fait apparaître des lacunes qu'une biologie comparative sans fossiles ne laisserait que deviner. Cette discontinuité est encore plus apparente lorsqu'on considère l'ensemble des chordés ou des deutérostomes dont, pourtant de nombreux caractères, notamment moléculaires, confirment la monophylie. Nous montrons ici que l'édifice de l'histoire et de l'évolution des vertébrés tel que nous le concevons aujourd'hui ne repose que sur quelques piliers, que sont l'homologie, la distribution des caractères et la parcimonie. Les processus et mécanismes qui viennent en expliquer les grandes transitions évolutives sont généralement fondés sur des études de cas actuels et, dans ce domaine, le rôle des fossiles se limite à illustrer ce qui est 'anatomiquement possible'.

LES DINOSAURES DU MAGHREB Histoire de leur découverte

TAQUET Philippe

Muséum National d'Histoire Naturelle, 8 rue Buffon, 75005, Paris, France. taquet@mnhn.fr

Un siècle de prospections et d'explorations a permis de découvrir en Afrique du Nord de remarquables gisements de Dinosaures et de mettre au jour des faunes spectaculaires et variées enfouies dans les sédiments du Mésozoïque. Les premières observations et publications furent l'œuvre de voyageurs courageux, de naturalistes intrépides ou de militaires motivés. Ils furent suivis par des expéditions scientifiques ayant pour but essentiel la récolte de restes plus complets de ces reptiles fossiles fascinants, les Dinosaures.

Aujourd'hui, par l'abondance, la variété et l'importance de ces gisements de Dinosaures, le Maghreb n'a rien à envier à la richesse paléontologique des Dinosaures d'Amérique du Nord ou d'Asie. La description de nouveaux genres et de nouvelles espèces de Dinosaures découverts ces dernières années dans le Nord de l'Afrique a changé complètement la vision que nous avons de ces grands reptiles mésozoïques, ainsi que la connaissance de leur histoire et de leur répartition géographique.

Depuis la première découverte d'empreintes de Dinosaures dans le Sud algérien en 1880 jusqu'à la récolte la plus récente d'ossements de Dinosaures liasiques dans les montagnes du Haut Atlas marocain, depuis l'exploration des sédiments du Cénomani du désert égyptien jusqu'aux expéditions sur l'incroyable cimetière de Dinosaures du Crétacé inférieur du Niger, de nombreuses localités ont livré des Théropodes, des Sauropodes, des Ornithopodes nouveaux et splendides.

Les gisements des pays d'Afrique du Nord de l'Afrique et spécialement ceux du Maghreb font partie maintenant des plus fameux gisements de Dinosaures connus dans le monde. Leurs faunes contribuent largement à la compréhension de l'évolution de la vie durant le Mésozoïque. La conservation de quelques-



uns des gisements et la présentation des découvertes au public sont un enjeu important pour l'éducation et elles ont aussi des effets positifs sur l'économie de la culture.

Mots clefs/Key words: Dinosaurés ; Mésozoïque ; Maghreb ; Afrique du Nord / Dinosaurs ; Mesozoic ; Maghreb ; North Africa.

THE DINOSAURS OF MAGHREB

History of their discovery

One century of prospections and explorations has allowed to discover in North Africa remarkable dinosaur localities and to excavate spectacular and diverse faunas from the mesozoic outcrops. The first observations and publications were the work of courageous travellers, of intrepid naturalists or of motivated soldiers. They were followed by scientific expeditions with the main purpose of collecting more complete remains of these fascinating fossil reptiles, the dinosaurs.

Today, by the number, the variety and the importance of its dinosaur localities, the Maghreb has nothing to envy the paleontological richness of dinosaurs from North America or Asia. The description of new genera and new species of dinosaurs discovered these last years in the North of Africa completely change the vision we had of these mesozoic reptiles, together with the knowledge of their history and of their geographical distribution.

From the first discovery of dinosaur footprints in the South of Algeria in 1880 to the most recent collect of liassic dinosaur bones in the High Atlas mountains of Morocco, from the exploration of the Cenomanian sediments of the Egyptian desert to the field expeditions on the incredible Lower Cretaceous graveyard of dinosaurs in Niger, numerous localities have yielded splendid and fascinating new Theropods, Sauropods and Ornithopods.

The countries of North-Africa and especially of the Maghreb are now on the first places among the most famous dinosaurs localities in the world. Their faunas contributed greatly to understand the evolution of life during the Mesozoic. The preservation of some fossil localities and the presentation of the discoveries to the public are an important challenge for education and also have positive results for the economy of culture.





PRÉSENTATIONS ORALES : PALÉOZOÏQUE
/
ORAL PRESENTATIONS: PALEOZOIC



Estampe, Natsumi KINEFUCHI ©



LA PALEONTOLOGIE DE L'EPOQUE PERMIENNE. PALEOFLORES "MIXTES" ET TRACES DE VERTEBRES TETRAPODES DU PERMIEN INFERIEUR DU MAROC CENTRAL : PALEO-ENVIRONNEMENT ET PALEOCLIMAT

AASSOUMI H.¹, BROUTIN J.², GAND G.³ & EL WARTITI M.⁴

¹Université Moulay Ismail, Faculté des Sciences et Techniques, Errachidia, h.aassoumi@yahoo.fr ; ²Université P. et M. Curie, Centre de Recherches en Paléobiodiversité et Paléoenvironnements, UMR - CNRS 7207, Bat. Géologie MNHN, 43 rue Buffon 75005 Paris, Jean.Broutin@snv.jussieu.fr ; ³Université de Bourgogne, Biogéosciences, AGPT, 6 Boulevard Gabriel, 21000-Dijon, georges.gand@wanadoo.fr ; ⁴Université Mohammed V, faculté des Sciences, Rabat, wartiti@hotmail.com

Au Maroc, les formations continentales du Permien sont conservées dans des petits bassins tardi-orogéniques. Les dépôts sont rouges à dominance détritique et souvent carbonatée.

Les bassins de Tiddas, Bou Achouch et Khénifra (Maroc central), ont livré des données paléontologiques importantes, en tant qu'outils de corrélation, notamment paléobotanique, palynologique et palichnologique. Les paléoflores abondantes et diversifiées, sont dominées par des Conifères, Ptéridospermes, Cordaïtes et Ginkgophytes, accompagnées de Filicophytes et Sphénophytes. Elles sont contemporaines aux paléoflores du Permien inférieur de l'Europe occidentale.

Des éléments gondwaniens, cathaysiens et angariens ont été trouvés, il s'agit donc d'une flore « mixte ».

Les pélites rouges du bassin de Tiddas ont livré des empreintes de pistes d'Invertébrés, de pas de Vertébrés et gouttes de pluie (El Wartiti et al., 1986 ; Broutin et al., 1987). Les genres *Amphisauroides*, *Gilmoreichnus*, du Permien inférieur du bassin de Thuringe (Allemagne), *Hyloidichnus*, qui est bien connu dans les Formations Hermit (Grand Canyon, Arizona) et Rabejac (Bassin de Lodève, France), ont été récemment ré-interprétés (Hmich et al., 2006).

La présence de végétaux hygrophiles dans les pélites grises et rouges contemporaines, indique un environnement à périodes humides. Ceci est confirmé par la structure d'un bois (Aassoumi & Vozenin-Serra, 1996)

Le bassin de Khénifra, a livré aussi des empreintes de pistes de Vertébrés, attribuées à *Limnopus*, *Dromopus* et *Batrachichnus* (Hmich et al., 2006). Les premiers os de Vertébrés amniotes, bien adaptés à la vie terrestre, ont été découverts (Jalil et al., 2006 ; Hmich et al., 2006). Le même gisement a fourni des végétaux méso-xérophiles et xérophiles adaptés à la sécheresse, indiquant un climat semi-humide. L'unique association sporo-pollinique, à caractère "mixte", provenant de Khénifra indique un âge "Saxonien" à fin Rotliegend (Broutin et al., 1998).

AASSOUMI H. & VOZENIN-SERRA C. 1996. Sur un bois silicifié à moelle conservée du Permien du Bassin de Tiddas (Maroc Central), *Mesopityoxylon tiddasense* gen. nov. Intérêts phylogénétique et paléoclimatique. *Rev. Palaeobot. Palynol.* 94: 57-73

BROUTIN J., EL WARTITI M., FREYTET P., HEYLER D., LAGHRIB M & MOREL, J.L. 1987. Nouvelles découvertes paléontologiques dans le bassin détritico carbonaté permien de Tiddas (Maroc Central). *C. R. Acad. Sci. Paris*, t.305, II: 143-148.

BROUTIN J., AASSOUMI H., EL WARTITI M., FREYTET P., KERP H., QUESADA C. & TOUTIN-MORIN N. 1998. The Permian basins of Tiddas, Bou Achouch and Khenifra (Central Morocco). Biostratigraphic and Palaeophytogeographic implications. in: CRASQUIN-SOLEAU S. & BARRIER E. (eds) Peri-Thetys Memoir 4: Epicratonic Basins of Peri-Tethyan platforms. *Mémoires du Muséum National d'Histoire Naturelle, Paris*, 179: 257-278.

EL WARTITI M., BROUTIN J. & FREYTET P. 1986. Premières découvertes paléontologiques dans les séries rouges carbonatées permien du bassin de Tiddas (Maroc Central). *C. R. Acad. Sci., Paris*, 303: 263-268.

HMICH D., SCHNEIDER J.W., SABER, H. VOIGT S. & EL WARTITI M. 2006. New continental Carboniferous and Permian fauna of Morocco: implications for biostratigraphy, palaeobiogeography and palaeoclimate. in: LUCAS S.G., CASSINIS G. & SCHNEIDER J.W.(eds) 2006. *Non Marine Permian Biostratigraphy and Biochronology*. Geological Society London, Special Publications, 265: 297-324

JALIL N.E., HMICH D., SCHNEIDER J.W, SABER H. & EL WARTITI M. 2006. Sur les plus anciens ossements de vertébrés d'Afrique du Nord (Bassin de Khénifra, Permien inférieur. 5^{ème} réunion du groupe marocain du Permien et du Trias, El Jadida, 26-29 Avril 2006, Maroc.



**RECONSTITUTIONS PALEO GEOGRAPHIQUES FIN PALEOZOÏQUE - DEBUT
MESOZOÏQUE ET DYNAMIQUE SPATIO-TEMPORELLE DU COUVERT VEGETAL DANS
LES BASSINS CONTINENTAUX DU DOMAINE OUEST TETHYSIEN : IMPLICATIONS
GEODYNAMIQUE ET CLIMATIQUE**

BOURQUIN Sylvie¹, BERCOVICI Antoine¹, BROUTIN Jean² & DIEZ José B.³

¹UMR 6118 (CNRS/INSU), Géosciences Rennes, Université de Rennes 1, Campus de Beaulieu, 35042 Rennes Cedex, France ;
²Université Paris 6, UMR 5143 CNRS, Paléobotanique et Paléoécologie / Paléobiodiversité, Systématique, Évolution des Embryophytes, 43 Rue Buffon, 75231 Paris cedex 05, France ; ³Departamento Geociencias Marinas y Ordenación del Territorio, Universidad de Vigo, Campus Lagoas-Marcosende, 36200 Vigo, Pontevedra, Spain

À l'échelle des bassins continentaux du domaine Ouest-Téthysien, une étude détaillée des sédiments attribués au Permo-Trias a permis de caractériser la fin de la sédimentation paléozoïque, la transition Paléozoïque - Mésozoïque et le début de la sédimentation mésozoïque. Dans la majorité des cas, l'absence de marqueur biochronologique du Trias inférieur rend l'attribution au Trias ou au Permien difficile. Ainsi, des caractérisations précises des discontinuités et des indicateurs sédimentaires et paléobotaniques du climat peuvent être des critères de corrélation dans les successions non marines, sans aucun marqueur biostratigraphique, au moins à l'échelle du domaine d'étude.

Dans tous les bassins du domaine nord-ouest téthysien la transition entre le Permien et le Trias est marquée par une discontinuité angulaire, associée à : (1) un fort flux sédimentaire dans certains bassins à la fin du Permien, (2) des périodes d'arrêt de sédimentation marquées par des horizons à paléosols dans d'autres bassins fini Permien, (3) des changements de paléocourants des réseaux fluviaux entre le Permien et le Trias et (4) une période de transit dans les zones continentales au Trias inférieur. Tous ces faits impliquent une période de réactivation des reliefs entre la fin du Paléozoïque et le début du Mésozoïque. De plus, quand la sédimentation est continue entre le Paléozoïque et le Mésozoïque, le climat régional montre le maintien de conditions chaudes et humides. Ainsi, le passage à un climat très aride ne se ferait pas à la transition P-T mais à l'Olénékien supérieur.

PALEOZOIC LOWER VERTEBRATES FROM NORTH-WESTERN GONDWANA

DERYCKE C.^{1,2}, GOUJET D.² & LELIEVRE H.²

¹Université de Lille 1, Géosystèmes (UMR 8157 CNRS), SN5, 59655 Villeneuve d'Ascq cedex, claire.derycke@univ-lille1.fr;

²Muséum national d'Histoire naturelle, (UMR 7207 CNRS), Rue Buffon, 75005 Paris, goujet@mnhn.fr, lelievre@mnhn.fr

North African lower vertebrate remains have been collected from Silurian to Carboniferous beds.

Few Silurian specimens are only reported from Algeria (Fabre, 1976; Blicek, 1982; Blicek et al., 1984).

Devonian remains are more abundant. In Algeria, Chondrichthyans, Placoderms and Acanthodians have been located in Emsian and Famennian levels (Lehman, 1964; Fabre, 1976; Lelièvre, 1988; Lelièvre et al., 1993; Derycke & Goujet, in progress). Chondrichthyan, Actinopterygian and Acanthodian remains have been extracted from Famennian limestones (Gour Bedda, Ginter et al., 2002).

In Morocco, Lower-Middle Devonian levels contain more commonly Placoderms, Acanthodians and Sarcopterygians (Lelièvre, 1995; Campbell et al., 2002) whereas Upper Devonian shows extra Chondrichthyans (Lehman, 1956, 1976, 1977, 1978; Fabre, 1976; Lelièvre & Janvier 1986, 1988; Derycke, 1992; Lelièvre et al., 1993).

Recently, Acanthodian, Placoderm and Chondrichthyan remains were found in Tafilalt (Emsian, Klug et al., 2008; Givetian, Hampe et al., 2004). In Famennian levels, Chondrichthyans, Acanthodians (Ginter et al., 2002), first Chondrichthyans in Maider and Actinopterygians (Derycke et al., 2008) were recorded.

In the Devonian of Fezzan (Libya), Placoderms have been found (Fabre 1976; Lelièvre, in progress). The first Palaeozoic ichthyofauna in Mauritania contains Gnathostomes (Racheboeuf et al., 2001).



Carboniferous mentions concern: scales (Abdala and Reggan Basins, Carboniferous, Namurian); bones (Ajjers Basin, Upper Tournaisian-Viséan), Paleoniscides and Selachians (Carboniferous-Permian), described with Acanthodians remains (Attar et al., 1981) and « fishes » (Taoudenni, Namurian-Westphalian) (Fabre, 1976).

Finally, a Sarcopterygian was found in the Westphalian (Morocco, Janvier et al., 1979).

- ATTAR A., FABRE J., JANVIER P. & LEHMAN J.-P. 1981. Les Vertébrés de la formation de Tiguentourine (Permo-Carbonifère, bassin d'Illizi, Algérie). *Bulletin du Muséum National d'Histoire naturelle, Paris, 4^{ème} série, 3, C, 4*: 301-309.
- BLIECK A. 1982. Les grandes lignes de la biogéographie des Hétérostracés du Silurien supérieur-Dévonien inférieur dans le domaine Nord-Atlantique. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 38: 283-316.
- BLIECK A., GOUJET D., JANVIER P. & LELIEVRE H. 1984. Microrestes de vertébrés du Siluro-Dévonien d'Algérie, de Turquie et de Thaïlande. *Geobios*, 17(6): 851-856.
- DERYCKE C. 1992. Microrestes de Sélaciens et autres Vertébrés du Dévonien supérieur du Maroc. *Bulletin du Muséum National d'Histoire naturelle, Paris, 4^{ème} série, T. 14, Section C, 1*: 15-61.
- DERYCKE C., SPALLETTA C., PERRI M.C. & CORRADINI C. 2008. Famennian chondrichthyan microremains from Morocco and Sardinia. *Journal of Paleontology*, 82(5): 984-995.
- CAMPBELL K.S.W, BARWICK R.E., CHATTERTON B.D.E. & SMITHSON T.R. 2002 A new Middle Devonian dipnoan from Morocco : structure and histology of the dental plates. *Records of the Western Australian Museum*, 21: 167-201
- FABRE J. 1976. Introduction à la géologie du Sahara algérien. *S.N.E.D.*, Alger, 1976: 422p.
- GINTER M., HAIRAPETIAN V., & KLUG C. 2002. Famennian chondrichthyans from the shelves of North Gondwana. *Acta Geologica Polonica* 52(2): 169-215.
- HAMPE O., ABOUSSALAM Z.S. & BECKER R.T. 2004. *Omalodus* teeth (Elasmobranchii: Omalodontida) from the northern Gondwana margin (middle Givetian: *ansatus* conodont Zone, Morocco). in ARRATIA G., WILSON M.V.H. & CLOUTIER R. (eds.): *Recent Advances in the Origin and Early Radiation of Vertebrates*, Verlag Dr. Friedrich Pfeil, München, Germany: 487-504
- JANVIER P., TERMIER H., TERMIER G. & VACHARD D. 1979. The osteolepidiform rhipidistian fish *Megalichthys* in the Lower Carboniferous of Morocco, with remarks on the paleobiogeography of the Upper Devonian and Permo-Carboniferous osteolepidids. *Neues Jahrbuch für Geologie und Paläontologie, Monatshefte*, 1979 (1): 7-14.
- KLUG C., KRÖGER B., KORN D., RÜCKLIN M., SCHEMM-GREGORY M., De BAETS K. & MAPES R.H. 2008. Ecological change during the early Emsian (Devonian) in the Tafilalt (Morocco), the origin of the Ammonoidea, and the first african Pyrgocystid Edrioasteroids, Machaerids and Phyllocarids. *Palaeontographica A*, 283: 83-176.
- LEHMAN J.P. 1956. Les Arthrodières du Dévonien supérieur du Tafilalt (Sud Marocain). *Notes et Mémoires du Service géologique du Maroc*, 129: 1-70.
- LEHMAN J. P. 1964. A propos de quelques Arthrodières et Ichthyodorulites sahariens. *Mémoire IFAN* 68: 193-200.
- LEHMAN J.P. 1976. Nouveaux poissons fossiles du Dévonien du Maroc. *Annales de Paléontologie, Vertébrés*, 62:1-34.
- LEHMAN J.P. 1977. Sur la présence d'un Ostéolépidiforme dans le Dévonien supérieur du Tafilalt. *Compte-Rendus de l'Académie des Sciences, Paris*, 285D: 151-153.
- LEHMAN J.P. 1978. A propos de deux poissons du Famennien du Tafilalt, *Annales de Paléontologie, Vertébrés*, 64: 143-152.
- LELIEVRE H. 1988. Nouveau matériel d'*Antineosteus lehmani* Lelièvre 1984 (Placoderme, Brachythoraci) et d'Acanthodiens du Dévonien inférieur (Emsien) d'Algérie, *Bulletin du Muséum National d'Histoire naturelle, Paris*, 10: 287-302.
- LELIEVRE H. 1995. Description of *Maideria falipoui* n.g., n.sp., a long snouted brachythoracid (Vertebrata, Placodermi, Arthrodira) from the Givetian of Maider (South Morocco), with a phylogenetic analysis of primitive brachythoracids. *Bulletin du Muséum National d'Histoire naturelle, Paris, 4^{ème} série, 17(C) 1-4*: 163-207.
- LELIEVRE H. & JANVIER P. 1986. L'Eusthénoptéridé (Osteichthyes, Sarcopterygii) du Famennien (Dévonien supérieur) du Tafilalt (Maroc) : nouvelle description. *Bulletin du Muséum National d'Histoire naturelle, Paris*, 351-365.
- LELIEVRE H. & JANVIER P. 1988. Un Actinistien (Sarcopterygii, Vertebrata) dans le Dévonien supérieur du Maroc, *Compte-Rendus de l'Académie des Sciences, Paris*, 307: 1425-1430.
- LELIEVRE H., JANVIER P. & BLIECK A. 1993. Silurian-Devonian vertebrate biostratigraphy of Western Gondwana and related terranes (South America, Africa, Armorica-Bohemia, Middle East). in Long J. A. (ed) *Palaeozoic Vertebrate Biostratigraphy and Biogeography*, 7: 139-173.
- RACHEBOEUF P.R., GIRARD C., LETHIERS F., DERYCKE C., HERRERA ZARELA A. & TROMPETTE R. 2001. Evidence for Givetian stage in the Mauritanian Adrar (West Africa): biostratigraphical data and palaeogeographic implications. *Newsletters on Stratigraphy*, 38 (2/3): 141-162.



**ANATOMIE DES DIPLOCAULIDES MAROCAINS (PERMIEN SUPERIEUR DE LA
FORMATION D'ARGANA, MAROC)**

GERMAIN Damien

UMR 7179, CNRS, MNHN, UPMC, Collège de France, équipe « Squelette des Vertébrés », case 19, 2 place Jussieu, F-75005 Paris (France), damien.germain@upmc.fr

Diplocaulus est l'un des plus étranges amphibiens qui ait jamais existé. Sa plus grande caractéristique est sa tête en forme de boomerang qui le rend aisément identifiable. Dutuit (1988) décrit un de ces nectridiens provenant du Permien de la formation d'Argana, au Maroc. Il nomma cette espèce *Diplocaulus minimus* Dutuit 1988. Ces spécimens sont les seuls lépospondyles ayant été trouvés en Afrique, et plus généralement sur le Gondwana, tous les autres ayant été découverts en Amérique du Nord ou en Europe. Il s'agit également des plus récents car ces derniers sont datés du Permien terminal, les autres lépospondyles n'atteignant qu'à peine le Permien moyen.

La redescription de l'anatomie de cet animal ainsi qu'une analyse phylogénétique (Germain, 2008) permettent de le rapprocher du genre américain *Diploceraspis* et de suggérer différents scénarios de dispersion sur le Gondwana à partir d'une souche nord-américaine. L'association faunique de ce gisement est également inédite et conforte les idées sur l'endémisme des faunes continentales lors du Permien.

GERMAIN D. 2008. *Anatomie des lépospondyles et origine des lissamphibiens*. Thèse de Doctorat du Muséum National d'Histoire Naturelle, Paris. 240 pp.

DUTUIT J.-M. 1988. *Diplocaulus minimus* n. sp. (Amphibia: Nectridea), lépospondyle de la formation d'Argana, dans l'Atlas occidental marocain. *Comptes Rendus de l'Académie des Sciences de Paris*, 307: 851-854.

**CLIMATE CHANGE, REGIONAL PROVINCIALISM, AND SHIFTS IN TERRESTRIAL
VERTEBRATE DISTRIBUTIONS ACROSS THE PERMO-CARBONIFEROUS TRANSITION**

HUTTENLOCKER Adam K.¹, PARDO Jason D.², SMALL Bryan J.³ & MILNER Andrew R.⁴

¹Department of Biology, University of Washington, Seattle, Washington, USA; ²Department of Animal Biology, University of Illinois, Champaign-Urbana, Illinois, USA; ³Department of Earth Sciences, Denver Museum of Nature and Science, Denver, Colorado, USA; ⁴Department of Palaeontology, Natural History Museum, London, UK

The Permo-Carboniferous transition was characterized by a shift from global icehouse to hothouse conditions, including increased seasonal aridity in paleoequatorial regions, and an associated, geographically diachronous replacement of 'wet' Pennsylvanian-type floras by conifers and more xeric floras. We tested whether Euramerican vertebrate faunas of the Edaphosaur-Nectridean Province exhibited similar geographic shifts. We assessed four major regional bins for statistically significant fidelity to faunal clusters, relative shifts in alpha and beta diversity, and probability distributions of estivation assemblages as indices of biotic response to aridification. The patterns were examined for over 120 vertebrate localities, arranged along a west-east paleoequatorial transect, over approximately 40 Ma (Moscovian through Kungurian global stages). Cluster analyses revealed greater regional partitioning in the Permian than in the Pennsylvanian and generated a null dichotomy between 'wet' versus 'dry' faunas. So-called 'dry' faunas began to proliferate along a west-east gradient as predicted by earlier authors and were associated with significant changes in beta diversity and estivation behavior. Finally, we consider the relevance of selected records outside our geographic sampling. For example, the 'Euramerican' nectridean *Diplocaulus* occurs in the Ikakern Formation (Argana Group) of Morocco, considered Chickasha-equivalent (Kungurian/Ufimian?) or younger. This possible refugium also includes medium-sized captorhinids (i.e., *Acrodonta*) and large moradisaurines, thus refining our understanding of the Permian vertebrate record of northern Africa and the initial colonization of the Gondwanan Province by Euramerican vertebrates. Increased geographic sampling will shed light on patterns of dispersal and vicariance, and will clarify global variation in community composition during the Permian.



AN ARCHOSAUR-DOMINATED FOOTPRINT ASSEMBLAGE IN PERMO-TRIASSIC RED-BEDS OF MOROCCO AND THE GLOBAL RECORD OF EARLY CHIROTHERIANS

KLEIN H.¹, SABER H.², VOIGT S.³, SCHNEIDER J.³, HMICH D.³ & HMINNA A.²

¹Rübezahlstr. 1, 92318 Neumarkt, Germany, Hendrik.Klein@combyphone.eu; ²Département de Géologie, Université Chouaib Doukkali, BP 20, 24000 El Jadida, Morocco hafidsaber@yahoo.fr; hminna_abdelkbir@yahoo.fr; ³Institut für Geologie, TU Bergakademie Freiberg, B.v.Cotta-Strasse 2, 09596 Freiberg, Germany s.voigt@geo.tu-freiberg.de; schneidj@geo.tu-freiberg.de

Tetrapod footprints were recently described from the Permo-Triassic of the Argana basin near Ierhi, western High Atlas, Morocco (Hmich et al., 2006). Several trackways were identified on the lower surface of a loose block the authors tentatively referred to the Permian Tourbihine Member (T2) of the Ikakern Formation. The Tourbihine Member has yielded skeletal remains of typical Permian vertebrates. The footprints on the loose block, however, were assigned to the ichnogenera *Synaptichnium* (archosaur) and *Rhynchosauroides* (lepidosauromorph/ archosauromorph), which are rather characteristic for Triassic strata.

Recent discoveries of similar footprints on in situ surfaces at the base of the Tanamert Member (T3) of the (?Middle - Late) Triassic Timezgadiouine Formation are used for re-assessment of the stratigraphic position of the isolated block and for ichnotaxonomical comparison with similar forms from the Triassic of central Europe. As a first result, there is a striking congruence between the chirotherians from the Argana basin and *Protochirotherium* from the Early Triassic Detfurth Formation of Germany (Olenekian; Fichter & Kunz, 2004) and a similar morphotype from the Wióry Formation of Poland (?Induan – Olenekian; Ptaszynski, 2000). The imprint morphology of these forms is characterized by long pedal digits IV and V. Their overall similarity gives evidence for a widespread pre-Anisian *Protochirotherium*/*Synaptichnium*-dominated tetrapod ichnofauna that precedes the first appearance of *Chirotherium barthii* near to the Olenekian-Anisian boundary (Klein & Haubold, 2007).

Temporally and morphologically, the conservatively shaped chirotherians we are concerned with herein may reflect the basis and evolutionary origin of later developments in foot-morphology of Triassic archosaurs. The Ierhi footprint assemblage points to an Early Triassic age though we can not exclude that archosaurs which left chirotherian-like footprints might have existed as early as in the Late Permian.

- FICHTER J. & KUNZ R. 2004. New genus and species of chirotheroid tracks in the Detfurth-Formation (Middle Bunter, Lower Triassic) of Central Germany. *Ichnos*, 11: 183-193.
- HMICH D, SCHNEIDER J.W., SABER H., VOIGT S. & EL WARTITI M. 2006. New continental Carboniferous and Permian faunas of Morocco: implications for biostratigraphy, palaeobiogeography and palaeoclimate. *Geological Society London, Special Publications*, 265: 297-324.
- KLEIN H. & HAUBOLD H. 2007. Archosaur footprints – Potential for biochronology of Triassic continental sequences. *New Mexico Museum of Natural History and Science, Bulletin*, 41: 120-130.
- PTASZYNSKI T. 2000. Lower Triassic vertebrate footprints from Wióry, Holy Cross Mountains, Poland. *Acta Palaeontologica Polonica*, 45: 151-194.

NEW PETALICHTHYDS (VERTEBRATA, PLACODERMS) FROM THE GIVETIAN OF MAIDER (MOROCCAN ANTI-ATLAS)

LÉLIEVRE Hervé

Muséum national d'Histoire naturelle – Département Sciences de la Terre, UMR 7207 Muséum-CNRS, Paris.

Petalichthyds are placoderms known from the Lower Devonian up to the Upper Devonian. Their remains have been collected in many localities so that the geographical distribution of petalichthyids can be considered as worldwide. Except in South America, they have been described in at least three continents in North America and Arctic Canada, in Laurasia (Europe and Spitsbergen). On the Gondwana they are known in the Lower Devonian of Australia, (New South Wales, Young, 1978, 1985), in the Middle Devonian of China (Liu, 1973, 1991). In northwestern Gondwana isolated remains have been briefly mentioned in the Emsian of Algeria (Lehman, 1964), and in Saudi Arabia (Lelièvre et al., 1994).



So the occurrence of Petalichthyids in the Lower to Middle Givetian of the Jbel Merakib Maider (Morocco) is new. The remains belong to both skull and thoracic armours and show that at least two different genera were occurring during the Givetian of the Maider Basin. Their remains are associated with other placoderms such as *Maideria falipoui* (Lelièvre, 1995), a large brachythoraci, evoking an eastmanosteid, a probable heterosteid, and *Paleomylus* a ptyctodontid. Remains of the dipnoan, *Dipnotuberculus gnathodus* have been described from the same levels (Campbell et al., 2002), they represent the first record of a dipnoan in the well-known Devonian of Morocco.

- CAMPBELL K.S.W, BARWICK R.E., CHATTERTON B.D.E. & SMITHSON T.R. 2002 A new Middle Devonian dipnoan from Morocco: structure and histology of the dental plates. *Records of the Western Australian Museum*, 21: 167-201
- LEHMAN J-P. 1961. A propos de quelques arthrodières et Ichthyodorulites sahariens. Extrait de Mélanges ichthyologiques. *Mémoire IFAN* n°68: 193-200.
- LELIÈVRE H. 1995. *Maideria falipoui* n.g., n.sp. a new long snouted brachythoracid (Vertebrata, Placodermi) from the Givetian of Maider (South Morocco), with a phylogenetic analysis of primitive brachythoracids. in ARSENAULT M., LELIÈVRE H. & JANVIER Ph. (eds.), 7^{ème} Symposium international "Étude des vertébrés inférieurs", Miguasha, Québec. *Bulletin du Muséum national d'Histoire naturelle. Paris, 4^e sér., 17, section C:1-2*: 163-207.
- LELIEVRE H., JANJOU D., HALAWANI M., JANVIER P., AI MUALLEM M., WYNNS R. & ROBELIN C. 1994. Nouveaux Vertébrés de la Formation de Jauf (Dévonien inférieur, région de Al Huj, Arabie Saoudite). *Comptes Rendus de l'Académie des Sciences, Paris*, t.319, série II: 1247-1254.
- LIU Y.H. 1973. On new forms of Polybranchiaspiformes and Petalichthyida from the Devonian of South East China. *Vertebrata Palasiatica* 11(2): 132-143. (in Chinese).
- LIU Y.H. 1991. A new petalichthyid, *Eurycaraspis incilis* gen et sp. nov. (Placodermi, Pisces) from the Middle Devonian of Zhanyi, Yunnan. in CHANG M.M., LIU Y.H. & YHANG G.R. (eds): *Early vertebrates and related problems of evolutionary biology*, Science Press, Beijing: 137-177.
- YOUNG G.C. 1978. A new Early Devonian petalichthyid fish from the Taemas/Wee Jasper region of New South Wales. *Alcheringa* 2: 103-116.
- YOUNG G.C. 1985. Further petalichthyid remains (placoderm fishes, early Devonian) from the Taemas-Wee Jasper région, New South Wales. *BMR Journal of Australian Geology and Geophysics*, 9: 121-131.

PALAEOBIOGEOGRAPHY OF THE DEVONIAN ICHTHYOFAUNA FROM SOUTHERN MOROCCO

RÜCKLIN Martin

Department of Earth Sciences, University of Bristol, Wills Memorial Building, Queen's Road, Bristol BS8 1RJ, United Kingdom;
M.Ruecklin@bristol.ac.uk

The Lower Devonian of Morocco is dominated by acanthodians (*Machaeracanthus*), and placoderms (*Antineosteus* and *Atlantidosteus*). *Machaeracanthus* is a typical faunal element for Gondwana and Armorica, a terrane of Gondwana. *Atlantidosteus* is described from Morocco and Australia and close phylogenetic relationships to the Australian genera *Goodradigbeeon* and *Taemasosteus* are hypothesized. Thus this assemblage and its distribution show a clear Gondwanan affinity in the Emsian.

A new placoderm assemblage from the late Frasnian of Morocco shows close similarity to that from the Bad Wildungen locality in Germany, with the arthrodière taxa *Enseosteus*, *Rhinosteus*, *Walterosteus*, *Brachydeirus*, *Oxyosteus*, *Brachyosteus*, *Erromenosteus* and *Aspidichthys* in common. Southern Morocco was located on the northern shelf of Gondwana and Bad Wildungen on the southern shelf of Laurussia during the Upper Devonian. The analysis of late Frasnian localities conflicts with the palaeogeographical model from palaeomagnetic data indicating a large ocean separating both continents. No palaeobiogeographic barrier to the placoderms was present between these continents, supporting an alternative hypothesis, based on palaeontological data, of a small and shallow ocean separating Gondwana and Laurussia and a connection in the Late Devonian.

The Famennian of Morocco is dominated by large arthrodières like *Dunkleosteus*, *Titanichthys* and *Tafilichthys*. The distribution of *Dunkleosteus* and *Titanichthys* in northern America, Morocco and Poland speaks for a close relationship of these localities and probably a connection of Gondwana and Laurussia in the Famennian, limiting the dispersal to eastern Gondwana, probably already established in the late Frasnian.



VERTEBRATE FAUNA OF THE UPPER PERMIAN MORADI FORMATION OF NIGER

SIDOR Christian A.¹, STEYER Sebastien², SMITH Roger M.H.³ & TABOR Neil J.⁴

¹Department of Biology, University of Washington, Seattle, WA, USA, casidor@u.washington.edu; ²Muséum national d'Histoire naturelle, Paris, France; ³Karoo Palaeontology, South African Museum, Cape Town, South Africa; ⁴Department of Earth Sciences, Southern Methodist University, Dallas, TX, USA.

The Middle-to-Upper Permian rocks of South Africa's Beaufort Group provide detailed baseline regarding the composition of end-Paleozoic terrestrial ecosystems at high southern paleo-latitudes. Aspects of the Karoo vertebrate fauna can be traced, however, to coeval Gondwanan rocks at lower paleo-latitude (e.g., in India, Tanzania, Zambia) as well as into the Northern Hemisphere (e.g., Russia, Laos). The broad geographic distribution of several genera has been considered compelling evidence for the unrestricted dispersal of tetrapods across a coalesced Pangean landscape. Recent work in the Upper Permian Moradi Formation of northern Niger has yielded a vertebrate fauna that is strikingly different from those known elsewhere on Africa. In contrast to the broadly distributed fauna known elsewhere, (1) Moradi tetrapods are endemic, and (2) the taxonomic composition of the fauna is unlike that of any other Upper Permian fauna. Abundant captorhinid and pareiasaur reptile remains have been recovered, in addition to two temnospondyl genera that are most closely related to Permo-Carboniferous forms from Euramerica. Most surprisingly, dicynodonts have yet to be discovered in the Moradi Formation, and therapsids are represented by only two fossils of gorgonopsians. Based on their faunal similarity, we suggest that the Moradi Formation of Niger and the Ikakern Formation of Morocco together represent a distinct tetrapod province, likely united by the desert-like conditions prevailing in central (low-latitude) Pangea at the close of the Paleozoic Era.

SEDIMENTOLOGY AND VERTEBRATE TAPHONOMY OF MORADI FORMATION (UPPER PERMIAN), NORTHERN NIGER

SMITH Roger M.H.¹, SIDOR Christian A.², TABOR Neil J.³ & STEYER J.-Sébastien⁴

¹Karoo Palaeontology, Iziko South African Museum, Cape Town, South Africa, rsmith@iziko.org.za; ²Department of Biology University of Washington, Seattle, Washington, USA.; ³Department of Earth Sciences, Southern Methodist University, Dallas TX, U.S.A.; ⁴CNRS-MNHN, Paris, France.

The Upper Permian Moradi Formation of northern Niger accumulated under subequatorial continental conditions approximately 10° south of the paleoequator in central Pangea. The basin lies within a 5000 km wide "corridor" between Gondwana and Laurasia. Recent field investigations have confirmed that climate was warm arid with seasonal monsoonal rainfall and possibly as a result of these unique physio-climatic conditions the tetrapod fauna shows a high degree of endemism.

Vertebrate fossils commonly occur in rubified fluvial deposits characterized by wide shallow anastomosing channels conformably filled with a conglomerate of reworked pedogenic carbonate nodules, rhizocretions, and claystone clods overlain by massive sandy siltstone. At Ibadanane, 20km west of Arlit, an area measuring 280 x 50 m was found to contain at least 15 concentrations of scattered bones comprising ribs, vertebrae and long bones of pareiasaurians. Preliminary quarrying revealed scattered, but still associated, skeletons of *Bunostegos* as well as amphibians such as *Nigerpeton* and the captorhinid *Moradisaurus*. The preliminary interpretation of the depositional setting of the pareiasaur "cemetery" site is of a distal alluvial fan where ephemeral flash-flood streams swept across a silt-dominated loessic plain, scouring through the sparsely vegetated soils to the more resistant calcrete horizons, reworking previously buried bones and burying desiccated drought-stricken cadavers.

Localized depressions filled with brecciated limestone overlain by finely-laminated calcic siltstone are interpreted as end-point playa deposits. They clearly demonstrate that this "wet desert" hosted standing water bodies and preserve a range of insect, arthropod, amphibian and reptile tracks not previously recorded from the Moradi Formation.



GEOCHEMISTRY AND SEDIMENTOLOGY OF THE UPPER PERMIAN MORADI FORMATION (NIGER) INDICATES SEVERELY DRY AND LOW-PRODUCTIVITY PERMIAN ECOSYSTEMS

TABOR Neil J.¹, SMITH Roger M.H.², SIDOR Christian A.³ & STEYER Jean Sebastien⁴

¹Department of Earth Sciences, Southern Methodist University, Dallas TX, U.S.A., ntabor@smu.edu; ²Karoo Palaeontology, South African Museum, Cape Town, South Africa; ³Department of Biology, University of Washington, Seattle, WA, USA; ⁴Muséum national d'Histoire naturelle, Paris, France

Little is known about Permo-Carboniferous paleoenvironments and paleoclimate between ~15° and ~45° in the northern and southern hemispheres compared to other parts of Pangean Paleogeography. This reflects, in large part, a lack of exposures from this time and paleogeographic position. We document environmentally-sensitive lithologies and geochemical proxies of paleoclimate from the Moradi Formation of Niger, which occupied a position near 20°S latitude during Middle and Late Permian time. Both alluvial- and soil-derived lithologies delineate numerous sedimentological and pedological processes, including “flashy” streams, ephemeral ponds, periodic shrink-swell of soil profiles and accumulation of soil carbonate, gypsum, and silica.

$\delta^{13}\text{C}$ values (n=50) of micritic calcite from paleosol nodules collected through the Moradi Formation strata range from -5.5 to -1.8‰ (avg. = 3.6±0.8‰), whereas organic matter $\delta^{13}\text{C}$ values (n=7) of co-existing organic matter occluded within carbonate nodules range from -21 to -24.5‰ (avg. = -23.4±1.1‰). The per mil difference (~20‰) between calcite and co-existing organic matter ($\delta_{\text{cc-om}}$) is among the largest of such values yet measured from the Permian, and it corresponds to an extremely low productivity soil.

Based upon modern environmental conditions associated with analogous sediments and soils, as well stable carbon isotope values of paleosol calcite and co-existing organic matter, the Moradi Formation was deposited in a continental basin on wide alluvial plains under a warm, arid climate characterized by strongly seasonal precipitation which, at times, was less than <<300 mm/yr. These results support the hypothesis that Permian endemic faunas of North Africa may have been isolated through extreme aridity.

THE PHYLOGENY AND BIOGEOGRAPHY OF PAREIASAURIDAE: NEW DISCOVERIES, NEW INSIGHTS

TSUJI Linda A.¹ & MÜLLER Johannes²

^{1,2}Museum für Naturkunde, Invalidenstrasse 43, D-10115 Berlin, Germany, ¹linda.tsuji@museum.hu-berlin.de, ²johannes.mueller@museum.hu-berlin.de

Despite their distinctive appearance and seeming ubiquity in the Middle and Late Permian, pareiasaurs are surprisingly poorly known, and only recently has progress been made in the revision of their taxonomy and evolutionary relationships. Knowledge of pareiasaurian anatomy and systematics is derived primarily from the Middle and Late Permian faunas of South Africa and Russia, where they are the most common and taxonomically diverse. However, pareiasaurs are widely distributed, and their fossils have also been found in the Permian of China, Brazil, and Western Europe. In addition, new taxa have recently been described, including *Obirkovia gladiator* from Russia, and two new taxa - *Arganaceras vacanti* and *Bunostegos akokanensis* - from Northern Africa.

The North African pareiasaurs are of particular interest not only because they provide new information about pareiasaurian anatomy, but also because these deposits preserve faunas from Permian equatorial regions. These low latitude taxa contrast with the high latitude forms that comprise the majority of known pareiasaurs, and they contribute significant information about possible origination and migration patterns within Pareiasauridae. Given the most recent evaluation of pareiasaurian interrelationships, there appears to have been relatively frequent faunal interchange between the southern high latitude South African Karoo and the northern high latitude deposits of Eastern Europe during the Permian. The North African low latitude pareiasaurs, at a geographical midpoint between the two better-known faunas, add



further complexity to biostratigraphical studies, with members being both among the most basal as well as the most derived forms.

LARGE IMPRINTS OF *HYLOIDICHNUS* GILMORE, 1927 FROM THE PERMIAN OF MOROCCO IN THE LIGHT OF CAPTORHINID PHYLOGENY AND BIOGEOGRAPHY

VOIGT S.¹, SABER H.², SCHNEIDER J.W.S.¹, HMINNA A.², HMICH D.² & KLEIN H.³

¹Geological Institute, TU Bergakademie Freiberg, B.-v.-Cotta-Str. 2, 09596 Freiberg, Germany, s.voigt@geo.tu-freiberg.de, schneidj@geo.tu-freiberg.de; ²Department of Geology, Chouaib Doukkali University, B.P. 20, 24000 El Jadida, Morocco, hafidsaber@yahoo.fr, hminna_abdelkbir@yahoo.fr; ³Rübezahlstrasse 1, 92318 Neumarkt, Germany; hendrik.klein@combyphone.eu

The Late Palaeozoic captorhinids represent one of the most diverse clades of basal terrestrial amniotes. They appeared during the Late Carboniferous in the palaeo-equatorial regions of North America and became an abundant and widely distributed element of Permian continental ecosystems.

Captorhinids are candidate trackmakers of fossil footprints assigned to *Varanopus* Moodie, 1929 and *Hyloidichnus* Gilmore, 1927. Both ichnotaxa are morphologically similar but differ with respect to the first appearance date and maximum size of referred imprints: The small tracks of *Varanopus* have been recorded from deposits as old as the Permian- Carboniferous boundary, whereas *Hyloidichnus* with significantly larger tracks first appears in strata of late Early Permian age. Comparison of the body and ichnofossil record by various aspects including morphology, phylogeny, stratigraphy, and biogeography, supports the assumption that *Varanopus* represents footprints of small to medium-sized early captorhinids, whereas *Hyloidichnus* can be most likely referred to large captorhinids of the Moradisaurinae clade. Consequently, skeletal remains and vertebrate tracks independently confirm a striking increase of body size in some derived captorhinids during the late Early Permian.

During the 1970s remains of a small non-moradisaurine and a large moradisaurine captorhinid have been described from the top of the Permian Ikakern Formation of the Argana Basin, Western High Atlas Mountains, Morocco. In spring 2008 exceptionally large tetrapod footprints of the ichnogenus *Hyloidichnus* were discovered in the same stratigraphic level. Because this is the first co-occurrence of moradisaurine skeletal remains and *Hyloidichnus* tracks, the Ikakern Formation possibly has a pivotal role for further studies on the evolutionary history of captorhinids.

NEW OBSERVATIONS ON THE SQUAMATION PATTERNS OF ARTICULATED EXOSKELETONS OF *LOGANELLIA SCOTICA* (VERTEBRATA: THELODONTI) FROM THE LOWER SILURIAN OF SCOTLAND

ŽIGAITĖ Živilė^{1,2} & GOUJET Daniel³

¹Department of Geology and Mineralogy, Vilnius University, M.K. Čiurlionio 21/27, LT-03101 Vilnius, Lithuania; Zivile.Zigaite@gf.vu.lt; ²University of Lille – 1, CNRS UMR 8157 «Géosystèmes», Team of Palaeozoic Palaeontology and Palaeogeography, 59655 Villeneuve d'Ascq cedex, France; ³Muséum national d'Histoire naturelle, CNRS UMR 5143, Département Histoire de la Terre, Laboratoire de Paléontologie, 8, rue Buffon, 75005 Paris, France; goujet@mnhn.fr

Articulated squamations of *Loganellia scotica* (Traquair, 1898) from the Lower Silurian Lesmahagow inliers of southern Scotland have been studied. They include seven articulated specimens, three of them representing complete thelodont fossils, and four partially preserved postpectoral, precaudal and caudal parts of the exoskeleton. All the five main types of thelodont squamation, that is rostral, cephalo-pectoral, postpectoral, precaudal, and pinnal, have been observed within the articulated squamations of the specimens. The specific squamations of orbital, branchial, and bucco-pharyngeal areas, characteristic of *L. scotica*, have not been observed due to the poor or non-preservation of these particular areas within the specimens studied. Tail morphology and squamation patterns of the caudal fin have been studied in particular details; the constitution of the caudal fin rays squamation has been defined. The rostral squamation is argued to be characteristic to *L. scotica*.

Key words: dentine, rostral scales, articulated squamation, thelodonts, early vertebrates



PRESENTATIONS ORALES : MESOZOÏQUE
/
ORAL PRESENTATIONS: MESOZOIC



Estampe, Natsumi KINEFUCHI ©



THE MARINE VERTEBRATE FAUNAL SUCCESSION (SELACHIANS, ACTINOPTERYGIANS AND MARINE REPTILES) FROM THE MAASTRICHTIAN PHOSPHATE DEPOSITS OF BENGUERIR (GANNTOUR BASIN, MOROCCO)

ADNET Sylvain¹, CAPPETTA Henri¹, BARDET Nathalie², PEREDA SUBERBIOLA Xabier³, AKKRIM Driss⁴, AMALIK Mohamed⁴ & BENABDALLAH Aziza⁵

¹UMR 5554 du CNRS, Institut des Sciences de l'Evolution, Université Montpellier II, Cc 064, place Eugène Bataillon, 34095 Montpellier cedex 5, France, sylvain.adnet@univ-montp2.fr, henri.cappetta@univ-montp2.fr; ²UMR 7207 du CNRS, Département Histoire de la Terre, MNHN, CP 38, 8 rue Buffon, 75005 Paris, France, bardet@mnhn.fr; ³Departamento Estratigrafía y Paleontología, Facultad de Ciencia y Tecnología, Universidad del País Vasco / EHU, Apto. 64, 48080 BILBAO, Espagne, xabier.pereda@ehu.es; ⁴Office Chérifien des Phosphates, Centre Minier de BenGuerir, Ben Guérir, Maroc; ⁵Ministère de l'Energie, des Mines, de l'Eau et de l'Environnement, Quartier Agdal, Rabat, Maroc.

The phosphates of Morocco (Maastrichtian-lowermost Lutetian) form part of the Mediterranean /western Atlantic Tethyan phosphogenic province. They are exploited in several basins, the most important being the Oulad Abdoun and the Ganntour basins.

Among the BenGuerir series, located East of the Ganntour Basin, Maastrichtian deposits consist of about 20 meters of phosphates displaying an alternance of soft phosphate levels numbered from basement "Couche 6" (C6) to top "Couche 2" (C2) and *Sillon X* (SX), marly horizons and hard phosphatic limestones.

Maastrichtian fossil teeth are numerous in the phosphatic deposits and concern essentially selachians, actinopterygians and reptiles.

The selachians are currently represented by 60 species belonging to 29 genera and 7 orders. Among them, the genus *Squalicorax* is one of the most interesting concerning fine biostratigraphy and correlations with other phosphate basins because of important proportion changes noted between the 5 species recovered from base (e.g. occurrence of *S. africanus*) to top (e.g. strong representation of *S. pristodontus*) of the Maastrichtian series.

The marine reptiles include mainly squamates but also scarcer plesiosaurs, chelonians and crocodylians, representing about 12 taxa. The mosasaurid squamates are the most abundant and diversified with several species ranging all along the series.

The actinopterygians include mainly teleosts (Enchodontidae, Dercetidae, Eotrigonodontidae and Phylloodontidae) but also pycnodonts, also common in all levels and representing at least 7 taxa.

An exhaustive list of the BenGuerir vertebrate faunas with their biostratigraphical distribution is provided. Their importance for biochronological purposes and correlations with other Maastrichtian phosphate deposits worldwide is discussed.

FIRST REVISION OF THE THEROPOD FROM THE TOARCICAN OF WAZZANT (HIGH ATLAS MOUNTAINS, MOROCCO): THE OLDEST KNOWN TETANURAE?

ALLAIN Ronan & BAILLEUL Alida

Muséum National d'Histoire Naturelle, Département Histoire de la Terre, CR2P, UMR 7207 du CNRS, Case Postale 38, 57 rue Cuvier, F-75231 Paris cedex 05, France. rallain@mnhn.fr

Tetanurae, the largest clade of carnivorous dinosaurs, first appear in the fossil record around the Middle Jurassic where they are already diversified. Indeed, Coelurosauria and Spinosauroida have been reported from various European, Bajocian and Bathonian localities. Numerous Early Jurassic taxa have been tentatively referred to Tetanurae, but their phylogenetic position has never been carefully tested, or they have been proved to be non-tetanuran theropods. Among these taxa is the small theropod from the Toarcian Wazzant Formation, in the Moroccan High Atlas Mountains. The remains of this theropod were discovered by Jacques and Catherine Jenny, Alain Lemarrec and Philippe Taquet and briefly described in 1980. Part of the material was figured in 1984, and referred to Coelurosauria, but it has never been reviewed since that time, although it could belong to the oldest Coelurosauria and/or Tetanurae.



The figured material (a complete articulated left foot including the astragalus and the distal tarsal III) and some other bones (a dorsal vertebra, femurs, tibiae, fibulae) are described here in details. At least three different individuals have been collected in Wazzant: two adults and a newly hatched juvenile. The other remains are still embedded in the hard sandstone matrix and are under preparation, a process which is going to take a long time. The phylogenetic position of the Wazzant theropod has been evaluated by means of cladistic analyses based to a large extent on two recent phylogenies (Allain et al., 2007; Smith et al., 2008). In both cases the Wazzant theropod is found to be the most basal tetanuran taxon and therefore the oldest known Tetanurae. This result is consistent with the major faunal turnover recorded at the end of the Early Jurassic (Allain & Aquesbi, 2008).

- ALLAIN R. & AQUESBI N. 2008. Anatomy and phylogenetic relationships of Tazoudasaurus naimi (Dinosauria, Sauropoda) from the late Early Jurassic of Morocco. *Geodiversitas*, 30(2): 345-424.
- ALLAIN R., TYKOSKI R., AQUESBI N., JALIL N.-E., MONBARON M., RUSSELL D. & TAQUET P. 2007. An abelisauroid (Dinosauria: Theropoda) from the Early Jurassic of the High Atlas Mountains, Morocco, and the radiation of ceratosaurs. *Journal of Vertebrate Paleontology*, 27(3): 610-624.
- JENNY J., JENNY-DESHUSSES C., MARREC A.L. & TAQUET P. 1980. Discovery of Dinosaur Bones in Lower Jurassic Sediments (Toarcian) of Central High Atlas, (Morocco). *Comptes Rendus Hebdomadaires Des Seances De L Academie Des Sciences Serie D*, 290(13): 839-842.
- SMITH N.D., MAKOVICKY P.J., AGNOLIN F.L., EZCURRA M.D., PAIS D.F. & SALISBURY S.W. 2008. A Megaraptor-like theropod (Dinosauria: Tetanurae) in Australia: support for faunal exchange across eastern and western Gondwana in the Mid-Cretaceous. *Proceedings of the Royal Society B-Biological Sciences*, 275(1647): 2085-2093.
- TAQUET, P. 1984. Two new Jurassic specimens of Coelurosaurs (Dinosauria). in HECHT M.K., OSTROM J.H., VIOHL G. & WELLNHOFER P. (eds) *The beginnings of birds*. Freunde des Jura-Museums Eichstätt, Eichstätt: 229-232

NEW DATA ON ARARIPESUCHUS WEGNERI (MESOEUCROCODYLIA, NOTOSUCHIA)

ANDRADE Marco Brandalise de

Department of Earth Sciences, University of Bristol, Wills Memorial Building, Queens Road, Bristol, UK, BS8 1RJ
marcobranda@yahoo.com.br

The small-sized *Araripesuchus wegneri* Buffetaut 1981, known from a single specimen (MNHN GDF-700), is a fossil crocodylian from the Aptian (Middle Cretaceous) of Tegama Basin (Elrhaz Fm). The fossil material, limited to rostrum and mandibles, was found at Gadoufaoua (Agadez, Niger). Despite its mention in a number of works, the specimen still lacks a detailed description. A reappraisal of the type specimen allowed the identification of new data on the maxilla, dentition and ectopterygoid, shared exclusively with *A. gomesii*. Other members of the genus are known from Argentina (*A. patagonicus*, *A. buitreaensis*) and Madagascar (*A. tsangatsangana*). The observations contrast with the prevalent phylogenetic position in the literature, where *A. wegneri* is depicted as the most basal member of its clade. Results show that character conflict comes from: (i) lack of information on other species of *Araripesuchus*, and (ii) the prevalence of young over mature specimens in the genus. The specific morphology of the ornamentation was used to access the ontogenetic stage of the holotype, showing that although GDF-700 is a small individual, it was not an immature. The morphology of rostrum, choanae and the ectopterygoid suggests that *Araripesuchus* (and possibly *Uruguaysuchus*) are more closely related to peirosaurids than to notosuchids, supporting previous phylogenetic works. Nevertheless, the pattern of dentition shows convergence with Upper Cretaceous notosuchians from South America. The phylogenetic relationships of *Araripesuchus* constitute important data, since they support particular models of paleobiogeography.



THE HIGHLY UNUSUAL SKULL OF THE DRYOLESTOID MAMMALS: KEYS FROM THE SOUTHERN PART OF THE ATLANTIC

APESTEGUÍA Sebastián¹, GAETANO Leandro² & ROUGIER Guillermo³

¹Área de Paleontología, Fundación de Historia Natural “Félix de Azara”, CEBBAD, Univ. Maimónides, Buenos Aires, Argentina, sebapestequia@gmail.com. ²Laboratorio de Paleontología, FCEyN, UBA, Ciudad Universitaria, Buenos Aires, Argentina, leandrogaetano@gmail.com. ³Department of Anatomical Sciences and Neurobiology, Health Science Center, 500 S. Preston, Louisville, KY 40202, USA, grougier@louisville.edu

Dryolestoids are relatively small mammals mainly known from Upper Jurassic-Lower Cretaceous rocks of the northern hemisphere, represented mostly by relatively abundant isolated teeth and occasional fragmentary lower jaws or partial skeletons. In the southern continents, dryolestoids are important in the Early Cretaceous of Morocco and latest Cretaceous and Early Paleocene strata of South America. The Campanian-Maastrichtian mammalian fauna from Patagonian is dryolestoid-dominated, with in addition ferugliotheriids, and gondwanatherians. The abundant Laurasian and Gondwanan dental record is in sharp contrast with the poor skull and postcranial knowledge. Recently, the early Late Cretaceous fluvial rocks of La Buitrera (Candeleros Fm, Cenomanian-Coniacian), Argentina, have provided a rich assemblage of small to mid-sized tetrapods including dinosaurs, crocodiles, turtles, sphenodontians, lizards, limbed snakes and mammals. Among the latter, dryolestoids are the most abundant, particularly a long snouted taxon with a rounded palate, surprisingly similar to zalambdalestid eutherians, or the living elephant shrew in superficial traits. Additionally, this taxon presents impressive miniature saber-tooth canines suggesting it was a very specialized mammal, for which no other similar model exists. It is probably part of a Gondwanan dryolestoid lineage that ultimately originated the latest Cretaceous and Paleocene South American forms. This new form is represented by several specimens including four partial skulls that retain a generalized plesiomorphic pattern of braincase organization. The new well preserved specimens will play a key role in the further understanding of dryolestoid diversity, evolution and paleobiogeography.

NOT JUST A PRETTY FACE: ANATOMICAL PECULIARITIES IN THE POSTCRANIUM OF REBBACHISAURIDS (SAUROPODA: DIPLODOCOIDEA) BASED ON SOUTH AMERICAN FORMS

APESTEGUÍA Sebastián¹, GALLINA Pablo Ariel¹ & HALUZA Alejandro²

¹Área de Paleontología, Fundación de Historia Natural “Félix de Azara”, CEBBAD, Univ. Maimónides, Buenos Aires, Argentina, sebapestequia@gmail.com; pablogallina@gmail.com; ²Área Laboratorio e Investigación, Museo Municipal Ernesto Bachmann, Villa El Chocón, Neuquén, Argentina, jujuyaspis@yahoo.com

Rebbachisauridae are poorly known “bizarre” sauropods with only two nearly complete skeletons collected: *Limaysaurus tessonei* from Patagonia and *Nigersaurus taqueti* from Niger. Whereas the later taxon allowed the understanding of their cranial novelties, South American species show some peculiarities in the postcranium. *Limaysaurus tessonei*, *Cathartesaura anaerobica* and a new form (MMCH-Pv-49) from Villa El Chocón, exhibit peculiar pectoral girdles and the loss of the hyposphene-hypantrum accessory articulations in their amphiplathian dorsal vertebrae. Actually, the postzygapophyses are not only devoid of hyposphenal locks but additionally show a curved postzygapophyseal eave that allows a slicing over the corresponding structure in the prezygapophysis, a curved concave and elongated platform continuous along both prezygapophyses: the prezygapophyseal shelf. In the same way that the acquiring of “ball and socket” opisthoceolous centra in macronarians optimized the mobility (controlled by bifid hyposphenes in basal forms), the “U-eave and shelf complex” of rebbachisaurids permitted an increased flexibility between successive vertebrae along the axial skeleton. Upper Cretaceous sauropods acquired more flexible vertebral columns along different paths. However, while in titanosaurs the increased mobility occurred related to the centrum shape, in rebbachisaurids responded as a complex system in the neural arch. Furthermore, whereas macronarians show large centra, rebbachisaurids underwent a minimization of the centrum changing the larger articular structure between vertebrae from ventral to dorsal respect to the



neural canal. These changes in both sauropod lineages probably had an outstanding relevance in the diversity and ecological roles that sauropods underwent in Cretaceous terrestrial ecosystems.

REPTILIAN FAUNAS FROM THE PHOSPHATES (MAASTRICHTIAN-LUTETIAN) OF MOROCCO: FROM ARAMBOURG TO PRESENT TIME

BARDET Nathalie¹, PEREDA SUBERBIOLA Xabier², JOUVE Stéphane¹, VINCENT Peggy¹, JALIL Nour-Eddine³, BOUYA Baâdi⁴ & AMAGHZAZ Mbarek⁴

¹CNRS UMR 7207, Dépt. HDT, MNHN, 8 rue Buffon, 75005 Paris, bardet@mnhn.fr, pvincent@mnhn.fr, jouvestephane@yahoo.fr; ²Depto. Estratigrafía y Paleontología, Facultad de Ciencia y Tecnología, Universidad del País Vasco / EHU, Apto. 64, 48080 Bilbao, xabier.pereda@ehu.es; Laboratoire « Biodiversité & Dynamique des Ecosystèmes », Dépts. Géologie et Biologie, Faculté des Sciences Semlalia, Université Cadi Ayyad, Marrakech, Maroc, [njilil@ucam.ac.ma](mailto:njalil@ucam.ac.ma); ⁴Office Chérifien des Phosphates, Centre Minier de Khouribga, Khourigba, b.bouya@ocpgroup.ma, m.amaghazaz@ocpgroup.ma.

The vertebrate faunas from the phosphates of Morocco are known since the pioneer work of Arambourg (1952). In spite of their exceptional richness in vertebrate fossils, few studies have been published since that time, except for selachians (i.e. Cappetta, 1987; Noubhani & Cappetta, 1997). In the last ten years, an official French-Moroccan scientific program has permitted large-scale fieldworks in the Oulad Abdoun and Ganntour basins. These resulted in the discovery of abundant remains belonging to marine and continental vertebrates, including selachians, bony fishes, “reptiles”, birds, and mammals, ranging in age from Maastrichtian to Ypresian (Jalil et al., 2006).

With regard to the reptiles, several major clades are represented: squamates (mosasaurids and *incertae sedis* varanoids, palaeophid snakes), crocodyliforms (gavialoid and crocodylid eusuchians, dyrosaurids), chelonians (bothremydid pleurodirans and chelonioid cryptodirans), plesiosaurs (elasmosaurid plesiosauroids), dinosaurs (abelisauroid theropods and titanosauriform sauropods) and pterosaurs (azhdarchid pterodactyloids). Mosasaurids, crocodyliforms and chelonians are the most diversified groups, whereas plesiosaurs and especially pterosaurs and dinosaurs are less abundant.

Only the squamate faunas were well known by Arambourg (mainly based on isolated remains) and few new taxa have been described since, though systematic rearrangements have been proposed (Bardet et al., 2008). Most of the Early Palaeogene crocodyliform taxa have been described recently (see Jouve et al., 2008). The Maastrichtian-Ypresian chelonians, the latest Cretaceous pterosaurs and dinosaurs were unknown at Arambourg’s time, as were the Early Palaeogene marine birds and continental mammals (Gheerbrant et al., 2003; Pereda Suberbiola et al., 2004; Gaffney et al., 2006; Bourdon et al., 2008).

- ARAMBOURG C. 1952. Les vertébrés fossiles des gisements de phosphates (Maroc-Algérie-Tunisie). *Notes et Mémoires du Service Géologique du Maroc*, 92: 1-372.
- BARDET N., PEREDA SUBERBIOLA X., SCHULP A. & BOUYA B. 2008. New material of *Carinodens* (Squamata, Mosasauridae) from the Maastrichtian (Late Cretaceous) Phosphates of Morocco. *Bulletin of the Fort Hays State University*, Special Issue 3: 29–36.
- BOURDON E., AMAGHZAZ M. & BOUYA B. 2008. A new seabird (Aves, cf. Phaethontidae) from the Lower Eocene phosphates of Morocco. *Geobios*, 41: 455–459.
- CAPPETTA H. 1987. Mesozoic and Cenozoic Elasmobranchii, Chondrichthyes. in Schultze, H.-P. (ed.), *Handbook of Paleoichthyology*, Vol. 3b. G.Fischer (Stuttgart, New York), 193 pp.
- GAFFNEY E.S., TONG H. & MEYLAN P.A. 2006. Evolution of the side-necked turtles: the families Bothremyidae, Euraxemydidae, Andaripemydidae. *Bulletin of the American Museum of Natural History*, 300: 1-698.
- GHEERBRANT E., SUDRE J., CAPPETTA H., MOURER-CHAUVIRÉ C., BOURDON E., IAROCHÈNE M., AMAGHZAZ M. & BOUYA B. 2003. Les localités à mammifères des carrières de Grand Daoui, Bassin des Ouled Abdoun, Maroc, Yprésien: premier état des lieux. *Bulletin de la Société Géologique de France*, 174: 279–93.
- JALIL N.-E., BARDET N., BOURDON E., CAPPETTA H., GHEERBRANT E., JOUVE S., NOUBHANI A., OUANAÏMI F., PEREDA SUBERBIOLA X., VINCENT P., AMAGHZAZ M., BOUYA B. & MCHICHI M. 2006. Les vertébrés fossiles des phosphates du Maroc. Nouvelle convention et état des connaissances. *COVAPHOS II*, Marrakech, p. 01-04-19.
- JOUVE S., BARDET N., JALIL N.-E., PEREDA SUBERBIOLA X., BOUYA B. & AMAGHZAZ M. 2008. The oldest African crocodylian: phylogeny, palaeobiogeography, and differential survivorship of marine reptiles through the Cretaceous-Tertiary boundary. *Journal of Vertebrate Paleontology*, 28(2): 409-421.



- NOUBHANI A. & CAPPETTA H. 1997. Les Orectolobiformes, Carcharhiniformes et Myliobatiformes (Elasmobranchii, Neoselachii) des bassins à phosphate du Maroc (Maastrichtien-Lutétien basal). Systématique, biostratigraphie, évolution et dynamique des faunes. *PalaeoIchthyologica* 8: 1-327.
- PEREDA SUBERBIOLA X., BARDET N., IAROCHÈNE M., BOUYA B. & AMAGHZAZ M. 2004. The first record of a sauropod dinosaur from the Late Cretaceous phosphates of Morocco. *Journal of African Earth Sciences*, 40: 81–88.

NEW MATERIAL OF *CARINODENS* (SQUAMATA, MOSASAURIDAE) FROM THE MAASTRICHTIAN PHOSPHATES OF MOROCCO

BARDET Nathalie¹, SCHULP Anne S.² & BOUYA Baâdi³

¹CNRS UMR 7207, Dépt. HDT, MNHN, CP 38, 8 rue Buffon, 75005 Paris, France, bardet@mnhn.fr; ²Natuurhistorisch Museum Maastricht, De Bosquetplein 6-7, 6211 KJ Maastricht, The Netherlands, anne.schulp@maastricht.nl; ³Office Chérifien des Phosphates, Centre Minier de Khouribga, Khourigba, Morocco, b.bouya@ocpgroup.ma

Except for a complete dentary (Dollo, 1913) and a jaw fragment (Schulp et al., 2004), the durophagous mosasaur *Carinodens* Thurmond 1963 is known by isolated teeth only. This Maastrichtian genus has a wide geographic distribution, ranging from Europe and the Middle East through North Africa and Brazil (e.g., Bardet et al., 2008).

Here we present new material from the Late Maastrichtian phosphates of Morocco, representing the most complete record of *Carinodens* recognised so far. The specimens are registered in the *Office Chérifien des Phosphates* collections and are kept in Khouribga (Morocco).

OCP DEK/GE 453 consists of two dentaries from a single individual, representing a new species of *Carinodens*. The dentaries differ from *C. belgicus* mainly in having a much straighter dorsal dentary margin and labiolingually considerably more compressed teeth.

OCP DEK/GE 454 consists of two complete dentaries from a single individual and OCP DEK/GE 455 is a small, incomplete dentary. Both can be referred to *C. belgicus*. The dentaries OCP DEK/GE 454 feature posteriorly to the 13th tooth position three very small teeth, pointed and posteriorly recurved, an anatomical detail previously unknown in *Carinodens*.

These new discoveries considerably improve our knowledge of this rare and enigmatic mosasaur. The much higher dentary tooth count and longer dentary requires conclusions from previous work (e.g., Schulp et al., 2004 and Schulp, 2005) to be reconsidered. From a taphonomic point of view it is interesting to note the disproportionate number of dentaries and isolated teeth recognized so far in the fossil record of *Carinodens*.

- BARDET N., PEREDA SUBERBIOLA X., SCHULP A. & BOUYA B. 2008. New material of *Carinodens* (Squamata, Mosasauridae) from the Maastrichtian (Late Cretaceous) Phosphates of Morocco. *Bulletin of the Fort Hays State University*, Special Issue 3: 29–36.
- DOLLO L. 1913. *Globidens fraasi*, mosasaurien mylodonte nouveau du Maastrichtien (Crétacé supérieur) du Limbourg, et l'Éthologie de la Nutrition chez les Mosasauriens. *Archives de Biologie* 28: 609-626.
- SCHULP A.S. 2005. Feeding the Mechanical Mosasaur: what did *Carinodens* eat? in SCHULP A.S. & JAGT J.W.M. (eds): Proceedings of the First Mosasaur Meeting. *Netherlands Journal of Geosciences* 84(3): 345-357
- SCHULP A. S., JAGT J.W.M & FONKEN F. 2004. New material of the mosasaur *Carinodens belgicus* from the Upper Cretaceous of The Netherlands. *Journal of Vertebrate Paleontology* 24: 744-747.

PATTERNS OF DISTRIBUTION OF SOUTHERN HEMISPHERE FISHES DURING THE LOWER CRETACEOUS.

BRITO Paulo M.¹ & ALVARADO-ORTEGA Jesús²

¹Departamento de Zoologia, Universidade do Estado do Rio de Janeiro, Rua São Francisco Xavier 524, Rio de Janeiro, RJ 20559-900, Brazil. pbritopaleo@yahoo.com.br; ²Instituto de Geología, Universidad Nacional Autónoma de México. Circuito de la investigación S/N, Ciudad Universitaria, Coyoacán, D. F., 04510, México.

Contrary to what was thought, a number of Lower Cretaceous clades, previously considered as endemic from the Southern Hemisphere, especially from South America, have representatives in North



America and Europe. In the present work we will present the individual tracks of different taxa, showing a clearly generalized biogeographical pattern. This distributional pattern can be easily explained by the presence of widespread epicontinental seas that extended southward from the shallow waters of the Tethys onto South America.

FROM THE TURONIAN TO THE MAASTRICHTIAN: THE MOSASAURIAN LIZARDS OF MOROCCO

CALDWELL M.W.¹, BARDET N.², BELL G.³, LeBLANC A.¹, KONISHI T.¹, SCHULP A.⁴ & POLCYN M.⁵

¹University of Alberta Laboratory for Vertebrate Palaeontology, Department of Biological Sciences, University of Alberta, Edmonton, Alberta, Canada, T6G 2E9; ²CNRS UMR 7207, Département Histoire de la Terre, Muséum National d'Histoire Naturelle, 8 rue Buffon, 75005, Paris, France; ³HC 60-#309, Salt Flat, Texas, U.S.A. 79847; ⁴Natuurhistorisch Museum Maastricht, De Bosquetplein 6, NL 6211 KJ Maastricht, The Netherlands; ⁵Roy M. Huffington Department of Earth Sciences, Southern Methodist University, Dallas, Texas.

During the Late Cretaceous the oceans, seas, estuaries and possibly even freshwater realms of the entire planet were open habitats to the radiation and evolution of the secondarily aquatically adapted marine lizards known as “mosasaurs”. The informal term mosasaur, as we use it here, refers to a radiation of nearly forty described genera of small to gigantic marine lizards, currently systematized into at least four large and morphologically diverse clades, possessing unique adaptations of the skull, postcrania, limbs, and girdles and marking a transition from a terrestrial to marine existence. The Cretaceous shores and seaways of ancient Morocco, as evidenced by the well-preserved assemblage of fossils found there, were productive habitats for a diverse assemblage of mosasaurs. One focus at this early phase in the study of Moroccan mosasaurs is to understand how the Moroccan assemblage relates both spatially and temporally, to other comparable mosasaur assemblages. We report here on new and important specimens of both new and currently recognized taxa acquired abroad as a means of removing important fossils from the commercial market. These specimens provide new understanding of the anatomy and systematics of Moroccan mosasaurs. We review the temporal and spatial relationships of all mosasaurs, noting relationships between Moroccan taxa and more globally distributed taxa previously considered to be endemic. We note that some Moroccan mosasaurs appear temporally and spatially restricted to the coastal margins of Late Cretaceous Africa. However, this apparent endemism may be nothing more than the effect of preservational bias and possibly rapid speciation.

THE PHYLOGENY OF MEGALOSAUROIDS (DINOSAURIA: THEROPODA) WITH IMPLICATIONS FOR THE EVOLUTION OF NORTH AFRICAN PALEOECOSYSTEMS

CARRANO Matthew¹, BENSON Roger² & SAMPSON Scott³

¹Department of Paleobiology, Smithsonian Institution, P.O. Box 37012, MRC 121, Washington, DC 20013-7012, USA; carranom@si.edu; ²Department of Earth Sciences, University of Cambridge, Downing Street, Cambridge, CB2 3EQ, United Kingdom; rbb27@cam.ac.uk; ³Department of Geology & Geophysics and Utah Museum of Natural History, University of Utah, Salt Lake City, UT 84112 USA; ssampson@umnh.utah.edu

Megalosauroids (spinosauroids) were a diverse, long-lived clade of basal tetanuran theropods that are known from nearly every continent during the Jurassic and Cretaceous. Their evolution has been difficult to decipher due to the fragmentary nature of many taxa, and longstanding problems with the taxonomy and nomenclature of the group. Recently we concluded a multi-year study that examined megalosauroid and basal tetanuran specimens firsthand, resulting in a new, well-resolved phylogeny for the group.

Our results confirm the sister-taxon relationship between spinosaurids and megalosaurids, the presence of a (*Marshosaurus* + *Condorraptor* + *Piatnitzkysaurus*) clade, and the presence of at least six additional megalosauroid taxa. This topology implies a missing spinosaurid lineage leading back at least to the Middle Jurassic. The earliest megalosaurid remains are Bajocian, with a primarily Jurassic radiation



for the clade. There are not yet any well-established records of megalosaurids or spinosaurids from any latest Cretaceous deposits.

South American and North African mid-Mesozoic faunas show similar transitions in predator diversity from megalosaurids to a mixed assemblage of spinosaurids, carcharodontosaurids, and abelisaurids. In contrast, latest Cretaceous faunas from South America, India, and Madagascar show lower diversities dominated by abelisaurids only. This may represent a genuine diversity peak, corresponding to increased sea levels and paleotemperatures. However, the prevalence of certain taxa in particular depositional settings, and the irregularity of present sampling, suggest caution in interpreting these patterns.

VERTEBRATE ASSEMBLAGES FROM THE EARLY LATE CRETACEOUS OF SOUTHEAST MOROCCO

CAVIN L.¹, TONG H.², BOUDAD L.³, MEISTER C.¹, PIUZ A.¹, TABOUELLE J.⁴, AARAB M.³, AMIOT R.⁵, BUFFETAUT E.², DYKE G.⁶, HUA S.⁷ & LE LOEUFF J.⁷

¹Dpt. de Géologie et Paléontologie, Muséum de Genève, CP 6434, 1211 Genève 6, Suisse. lionel.cavin@ville-ge.ch; ²CNRS, UMR 8538, Laboratoire de Géologie de l'Ecole Normale Supérieure, 16 cour du Liégar, 75013 Paris, France; ³Faculté des Sciences et Techniques, BP, 509, Boutalamine, Errachidia, Maroc; ⁴Musée municipal, 76500 Elbeuf-sur-Seine, France; ⁵IVPP, Chinese Academy of Sciences, 142 XiZhiMenWai DaJie, Beijing 100044, China; ⁶School of Biology and Environmental Science, University College Dublin, Belfield, Dublin 4, Ireland; ⁷Musée des Dinosaures, 11260 Espéraza, France

The Cretaceous deposits surrounding the northern, eastern and southern borders of the Palaeozoic Tafilalet and Mader basins have yielded numerous vertebrate remains for more than fifty years. During the last twenty years, local people have engaged very active excavation works for collecting Cretaceous fossils for commercial purpose. Beautifully preserved specimens have been discovered by this way in the Kem Kem and Goulmima areas, but few information about sedimentology, stratigraphy and geographical location are usually associated with this material. Moreover, because of the rudimentary techniques used by local collectors to remove fossils from the field, the specimens are often only partially kept, and numerous specimens or parts of specimens with no commercial value are neglected and not collected. Although important for the local economy, this collecting activity is harmful for preservation of the palaeontological heritage of Morocco and for scientific studies. Sometimes, natural history museums worldwide acquire specimens, thus allowing conservation and study of this heritage. Specimens corresponding to about 60 taxa of vertebrates from the early Late Cretaceous housed in various public collections have been described so far, most of them on the basis of fossils found by local people, and with only few associated field data.

Here we present results of fieldworks sporadically conducted by the authors for fifteen years. This data are very important because they allow drawing up a regional synthesis of the early Late Cretaceous vertebrate assemblages' succession. We present the succession of palaeoenvironments, and we discuss the palaeogeographical connections of the assemblages by focusing on the vertebrate remains, the microfaunas and the ammonites.

A NEUROVASCULAR CAVITY WITHIN THE SNOUT OF THE PREDATORY DINOSAUR *SPINOSAURUS*

DAL SASSO Cristiano¹, MAGANUCO Simone² & CIOFFI Armando³

¹Museo di Storia Naturale di Milano, Corso Venezia 55, 20121 Milano, Italy, cdalsasso@yahoo.com; ²Museo di Storia Naturale di Milano, Corso Venezia 55, 20121 Milano, Italy, simonemaganuco@iol.it; ³Siemens S.p.A., Viale Piero e Alberto Pirelli 10, 20126 Milano, Italy, armando.cioffi@siemens.com

In 2005, Dal Sasso et al. described an almost complete snout of the unusual theropod *Spinosaurus*, from the Late Cretaceous of Morocco. Siemens CAT scan analysis, performed recently on the same specimen at the Ospedale Maggiore di Milano, reveals that the numerous foramina located on the outer wall of the rostrum communicate with a common internal cavity, deeply encased medially within the



premaxillae, which is unique among theropod dinosaurs. The extreme retraction of the external nares in *Spinosaurus* permits to exclude any respiratory/olfactory function of this cavity, which in turn has a neurovascular nature. The cavity flows into two paired neurovascular passages, going through the entire snout and meeting caudally at level of the fifth maxillary tooth. This suggests that a rostral extension of the trigeminal nerve innervated the cavity.

Soares (2002) demonstrated that the foramina on the facial bones of living and extinct semi-aquatic crocodylians house dome pressure receptors, innervated by the trigeminal nerve, that are useful to hunt even in darkness, detecting prey-made pressure waves associated with disruptions to the air-water interface. According to Taquet (1984) and Holtz (2003), spinosaurids might have hunted in riparian habitats in a manner similar to herons. As for *Spinosaurus*, we postulate the presence of croc-like pressure receptors, that might have given its mouth, when positioned on the air-water interface, an unexpected tactile function, useful to catch swimming preys without relying on sight.

- DAL SASSO C., MAGANUCO S., BUFFETAUT E. & MENDEZ M. 2005. New information on the skull of the enigmatic theropod *Spinosaurus*, with remarks on its size and affinities. *Journal of Vertebrate Paleontology*, 25 (4): 888-896.
- HOLTZ T.R. Jr. 2003. Dinosaur Predation. Evidence and ecomorphology. in KELLEY P.H., KOWALEWSKY M., & HANSEN T.A. (eds.), *Predator-Prey Interactions in the fossil record*. Kluwer Academic/Plenum Publishers, New York: 325-340
- SOARES D. 2002. An ancient sensory organ in crocodylians. *Nature* 417: 241-242.
- TAQUET P. 1984. Une curieuse spécialisation du crâne de certains Dinosaures carnivores du Crétacé: Le museau long et étroit des Spinosauridés. *Comptes Rendus de l'Academie des Sciences, Paris, série II*, 299: 217-222.

TWO NEW SHORT-BODIES CLADISTIA (ACTINOPTERII) FROM THE KEM KEM BEDS (CENOMANIAN OF MOROCCO)

DUTHEIL Didier B.

15 passage du Buisson Saint-Louis, 75010 Paris, France. didierduthail@free.fr

Cladistia are considered the most primitive of all extant actinopterygians fish. The oldest doubtless fossil record of this group is from the beginning of the Upper Cretaceous of North Africa (Egypt, Sudan and Morocco). *Serenoichthys kemkemensis* from the Kem Kem beds (Cenomanian of Morocco) is the only articulated species from the Mesozoic. From the same locality, two other species have been found. Like *Serenoichthys* they are small, with less than 80 mm in length and share the synapomorphy of the group (cf., special dorsal composed by finlets). The first species can be distinguished from all other recent or extinct Cladistia by the following combination of characters: ornamented scales in the anterior part of the body and smooth scales in the posterior part; ten rows of scales below the 3rd dorsal fin spine; nine-ten predorsal scales; thirteen closely-set dorsal finlets; six elongated and bifid pelvic spines. The second species differs from all other Cladistia by the possession of at least of three very strong spines between the anal and the caudal fins and by spiny scales below the lateral line.

Les vertébrés de la collection du Département des Sciences de la Terre de l'Institut Scientifique (Rabat) : inventaire et mise en valeur

FEDAN Bouaza & MEDINA Fida

Université Mohammed V-Agdal, Institut Scientifique, Département des Sciences de la Terre, Charia Ibn Batouta, B. P. 703, Agdal-Rabat, bouazafedan@yahoo.fr, fedan@israbat.ac.ma, medina@israbat.ac.ma

Le Département des Sciences de la Terre de l'Institut Scientifique de Rabat, Maroc, abrite des collections géologiques riches et diversifiées, fruit des recherches menées depuis 1921. La composante paléontologique de ce patrimoine national comporte plus de 400 spécimens de Vertébrés, dont la moitié reste indéterminée.

Ces fossiles comprennent essentiellement des Chondrichthyens (167 spécimens répartis en 28 genres et 69 espèces), des Actinoptérygiens basaux (6 spécimens pour 2 genres et 4 espèces), des Téléostéens (26



spécimens, 13 genres, 15 espèces) ainsi que 176 spécimens indéterminés. Les Tétrapodes sont représentés par des Mammifères Ongulés (15 spécimens, 5 genres, 6 espèces), des Reptiles Chéloniens (fragment de plastron), Ophidiens (squelette de serpent), des Crocodiliens (*Dyrosaurus paucidens*) et des Dinosauriens (des os longs, côtes et vertèbres de 20 spécimens).

Le matériel ichthyologique comprend des squelettes sub-complets mais aussi des dents, des vertèbres isolées, des otolithes et des empreintes. Les restes de Mammifères sont plutôt désarticulés : fémur, humérus, fragments de mâchoire et dents (dont des défenses), bassin, vertèbres.

Les échantillons de cette collection proviennent pour la plupart de gisements marocains (Plateau des phosphates, Moyen Atlas, Bassin de Guercif...), de Tunisie et de France. Ils sont datés du Jurassique au Miocène.

BRACHYCHIROTHERIUM ICHNOFAUNA FROM THE UPPER TRIASSIC OF OUED OUM ER RBIAA FORMATION OF SIDI SAÏD M'AACHOU BASIN, COASTAL MESETA, MOROCCO

HMINNA A.¹, SABER H.¹, SCHNEIDER J.W., KLEIN H.³, VOIGT S.² & HMICH D.²

¹Department of Geology, Chouaïb Doukkali University, B.P. 20, 24000 El Jadida, Morocco, hmima_abdelkbir@yahoo.fr, hafidsaber@yahoo.fr; ²Institut für Geologie, TU Bergakademie Freiberg, B.-v.-Cotta-Str. 2, 09596 Freiberg, Germany, hmich@gmx.net, schneidj@geo.tu-freiberg.de, s.vogt@geo.tu-freiberg.de; ³Rübezahlstrasse 1, D-92318 Neumarkt, Germany

Thin-bedded lacustrine sediments (60 cm), in the upper part of the Oued Oum Er Rbiaa Formation (Sidi Saïd M'aachou Basin), contain notostracans, insects, ostracodes and scale fish fossils. Plant remains are also observed.

The overlying trace fossil bearing horizon (60 cm), consists of thinly interbedded alternating layers of red and grey siltstone, claystone and fine sandstone. Desiccation cracks and salt crystal casts are present locally.

Three imprints show features diagnostic of the ichnogenus *Brachychirotherium*, a taxon first described by Beurlen (1950) from the Late Carnian of Germany and documented thus far from Late Triassic track-surfaces in a global distribution. Characteristic is the broad pentadactyl and semiplantigrade pes with short, thick digits and small claws. Digit III is the longest, V is present only by an oval basal pad in a postero-lateral position to the rest of the foot. Supposed trackmakers are archosaurs of the crocodile stem-group (Crurotarsi), widely spread over Triassic Pangea.

Several authors have extended the stratigraphical range of the ichnotaxon back to the Middle or Early Triassic (Haubold, 1971; Demathieu, 1971). However, this turned out to be problematic during the re-examination of the German type material by Karl and Haubold (1998). A further study revealed *Brachychirotherium*-like forms from this interval as extramorphological variants of *Synaptichnium*, another chirotherian of more primitive morphology (Klein and Haubold, 2004). Obviously, the vertical distribution of *Brachychirotherium* is restricted to Late Triassic strata. Consequently, the presence of the ichnogenus in the Oued Oum Er Rbiaa Formation is a strong indication for a Carnian – Norian age of the sequence.

Keywords: Triassic, Morocco, Ichnogenus *Brachychirotherium*

BEURLEN K. 1950. Neue Fährtenfunde aus der fränkischen Trias. *Neues Jahrbuch für Geologie und Paläontologie, Monatshefte*, 1950: 308-320.

DEMATHEIU G. 1971. Cinq nouvelles espèces d'empreintes de reptiles du Trias de la bordure nord-est du Massif Central. *Comptes Rendus de l'Académie des Sciences Paris, D 272*: 812-814.

HAUBOLD H. 1971. Ichnia Amphibiorum et Reptiliorum fossilium. *Encyclopedia of Paleoherpétology*, 18: 1-124.

KARL C. & HAUBOLD H. 1998. *Brachychirotherium* aus dem Coburger Sandstein (Mittlerer Keuper, Karn/Nor) in Nordbayern. *Hallesches Jahrbuch für Geowissenschaften B*, 20: 33-58.

KLEIN H. & HAUBOLD H. 2004. Überlieferungsbedingte Variation bei Chirotherien und Hinweise zur Ichnotaxonomie nach Beispielen aus der Mittel- bis Ober-Trias (Anisium – Karnium) von Nordbayern. *Hallesches Jahrbuch für Geowissenschaften B*, 26: 1-15.



FOSSIL VERTEBRATES FROM THE EARLY LATE CRETACEOUS OF MOROCCO

IBRAHIM Nizar¹, ZOUHRI Samir² & BAIDDER Lahssen²

¹University College Dublin, School of Biology and Environmental Science, Belfield, Dublin 4, Ireland; ²Département de Géologie, Faculté des Sciences Ain Chok, Université Hassan II, Casablanca, Morocco

In contrast to Laurasia and South America, Cretaceous terrestrial vertebrate evolution in Africa remains poorly understood. Recent and historical discoveries from Morocco have provided key insights into the continent's evolutionary past. Of particular note, the Kem Kem Beds of South Eastern Morocco, located in a remote area in the border region between Morocco and Algeria and first explored by French scientists, have yielded one of the world's richest 'mid' Cretaceous terrestrial vertebrate assemblages. As part of an ongoing research project, new discoveries, including spectacular specimens and new taxa of fish, turtles, crocodiles, dinosaurs and pterosaurs are currently being described. In combination with museum data, these finds expand our understanding of the diversity and composition of this assemblage as well as the taphonomy of the fossils. Freshwater taxa are extremely common and, surprisingly, remains of giant predatory dinosaurs, such as *Carcharodontosaurus* and *Spinosaurus*, appear to be unusually abundant in museum collections as well as in the field. Herbivorous dinosaurs are only represented by one genus, *Rebbachisaurus*, but new elements of large sauropods found in 2008 might reveal a higher diversity. New remains of pterosaurs have also been collected and indicate a diverse and unique assemblage, significantly expanding our understanding of the evolution of pterosaur clades.

TRAMPLED GROUND AND EXTREMELY NARROW GAUGE TRACKWAY OF JURASSIC SAUROPOD DINOSAUR FROM WESTERN HIGH ATLAS MOUNTAINS, MOROCCO.

ISHIGAKI Shinobu

Hayashibara Museum of Natural Sciences, 1-2-3 Shimoiishi, Okayama 700-0907, Japan, isgk@hayashibaramuseum.jp

Jenny et al. (1981) reported the occurrence of dinosaur tracks from Middle Jurassic red beds 14km WSW from the town of Imi-n-Tanoute, Morocco. I studied the area and reported the preliminary results in Ishigaki (1985, 2007). There are two tracksites. In site 1, footprint-bearing bed is red or gray-white fine sandstone, extending 5m high and 46m wide as almost vertical outcrop. In site 2 the bed is gray-white fine sandstone extending 5m high and 1.5m wide. Both beds are interbedded between red, massive siltstone. In site 1, more than 500 oval or half-moon shaped footprints covered all over the bedding surface showing the view like honey-comb. It is dinoturbation surface trampled by large trackmakers. From the site, five sauropod trackways were distinguished. Lengths of anterior and posterior footprints are around 20cm and 70cm respectively. At site 2, one sauropod trackway of similar size was discovered. Well preserved footprints have claw marks and digital impressions. Those 6 trackways show very narrow gauge. Narrowest one has only 60cm in total trackway width while the hind-print width is 35cm, and the average pace angulation of hind-print is 143°. Another initial characteristic of those trackways is that the axis of manus is rotated strongly to outward from walking direction. The average rotation angle in most extreme example is 101°. Those characteristics had not been reported among sauropod tracks. If the precise age of the bed were determined, those evidences would be useful to reconstruct the evolution of sauropod locomotion.

ISHIGAKI S. 1985. Dinosaur footprints from Atlas Mountains (1) *Nature Study*, 31 (10): 5-8, Osaka City Museum of Natural History, Osaka, Japan. (In Japanese)

ISHIGAKI S. 2007. Footprint evidence of extreme outward rotation of the manus of sauropod dinosaur from middle Jurassic of western Morocco. *Journal of Vertebrate Paleontology*, 27, supplement to no3: 94A

JENNY J., Le MARREC A. & MONBARON M. 1981. Les empreintes de pas de Dinosauriens du Haut Atlas central (Maroc) : nouveaux gisements et précisions stratigraphiques. *Geobios*, 14(3): 427-431.



A NEW SAUROPOD FROM NIGER

JOGER Ulrich¹, KOSMA Ralf¹, REMES Kristian², ORTEGA Francisco^{3,4}, FIERRO Ignacio^{4,5} & MARÍN-FERRER José Manuel^{4,5}

¹State Natural History Museum, Pockelsstr. 10, 38106 Braunschweig, Germany; ²Institute of Geology, Mineralogy and Paleontology, University of Bonn, Nussallee 8, 53115 Bonn, Germany; ³Grupo de Biología, Facultad de Ciencias, UNED, Paseo Senda del Rey 9, 28040 Madrid, Spain; ⁴Proyecto Paldes. Plaça de Sant Joan, 03203 Elche, Spain; ⁵Museo Paleontológico de Elche (MUPE), Plaça de Sant Joan, 03203 Elche, Spain.

The fieldwork carried out in northern Niger during the years 2006 and 2007 yielded two partial skeletons of a sauropod which appears to be new to science. Together, both specimens represent about 70% of the skeleton of the new form, including parts of the skull. Most bones are in an excellent state of preservation. Except the distal appendicular elements, a fairly complete 3D reconstruction of the skeleton was possible.

The systematic of this sauropod is currently under study, but it is probably a new basal form of Eusauropoda, branching off the common stem of Sauropoda just after *Tazoudasaurus*. It is not closely related to any sauropod known from Niger. Among other autapomorphies, it is distinguished by a particular dentition, by the structure of the vertebrae and by fused hemapophyses in the distal part of the tail which was probably armed with spines. The total length of the vertebral column is 12-14 m. Sauropod footprints found near the locality may stem from the same species. We expect that the analysis of the phylogeny of this new taxon will shed light on the relationships of Gondwanan and Laurasian basal sauropods.

BRIEF REVIEW OF THE PTEROSAUR RECORD IN AFRICA

KELLNER Alexander Wilhelm Armin

Departamento de Geologia e Paleontologia, Museu Nacional/UFRJ - Fellow FAPERJ and CNPq, kellner@mn.ufrj.br

Pterosaurs from Africa are represented by rare and mainly isolated elements. The oldest record comes from the Upper Jurassic Tendaguru Beds of Tanzania, where remains have been collected in two horizons: the Middle and Upper Saurian Beds. Four pterosaur taxa were described from the later, all presently regarded as *nomina dubia* (Unwin & Heinrich, 1999; Kellner et al., 2007). The best pterosaur material is an incomplete lower jaw from the slightly older Middle Saurian Beds, *Tendaguripterus recki*. First regarded as a member of the pterodactyloid clade Dsungaripteridae (Unwin & Heinrich, 1999), *Tendaguripterus* was recently considered representing a new clade of African pterosaurs (Tendaguripteridae) (Kellner et al., 2007). Isolated elements also show the presence of archaeopterodactyloid and possible azhdarchid taxa in the Tendaguru deposits (Sayão & Kellner, 2001).

In recent years, most flying reptile material comes from the Albian/Cenomanian red beds of Hamada du Guir (Taouz, Morocco). The only named pterosaur from those deposits is the anhanguerid *Siroccopteryx moroccensis* (Mader & Kellner, 1999), but Tapejaridae, Pteranodontoidea, and Azhdarchidae were also recorded (Wellnhofer & Buffetaut, 1999). A partial sequence of cervical vertebrae (*Phosphatodraco mauritanicus*) recently described expands the azhdarchid record in Morocco to the Maastrichtian (Pereda Suberbiola et al., 2003).

Further rare isolated pterosaur remains have been reported from Cretaceous deposits of Congo, Israel, Senegal, Jordan, Niger, Tunisia and Lebanon. The later has furnished at least two specimens, both representing articulated wing elements of a pteranodontoid and a possible azhdarchid (Dalla Vecchia et al., 2001; Kellner et al., 2007). Discoveries made in recent years indicate a rather diverse pterosaur fauna in Africa with both cosmopolitan and endemic groups.



- DALLA VECCHIA F.M., ARDUINI P. & KELLNER A.W.A. 2001. The first pterosaur from the Cenomanian (Late Cretaceous) Lagerstätten of Lebanon. *Cretaceous Research*, 22: 219-225.
- KELLNER A.W.A., MELLO A.M.S. & FORD T. 2007. A survey of pterosaurs from Africa with the description of a new specimen from Morocco. in CARVALHO I.S. et al. (eds.). *Paleontologia: Cenários da Vida*, Vol. 1. Interciência, p. 257-267 (ISBN 978-85-7193-184-8).
- MADER B. J. & KELLNER A.W.A. 1999. A new anhanguerid pterosaur from the Cretaceous of Morocco. *Boletim do Museu Nacional, Geologia*, 45: 1-11.
- PEREDA SUBERBIOLA X., BARDET N., JOUVE S., IAROCHÈNE M., BOUYA B. & AMAGHZAZ M. 2003. A new azhdarchid pterosaur from the Late Cretaceous phosphates of Morocco. in BUFFETAUT E. & MAZIN J.M. (eds). *Evolution and Palaeobiology of Pterosaurs. Geological Society, Special Publication*, 217: 79-90.
- SAYÃO J.M. & KELLNER A.W.A. 2001. Comments on the pterosaur fauna from Tendaguru, Upper Jurassic of Africa, with the identification of a possible azhdarchid. *Boletim de resumos, 17. Congresso Brasileiro de Paleontologia*, p. 145, UFAC, Rio Branco, Acre.
- UNWIN D.M. & HEINRICH W.-D. 1999. On a pterosaur jaw from the Upper Jurassic of Tendaguru (Tanzania). *Mitteilungen Museum für Naturkunde Berlin*, 2: 121-134.
- WELLNHOFFER P. & BUFFETAUT E. 1999. Pterosaur remains from the Cretaceous of Morocco. *Paläontologische Zeitschrift*, 73: 133-142.

**NEW PALEONTOLOGICAL AND GEOLOGICAL DATA IN THE JBEL TSELFAT
(CENOMANIAN OF MOROCCO) /
NOUVELLES DONNEES PALEONTOLOGIQUES ET GEOLOGIQUES SUR LE JBEL TSELFAT
(CENOMANIEN, MAROC)**

KHALLOUFI Bouziane¹, OUARHACHE Driss², LELIEVRE Hervé¹ & JALIL Nour-Eddine³

¹Centre de Recherches sur la Paléobiodiversité et les Paléoenvironnements (CR2P) - UMR 7207 du CNRS, Département Histoire de la Terre - CP 38, Muséum National d'Histoire Naturelle ; 8, rue Buffon, 75231 Paris Cedex 05, France; ²Faculté des Sciences Dhar El Mahraz, Département de Géologie, BP 1796 - Atlas, Fès – Maroc; ³ Laboratoire « Biodiversité & Dynamique des Ecosystèmes », Dépts. Géologie et Biologie, Faculté des Sciences Semlalia, Université Cadi Ayyad, Marrakech, Maroc

The ridge of the Jbel Tselfat is located at about 40 km north of Meknes city (Morocco). It is composed by a Jurassic core (Toarcian to Bajocian) surrounding by Miocene levels dated as Burdigalian and 'Helvetian'. Some outcrops of bituminous schist dated as Cenomanian are present in a thrust sheet containing fossil fishes. Jbel Tselfat was carefully explored by French paleontologists, i.e. Arambourg, between 1934 and 1954 and an extensive collection of actinopterygian fishes has been made from two localities, Aïn el Kerma and Sigda.

In the framework of ongoing collaborative Franco-Moroccan research project, a recent field work has been done (autumn 2008), and an abundant material has been collected from three sites near Aïn el Kerma. This new assemblage is dominated by dercetids and pycnodonts, represented by some complete specimens. New information result in the discovery of one ammonite and several plant remains. An updated revision of the specimens available in the collection of the MNHN (Paris) associated with these new specimens will permit to complete our knowledge of the Jbel Tselfat ichthyofauna and shed new light on their age and biogeographic affinities. Forams and Radiolarians research is performed to precise the age of Jbel Tselfat faunas.

Ongoing geological studies and analysis of thin sections are realized for a better knowledge of the geologic and paleoenvironmental contexts of vertebrate bearing strata of Jbel Tselfat.

La ride du Jbel Tselfat est située à environ quarante kilomètres au nord de la ville de Meknès (Maroc). Elle est constituée d'un noyau jurassique (Toarcien à Bajocien) entouré par des niveaux miocènes (Burdigalien et « Helvétien »). Quelques affleurements de schistes bitumineux datés du Cénomaniens sont présents dans une nappe de charriage et contiennent des fossiles d'Actinoptérygiens. Diverses missions, réalisées principalement par Arambourg entre 1934 et 1954, ont mis à jour deux sites fossilifères, Aïn el Kerma et Sigda et ont permis de récolter une importante collection de "poissons" fossiles.

Une mission de terrain réalisée en octobre 2008 a permis de retrouver quelques affleurements et trois points fossilifères aux alentours d'Aïn el Kerma. Des fossiles apparentés aux pycnodontes, aux dercétidés,



mais aussi à d'autres formes ont été récoltés. De nouvelles données sont disponibles : une empreinte d'ammonite et quelques restes de végétaux. Ce matériel paléontologique associé à une révision actualisée des fossiles en collection au MNHN (Paris) permet de compléter les connaissances sur les ichthyofaunes de Jbel Tselfat.

Des relevés géologiques, *in situ*, et l'analyse de lames minces sont réalisés pour confirmer l'histoire géologique et le contexte paléo-environnemental de la localité. La recherche de Foraminifères et de Radiolaires est en cours pour affiner la datation du gisement, considéré Cénomaniens inférieur ou supérieur en fonction des auteurs.

NEW DATA ABOUT THE ANATOMY AND THE PHYLOGENETIC RELATIONSHIPS OF *CHEBSAURUS ALGERIENSIS* (DINOSAURIA, SAUROPODA) FROM THE MIDDLE JURASSIC OF ALGERIA

LÄNG Emilie

MNHN, UMR 7207 CR2P, CP 38, 57 rue Cuvier 75231 Paris Cedex 05, France, lang@mnhn.fr

More details about the osteology of the sauropod *Chebsaurus algeriensis* from the Middle Jurassic Aïssa Formation of the Naama Province, Algeria, are presented. The described material belongs to two juvenile individuals. Recent field works have provided new cranial and post-cranial (forelimbs and girdles) in relation to the preliminary study published by Mahammed et al. (2005). This new material presents a combination of plesiomorphic and apomorphic eusauropod characters giving more data about the skull and the postcranial skeleton morphology. A phylogenetic analysis (237 characters, 39 taxa: 16 parsimonious trees of 479 steps, CI=0.53, RI=0.73) (Läng 2008) indicates an unsolved phylogenetic position of *Chebsaurus* within the non-Neosauropoda Eusauropoda. Indeed, *Chebsaurus* is positioned in a multifurcation with Middle Jurassic "cetiosaurids" *Lapparentosaurus madagascariensis*, *Ferganasaurus verzilini*, *?Cetiosaurus mogrebiensis* and *Cetiosaurus oxoniensis* from Oxford. This above-mentioned polytomy could be explained by numerous missing data and also by the incongruence of the informative characters for the Middle Jurassic non-neosauropod eusauropods, which also could be the result of an evolutive radiation that could succeed the extinction at the end of the Early Jurassic (Pliensbachian-Toarcian) and/or that could be linked to the Pangea break-up.

LÄNG E. 2008. *Les cétiosaures (Dinosauria, Sauropoda) et les sauropodes du Jurassique moyen : révision systématique, nouvelles découvertes et implications phylogénétiques*. Thèse de doctorat du Muséum National d'Histoire Naturelle de Paris. 2 volumes, pp. 638.

MAHAMMED F., LÄNG E., MAMI L., MEKHALI L., BENHAMOU M., BOUTERFA B., KACEMI A., CHERIEF S.-A., CHAOUATI H. & TAQUET P. 2005. The 'Giant of Ksour', a Middle Jurassic sauropod dinosaur from Algeria. *Comptes Rendus Palevol* 4: 707-714.

A NEW CYCLOTOSAURID (AMPHIBIA, TEMNOSPONDYLI) FROM THE TRIASSIC OF ARGANA BASIN (HIGH ATLAS MOUNTAINS, MOROCCO); BIOSTRATIGRAPHIC IMPLICATIONS

JALIL Nour-Eddine¹, JANVIER Philippe² & STEYER Jean-Sébastien²

¹Laboratoire « Biodiversité & Dynamique des Ecosystèmes », Dépts. Géologie et Biologie, Faculté des Sciences Semlalia, Université Cadi Ayyad, Marrakech, Maroc, njalil@ucam.ac.ma, ²Centre de recherches sur la Paléobiodiversité et les Paléoenvironnements (CR2P), UMR 7207 du CNRS, Muséum National d'Histoire Naturelle, 8 rue Buffon, 75231 Paris Cedex 05 Paris, France, janvier@mnhn.fr, steyer@mnhn.fr

Here we describe a previously undescribed temnospondyl from the upper Aglegal Member (Timezgadiwine Formation, Argana Basin). It consists of posterior portion of a skull showing articulated post-parietals, tabulars and a right squamosal, and nicely preserved posterior part of the palate and occiput.



The entirely closed otich notch and the flattened occiput suggest an heylerosaurine Cyclotosauridae (sensu Schoch & Milner, 2000). This is the first described vertebrate remain from the Aglegal Member and the first known cyclotosaurid temnospondyl from Morocco. Up to now, Moroccan temnospondyls were only reported in the younger Irohalene Member (Late Triassic, Carnian) and are represented by metoposaurids (*Dutuitosaurus*, *ouazzoui Arganasaurus lyazidi* and *Metoposaurus azerouali*) and an almasaurid (*Almasaurus habbazi*).

Except for the derived and monogeneric Late Triassic Cyclotosaurinae represented by large to giant forms, all Cyclotosauridae are reported from the Middle Triassic (Anisian: Stenotosaurinae and Heylerosaurinae; Ladinian: Tatrassuchinae). The heylerosaurine from Argana supports an Anisian age for the upper Aglegal member and then supports the Middle Triassic age suggested by Characae (Porocharacae) and Ostracod faunas (Medina et al., 2001).

Further preparation (work in progress) of material available in collection will allow a better knowledge on the anatomy and the phylogenetic relationships of the Moroccan heylerosaurines.

The Permian to Upper Triassic (Carnian) beds of the Argana basin have a central position with regard to the Pangaea question. They provide, so far, the best record of the end-Paleozoic and Upper Triassic terrestrial vertebrates in the Northern part of Gondwana and have an important potential for studies on biogeographic distribution of the Permian and Triassic terrestrial vertebrates.

MEDINA F., VACHARD D., COLIN J.-P., OUARHACHE D.D & AHMAMOU M. 2001. Charophytes et ostracodes du niveau carbonaté de Taourirt Imzilen (Membre d'Aglegal, Trias d'Argana) ; implications stratigraphiques. *Bulletin de l'Institut scientifique, Rabat, section Sciences de la Terre*, 2001, n°23, 21-26. *Bulletin de l'Institut scientifique, Rabat, section Sciences de la Terre*, 2001, n°23, 21-26.

SCHOCH R.R. & MILNER A.R. 2000. *Encyclopedia of Paleoherpetology; Part 3B: Stereospondyli*, Verlag Dr. Friedrich Pfeil. München, 203 p.

A NEW PLOTOSAURINE MOSASAUR FROM THE UPPER MAASTRICHTIAN PHOSPHATE DEPOSITS OF MOROCCO

LeBLANC Aaron & CALDWELL Michael W.

University of Alberta Laboratory for Vertebrate Palaeontology, Department of Biological Science, University of Alberta, Edmonton, Alberta, Canada, T6G 2E9

The relationships of *Plotosaurus bennisoni* to other derived mosasaurs remain problematic due to the specialized morphology of the taxon and its apparent temporal and spatial restriction to the mid-Maastrichtian of the West Coast of North America. This “endemism” is made more curious by the recently described specializations of the axial and appendicular skeleton considered indicative of an open marine, pelagic lifestyle. We report on the morphology of a nearly complete mosasaur skeleton from the Maastrichtian deposits of the Oulad Abdoun phosphate basin of Morocco. This new specimen shares a number of features with the varied specimens assigned to *P. bennisoni* that are not shared with more basal mosasaurs. The new specimen includes a nearly complete vertebral column comprised of twenty pygal vertebrae, a pygal count rivaled only by *P. bennisoni*. It has been suggested that the expanded pygal region in *P. bennisoni* corresponds with a trend towards a more efficient thunniform swimming style. This, among other adaptations, has led to the notion that the body plan of *P. bennisoni* is convergent with that of early ichthyosaurs. A similar trend appears to have developed by the middle Maastrichtian in Morocco as well. The geographic and temporal disparity between *P. bennisoni* and the new Moroccan species has broad implications for the expansion of the pygal series within derived mosasaurs. The similarities in the axial skeletons of these two groups may be an example of multiple plotosaurine lineages converging on a similar swimming style, or the emergence of an evolutionary trend across two lineages that diverged earlier in the Late Cretaceous.



A COMPARISON OF LATE JURASSIC NARROW-GAUGE SAUROPOD TRACKWAYS FROM THE CENTRAL HIGH ATLAS (MOROCCO) AND THE JURA MOUNTAINS (NW SWITZERLAND)

MARTY¹ Daniel, BELVEDERE Matteo², MEYER Christian A.³, MIETTO Paolo² & THÜRING Basil³

¹Office de la Culture, Section d'archéologie et paléontologie, Paléontologie A16, Hôtel des Halles, C.P. 64, 2900 Porrentruy 2, Switzerland, daniel.marty@palaeojura.ch; ²Università di Padova, Dipartimento di Geoscienze, Via Giotto 1, 35137 Padova, Italy, matteo.belvedere@unipd.it, paolo.mietto@unipd.it; ³Naturhistorisches Museum, Augustinergasse 2, 4001 Basel, Switzerland, christian.meyer@bs.ch, basil.thuering@bs.ch

Sauropod trackways are generally classified according to their trackway width as narrow- and wide-gauge, and these categories are thought to have been left by basal (Diplodocidae) and more derived (Brachiosauridae and titanosauriform) sauropod dinosaurs, respectively. Nonetheless, a quantification of trackway gauge was only recently proposed by Romano et al. (2007) introducing the pes trackway ratio and by Marty (2008) introducing a ratio between the width of the pes angulation pattern and the corresponding pes track length. Narrow-gauge sauropod trackways from Morocco assigned to the ichnogenus *Breviparopus* Dutuit & Ouazzou 1980 do not show – contra all published outline drawings (e.g., Dutuit & Ouazzou, 1980; Ishigaki, 1989) – any evident toe or pollex impressions (Meyer & Monbaron, 2002; Belvedere, 2008). Depending on their preservational state, those from Switzerland may exhibit toe and/or claw impressions, and they are assigned to *Parabrontopodus* Lockley, Farlow & Meyer 1994 (e.g., Marty et al., 2003). Here, we compare Late Jurassic narrow-gauge trackways of different size classes from continental siliciclastic deposits of the central High Atlas and from carbonate-platform tidal-flat deposits of the Jura Mountains with respect to track preservation, track morphology, and trackway configuration (notably gauge). In doing so, we will highlight the influence of substrate properties, trackmaker behaviour (e.g., locomotion speed), and ontogenetic stage of the trackmakers on track morphology and trackway configuration. Finally, we will discuss the validity of the two ichnogenera, and – because *Breviparopus* may be restricted to the Gondwanan realm – their use in palaeo(bio)geographical reconstructions around the Tethys during the Middle to Late Jurassic.

- BELVEDERE M. 2008. *Ichnological researches on the Upper Jurassic dinosaur tracks in the Iouaridène area (Demnat, central High-Atlas, Morocco)*. Unpublished Ph.D. thesis, Università degli Studi di Padova, Padova, Italy.
- DUTUIT J.-M. & OUAZZOU A. 1980. Découverte d'une piste de dinosaure sauropode sur le site d'empreintes de Demnat (Haut Atlas marocain). *Mémoires de la Société géologique de France, nouvelle série*, 139: 95–102.
- ISHIGAKI S. 1989: Footprints of swimming sauropods from Morocco. in: GILLETTE, D.D. & LOCKLEY, M.G. (eds.), *Dinosaur tracks and traces*, Cambridge University Press, Cambridge: 421–425.
- LOCKLEY M.G., FARLOW J.O. & MEYER C.A. 1994. *Brontopodus* and *Parabrontopodus* ichnogen. nov. and the significance of wide- and narrow-gauge sauropod trackways. *Gaia*, 10: 135–146.
- MARTY D. 2008. *Sedimentology, taphonomy, and ichnology of Late Jurassic dinosaur tracks from the Jura carbonate platform (Chevenez—Combe Ronde tracksite, NW Switzerland): insights into the tidal-flat environment and dinosaur diversity, locomotion, and palaeoecology*. PhD Thesis University of Fribourg, GeoFocus, 21, 278 pp.
- MARTY D., CAVIN L., HUG W.A., MEYER C.A., LOCKLEY M.G. & IBERG A. 2003. Preliminary report on the Courtedoux dinosaur tracksite from the Kimmeridgian of Switzerland. *Ichnos*, 10: 209–219.
- MEYER C.A. & MONBARON M. 2002. Middle Jurassic dinosaur tracks from Morocco — Facts and fiction. *7th European Workshop on Vertebrate Palaeontology*, Sibiu (Romania), 2.-7.07.2002, abstracts volume and excursion field guide: 27.
- ROMANO M., WHYTE M.A. & JACKSON S.J. 2007. Trackway ratio: a new look at trackway gauge in the analysis of quadrupedal dinosaur trackways and its implications for ichnotaxonomy. *Ichnos*, 14: 257–270.



A SURFEIT OF THEROPODS IN THE MOROCCAN LATE CRETACEOUS?: COMPARING DIVERSITY ESTIMATES FROM FIELD DATA AND FOSSIL SHOPS

McGOWAN Alistair J.¹ & DYKE Gareth J.²

¹Leibniz Institute for Research on Evolution and Biodiversity at the Humboldt University Berlin, Museum für Naturkunde, Invalidenstrasse 43, Berlin D-10115, Germany, alandchristine@googlemail.com; ²School of Biology and Environmental Science, University College Dublin, Belfield 4, Dublin, Ireland, gareth.dyke@ucd.ie

The composition of the Kem Kem vertebrate fauna has been debated for more than 50 years; this sequence is the best-known package of dinosaur-bearing sediments from North Africa. In particular, people have spent a lot of time and energy speculating about whether recorded abundances of described taxa can be used to reconstruct the palaeoecology of the Kem Kem.

An unusually high proportion of large-bodied carnivorous theropod dinosaurs has been recorded from this sequence. Taking a numerical approach, we investigate whether, or not, recorded proportions of predator and prey taxa are real, or an artefact generated by collecting biases. To do this we compare field-collected data with counts of fossil vertebrates from Moroccan fossil shops. The application of common techniques for standardising ecological survey data confirm that previous workers have been misled by the acquisition by museums of many specimens from commercial collectors rather than detailed surveying and collecting.

Our findings strongly indicate a role for collecting biases, rather than unusual community assembly dynamics, as the source of the odd proportions of higher taxa in the Kem Kem. Other factors such as taphonomy also require further investigation. Collecting bias is likely due to commercial, rather than scientific, priorities. Such obvious biases must be accounted for before building scenarios that invoke non-analogue communities based on data that have not been vetted and statistically analysed. Hutton's (1795) remark about geological processes, "the present is the key to the past" is just as relevant to our current understanding of vertebrate palaeoecology.

STRATIGRAPHICAL AND PALAEOENVIRONMENTAL CHANGES IN SELACHIAN ASSEMBLAGES FROM A MAASTRICHTIAN SHALLOW MARINE CLASTIC SUCCESSION.

NICHOLLS Emma-Louise¹, UNDERWOOD Charlie J.¹, WARD David J.² & NOUBHANI Abdelmajid³

¹School of Earth Sciences, Birkbeck College, Malet Street, London WC1E 7HX, UK, ptychodus@googlemail.com; c.underwood@bbk.ac.uk; ²Crofton Court 81 Crofton Lane, Orpington Kent, BR5 1HB UK, david@fossil.ws; ³Chouaib Doukkali University, Faculty of Sciences, Geology Department, Lab. Geosciences & Techniques of Environment, P.O. Box 20 El Jadida, Morocco, noubhani2002@yahoo.fr

Systematic sampling through an expanded late Cretaceous section in the western Atlas of Morocco has recovered selachian remains from within facies varying from mid shelf to inner shoreface. 50 vertebrate-rich levels were sampled from 240 metres of section, with teeth and other remains of over 50 species of sharks and rays being recovered. These assemblages show considerable variation, due to a combination of both biostratigraphic changes and changes in palaeoenvironment. Stratigraphical changes are especially well seen within the rhombodontid rays and the genus †*Coupatezia*, where replacement by successive species is seen through the section. Changes in assemblage structure with changing water depth are also marked. Shoreface facies, often associated with hummock cross stratification, contain low diversity assemblages dominated by small-toothed batoids and small †*Serratolamna*, often associated with common chelonian remains. In more offshore facies, other batoids, especially rhombodontids, typically dominate and †*Schizorhiza* and †*Dalpiazia* are often common, along with larger †*Serratolamna* species. Highest diversity assemblages are present in the most offshore facies, with pelagic predatory anacoracids and small nectobenthic sharks becoming frequent.



THE SELACHIANS FAUNAS OF THE MOROCCAN PHOSPHATE DEPOSITS AND THE K/T MASS-EXTINCTIONS

NOUBHANI Abdelmajid

Chouaïb Doukkali University, Faculty of Sciences Lab. Geosciences & Techniques of Environment, P.O. Box 20 El Jadida – Morocco, noubhani2002@yahoo.fr, noubhani@ucd.acma

The Moroccan phosphate deposits, which extend for more than 25 My (early Maastrichtian - Lower Lutetian), are well known for their rich fossil archives. The Selachian fishes constitute the most abundant and varied vertebrate faunas, and their account is far from being closed despite the extensive amount of work and effort conducted on them. The recent revision led to describe many new genera and species which has improved our knowledge and changed the picture of evolution of such very successful group (Noubhani, 1993; Noubhani & Cappetta, 1992-2001).

Analysis of the dynamics and patterns of extinctions and faunal renewals allowed to the identification of two significant episodes of high rate extinction. A mass-extinctions event took place at the end of the Maastrichtian (K/T boundary), when more than 95% of species disappeared. The Lower Ypresian witnessed a second, selective, event which appears to have mainly affected sharks. The Causes of these events have been examined in the light of geochemical data suggesting severe environmental changes.

The paleobiogeographic significance of these faunas within the phosphate basins was clarified. Comparison of the Moroccan faunas with contemporaries from other regions of the world has shown that the faunal exchange was maintained permanently during this extensive period of time around the Tethyan sea.

Key words: Vertebrates, Selachians, Paleobiogeography, Evolution, Extinctions, Faunal renewal, K/T boundary, Phosphate deposits, Morocco.

LA PALEOICHOLOGIE DES EMPREINTES DE PAS DE DINOSAURIENS DANS LE JURASSIQUE DU HAUT-ATLAS CENTRAL

NOURI Jaouad¹, BOUTAKIOUT Mohamed¹, PEREZ-LORENTE Félix² & ENNADIFI Y.³

¹Faculté des Sciences. Université Mohamed V. Avenue Ibn Batota. Rabat-Agdal. Maroc, APPGM; ²Universidad de La Rioja. Madre de Dios 51-53. E-26006 Logroño, España, APPGM; ³Holcim Maroc, APPGM

Le Haut-Atlas central du Maroc constitue une zone privilégiée pour l'étude ichnologique des empreintes de pas des dinosaures Jurassiques.

L'analyse ichnologique a été réalisée à partir de l'étude de trois secteurs : Aït Bou Guemmez avec six gisements du Lias, Bin El Ouidane avec trois gisements du Dogger, Iouaridène avec douze gisements du Malm.

L'ichno-taxinomie a conduit à reconnaître cinq groupes d'empreintes de pas dans le Haut-Atlas central :

- * les petits théropodes «Coelurosauriens» se distinguant par des empreintes allongées et effilées de petite taille qui ne dépassent guère 25 cm de longueur ;

- * les grands théropodes «Carnosauriens» caractérisés par de grandes empreintes allongées, robustes et portant des doigts massifs, articulés et terminés par des griffes crochues à l'intérieur de la piste ;

- * les Mégalosauriens tétradactyles et digitigrades qui se différencient par l'intégration du hallux dans l'enveloppe de l'empreinte ;

- * les ornithopodes dont l'autopode subcirculaire mesure autant de longueur que de largeur, les empreintes sont digitigrades et tridactyles avec un coussinet par doigt ;

- * les sauropodes forment des pistes quadrupèdes (pied/main) avec des traces ovales, les empreintes antérieures sont davantage écartées vers l'extérieur de la piste par rapport à celles des empreintes postérieures, l'ichnogenre le plus reconnu est *Breviparopus* ou *Parabrontopodus*.



THE NORTH AFRICAN MOSASAUR *GLOBIDENS PHOSPHATICUS* FROM THE MAASTRICHTIAN OF ANGOLA

POLCYN Michael J.¹, JACOBS Louis L.¹, SCHULP Anne S.² & MATEUS Octávio^{3,4}

¹Huffington Department of Earth Sciences, Southern Methodist University, Dallas, TX, USA, mpolcyn@smu.edu; jacobs@smu.edu; ²Natuurhistorisch Museum Maastricht, de Bosquetplein 6 - 7, NL-6211 KJ Maastricht, The Netherlands, anne.schulp@maastricht.nl; ³Museu da Lourinhã, Lourinhã, Portugal, ⁴Universidade Nova de Lisboa, Centro de Estudos Geológicos da Faculdade de Ciências e Tecnologia, Monte de Caparica, Portugal, omateus@museulourinha.org

New mosasaur fossils from Maastrichtian beds at Bentiaba, Angola, representing most elements of the skull and a large portion of the postcranial axial skeleton from two individuals of the durophagous genus *Globidens*, are presented. Based on dental morphology, specifically the inflated posterior surface and vertical sulci, the Bentiaba specimens are identified as *G. phosphaticus*, a species defined by characters of a composite dentition from the Maastrichtian of Morocco. By comparison with the Angolan material of the species, *G. phosphaticus* is most closely related to *G. schurmanni*, the youngest North American *Globidens* species, known from a single complete but poorly preserved skull with some postcrania from the Late Campanian of South Dakota. *G. phosphaticus* shares with *G. schurmanni* a broad short frontal bearing a strong anterior median ridge with smaller anterolaterally radiating ridges and reduced marginal tooth count, but is autapomorphic in that the maxillae meet at the midline anteriorly, obscuring the internarial process of the premaxilla in dorsal view. In addition, *G. schurmanni* is distinct from *G. phosphaticus* in having an unusually broad suprastapedial process of the quadrate, accessory flange on posterodorsolateral squamosal, and distinct morphology of the marginal dentition. There are at least six genera of mosasaurs known from Bentiaba that are also known from Europe or North America, demonstrating the broad latitudinal distribution of Late Campanian and Maastrichtian mosasaurs in general. The presence of *G. phosphaticus* at Bentiaba demonstrates the validity of this taxon and its wide distribution in North and West Africa.

JURASSIC DINOSAUR TRACKS FROM THE REPUBLIC OF YEMEN

SCHULP Anne S.¹, AL-WOSABI Mohammed², ABU HARRASH Salah³ & STEVENS Nancy J.⁴

¹Natuurhistorisch Museum Maastricht, De Bosquetplein 6-7, NL6211KJ Maastricht, The Netherlands; ²Department of Geology, Sana'a University, Sana'a, Republic of Yemen; ³Jamiyah Sarwah-Arhab Athar (Archaeological society of Sarwah-Arhab), Madar, Republic of Yemen; ⁴Department of Biomedical Sciences, College of Osteopathic Medicine, Ohio University, Athens, Ohio, USA

The Madar Tracksite, fifty kilometers north of Sana'a is the only dinosaur tracksite described thus far from the Arabian Peninsula (Schulp et al., 2008). Additional dinosaur tracks and trackways have now been mapped in the greater Madar area. The age of the track-bearing limestone strata is constrained biostratigraphically to Callovian or Bathonian to Berriasian age. The track horizons may correlate with the *Alveosepta jaccardi* foraminiferal biozone of Oxfordian-Kimmeridgian age.

Two different ichnotaxa have been described so far from near Madar village: eleven parallel trackways of a sauropod herd, and a single trackway of an unusually large ornithopod (Schulp et al., 2008). Eight additional sites preserving tracks or trackways have subsequently been recognized in the wider area by local villagers. The Archaeological Society of Sarwah-Arhab (Jamiyat Atahr Sarwah-Arhab) compiled an inventory of the outcrops, and excavated additional trackways. Of note is the new trackway at the Al-Nejer site, an elongate, bipedal trackway of uncertain affinity, consisting of at least 11 consecutive tridactyl tracks, five of which are recognizable but poorly preserved, and the remaining six preserving only indistinct impressions. The tracks, up 90 cm long, 50 cm wide, and distributed at a more or less constant pace length of 170 cm, are characterized by a remarkably long hallux, and blunt, rounded toes. Many dinosaur tracks in the Madar localities are remarkably well-preserved. Fieldwork performed so far suggests that the region holds much promise for further discoveries. The Yemen Geological Survey has implemented measures to protect the exceptionally well-preserved ornithopod trackway.

SCHULP A.S., AL-WOSABI M. & STEVENS N.J. 2008. First Dinosaur Tracks from the Arabian Peninsula. *PLoS ONE* 3(5): e2243. doi:10.1371/journal.pone.0002243.



NEW CRETACEOUS CROCODYLOMORPHS FROM MOROCCO AND NIGER

SERENO Paul C.

Department of Organismal Biology and Anatomy, University of Chicago, Chicago, IL, 60637, USA, dinosaur@uchicago.edu

The paleobiogeographic relation between Africa and other southern continents is particularly interesting during the Cretaceous period, during the initial phase of the break-up of Gondwana. The African record of crocodylomorphs during the Cretaceous is reviewed and compared to the better known record on South America.

Two new species from the Lower Cretaceous Tiouraren Formation in Niger include a protosuchid similar to *Edentosuchus* and a goniopholidid similar to *Sunosuchus*. Middle Cretaceous (Aptian-Albian) crocodylomorphs from Niger is based on well preserved material from the EIRhaz Formation that pertains to the *Sarcosuchus*, the peirosaurid *Stolokrosuchus*, and two notosuchians *Anatosuchus* and *Araripesuchus*. Three new species are from early Upper Cretaceous (Cenomanian) formations in Niger and Morocco. These include a crocodylomorph with a very low skull similar to *Stomatosuchus*, which is known from closely related species in Morocco and Niger. Another species with enigmatic relationships based on a complete skull has xiphodont teeth with prominent opposing caniniforms. The third species is small and has a pair of enlarged procumbent incisors at the anterior end of its dentary similar to the derived Brazilian notosuchian *Mariliasuchus*.

This updated crocodylomorph record for the Africa Cretaceous includes several species with close relationships to South American taxa and questions break-up scenarios that posit the early isolation of Africa.

DEPOSITIONAL AND CLIMATIC SETTING OF THE UPPER TRIASSIC TEMNOSPONDYL-BEARING STRATA OF THE IROHALENE MUDSTONE IN ARGANA BASIN (WESTERN HIGH ATLAS, MOROCCO)

TOURANI Abdelilah & BENAOUISS Naïma

Laboratoire "Géologie des bassins sédimentaires marocains"; Département de Géologie; Faculté des Sciences Semlalia; B.P. : 2390; Marrakech -Maroc, tourani@ucam.ac.ma, benauouiss@ucam.ac.ma

The Upper Triassic Irohalene mudstone of Argana basin preserve semi- to fully-articulated specimens of the metoposaurid *Dutuitosaurus ouazzoui* (Gisement XIII of Dutuit, 1976), which have aquatic lifestyle with seasonal changes in the local environment (Steyer et al., 2004). We assume that this locality represent the environment in which the temnospondyl lived. Sedimentologic analysis indicates ponds facies filling isolated depressions, in margins of playa lake environment and recording cyclical wetting and drying under semi-arid to arid climate. The temnospondyl-bearing cycle is characterized by fine rippled and burrowed sandstone representing marginal pond, overlain by perennial freshwater pond intermittently dry thin-bedded non mudcracked mudstone, which is brecciated in its upper part and contains conchostracans and vertebrate skeletons. The upper part of the cycle display red to purple massive mudstone which show pseudo-anticlines and carbonate nodules that indicate dry to vegetated playa mudflat. The mass-death (Dutuit & Heyler, 1983) of the metoposaurid *Dutuitosaurus ouazzoui* is a consequence of subaerial exposure and drying up of the perennial pond bottom.

DUTUIT J.M. 1976. Introduction à l'étude paléontologique du Trias continental marocain. Description des premiers Stégocéphales recueillis dans le couloir d'Argana (Atlas occidental). *Mém. Mus. natn. Hist. nat.* 36, 1-253.

DUTUIT J.M. & HEYLER D. 1983. Taphonomie des gisements de Vertébrés triasiques marocains (couloir d'Argana) et paléogéographie. *Bull. Soc. géol. France* 25(4), 623-633.

STEYER J.S., LAURIN M., CASTANET J. & de RICQLES A. 2004. First histological and skeletochronological data on temnospondyl growth; palaeoecological and palaeoclimatological implications. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 206: 193-201.



BATOIDS FROM THE TURONIAN OF SE MOROCCO

UNDERWOOD Charlie J.¹, CLAESON Kerin M.² & WARD David J.³

¹School of Earth Sciences, Birkbeck College, Malet Street, London WC1E 7HX, UK, c.underwood@bbk.ac.uk; ²The Jackson School of Geosciences, The University of Texas at Austin, 1 University Station C1100, Austin, Texas 78712 USA, kclaeson@mail.utexas.edu; ³Crofton Court 81 Crofton Lane, Orpington Kent, BR5 1HB UK, david@fossil.ws

The Middle Turonian of the Goulmima region, SE Morocco yields abundant and exceptionally well-preserved fossils from at least two levels of concretions in a marl unit within an otherwise shallow water to peritidal carbonate succession. Most concretions contain ammonites and occasionally teleost fish. Marine reptiles are rare, published chondrichthyan material is limited to isolated teeth of the batoid †*Ptychotrygon*. Skeletal remains of batoids are, however, present and represent some of the most completely preserved chondrichthyans known from the Mesozoic.

A rhinobatid-grade skate is represented by a 3-dimensional skeleton, preserved uncrushed within a carbonate concretion. This nearly complete specimen lacks only distal extremities. Manual preparation of the ventral surface, along with CT scanning of the entire specimen, has revealed many characters of taxonomic importance including slender mandibular arch cartilages in full articulation and a synarcual, or an elongate series of fused vertebral bodies. In addition, well preserved teeth and denticles have been extracted.

A second batoid taxon is represented by parts of the cranial and proximal postcranial skeleton of a large sclerorhynchid, which is currently under preparation. An isolated synarcual is also referred to this latter taxon. At least one additional batoid species is known to be present, with a small sclerorhynchid skeleton known to be in a private collection.

The taxonomic significance of these specimens will be discussed, as well as the unusual palaeoecological context of the material.

A NEW ELASMOSAURID PLESIOSAUR (SAUROPTERYGIA) FROM THE MAASTRICHTIAN (LATEST CRETACEOUS) PHOSPHATES OF MOROCCO

VINCENT Peggy¹, BARDET Nathalie¹, PEREDA SUBERBIOLA Xabier², BOUYA Baâdi³, AMAGHZAZ Mbarek³ & MESLOUH Saïd⁴

¹CNRS UMR 7207, Dépt. HDT, MNHN, 8 rue Buffon, 75005 Paris, pvincent@mnhn.fr, barDET@mnhn.fr; ²Depto. Estratigrafía y Paleontología, Facultad de Ciencia y Tecnología, Universidad del País Vasco / EHU, Apto. 64, 48080 Bilbao, xabier.pereda@ehu.es; ³Office Chérifien des Phosphates, Centre Minier de Khouribga, Khourigba, b.bouya@ocpgroup.ma, m.amaghazaz@ocpgroup.ma; ⁴Ministère de l'Energie, des Mines, de l'Eau et de l'Environnement, Quartier Agdal, Rabat, Morocco, meslouh.said@caramail.com

The vertebrate faunas from the phosphates of Morocco are known since the pioneer work of Arambourg (1952). The faunas are mainly marines and represented by selachians, bony fishes and reptiles. Among the marine reptiles, the most abundant and diversified are the Maastrichtian mosasaurid squamates and the miroiring Palaeogene dyrosaurid crocodyliformes and bothremydid turtles.

Though these phosphates are very rich in marine vertebrate assemblages, plesiosaur specimens remain exceptional. The only hitherto recognised plesiosaur species from the Maastrichtian phosphates of Morocco was *Plesiosaurus mauritanicus* Arambourg, 1952, which identification was based on isolated teeth and vertebrae. Recent fieldworks in the Late Maastrichtian fossiliferous strata led to the discovery of diagnostic cranial remains of a new elasmosaurid plesiosaur.

The new material, though somewhat crushed and displaced, consists of a beautifully preserved, sub-complete skull that includes a complete palate and mandible. The unique combination of synapomorphies that characterizes the specimen indicates that it belongs to a new genus and species. Among this distinctive suite of characters, the general shape and organisation of the palate are particularly unusual compared with other elasmosaurid taxa. Moreover, the specimen bears four pairs of dentary teeth on the symphysis, a combination that is absent in all Jurassic and Cretaceous plesiosaur taxa but *Microcleidus homalospondylus*. Phylogenetic analysis of elasmosaurids incorporating the new taxon indicates that it has



close affinities with North American Elasmosauridae. This new genus and species completes our understanding of the Late Cretaceous plesiosaur biodiversity and will provide a useful basis for future palaeobiogeographic reconstructions.

ALBIAN-CENOMANIAN VERTEBRATE FAUNA FROM NORTH AFRICA: REVIEW AND RELATIONSHIPS WITH SOME OTHER MID-CRETACEOUS FAUNAS

VULLO Romain

Laboratoire de Paléontologie, Géosciences, UMR 6118, Université de Rennes 1, 263 avenue du Général Leclerc, 35042 Rennes cedex, France, romain.vullo@gmail.com

Albian-Cenomanian continental to paralic siliciclastic deposits of North Africa are famous for their rich and diverse vertebrate assemblages. Originally termed as the Saharan “Continental Intercalaire”, these red sandstone beds crop out in Morocco, Algeria, Tunisia, Libya, Egypt, Mali, Niger and Sudan. Various coeval or nearly coeval formations have been recognized, such as the Kem Kem beds in Morocco or the Bahariya Formation in Egypt. Since the pioneer works of Stromer, Lavocat, or Lapparent, vertebrate remains have been intensively collected and studied, and the taxonomic composition of this fauna is now well known. Associated to a rich ichthyofauna (both selachians and bony fishes), all tetrapod groups (amphibians, reptiles, birds, and mammals) are represented. However, tetrapod assemblages are mostly dominated by turtle, crocodyliform, and dinosaur remains, with some variations in the faunal composition between the different formations (according to their palaeogeographic, palaeoenvironmental, and taphonomic conditions).

Cretaceous vertebrate-bearing beds of sub-Saharan Africa (Malawi, Tanzania) show affinities with North African localities, but are somewhat older (?Aptian). In the northern margin of Gondwana, the Albian-Cenomanian fauna from North Africa can be compared to the fauna of similar age recovered from the Alcântara Formation in Brazil. Outside Gondwana, the most similar vertebrate assemblage has been found in the Cenomanian beds of Charentes in France. With its peculiar faunal features, the Charentes region seems to have been like a small Gondwanan enclave. Faunal exchanges may have occurred at the end of the Early Cretaceous between North Africa (Morocco) and Charentes, probably via the Iberian Peninsula.

LATE CRETACEOUS ACTINOPTERYGIAN FISHES FROM MOROCCO

WILSON Mark V.H.¹, MURRAY Alison M.¹, CHATTERTON Brian D.E.² & GIBB Stacey²

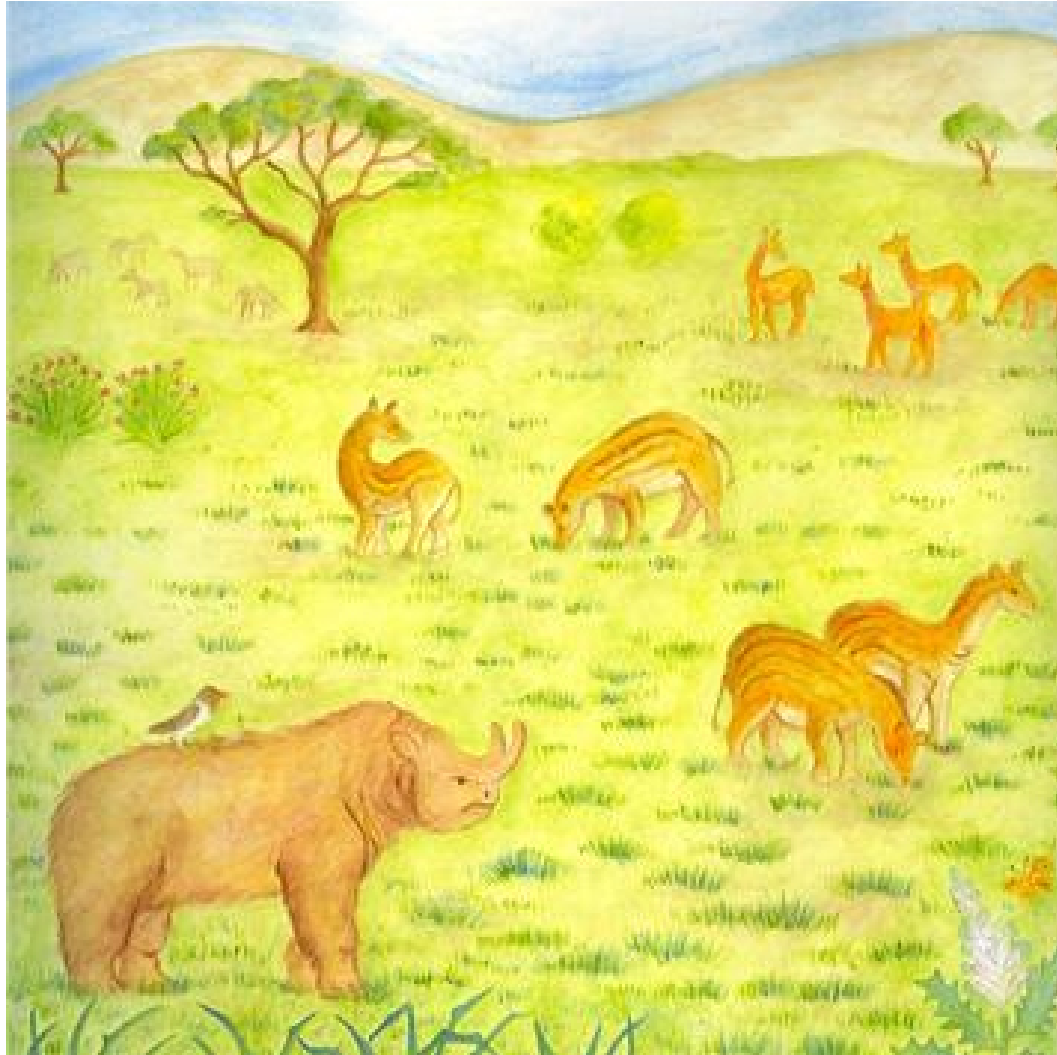
¹Department of Biological Sciences, mark.wilson@ualberta.ca; ammurray@ualberta.ca; ²Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton AB T6G 2E9, Canada, bchatter@ualberta.ca; sgibb@ualberta.ca

Actinopterygian fishes have recently been recovered from a new locality in Late Cenomanian or Turonian deposits of southeastern Morocco, from the northwestern margin of the Kem-Kem Plateau. Many of the new specimens were collected in the field on site, and are thus from a known outcrop and stratigraphic position. Additional material was obtained from local collectors also on site. These fossils occur in marine carbonates of the Akrabou Formation, which overlies the freshwater Kem Kem Beds. The outcrop demonstrates fluctuating $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ levels throughout, indicating that diagenetic processes have not destroyed the original stable-isotopic signal. The $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ levels of the fish-bearing layer indicate that the fishes and substrate were deposited in a normal marine setting.

The new assemblage is similar to a small ichthyofauna reported earlier from Oued Daoura, about 50 km from the present locality. The ichthyofauna is generally similar at the familial level to that of marine Cenomanian and Turonian sites long known from Lebanon and from Jebel Tselfat in northern Africa, but includes elements (e.g., Macrosemiidae) that had not previously been reported from deposits of this age in the Tethys basin or from northern Africa. Taxa represented include a new genus and species of macrosemiid, a pycnodont, at least two different paraclupeids, a dercetid, a euteleost (*Lusitanichthys africanus*), and an acanthomorph. Some of these taxa, such as the Dercetidae, are essentially circum-Tethyan; however, others, such as the Paraclupeidae, are known from Cretaceous deposits worldwide, including Mexico, Europe, Canada and China.



PRÉSENTATIONS ORALES : CÉNOZOÏQUE
/
ORAL PRESENTATIONS: CENOZOIC



Estampe, Natsumi KINEFUCHI ©



LES SQUAMATES (LACERTILIA - SERPENTES) DU NEOGENE ET DU QUATERNAIRE DU MAROC.

BAILON Salvador

UMR 7209-USM 303 du CNRS, Département Ecologie et Gestion de la Biodiversité, Anatomie Comparée CP 55, 55 rue Buffon, 75005, Paris, France, salvador.bailon@mnhn.fr

L'ensemble des données fossiles concernant les faunes de lacertiliens et de serpents du Néogène et du Quaternaire du Maroc sera présenté. Il concerne moins d'une dizaine de localités d'âges divers (Miocène moyen, Pliocène terminal, Pléistocène supérieur et Holocène) et à localisation géographique éparse [Maroc occidental, région de Tadla-Azilal et Maroc atlantique (entre les régions de Rabat et de Doukkala)].

Depuis le Miocène moyen, les familles et les genres représentés au Maroc sont de type moderne. Parmi ceux-ci, seul le genre *Python*, représenté au Miocène moyen par l'espèce fossile *P. maurus*, n'est plus actuellement présent au Maroc. D'autres genres (*Trogonophis*, *Naja* et « *Vipera* »), encore présents au Maroc aujourd'hui, sont représentés par des espèces actuellement éteintes : *T. darelbeidae* du Pliocène terminal d'Ahl Al Oughlam et *N. antiqua* et « *Vipera* » *maghrebiana* du Miocène Moyen de Beni Mellal.

Au Miocène moyen, la faune de squamates semble montrer un cachet nord-africain prononcé et différent de celui du Miocène européen, tandis qu'à partir du Pliocène terminal, des taxons communs entre les deux continents apparaissent.

THE IMPORTANCE OF THE AIT KANDOULA BASIN IN THE CHRONOLOGY OF THE CONTINENTAL NEOGENE OF MOROCCO

BENAMMI Mouloud¹ & BENAMMI Mohamed²

¹Institut International de Paléoprimateologie, Paléontologie Humaine (IPHEP), UMR CNRS 6046 - Bât Sci. Naturelle, 40 av. Recteur Pineau - F86022 Poitiers Cedex, mouloud.benammi@univ-poitiers.fr; ²Université Ibn Tofail, Faculté des Sciences, Département de Géologie, Laboratoire Interdisciplinaire en Ressources Naturelles et Environnement "LIRNE", B.P : 133, Kenitra, 14000, Maroc, benammim@hotmail.com

A detailed chronology for the Middle to Late Miocene continental record in the Ait Kandoula Basin is presented based on high-resolution magnetostratigraphic data of mammal-bearing sections that were studied in several localities. The magnetostratigraphy of four individual sections, covering the entire Ait Kandoula Formation, provides good correlation with the Geomagnetic Polarity Time Scale (GPTS). Our results indicate that these sections compose an almost complete magnetostratigraphic succession from the Middle Miocene MN6 (Astarasian) to the Lower Ruscinian MN14. The oldest locality Azdal occurs in chron C5AA_n with a corresponding age of about 13 Myr. Four localities in the upper part have yielded western European species of micromammals, indicating transmediterranean terrestrial faunal exchanges between these two continents during the Late Miocene. The magnetostratigraphic data suggest therefore that the beginning of terrestrial faunal exchanges between North Africa and Western Europe took place in subchron C3An.1n, at about 6.1 Myr, some 0.4 Myr before the beginning of the Messinian salinity crisis. Ait Kandoula sequence provide now reliable continental references for the Middle to Upper Miocene of Morocco. Additional work on other sections in the surrounding areas, and magnetostratigraphic correlations with other fossiliferous localities are required.



LA GRANDE FAUNE DU PLEISTOCENE SUPERIEUR DE LA GROTTTE DES GAZELLES A TAMARIS I (CASABLANCA, MAROC) : PALEOENVIRONNEMENT, BIOCHRONOLOGIE ET TAPHONOMIE

BOUGARIANE Bouchra¹, ZOUHRI Samir¹, OUCHAOU Brahim², OUJAA Aicha¹ & BOUDAD Larbi³

¹Laboratoire de Géosciences, Département de Géologie, Facultés des Sciences, Aïn Chock – Casablanca, bouchra_bougariane@yahoo.fr ; ²Département de Géologie, Faculté des Sciences, Meknès ; ³Département de Géologie, Faculté des Sciences et Techniques, Errachidia

La grotte des gazelles à Tamaris I de la région de Casablanca, a été découverte suite à des travaux de construction. Elle se présente sous forme d'une poche de dissolution creusée dans des calcarénites marines du « Membre de Aïn Roummana » avec un remplissage continental (Membre de Lahlalfa) d'âge Pléistocène supérieur.

Les Herbivores sont largement dominés par les Gazelles d'où le nom du site. Les chevilles osseuses indiquent la présence de *Gazella atlantica*, *Gazella cuvieri* et *Gazella dorcas*. Les autres taxons herbivores appartiennent aux Equidés (*Equus* sp.), Suidés (*Sus scrofa*), Alcélapinés (*Alcelaphus buselaphus* et *Connochaetes taurinus*), Bovinés (*Bos primigenius*) et Caprinés (*Ammotragus lervia*). Il est à noter aussi la présence de quelques restes de rhinocéros (*Ceratotherium simum*). Six espèces de Carnivores ont été également soulignées : *Canis aureus*, *Canis* sp., *Vulpes vulpes*, *Hyaena hyaena*, *Crocuta crocuta* et *Panthera pardus*.

Le matériel découvert dans la grotte des gazelles a permis d'avoir une idée plus exhaustive sur le canidé de grande taille (*Canis* sp.) régulièrement signalé dans de nombreux sites préhistoriques d'Afrique du Nord mais jamais formellement caractérisé.

Ce matériel a permis aussi de confirmer la présence au Pléistocène supérieur du mouflon à manchettes, dans le littoral marocain, considéré auparavant comme étant confiné aux montagnes.

Cette association faunique témoigne d'un paysage de savane sous un climat tempéré et humide. Le remplissage de la grotte est dû à une action naturelle, les taxons déterminés sont probablement représentatifs du spectre faunique de la région à cette époque.

ETAT DES RECHERCHES SUR LA FAUNE DE MAMMIFERES PLIO-PLEISTOCENE ET HOLOCENE D'ALGERIE

CHAÏD SAOUDI Yasmina

Institut d'Archéologie - Université d'Alger, 19 avenue Boubella Mohammed, 16035 – Alger, Algérie, chaid_saoudi@yahoo.fr

A la suite des grandes synthèses paléontologiques du siècle dernier sanctionnées par la découverte d'un très grand nombre d'espèces, les recherches entreprises actuellement sur les mammifères quaternaires tendent à apporter des additifs d'ordre taxonomique qui soulèvent pour nous des interrogations liées à la chronostratigraphie quaternaire.

Ainsi, parmi la faune du site Pléistocène inférieur de Mansourah, des espèces telles que *Kolpochoerus cf maroccanus* et *Tragelaphus cf gaudryi*, témoignent d'une évolution phylétique locale qui semble différente de celle que l'on connaisse dans le reste de l'Afrique et qui est synchrone d'une limitation de la diversité à l'intérieur de l'assemblage faunique considéré.

La catégorisation entreprise sur le site de Mansourah par le biais d'histogrammes écologiques puis élargie aux autres sites pliocènes et pléistocènes met l'accent sur une similitude des groupes taxonomiques de Aïn Boucherit (Villafranchien ancien), Aïn Hanech (Villafranchien supérieur, Pléistocène inférieur) et Mansourah (Pléistocène inférieur), sur leur moindre diversité alimentaire et locomotrice et leur taux de renouvellement insignifiant sur le plan générique. Ceci nous amène à reconsidérer la coupure Plio-Pléistocène établie autour de 1,8 million d'années.

Par ailleurs, la révision du matériel habituellement attribué à *Equus mauritanicus*, a nié la présence de ce dernier dans les niveaux du Pléistocène supérieur et de l'Holocène, donnant ainsi à cette espèce une



signification biostratigraphique plus limitée, intimement liée au Pléistocène moyen. Ce niveau s'individualise de plus en plus en tant que biozone.

Mots clefs : Faune - Algérie - Mammifères – Plio-Pléistocène – Holocène - mammifères – Bio chronologie – Sites préhistoriques

NEOGENE VEGETATION AND CLIMATE IN NORTHERN AFRICA AND SOUTHERN IBERIAN PENINSULA: WHAT PALEOENVIRONMENTS FOR ANIMALS?

FAUQUETTE S.¹, FEDDI N.², JIMENEZ-MORENO G.³, SUC J.-P.⁴, WARNY S.⁵, BACHIRI TAOUFIQ N.⁶, BARHOUN N.⁷ & SAFRA A.⁸

¹Institut des Sciences de l'Evolution (UMR CNRS 5554), CC 061, Université de Montpellier 2, 34095 Montpellier cedex 5, France, severine.fauquette@univ-montp2.fr; ²Laboratoire « Biodiversité & Dynamique des Ecosystèmes », Dépts. Géologie et Biologie, Faculté des Sciences Semlalia, Université Cadi Ayyad, Marrakech, Maroc, feddi@ucam.ac.ma; ³Departamento de Estratigrafía y Paleontología, Universidad de Granada, Fuente Nueva S/N, 18002, Granada, Spain, gonzaloj@ugr.es; ⁴Laboratoire PaléoEnvironnements et PaléobioSphère (UMR CNRS 5125), Université Claude Bernard - Lyon 1, boulevard du 11 Novembre, 69622 Villeurbanne cedex, France, jean-pierre.suc@univ-lyon1.fr; ⁵Museum of Natural Science and Department of Geology and Geophysics, Louisiana State University, 109 Howe-Russell Building, Baton Rouge, LA 70803, USA; ⁶Département de Géologie, Faculté des Sciences de Ben M'Sik, Université Hassan II – Mohammedia, BP 7955 Sidi Othmane, Casablanca, Morocco bachinai@yahoo.fr; ⁷Département de Géologie, Faculté des Sciences de Ben M'Sik, Université Hassan II – Mohammedia, BP 7955 Sidi Othmane, Casablanca, Morocco nbarhoun@yahoo.fr; ⁸Laboratoire de Géologie Structurale et Appliquée, Faculté des Sciences, Université El Manar, 1060 Tunis, Tunisia

Mid-Miocene to Upper Pliocene pollen data from the south-western Mediterranean area (Southern Spain, Morocco and Tunisia) allowed for the reconstruction of vegetation and climate evolution during a global cooling context.

During the Miocene in this area, an *Avicennia* mangrove persisted on the coastline and a sub-desertic herbaceous environment (abundance of subdesertic elements, such as *Nitraria*, *Lygeum*, *Prosopis*, *Neurada*, *Calligonum*) lived at low altitude, indicating very dry and warm conditions. Forests composed of subtropical to warm-temperate plants developed at higher altitude. A dry subtropical climate is interpreted from the pollen data, which is in accordance with previous climatic interpretations for the Early Miocene based on fossil mammals. During the Tortonian, tropical plants (in particular *Avicennia*) tended to disappear in Southern Spain but were still present in Morocco. Pollen data still indicate open subdesertic vegetation dominated by herbs and shrubs. For what concerns the Messinian, pollen data indicate that open and dry environments existed in the southern Mediterranean region prior to, during and after the Messinian Salinity crisis. Climatic quantifications from pollen data do not show obvious climatic changes due to the desiccation of the Mediterranean Sea. During the Pliocene, the continuous decrease in thermophilous plants, to the benefit of warm-temperate and altitudinal trees, can be interpreted as a result of the above-mentioned climatic cooling. However, pollen data still characterise open dry environments. During the Middle Pliocene, pollen data show a strong development of *Artemisia* steppes in the Iberian Peninsula and Morocco and the development of *Cedrus* forests in Morocco. These vegetation changes may be linked to climatic change and coincide with similar vegetation changes in Northwestern Mediterranean area. These modifications were probably forced by the appearance of the first arctic glacial-interglacial cycles.



LES FAUNES DE MAMMIFERES DU PLIOCENE ET DU PLEISTOCENE DE CASABLANCA

GERAADS Denis¹, RAYNAL Jean-Paul² & SBIHI-ALAOUI Fatima-Zohra³

¹CNRS UPR 2147, 44 rue de l'Amiral Mouchez, F 75014 Paris, denis.geraads@evolhum.cnrs.fr; ²Université de Bordeaux 1, Sciences et Technologies, UMR 5199 PACEA, IPGQ, avenue des Facultés, F-33405 Talence Cedex; ³Institut National des Sciences de l'Archéologie et du patrimoine, Hay Riad, Madinat Al Irfane, Angle rues 5 et 7, Rabat-Instituts, 10 000 Rabat

Grottes et fissures dans les dépôts littoraux de Casablanca sont riches en remplissages fossilifères. Longtemps attribués au seul Quaternaire, ils remontent en fait au Mio-Pliocène. Les principaux jalons sont :

1) Lissasfa, proche de la limite Mio-Pliocène, pauvre en grande faune, mais riche en rongeurs témoignant d'échanges avec l'Europe.

2) Ahl al Oughlam. Ce site du Pliocène terminal est le plus riche du Maghreb ; il n'a livré aucun reste humain, mais une centaine d'espèces de Vertébrés : amphibiens, reptiles, 24 oiseaux, et près de 60 mammifères (dont 23 carnivores, principaux accumulateurs d'ossements, mais seulement 6 rongeurs). L'absence d'*Equus* repousse le gisement au-delà de 2,3 Ma, mais carnivores et ongulés indiquent un âge à peine supérieur. Les rongeurs sont bien distincts de ceux d'Afrique orientale, à l'inverse des ongulés, dont les similitudes démontrent l'absence de barrière saharienne continue et permanente à cette époque. La rareté des primates, l'abondance des antilopes de milieux ouverts, la présence de taxons "froids", la faible diversité taxonomique dans plusieurs groupes, suggèrent un milieu à dominante steppique.

3) Carrières Thomas – Oulad Hamida. Leur succession stratigraphique complexe renferme plusieurs niveaux archéologiques fossilifères. Le plus ancien a plus de 1 Ma, les plus riches ont autour de 500.000 ans. Leurs assemblages fauniques témoignent d'un milieu très ouvert.

4) Au Pléistocène supérieur, la baisse de diversité des rongeurs et la prédominance écrasante des gazelles reflètent une nouvelle dégradation du climat.

La protection de ces sites est difficile, du fait de leur localisation dans une zone en cours d'urbanisation intense. Certains semblent provisoirement sauvegardés, mais Lissasfa est remblayé, et Ahl al Oughlam est en voie de disparition.

THE BEGINNING OF THE PLACENTAL HISTORY IN AFRICA: PALEOCENE AND EARLY EOCENE FAUNAS FROM MOROCCO

GHEERBRANT Emmanuel

UMR 7207 du CNRS "CR2P", CP 38, Département Histoire de la Terre, Muséum National d'Histoire Naturelle, 8, rue Buffon, F - 75005 Paris, France, gheebra@mnhn.fr

The fossil record illustrating the early history of placental mammals in Africa is poor and heterogeneous, most Paleogene data coming from the early Oligocene. The oldest known African placentals come from the late Paleocene and early Eocene of Morocco. Several Thanetian and Ypresian sites were found in 1977 in the Ouarzazate Basin. They yielded only isolated teeth of micromammals because of taphonomic bias. The fauna is diversified (~30 species), but this is the result of the wide predominance of various diminutive primitive eutherians ("insectivores"), aside to some other important taxa such as the oldest hyaenodontid creodont (*Tinerhodon*) and simiiform primates (*Altiatlasius*). These mammals display Laurasian affinities indicating several trans-Tethyan dispersals. Discovery of mammals in the Ouled Abdoun phosphate basin was made later, in 1996, with the oldest known proboscidean *Phosphatherium*. By contrast to Ouarzazate fauna, mammals are extremely rare in Ouled Abdoun phosphates which are otherwise renowned for their very rich marine vertebrate fauna. However, at least 14 species have been found, thanks to collaboration with OCP, most of which are representatives of the earliest African ungulate macrofauna. First discoveries were made in the Ypresian levels of NE quarries of Grand Daoui. In addition to *Phosphatherium*, they include the proboscidean *Daouitherium* which is the oldest large African mammal, a primitive hyracoid close to *Seggeurius*, and *Boualitomus* the earliest



African hyaenodontid. New and major discoveries were made recently in the late Paleocene in southern quarries of Sidi Chennane. They yielded the oldest known placentals from Africa, among which primitive condylarth-like taxa such as *Ocepeia* and *Abdounodus*, the oldest known hyaenodontid *Lahimia*, and a new very primitive and small proboscidean. The Ouled Abdoun mammals are basically representative of the endemic African fauna.

THE BEGINNING OF THE PLACENTAL HISTORY IN AFRICA: DISCOVERY OF A NEW EARLIEST KNOWN PROBOSCIDEAN IN THE LATE PALEOCENE OF THE OULED ABDOUN BASIN, MOROCCO

GHEERBRANT Emmanuel¹, CAPPETTA Henri², BOUYA Baâdi³ & AMAGHZAZ Mbarek³

¹UMR 7207 du CNRS "CR2P", CP 38, Département Histoire de la Terre, Muséum National d'Histoire Naturelle, 8, rue Buffon, F - 75005 Paris, France, gheerbra@mnhn.fr; ²UMR 5554 du CNRS, Institut des Sciences de l'Evolution, Université Montpellier II, Cc 064, place Eugène Bataillon, 34095 Montpellier cedex 5, France, henri.cappetta@univ-montp2.fr; ³Office Chérifien des Phosphates, Centre Minier de Khouribga, Khouribga, b.bouya@ocpgroup.ma, m.amaghazaz@ocpgroup.ma

The most important recent mammal discoveries in the Ouled Abdoun basin (Morocco) were made in Sidi Chennane quarries, which yielded the earliest known placentals from Africa. Several early Ypresian and Thanetian fossiliferous mammal levels have been recognized in these quarries. The lowermost of these levels, which is located at the base of the phosphate bed Ila and is dated as early Late Paleocene age (*ca.* 60 Mys), has yielded a new archaic proboscidean predating *Phosphatherium* from about 5 Mys. It yielded other mammals, including the oldest known hyaenodontid creodonts (*Lahimia*), and two condylarth-like taxa with paenungulate affinities (*Abdounodus*, *Ocepeia*). The new proboscidean from Sidi Chennane is documented by fifteen specimens illustrating most of its dentition and the anterior part of the skull (rostrum). Its proboscidean relationship is supported by an extended phylogenetic analysis among lophodont ungulates. The species is strikingly primitive; its dentition shows first recognized reminiscences with louisinine "condylarths" and early macroselideans among paenungulates (African ungulates). Its primitive morphology suggests a recent and rapid paenungulate radiation after the Cretaceous-Tertiary (KT) boundary, probably favoured by early endemic African paleoecosystems. It also points to major and rapid proboscidean intraordinal evolution at the beginning of the Eocene when true lophodonty and large size evolved. At broader scale, the new proboscidean from Sidi Chennane provides new and direct evidence for calibration of the placental interordinal radiation.

THE PALEOGENE FISH FAUNA OF THE REPUBLIC OF MALI AND ITS RELATIONSHIP TO OTHER AFRICAN FOSSIL FISH FAUNAS

LONGBOTTOM Alison

Department of Palaeontology, Natural History Museum, Cromwell Road, London SW7 5BD, United Kingdom, A.Longbottom@nhm.ac.uk

The Tilemsi Valley in Mali, West Africa, is well known for fossil vertebrates with several levels of phosphorites yielding abundant remains of rays, bony fishes, crocodylians, snakes and mammals. The rocks exposed in bluffs along the valley range from Maastrichtian to post-Eocene in age. The Tertiary phosphate deposits found in the Tilemsi Valley sit on a limestone horizon (Terrecht 2) and comprise alternating conglomeratic phosphorites and fissile-weathering ("paper") shales. Despite the rich vertebrate faunas present, the exact age of the material has been in some doubt. The phosphatic levels have previously been dated as either Early or Middle Eocene by various authors.

Mammals, crocodiles and snakes from the phosphorites have been described, but the abundant fish faunas are relatively poorly known. Radier (1959), listed *Pycnodus variabilis*, *Phosphichthys thomasi*, *Eotrigonodon laevis*, *Trichiurides plicidens*, Siluridae, *Rhinobatus*, Myliobatidae, Dasyatidae and Trygonidae from the phosphates but gave no descriptions. Lavocat (1955) and Martin (1995) described



dentitions of lungfish, Longbottom (1984) the pycnodont fauna and Patterson & Longbottom (1989) the amiid *Maliamia gigas*.

The fishes and other vertebrates from the phosphates of the Tilemsi Valley show similarities at generic and sometimes species level with several other faunas from North and West Africa, including Nigeria, Niger, Togo, Morocco and Cabinda, Angola, which are variously considered to be Late Palaeocene (Landenian) to Early Eocene (Ypresian).

Ongoing research on the fossil fishes from Mali and comparison with those of other African localities suggests that the Mali phosphates are also Late Palaeocene or Early Eocene in age.

LAVOCAT R. 1955. Découverte de Dipneustes du genre *Protopterus* dans le Tertiaire ancien de Tamaguielt (Soudan français). *Compte Rendu Hebdomadaire des Séances de l'Académie des Sciences. Paris*, 240: 1915-1917.

Longbottom A.E. 1984. New Tertiary pycnodonts from the Tilemsi Valley, Republic of Mali. *Bulletin of the British Museum (Natural History), Geology series*, 38: 1-26.

Martin M. 1995. Nouveaux lepidosirenides (Dipnoi) du Tertiaire africain. *Geobios, Mémoire Special*, 19: 275-280.

Patterson C.P. & Longbottom A.E. 1989. An Eocene Amiid fish from Mali, West Africa. *Copeia*, 4: 827-836.

Radier H. 1959. Contribution à l'étude géologique du Soudan oriental (A.O.F). *Bulletin de la Direction des Mines de l'Afrique Occidentale Française*, 26: 1-556.

LA GRANDE FAUNE DU PALEOLITHIQUE SUPERIEUR ET DU PALEOLITHIQUE MOYEN DE LA GROTTTE D'EL HARHOURA 2 (TEMARA, MAROC) : ETUDE PALEONTOLOGIQUE, RECONSTITUTIONS PALEOECOLOGIQUES ET PALEOCLIMATIQUES.

MICHEL Patrick¹, CAMPMAS Emilie¹, STOETZEL Emmanuelle², NESPOULET Roland³, EL HAJRAOUI Mohammed Abdeljalil⁴ & AMANI Fethi⁴

¹Université Bordeaux 1, IPGQ – PACEA, UMR 5199, Bâtiment B8, Avenue des facultés 33405 Talence Cedex (France), p.michel@ipgq.u-bordeaux1.fr; ²Muséum national d'histoire naturelle, Département de Systématique et Évolution, UMR 5202, USM 601, 55 rue Buffon 75005 Paris (France); ³Muséum national d'histoire naturelle, Département de Préhistoire, UMR 5198, 1 rue René Panhard, 75013 Paris (France); ⁴Institut National des Sciences de l'Archéologie et du Patrimoine, angle rues 5 et 7, Rabat Instituts, Madinat Al Irfane, Rabat Hay Riyad (Maroc).

La grotte d'El Harhoura 2 se trouve sur la commune d'El Harhoura dans la province de Témara. Elle s'ouvre à l'Ouest, vers l'Océan à une distance d'environ 200 m du rivage actuel et à une altitude de 16 m environ au-dessus du niveau de la mer. Sa stratigraphie comprend 11 couches numérotées du sommet vers la base de la stratigraphie. Les données archéologiques de la couche 2 placent celle-ci dans le Paléolithique supérieur (Ibéromaurusien). Les couches 3 à 11 sont attribuées au Paléolithique moyen (Atérien). Depuis 1977, une surface de 37 m² a été fouillée. Ces travaux ayant permis, en particulier, de mettre au jour un important matériel paléontologique. Lors de cette communication nous présenterons les résultats issus de l'étude paléontologique ainsi que les conclusions d'ordre paléoécologique et paléoclimatologique pour tous les niveaux de la stratigraphie connue de ce site

Mots clés : Grotte d'El Harhoura 2 / Témara / Maroc / grands mammifères / Ibéromaurusien, Atérien / Paléolithique supérieur / Paléolithique moyen / Pléistocène supérieur.

PALAEOFAUNAL POTENTIAL OF KARST INFILLINGS OF EGYPT

PICKFORD Martin^{1,2}, SÉGALEN Loïc³ & SENUT Brigitte²

¹Collège de France, GDR 983 et UMR 7207, CR2P du CNRS, Case postale 38, 8, rue Buffon, 75005 Paris, pickford@mnhn.fr;

²Département Histoire de la Terre, UMR 7207, CR2P du CNRS, Case postale 38, 8, rue Buffon, 75005, Paris, bsenut@mnhn.fr;

³Université Pierre et Marie Curie-Paris06, ISTeP UMR 7193, Lab. Biominéralisations et Environnements sédimentaires, 56-55 5E case postale 116, 4 place Jussieu, 75 252 Paris cedex 05, France, segalen@ccr.jussieu.fr

Egypt is well known for its continental Cainozoic deposits which accumulated in fluvio-paludal or fluvio-marine conditions. Until 2005, karst infillings were poorly known in Egypt, contrasting with the Maghreb which contains richly fossiliferous localities. Surveys in the Western Desert of Egypt revealed a



huge palaeokarst network in the Bahariya-Farafra area. After complete erosion of the roof of the cave system, enormous quantities of speleothems and cave breccias are exposed at Sheikh Abdallah.

The fossils found in red sandy breccia associated with speleothems indicate a Vallesian age for the infillings (Figure). The vertebrate lineages, suggest extremely humid conditions (fish, amphibians) and well wooded to forested palaeoenvironment (megadermids, galagid, colobine, *Atherurus*, glirid, macroscelidids), but some were living in more open wooded or savannah areas (ctenodactylids, burrowing rodents).

Biogeographically, the deposits contain tropical African and southern Eurasian faunas, permitting correlations between the East African (faunal sets) to European (MN zones) biochronological zones (Pickford et al., 2006, 2008).

Conglomerates and freshwater limestones indicate subaerial fluvial and lacustrine deposits, possibly syndepositional with the karstic activity. The Vallesian was a humid, tropical period, called «Washhouse» Europe (Boehme et al., 2008) in mid-latitude Eurasia, and extremely humid in Egypt and Maghreb. The phreatic and vadose phases of the palaeocave system correlate reasonably well with eustatic variations: high sea-levels associated with high water tables, and low sea levels to low water tables or aridity.

Thus, the Sahara Desert did not exist as such during the Vallesian (11-10 Ma), developed after about 8 Ma, in accordance with changes related to growth of the Arctic Ice Cap and onset of the monsoon weather system in the Indian Ocean hemisphere.



Fig. Stalagmite at Sheikh Abdallah, associated with Vallesian fossil mammals.

BÖHME M., ILG A., & WINKLHOFER M. 2008. Late Miocene “Washhouse” climate in Europe. *Earth and Planetary Science Letters*, doi:10.1016/j.epsl.2008.09.011

PICKFORD M., WANAS H., MEIN P., & SOLIMAN H. 2008. Humid conditions in the Western Desert of Egypt during the Vallesian (Late Miocene). *Bulletin of the Tethys Geological Society*, 3: 63-79.

PICKFORD M., WANAS H. & SOLIMAN H. 2006. Indications for a humid climate in the Western Desert of Egypt 11-10 million years ago: evidence from Galagidae (Primates, Mammalia). *Comptes Rendus Palévol*, 5: 935-943.

A MICROMAMMAL FAUNA FROM PLEISTOCENE LEVELS AT GROTTA DES CONTREBANDIERS (SMUGGLER’S CAVE), MOROCCO

REED Denné N.

Dept. of Anthropology C3200, University of Texas at Austin, Austin, TX 78712, USA, reedd@mail.utexas.edu

New excavations at Grotte de Contrebandiers, Temara, Morocco, have uncovered a micromammal fauna from Pleistocene levels associated with Aterian lithic materials. This paper presents preliminary systematics and paleoenvironmental findings on the micromammals present in the assemblages. The micromammals include rodents from no fewer than three subfamilies: Gerbilinae, Murinae and Cricetinae along with crociduran shrews. Taphonomically, the assemblage is unusual for preserving micromammals in relatively low abundance compared to other nearby cave sites of similar age such as El Harhoura II. The degree of fragmentation, surface modification of the bone and relatively low density of specimens suggests a taphonomic regime other than an avian predator, which is the most common mode of accumulation in cave sites. A mammalian predator, or combination of mammalian predators and natural deaths is a possible taphonomic model for Contrebandiers.



REPARTITION PANAFRICAINNE DES HOMINOÏDEA AU MIOCENE SUPERIEUR : APPORT DU NIGER

SENUT Brigitte¹, PICKFORD Martin^{1,2}, COPPENS Yves³, BRAGA José⁴ & MORALES Jorge⁵

¹Département « Histoire de la Terre » du Muséum National d'Histoire Naturelle et UMR 7205 CNRS (CR2P), CP 38, 8, rue Buffon, 75231 Paris Cedex 05, France. bsenut@mnhn.fr; ²Collège de France, Chaire de Biologie historique et d'Evolutionnisme, 11, place Marcellin Berthelot, 75231 Paris, Cedex 05, France. pickford@mnhn.fr; ³Collège de France, 11, place Marcellin Berthelot, 75231 Paris, Cedex 05, France. yves.coppens@college-de-france.fr; ⁴Université Paul Sabatier, FRE 2960 CNRS, Anthropologie et Imagerie anatomique, 39, allées Jules Guesde, 31000 Toulouse, France. braga@cict.fr; ⁵Paleobiologia, Museo Nacional de Ciencias Naturales, CSIC, José Gutierrez Abascal 2, 28006, Madrid, Espagne. mcm166@mncn.csic.es

En 1964 lors d'une prospection pétrolière au Niger, le géologue Mr Nieuwenhuys, ramassait une faune de vertébrés (N. 885) qu'il confia au Prof. Camille Arambourg. Parmi ces restes, se trouvait un fragment de mandibule d'un hominoïde, reconnue récemment.

La faune non-primat comprend *Lates niloticus*, *Crocodylus* cf. *niloticus* et des mammifères (une partie distale de métapode IV d'un Anthracotheriidae de grande taille et un frontal portant une cheville osseuse de Bovidae). Ces derniers permettent d'estimer un âge Miocène supérieur (compris entre 11 et 5 millions d'années) pour l'association faunique sur la base de comparaisons effectuées avec les gisements mio-pliocènes libyen, tunisien, tchadien, sud-africain et est-africains. Le Bovidae indique des plaines d'herbe haute avec présence d'eau, ou des habitats plus ouverts avec des franges forestières.

Le reste d'hominoïde est un fragment de mandibule droite comprenant les racines de la m/1. Après comparaison avec de nombreux mammifères actuels, il apparaît que ce fragment appartient à un primate et se rapproche des hominoïdes africains (morphologie générale de la mâchoire, longueur et orientation des racines, fusion bucco-linguale des racines) et notamment de *Pan*. Ce fragment appartenant à une mandibule plutôt grêle s'isole des Hominidés plio-pléistocènes, et des formes connues d'hominoïdes du Miocène supérieur. La meilleure comparaison s'effectue avec le chimpanzé actuel. Toutefois, il est encore trop tôt pour attribuer la pièce à une espèce précise, mais son importance est incontestée puisqu'elle pourrait représenter une forme sur la lignée des chimpanzés, dont l'histoire paléontologique est pratiquement vierge. Autre résultat d'importance, le Niger, éloigné des zones classiques à hominoïdes, doit être placé sur la carte internationale des pays potentiellement intéressants dans la recherche de la dichotomie entre les grands singes et les Hommes.



PICKFORD M., COPPENS Y., SENUT B., MORALES J. & BRAGA J. in press Late Miocene hominoid from Niger. *C. R. Palevol.*



LES MICROVERTEBRES PLEISTOCENES ET HOLOCENES D'EL HARHOURA 2 (RABAT-TEMARA, MAROC)

STOETZEL Emmanuelle¹, DENYS Christiane¹, BAILON Salvador², NESPOULET Roland³ & EL HAJRAOUI Mohammed Abdeljalil⁴

^{1,2,3}Muséum National d'Histoire Naturelle: ¹Département Systématique et Evolution, UMR 5202 – USM 601, Laboratoire de Zoologie Mammifères et Oiseaux, 55 rue Buffon – CP 51, 75005 Paris, France stoetzel@mnhn.fr, denys@mnhn.fr; ²Département Ecologie et Gestion de la Biodiversité UMR 5197 - USM 303, Anatomie Comparée, 55 rue Buffon – CP 55, 75005 Paris, France salvador.bailon@mnhn.fr; ³Département de Préhistoire, UMR 5198 – USM 103, Institut de Paléontologie Humaine, 01 rue René Panhard, 75013 PARIS roland.nespoulet@mnhn.fr; ⁴Institut National des Sciences de l'Archéologie et du Patrimoine, angle rues 5 et 7 Rabat instituts, Madinat Al Irfane, Rabat Hay Riyad, Maroc maelhajraoui@gmail.com

Les petits vertébrés (rongeurs, insectivores, amphibiens, reptiles) retrouvés en contexte archéologique peuvent nous renseigner sur l'évolution de la biodiversité et fournissent souvent des informations paléoenvironnementales plus précises que les grands mammifères. Ils sont peu étudiés en Afrique du Nord, notamment en ce qui concerne la fin du Quaternaire. Parmi les quelques sites nord-africains de cette période on trouve la grotte d'El Harhoura 2 (Rabat-Témara, Maroc) remarquable tant par la richesse spécifique des petits vertébrés terrestres (plus d'une trentaine de taxons) que l'abondance des restes identifiables (une concentration allant jusqu'à 250 000 éléments par m³ de sédiments). Ce site a livré plusieurs couches archéologiques qui permettent de suivre l'évolution des faunes et des environnements au cours de la transition Pléistocène supérieur - Holocène.

L'analyse taphonomique montre des différences de prédateurs entre les différents niveaux (rapaces nocturnes vs petits carnivores ou rapaces diurnes) et des altérations post-prédatons qui indiquent l'absence de tri, une faible météorisation, mais beaucoup de traces de racines et une éventuelle bioturbation. L'étude paléoécologique montre des paysages en mosaïques tout au long de la séquence, avec cependant des épisodes plus ouverts au cours du Pléistocène supérieur, et une ultime période plus boisée à l'Holocène moyen. La nature locale (modifications du paysage, proximité des points d'eau, prédateurs ayant des régimes alimentaires différents) ou globale (climat, aridité/humidité) de ces changements est discutée dans le contexte archéologique et paléoclimatique. Ces données nous permettent d'améliorer nos connaissances sur le cadre environnemental dans lequel l'Homme moderne est apparu et a évolué dans cette région.

Mots clés : Microvertébrés, Afrique du Nord, Maroc, Pléistocène, Holocène, Systématique, Taphonomie, Paléoécologie, Homme moderne.

THE REMARKABLE DIVERSITY OF THE MAMMALIAN ORDER HYRACOIDEA IN THE EOCENE OF THE GOUR LAZIB, ALGERIA

TABUCE Rodolphe¹, ADACI Mohammed², BENSALAH Mustapha², MEBROUK Fateh³ & MAHBOUBI M'hammed⁴

¹Institut des Sciences de l'Évolution, cc064, Université Montpellier II, place Eugène Bataillon, 34095 Montpellier cedex 05, France, rodolphe.tabuce@univ-montp2.fr; ²Laboratoire de recherche n°25, Département des Sciences de la Terre, Université Abou Bekr Belkaïd, B.P. 119 Tlemcen 13000, Algérie, m_adaci@yahoo.fr, mus_bensalah@yahoo.fr; ³Laboratoire de Paléontologie stratigraphique et Paléoenvironnement, Université d'Oran, B.P. 1524 El M'naouer, Oran 31000, Algérie, mebrouk06@yahoo.fr; ⁴Département des Sciences de la Terre, Faculté des Sciences, Université de Jijel, B.P. 98 Ouled Aïssa, 18000 Jijel, Algérie, mahboubi.mahammed@caramail.com.

Living hyraxes are poorly diversified with only three small-sized genera restricted to Africa and Middle East. They represented, on the contrary, the dominant 'ungulate' group during the Paleogene on the Arabo-African continent. Late Eocene to Oligocene sites of the Fayum in Egypt are particularly famous for their hyrax fossil record. The beginning of the hyrax radiation is however less documented yet, since rare fragmentary remains are known from few Early to Middle Eocene sites in North Africa. Among them, the Glib Zegdou and Gour Lazib localities in the Algerian Sahara have yielded, until recently, four



species mainly documented by dental remains only. Since 2003, paleontological expeditions in this area have led to the recovery of numerous new craniodental and postcranial remains of, at least, five other species, making the Gour Lazib sites the richest localities documenting the early stage of the hyrax radiation. The taxa are ecologically differentiated from each other by diverse dental morphologies that indicate several dietary specializations from omnivory to folivory; their estimated body-mass ranges from 3kg to over 1000kg; and several types of astragalus indicate generalist, arboreal and cursorial adaptations. This remarkable diversity, comparable to that found in the Fayum, is surprising at such an early date and reveals the great antiquity of the order Hyracoidea and its rapid diversification during the early Eocene.

SHARK AND RAY REMAINS FROM THE MIDDLE AND LATE EOCENE OF THE WESTERN DESERT OF EGYPT

WARD David J.¹, **UNDERWOOD Charlie J.**², **ZALMOUT Iyad**³, **GINGERICH Philip**³ & **ANTAR Mohammed Sameh M.**⁴

¹Crofton Court 81 Crofton Lane, Orpington Kent, BR5 1HB UK, david@fossil.ws; ²School of Earth Sciences, Birkbeck College, Malet Street, London WC1E 7HX, UK, c.underwood@bbk.ac.uk; ³University of Michigan, Museum of Paleontology and Department of Geological Sciences, Ann Arbor, Michigan, 48109, USA, zalmouti@umich.edu; e-mail: gingeric@umich.edu; ⁴Egyptian Environmental Affairs Agency, Wadi Al-Hitan World Heritage Site, Fayum, Egypt, wprashark@yahoo.com

The Fayum of Egypt is well known by vertebrate palaeontologists for its rich marine mammal faunas. Less well known are the equally rich and diverse shark and ray faunas based on isolated and occasionally associated teeth.

Over the last 20 years, large collections of fossil fish remains have been collected from the Middle and Late Eocene sediments at Wadi AL Hitan World Heritage Site (Zeuglodon Valley) and its surroundings by fieldworkers from the universities of Michigan and London and the Rangers of the EEAA (Egyptian Environmental Affairs Agency). Surface collecting was complemented by bulk sampling from geographically and stratigraphically defined sections from sediments representing palaeoenvironments ranging from offshore to lagoonal.

Although some of the larger teeth have been described and figured over the last century, the bulk of the fauna, those with teeth under 5mm in size, has previously remained undescribed.

This talk focuses on the sharks and rays that were collected from the sediment around a large skeleton of †*Basilosaurus isis*, collected in 2006 and prepared in the Museum of Paleontology, University of Michigan, Ann Arbor in 2007 and 2008. Large numbers of shark and ray teeth were obtained, and represent a high diversity assemblage from a probable inner shelf setting. Possible direct association between the whale remains and some of the sharks and rays will be discussed.





**PRÉSENTATIONS AFFICHÉES : HISTOIRE DES SCIENCES &
PALEONTOLOGIE POUR LE DEVELOPPEMENT**

/

***POSTER PRESENTATIONS: HISTORY OF SCIENCES AND
PALEONTOLOGY FOR DEVELOPMENT***



LA PALEONTOLOGIE DES VERTEBRES DU NORD DE L'AFRIQUE A TRAVERS LES RECHERCHES DE CAMILLE ARAMBOURG. BILAN DES FAUNES DE VERTEBRES DU NEOGENE DU NORD DE L'AFRIQUE.

HADJOUIS Djillali

Service d'Archéologie du Val de Marne, 7/9 rue Guy Moquet, 94800, Villejuif, France et CNRPAH, Algérie, djillali.hadjouis@cg94.fr

Camille Arambourg est ingénieur agronome dès 1908 à Alger puis jeune chercheur dans les laboratoires de géologie et de zoologie de l'Ecole des Sciences d'Alger. Les collections de fossiles de vertébrés et d'Anatomie comparée que Pomel avait rassemblées au XIX^{ème} siècle vont lui procurer les connaissances en Sciences naturelles et lui ouvrir les portes de la recherche géologique et paléontologique.

Entre les années 1910 et 1969, date de sa mort, Camille Arambourg, succède au professeur Marcellin Boule en 1936, à la chaire de Paléontologie du Muséum d'Histoire naturelle de Paris après avoir été son disciple. Il n'aura de cesse d'explorer, de fouiller, d'étudier, de classer mais surtout de découvrir un grand nombre de taxons nouveaux de vertébrés, y compris chez l'Homme.

Les recherches effectuées par Arambourg en Algérie, au Maroc et en Tunisie sont primordiales pour la connaissance géologique et paléontologique de l'Afrique du Nord. D'abord parce qu'elles définissent de nouveaux faciès et de nouveaux étages stratigraphiques, ensuite elles se concrétisent par la description de très nombreux taxons de vertébrés à tous les niveaux de la classification, enfin elles nous lèguent un patrimoine universel inestimable, représenté notamment par des sites paléontologiques et préhistoriques dont certains sont encore fouillés aujourd'hui.

Mots clés : Vertébrés néogènes, Histoire des Sciences, Afrique du Nord

PALDES PROJECT. PALEONTOLOGY FOR DEVELOPMENT IN NIGER

ORTEGA F.J.^{2,4}, FIERRO I.³, CHIAPPE L.⁸, DANTAS P.^{4,5,7}, ESCASO F.^{1,6}, GASULLA J.M.¹, LÓPEZ E.³, MARÍN-FERRER J.M.³, POMARES A.³, RIBEIRO B.⁷, SANZ J.L.¹, TENT-MANCLÚS J.E.⁹, AMADOU O.¹⁰ & MAGA A.¹⁰

¹Unidad de Paleontología. Facultad de Ciencias. Universidad Autónoma de Madrid. Cantoblanco, 28049 Madrid, Spain; ²Facultad de Ciencias. UNED. c/ Senda del Rey, 9. 28040 Madrid, Spain; ³UPE. Paza de San Juan s/n. 03203. Elche, Spain; ⁴Laboratório de Paleontologia da ALT-SHN, Torres Vedras (Portugal); ⁵Laboratório de História Natural da Batalha (Portugal); ⁶Museo de las Ciencias de Castilla-La Mancha (Cuenca, Spain); ⁷Museu Nacional de História Natural (Lisboa, Portugal); ⁸Dinosaur Institute. The Natural History Museum of Los Angeles County USA.; ⁹Universidad de Alicante (Spain); ¹⁰Université Abdou Moumouni, IRSH, Niamey (Niger)

PALDES project is the way of combining the research work on some Mesozoic fossil sites in southern Agadez (Niger) with a regional development program. This area is well-known by outcrops like those from the Tiguidit cliffs or Gadofaoua.

The PALDES project began in 2003, bringing together a number of Spanish institutions with scientific and social objectives around a proposal by the Niger Association AJOPER (Association pour la Protection, la Surveillance et l'Entretien des Sites de Dinosaures). Since then, were identified the primary goals of the project: the construction of a Museum of Paleontology in Tadibene, the application for a international protection figure for the fossil sites in the area, the construction of the needed infrastructures to promote a Tourism of Quality, the construction of Health infrastructures indispensable for the nomads and the tourists, the strengthening of educational structures in the area (especially the nomadic schools) the development of agropastoral activities and the improvement of water resources.

During last years, PALDES has developed various institutional activities, the development and financing of the Museum of Tadibene project and several field seasons, such as that which enabled the recovery of remains of a new sauropod in Azenak (Aderbissinat) that is currently under preparation at the Spanish Museo Paleontológico de Elche.



Currently the project's goal is broader, seeking to collaborate in establishing a general trend of tourism development based on the potential of paleontological resources in the axis between Niamey (by reference to the National Museum) and deposits in the area of Agadez.

Key words: PALDES, dinosaurs, museum, Lower Cretaceous, Niger, Africa, Development.



PRÉSENTATIONS AFFICHÉES : PALÉOZOÏQUE
/
POSTER PRESENTATIONS: PALEOZOIC



**EMPREINTES DE TRACES D'AUTOPODES DE VERTÉBRÉS ET DE PLANTES ASSOCIÉES
DANS LES PÉLITES ROUGES DU BASSIN PERMIEN DE TIDDAS (MAROC CENTRAL).**

BROUTIN Jean¹, GAND Georges², El WARTITI Mohamed³ & AASSOUMI Habiba⁴

¹Université P. et M. Curie, Centre de Recherche en Paléobiodiversité et Paléoenvironnements, UMR - CNRS 7207, Bat. Géologie MNHN, 43 rue Buffon 75005 Paris, France, Jean.Broutin@upmc.fr; ²Université de Bourgogne, Centre des Sciences de la Terre, 6 Bd Gabriel - Dijon, France; ³Université Mohamed V, Faculté des Sciences, Laboratoire de Géologie appliquée, Avenue Ibn Batouta - Rabat, Maroc; ⁴Université Moulay Ismail, Faculté des Sciences et Techniques, Département de Géologie, BP509 - Errachidia, Maroc.

Les dépôts sédimentaires accumulés dans le bassin permien de Tiddas sont, pour l'essentiel, constitués de pélites rouges de grain souvent remarquablement fin. Longtemps réputés azoïques, ces sédiments sont à l'origine de l'interprétation paléoclimatique hyper-désertique « incompatible avec un peuplement animal et végétal stables » qui a prévalu pour ce bassin, jusque dans les années 1980.

Après la découverte de quelques empreintes de conifères fossiles dans « le rouge » (El Wartiti et al., 1986), de très nombreux restes de plantes ont été extraits de lentilles de pélites grises intercalées (Broutin et al., 1987; Aassoumi, 1994).

Dans les années 1990 - 2000, des prospections systématiques dans les pélites rouges à grain très fin ont permis de découvrir des empreintes de plantes fossiles et des traces d'activité animale : pistes d'invertébrés et empreintes d'autopodes de vertébrés.

Outre les empreintes de rameaux feuillés de coniférophytes et de quelques sphénophytes, une vingtaine de petites dalles à grain très fin ont livré de nombreuses traces de vertébrés tétrapodes (sous forme d'hyporeliefs), souvent associées à des marques de gouttes de pluies.

Une Association à *Batrachichnus salamandroides* – *Dromopus cf. lacertoides* – *Hylodichnus major*, a été mise en évidence. Elle est similaire à celle de la Formation du Salagou du bassin permien de Lodève, datée du Koungourien au Lopingien inférieur.

Une synthèse sur la globalité du matériel récolté dans ces pélites rouges est présentée pour la première fois. Les implications paléoenvironnementales de la découverte de ces restes animaux et végétaux associés sont analysées.

AASSOUMI Habiba. 1994. *Les paléoflores du Permien inférieur du Maroc Central. Implications biostratigraphiques, paléoécologiques et paléogéographiques pour le domaine péritéthysien occidental*. Thèse Université P. et M. Curie, Mémoires des Sciences de la Terre n°94.16, 226p., 17 pl. h.t.

BROUTIN Jean, El WARTITI Mohamed, FREYTET Pierre, HEYLER Daniel, LAHRHIB Mohamed & MOREL Jean Luc. 1987. Nouvelles découvertes paléontologiques dans le bassin détritico carbonaté permien de Tiddas (Maroc Central). *C. R. Acad. Sci. Paris*, 305, II: 143-148.

El WARTITI Mohamed, BROUTIN Jean & FREYTET Pierre. 1986. Premières découvertes paléontologiques dans les séries rouges carbonatées permien du bassin de Tiddas (Maroc Central). *C. R. Acad. Sci. Paris*, 303, II: 263-268

**TETRAPOD FOOTPRINTS FROM IKAKERN FORMATION (ARGANA BASIN, WESTERN
HIGH ATLAS, MOROCCO).**

**HMINNA Abdelkbir¹, VOIGT Sebastian², SABER Hafid¹ &
SCHNEIDER Jörg W.² & HMICH Driss²**

¹Department of Geology, Chouaib Doukkali University, B.P. 20, 24000 El Jadida, Morocco; hminna_abdelkbir@yahoo.fr, hafidsaber@yahoo.fr, hmich@gmx.net; ²Institut für Geologie, TU Bergakademie Freiberg, B.-v.-Cotta-Str. 2, 09596 Freiberg, Germany; schneidj@geo.tu-freiberg.de, s.voigt@geo.tu-freiberg.de

The Ikakern Formation of the Argana Basin represents a fining-upward sequence of about 600 m thick alluvial fan conglomerates (T1, Ait Driss Member) grading laterally and vertically into a several hundred metres thick sequence of fluvial channel sandstones and overbank fines (T2, Tourbihine Member). The problems concern especially the age of the lower part of the succession

Abundant vertebrate tracks assigned to the ichnogenera *Amphisauropus* (Haubold, 1970), *Dromopus* (Marsh, 1891), *Erpetopus* (Moodie, 1929), and *Hylodichnus* (Gilmore, 1927) are found in this association.



The assemblage is a typical example for the *Scoyenia* ichnofacies in a low energy, episodically submerged floodplain environment, which was inhabited by annelids, phyllopods, terrestrial insects, and various tetrapods (reptiliomorph amphibians, parareptiles, and eureptiles)

So far, the upper part of the T2 level of the Ikakern Formation has been variously interpreted as Early, Middle, Late Permian, as well as Triassic in age based on macrofloral remains, a single vertebrate trackway, neotridian, captorhinid, and pareiasaurid tetrapod finds (Dutuit, 1988; Jalil & Dutuit, 1996; Jalil & Janvier, 2005). Though the recently discovered tetrapod footprint assemblage is most similar to late Early Permian track sites like the Hermit Formation, Grand Canyon, USA, or the Rabejac Formation, Lodève Basin, Southern France, neither the tetrapod ichnotaxa nor the referred trackmakers exclude a younger Permian age. Because Middle to Late Permian continental ichnofaunas are little known, the Ikakern Formation might be of great potential for the reconstruction of Late Palaeozoic ecosystems.

Key words: Late Permian, Morocco, Argana, tetrapods, Ichnology

DUTUIT J.-M. 1988. *Diplocaulus minimus* n. sp. (Amphibia: Nectridea), lépospondyle de la formation d'Argana, dans l'Atlas occidental marocain. *Comptes Rendus de l'Académie des Sciences de Paris*, 307: 851-854.

JALIL N.-E. & DUTUIT J.-M. 1996. Permian captorhinid reptiles from the Argana Formation, Morocco. *Palaeontology* 29: 907-918.

JALIL N.-E. & JANVIER P. 2005. Les paréiasaures (Amniota, Parareptilia) du Permien supérieur du Bassin d'Argana, Maroc. *Geodiversitas* 27: 35-132.

TEMNOSPONDYLS FROM NORTH AFRICA: REVIEW AND PERSPECTIVES

STEYER J.Sébastien¹, JALIL Nour-Eddine², TAQUET Philippe¹, BITAM Ihacen³, AÏTOUALI Rachid⁴, NEDJARI A.⁴, BOUZIDI Ouahiba³ & KEDADRA Bilal⁵

¹Centre de Recherches sur la Paléobiodiversité et les Paléoenvironnements, UMR 7207 du CNRS, Département Histoire de la Terre, CP 38, Muséum National d'Histoire Naturelle, 8, rue Buffon, 75231 Paris Cedex 05, France, steyer@mnhn.fr; ²Laboratoire « Biodiversité & Dynamique des Ecosystèmes », Dépts. Géologie et Biologie, Faculté des Sciences Semlalia, Université Cadi Ayyad, Marrakech, Maroc, [njilil@ucam.ac.ma](mailto:njalil@ucam.ac.ma); ³Agence Nationale Géologique du Contrôle Minier, Alger, Algérie; ⁴Université d'Alger, Algérie; ⁵Société Nationale de TRANsport et de Commercialisation des Hydrocarbures, SONATRACH

The temnospondyls from North Africa were known so far in the Late Triassic of Morocco and in the Middle-?Late Triassic of Algeria.

In Algeria, they come from the Zarzaïtine Formation (Illizi Basin), the age of which extends from late Early-early Middle to early Late Triassic (probably Carnien). They consist of capitosaurian, brachyopoid and trematosaurian stereospondyls. The capitosaurs “*Parotosaurus*” *lapparenti* Lehman, 1971 and “*Wellesaurus bussoni*” Lehman, 1971 are relatively well preserved and under revision by the authors. The brachyopoid and the lonchorhynchine trematosaurian are very fragmentary. These amphibians are associated with plants, fishes (hybodontid chondrichthians and lungfish) and archosauromorph reptiles (prolacertiforms, aetosaurs, parasuchians and probable rauisuchians).

In Morocco, the temnospondyls come from the Carnian Timezgadiouine Formation (Argana Basin) and consist of numerous metoposaurians (e.g., *Dutuitosaurus*, *Arganasaurus* and *Metoposaurus*) and almasaurid (*Almasaurus habbazi*). They are associated with plants, fishes, archosaurs (aetosaurs, parasuchians and rauisuchians) and synapsids (dicynodonts). Although well diversified, these different North African amphibian faunas remain however underestimated in the intercontinental correlation attempts and in the global Pangaeian reconstructions, compared to those of southern Africa for example. Recent field investigations in Morocco and Algeria led to the discovery of (respectively) 1, fragmentary material in the Late Permian of Argana (the first evidence of a temnospondyl in the Palaeozoic of North Africa) and 2, a capitosaurian Lagerstätte in the Triassic of Zarzaïtine. These discoveries will lead to interesting palaeogeographical and palaeoclimatical implications for the evolution of the temnospondyls before and after the “mother of mass extinction”, the P-T crisis.

Lehman, J.P. 1971. 1971. Nouveaux vertébrés du Trias de la Série de Zarzaïtine. *Annales de Paléontologie (Vertébrés)*, 57(1): 71-93.



PRÉSENTATIONS AFFICHÉES : MÉSOZOÏQUE
/
POSTER PRESENTATIONS: MESOZOIC



PATTERNS OF JUGAL FORAMINA IN CROCODYLIANS, AND THEIR IMPORTANCE AS PHYLOGENETIC INFORMATION

ANDRADE Marco Brandalise de

Department of Earth Sciences, University of Bristol, Wills Memorial Building, Queens Road, Bristol, UK, BS8 1RJ
marcobranda@yahoo.com.br

Neurovascular foramina are an important, but frequently overlooked source of phylogenetic information within Crocodylomorpha. Such structures are poorly documented, despite their occurrence in jugal, premaxilla, maxilla, postorbital, dentary and angular. Morphological study of fossil/extant material identified a diversity of patterns in the distribution of foramina within mesoeucrocodylians. Jugal foramina are absent in archosauromorphs to basal mesoeucrocodylians, but occur in eusuchians, basal neosuchians and derived notosuchians. Within Eusuchia, small foramina (2-5) are present in alligatorids, *Crocodylus*, *Osteolaemus*, *Diplocynodon* and *Asiatosuchus*, usually facing lateroventrally. Gavialoids may show extraordinary diversity of patterns, for the morphology found in *Gavialis gangeticus* (several minute foramina, anterior to the orbit) and *Piscogavialis* (two enlarged foramina, lateral to the orbit). Two ventrally oriented foramina are present in basal neosuchians (*Pholidosaurus*, Dyrosauridae indet.), supporting their phylogenetic proximity with eusuchians. Derived notosuchians (e.g. *Mariliasuchus*, *Sphagesaurus*) have a single enlarged and laterally oriented jugal foramen, which is absent from *Notosuchus* and baurusuchids. Thalattosuchians seem to lack jugal foramina, which could be an atavism, or evidence for a basal position of this clade, within Mesoeucrocodylia. Jugal foramina seem to be primarily vascular openings, but at least in *Gavialis*, foramina may be related to dome pressure receptors, with a sensory function. Crocodylomorphs show distinct patterns of jugal neurovascular foramina, consistent with recent phylogenetic proposals. However, jugal foramina are still poorly documented and should be collected for several taxa (e.g. *Allognathosuchus*, *Pristichampsus*, *Bernissartia*, *Isisfordia*, *Sarcosuchus*, *Elosuchus*).

FIRST AFRICAN RECORD OF THE ICHNOGENUS *DELTAPODUS* FROM THE UPPER JURASSIC IOUARIDÈNE FM. (CENTRAL HIGH-ATLAS, MOROCCO)

BELVEDERE Matteo & MIETTO Paolo

Università degli Studi di Padova, Dipartimento di Geoscienze, Via Giotto, 1 – 35137 – Padova – Italy.
matteo.belvedere@unipd.it; paolo.mietto@unipd.it

We describe the first two African tracks of the stegosaur ichnogenus *Deltapodus*, recorded in the type-locality of the Upper Jurassic Iouaridène Formation, close to the villages of Taghbalout and Aghri (Belvedere and Mietto, in press). The footprints have different preservation: one is a deep and detailed true track, with evident displacement rims, the other is a shallow and faint underprint. Both the prints are pes and no manus evidences have been found. 3D models have been carried out for both the specimens, allowing a detail examination of the tracks shape also in cross-section. Thus, it has been possible to highlight a relieved part in the middle part of the track, which has also been recorded in most of the latest *Deltapodus* discovered. The size of the two samples is different and varies from 17 to 26 cm in length and from 11 to 17 cm in width; although both the tracks are small compared with the known record, they well fit in the range given for this ichnotaxon.

Deltapodus brodricki Whyte and Romano was firstly described from the Middle Jurassic of Yorkshire (UK), but comparable specimens are now known from the Upper Jurassic of Spain (e.g. García-Ramos et al., 2008), Portugal (Mateus & Milàn, 2008) and USA (Milàn & Chiappe, in press). This new discovery extends the geographical distribution of *Deltapodus* beyond the southern margin of the Tethys, and highlights the similarities of the Late Jurassic Iouaridène ichnofauna with the coeval ones of the Iberian Peninsula (Belvedere, 2008).



- BELVEDERE M. 2008. *Ichnological researches on the Upper Jurassic dinosaur tracks in the Iouaridène area (Demnat, central High-Atlas, Morocco)*. Unpublished Ph.D. thesis, Università degli Studi di Padova, Padova. 122 p.
- BELVEDERE M. & MIETTO P. in press. First evidence of stegosaurian *Deltapodus* footprints in North Africa (Iouaridène Fm., Upper Jurassic, Morocco). *Palaeontology*.
- MILÀN J. & CHIAPPE L.M. in press. First American record of the Jurassic ichnogenus *Deltapodus* and a review of the fossil record of stegosaurian footprints. *Journal of Geology*
- MATEUS O. & MILÀN J. 2008. Ichnological evidence for giant ornithopod dinosaurs in the Upper Jurassic Lourinhã Formation, Portugal. *Oryctos*, 8: 47-52.
- GARCÍA-RAMOS J.C., PIÑUELA L., RUIZ-OMEÑACA J.I. & PEREDA SUPERBIOLA X. 2008. Costas jurásica frecuentadas por estegosaurios. 33-34. in RUIZ-OMEÑACA J.I., PIÑUELA L. & GARCÍA-RAMOS J.C. (eds). *Libro de resúmenes. XXIV Jornadas de la Sociedad Española de Paleontología*. Museo del Jurásico de Asturias (MUJA), Colunga, 15-18 de octubre de 2008. Museo del Jurásico de Asturias XVII, Colunga, Spain, 280 pp.
- WHYTE M.A. & ROMANO M. 1994. Probable sauropod footprints from the Middle Jurassic of Yorkshire. *Gaia*, 10: 15-26.

LE BASSIN CRETACE DU GUIR (BECHAR, SUD-OUEST ALGERIEN) : DECOUVERTE DES GISEMENTS A RESTES DE VERTEBRES

**BENYOUCEF Madani¹, BENSALAH Mustapha², BENDELLA Mohamed³, MEKKAOUI
Abderahmane⁴, AOUS Slimane¹ & MOHAMED BENALI Mourad Mohamed¹**

¹Laboratoire des Travaux Publics de l'Ouest (LTPO, Unité d'Oran), Algérie, benyoucef.madani@caramail.com; ²Département de Géologie, Université d'Abou Bakr Belkaid, Tlemcen, Algérie; ³Département de Géologie, Université d'Oran, Algérie; ⁴Université de Béchar, Algérie

Dans le bassin crétacé du Guir (Algérie du Sud Ouest), la formation des « Argiles à gypse inférieures » recouvre le Paléozoïque soit directement soit par l'intermédiaire de lits discontinus de cailloutis et de grès (bordures méridionales du bassin) ou de chenaux gréseux d'épaisseur métrique (bordures septentrionales du bassin). Ces niveaux, connus sous le nom de « grès continentaux antécénomaniens » révèlent occasionnellement des restes de vertébrés variés, découverts pour la première fois lors de nos récents travaux de terrains. Ils se présentent en plusieurs gisements dont les plus importants sont : (i) le gisement de Kénadsa qui a révélé des dents de dipneustes du genre *Ceratodus africanus*, des écailles en forme de losange d'un poisson semionotiforme (*Lepidotes*), des écailles de sarcoptérygien (*Mawsonia*) et des os de poissons indéterminés, ainsi que des coprolithes de reptiles ; (ii) le gisement de Bou Kaïs qui a recélé un ensemble de dents isolées de dinosauriens (Théropode Spinosauridé) et d'*Onchopristis numidus* ainsi que des vertèbres et des dents de crocodiliens et de poissons indéterminés.

Ces couches à restes de vertébrés offrent certaines similitudes avec d'autres niveaux dans la ceinture atlasique et au Sahara : le Cénomalien inférieur du plateau de Kem Kem ; l'Albien de Oued Boudjihane (Monts des Ksour) ; près de Timimoun et au Djoua ; les couches albiennes de Samani (Tademaït), le gisement de Gadoufaoua au Niger et celui de Bahariya en Egypte. L'emplacement géographique de ces sites fossilifères, montre une relation faunistique étroite unissant les divers territoires d'Afrique du Nord depuis l'Égypte jusqu'au Maroc.

Mots clés : Bassin Crétacé du Guir, Béchar, Algérie, Restes de Vertébrés



PRESENCE OF NOTOPTERIDAE (TELEOSTEI: OSTEOGLOSSOMORPHA) IN THE KEM-KEM BEDS, CRETACEOUS OF MOROCCO.

BRITO Paulo M.¹, DUTHEIL Didier² & MEUNIER François³

¹Departamento de Zoologia, Universidade do Estado do Rio de Janeiro, Rua São Francisco Xavier 524, Rio de Janeiro, RJ 20559-900, Brazil, pbritopaleo@yahoo.com.br; ²15 passage du Buisson Saint-Louis, 75010 Paris, France. didierdutheil@free.fr; ³USM 403 "Biodiversité et Dynamique des Communautés aquatiques", Département des Milieux et Peuplements aquatiques, Muséum National d'Histoire Naturelle, 43 rue Cuvier, 75231 Paris cedex 05, France.

Notopterids are one of the taxonomic groups of the Osteoglossomorpha represented in the extant fauna by fishes confined to freshwater of Africa. Confirmed fossils of this group are rare and thus the description of any articulated or semi-articulated fossil is very important for the knowledge of the systematic and biogeographical problem.

In this paper, we described a skull and some post-cranial elements assigned to an osteoglossomorpha from Kem-Kem Beds, Morocco. This taxon shows affinity with the extant Notopterids rather than with the group of Palaeonotopterids.

THE AMIIFORMS (ACTINOPTERYGII: HOLOSTEI) FROM THE WESTERN GONDWANA.

BRITO Paulo M.

Departamento de Zoologia, Universidade do Estado do Rio de Janeiro, Rua São Francisco Xavier 524, Rio de Janeiro, RJ 20559-900, Brazil. pbritopaleo@yahoo.com.br

Amiiforms are known, on lands of western Gondwana, by three species of the Cretaceous genus †*Calamopleurus*: †*C. cylindricus* Agassiz, 1841, the type species, known from numerous and very well preserved specimens from the Albian Santana Formation of the Araripe Basin, northeastern Brazil, †*C. mawsoni* (Woodward, 1902) from the Barremian of the Ilhas Formation, State of Bahia, northeastern Brazil, and †*C. africanus* Forey & Grande (1998), from the Upper Cretaceous, ?Cenomanian, of the Kem Kem beds of Morocco, as well as by †*Cratoamia longidorsalis* Brito, Yabumoto & Grande, 2008, from the Aptian Crato Formation of the Araripe Basin and the Eocene †*Maliamia gigas* Patterson & Longbottom, 1989, from the Republic of Mali, Africa. These taxa had been respectively assigned to the subfamily †Vidalamiinae and to the tribe †Calamopleurini (Grande & Bemis, 1998). In the present work, we will discuss the systematic relationships of these taxa and their paleogeographical distribution.

ARTICULATED CRANIUM OF *ONCHOPRISTIS NUMIDUS* (SCLERORHYNCHIDAE, ELASMOBRANCHII) FROM THE KEM KEM BED, MOROCCO

DUTHEIL Didier B.¹ & BRITO Paulo M.²

¹15 passage du Buisson Saint-Louis, 75010 Paris, France. didierdutheil@free.fr; ²Departamento de Zoologia, Universidade do Estado do Rio de Janeiro, Rua São Francisco Xavier 524, Rio de Janeiro, RJ 20559-900, Brazil; pbritopaleo@yahoo.com.br

Except for few skeletons from the Upper Cretaceous of Lebanon, articulated skeletons of Sclerorhynchidae are rare and restricted to very few species. Thus, the new semi-articulated specimen of this family found in the Kem Kem beds, Cenomanian of south-eastern Morocco, is important. This specimen could be assigned to *Onchopristis numidus* and show roughly the rostrum, the roof skull, the meckel cartilage with teeth, the synarcual and couple vertebrae. The teeth headlight definitively the fact that the teeth attribute to *Sechmetia aegyptiaca* must be referred definitively to *Onchopristis numidus*.



**NEW ICHNITES FROM THE MIDDLE TRIASSIC OF THE IBERIAN RANGES (SPAIN):
PALAEOENVIRONMENTAL AND PALAEOGEOGRAPHICAL IMPLICATIONS.**

**GAND G.¹, DE LA HORRA R.², GALAN-ABELLAN B.², LOPEZ-GOMEZ J.², FERNANDEZ-
BARRENECHEA J.³, ARCHE A.² & BENITO M. I.²**

¹Biogéosciences UMR 5561, Centre des Sciences de la Terre, Univ. de Bourgogne. 6 Boulevard Gabriel, 21000 Dijon, France. georges.gand@wanadoo.fr; ²Inst. de Geología Económica. Fac. Geología, UCM-CSIC. C/ José Antonio Nováis, 2 Madrid 28040, Spain. rhorraba@geo.ucm.es jlopez@geo.ucm.es; ³Dept. Cristalografía y Mineralogía. Fac. Geología, UCM C/ José Antonio Nováis, 2 Madrid 28040 Spain.

This work is based on the study of new ichnites found in the Triassic rocks of the SE Iberian Ranges, eastern Spain. The Iberian basin, or present-day Iberian Ranges, was refilled with red clastic sediments of alluvial origin during the Late Permian-Middle (Anisian) Triassic. The Lower Triassic and the lower part of the Middle Triassic in the SE of the Iberian Ranges is represented by the Cañizar (Olenekian-Anisian) and Eslida (Anisian) Fms., both so known as Buntsandstein facies. Also during the Anisian times, the Tethys sea reached the eastern Iberian microplate, represented by the Landete Formation, so called Muschelkalk facies. The studied ichnites belong to the Anisian continental-marine transition.

In the Eslida Fm., specimens from *Lacertoïde* and *Crocodiloïde* Groups have been found. *Rhynchosauroïdes* sp. is the most representative ichnospecies of the first group, while in the *Crocodiloïde* Group, *Chirotherium bartii* Kaup 1835 and *Isochirotherium* cf. *coureli* (Demathieu, 1970) Haubold 1970, are the most representative ichnospecies.

Specimens from *Crocodiloïde* and *Dinosaurioïde* Groups have been found in the Landete Fm. *Brachychirotherium gallicum* Willruth 1917, *Brachychirotherium* sp. and *Chirotherium* sp. are the most representative of the first group, while *Coelurosaurichnus perriauxi* and *Paratrisauropus latus* are the most representative ichnospecies of the second group.

Some of the described specimens have also been described in the Triassic of North America and France, and some of them plunge their roots into the Lower Triassic. Based on different sedimentary structures, the described footprints were mainly made during dry periods, but also during wet ones.

**TWO TRACKWAYS OF LIMPING DINOSAUR AND A DIDACTYL THEROPOD TRACKWAY
FROM THE LOWER JURASSIC AGANANE FORMATION, CENTRAL HIGH ATLAS
MOUNTAINS, MOROCCO.**

ISHIGAKI Shinobu

Hayashibara Museum of Natural Sciences, 1-2-3 Shimoishii, Okayama 700-0907, Japan, isgk@hayashibaramuseum.jp

Jenny and Jossen (1982), first reported the occurrence of theropod tracks including one trackway who has irregular gait suggesting the limping behavior of the trackmaker from the lower Jurassic Aganane formation cropped out close to the village of Ait Blal in High Atlas Mountains, 150km east of Marrakech, Morocco. Ishigaki (1986, 1988) preliminary described those footprints including one limping theropod trackway and didactyl footprints. I performed further research in 1988, and here I report and discuss about two trackways of limping theropod and a didactyl trackway. Those footprints are around 30cm in length. Two limping theropod trackways present clearly the locomotion of the dinosaur that had troubles in their leg. Their shorter pace length is 80 % of longer one. The difference between left and right footprints of one trackway tells that the animal might lost the distal part of digit IV, and could not open fully the angle between digit III and IV. The heel impression of right footprint is very deep, while the left one is shallow. This suggests the animal could not support the body weight by the digital part of the right foot and it obliged to use heel part to support the weight. One didactyl trackway was also discovered, and that is the first didactyl dinosaur trackway from Africa, and also from Lower Jurassic. If the trackmaker was dromaeosaurid, the discovery support the idea that dromaeosaurid are the ancestor of birds, because the age of the substrate is Lower Jurassic.



- ISHIGAKI S. 1986. Dinosaur footprints from Atlas Mountains (3) *Nature Study*, vol.32, no.1: 6-9, Osaka City Museum of Natural History, Osaka, Japan. (In Japanese)
- ISHIGAKI S. 1988. Les empreintes de Dinosaures du Jurassique inférieur du Haut-Atlas central marocain. *Notes Serv. Géol. Maroc*, 44, 334: 79-86.
- JENNY Y. & JOSSEN J.A. 1982. Découverte d'empreintes de dinosauriens dans le Jurassique inférieur (Pliensbachien) du Haut Atlas Central (Maroc). *C.R. Acad. Sci., Paris*, t. 294, Ser. II: 223-226.

LES VERTEBRES FOSSILES DU BASSIN D'ARGANA (PERMIEN-TRIAS, HAUT ATLAS OCCIDENTAL) : LISTE FAUNIQUE ET NIVEAUX STRATIGRAPHIQUES

KHALDOUNE Fatima¹, JALIL Nour-Eddine¹ & PEYER Karin²

¹ Laboratoire « Biodiversité & Dynamique des Ecosystèmes », Dépts. Géologie et Biologie, Faculté des Sciences Semailia, Université Cadi Ayyad, Marrakech, Maroc, khaldoune-fa@hotmail.fr, [njilil@ucam.ac.ma](mailto:njalil@ucam.ac.ma); ²Muséum National d'Histoire Naturelle, Département Histoire de la Terre, UMR-CNRS 5143 "Paléodiversité" case postale 38, 57 rue Cuvier, F-75231 Paris cedex 05 (France), karin_peyer@yahoo.fr

Situé sur le versant Nord du Haut-Atlas occidental, le couloir d'Argana forme une bande d'affleurements à couleur rouge-brique s'étendant NNE-SSW sur environ 70 Km, depuis Imi n'Tanout au nord jusqu'à Amskroud au sud. Les travaux paléontologiques réalisés dans la région ont permis de constituer une importante collection de vertébrés permien et triasiques, considérée aujourd'hui, comme la plus riche de toute l'Afrique du Nord. Au moins 30 gisements fossilifères sont connus dans le bassin d'Argana. Ces gisements sont localisés dans quatre niveaux stratigraphiques répartis sur trois membres : sommet de T2 (Permien supérieur); sommet de T4 (Trias) et base et sommet de T5 (Trias supérieur, Carnien).

Les vertébrés permien sont représentés par des Amniotes Parareptiles (*Arganaceras vacanti*), et Captorhinides (*Acrodonta irerhi* et un *Moradisaurinae*) et des Amphibiens Lépospondyles (*Diplocaulus minimus*). De récents travaux de terrain ont permis de mettre à jours des restes d'un Amphibien Temnospondyle (Steyer et al., 2009 ; Steyer & Jalil, accepted).

La faune triasique, largement présente dans le bassin d'Argana, est concentrée au niveau du Membre Irohalène (T5). Elle est représentée par des "poissons" Actinoptérygiens (*Dipteronotus gibbosus*; *Mauritanichthys rugosus*; *Ischnolepis sp.*; *Procheirichthys sp.*; *Atopocephala sp.*) et Sarcopterygiens Dipnoi (*Asiatoceratodus atlanti*) et Actinisti (*Coelanthidae* gen. et sp. indet.); des Amphibiens Temnospondyles Metoposauridae (*Arganasaurus lyazidi*; *Dutuitosaurus ouazzoui*; *Metoposaurus azerouali*), Almasauridae (*Almasaurus habbasi*) et Cyclotosauridae (Jalil et al., 2009).

Les Parasuchia (*Angistorhinus talainti*, *Paleorhinus magnoculus*), les Aetosauria et une autre espèce décrite comme un dinosaure Ornithischien ou Prosauropode (*Azendohsaurus laaroussii*) forment les Reptiles Archosaures.

Trois formes de dicynodontes sont décrites dans le couloir d'Argana (*Moghreberia nmachouensis*; *Azarifeneria barrati* et *Azarifeneria robustus*).

JALIL N.E., JANVIER Ph. & STEYER J.S. 2009. A new cyclotosaurid (Amphibia, Temnospondyli) from the Triassic of Argana Basin (High Atlas mountains, Morocco); biostratigraphic implications. *Présent Volume*

STEYER J.S. & JALIL N.E. (accepted). First evidence of a temnospondyl in the Late Permian of the Argana Basin, Morocco. *Palaeontology*

STEYER J.Sébastien, JALIL Nour-Eddine, TAQUET Philippe, BITAM Ihacem, AÏTOUALI Rachid, NEDJARI A., BOUZIDI Ouahiba & KEDADRA Bilal. 2009. Temnospondyls from North Africa: review and perspectives. *Présent Volume*



A RECONSTRUCTION OF *TAZOUDASAURUS NAIMI* (DINOSARUIA, SAUROPODA) FROM THE LATE EARLY JURASSIC OF MOROCCO.

PEYER Karin & ALLAIN Ronan

Muséum National d'Histoire Naturelle, Département Histoire de la Terre, UMR-CNRS 7207 "Paléodiversité" case postale 38, 57 rue Cuvier, F-75231 Paris cedex 05 (France)

The small vulcanodontid sauropod *Tazoudasaurus* from the Early Jurassic of Morocco is represented by at least six juvenile to adult individuals. They were recovered in the Azilal Formation (Toarcian to Early Aalenian age) of the Toundoute continental series of Ouarzazate Province. Except for the skull, the osteology of *Tazoudasaurus* is completely known. Of special interest is the virtually intact, articulated manus. Superb preservation and the abundance of osteological data from the presently known *Tazoudasaurus* individuals make it possible to provide a detailed skeletal reconstruction for the first time.

LA PALEOBIODIVERSITE DES DINOSAURES AU MAROC, DU TRIAS SUPERIEUR AU CRETACE TERMINAL : UNE FAUNE EXCEPTIONNELLEMENT RICHE ET DIVERSIFIEE

ZITOUNI S.¹; JALIL N.E.¹ & ALLAIN R.²

¹Laboratoire « Biodiversité & Dynamique des Ecosystèmes », Dépts. Géologie et Biologie, Faculté des Sciences Semlalia, Université Cadi Ayyad, Marrakech, Maroc, s.zitouni@ucam.ac.ma, njalil@ucam.ac.ma ; ²Muséum National d'Histoire Naturelle, Département Histoire de la Terre, CR2P, UMR 7207 du CNRS, Case Postale 38, 57 rue Cuvier, F-75231 Paris cedex 05, France, rallain@mnhn.fr

Depuis la première découverte de restes de dinosaures dans la région d'El Mers, au début du XX^{ème} siècle, par le géologue français H. Termier, de nombreux gisements de dinosaures ont été signalés. Ces gisements couvrent une période de presque 160 MA, du Trias supérieur (Carnien, Bassin d'Argana) au Crétacé Terminal (Maastrichtien, bassin des Oulad Abdoun). La faune de dinosaures ainsi découverte est constituée principalement de saurischiens. Elle comprend l'un des plus anciens Sauropodes (*Tazoudasaurus naimi*) du Jurassique inférieur de Tazouda (Allain et al., 2004) et le crâne d'un des plus grands dinosaures carnivores (*Carcharodontosaurus saharicus*) du Crétacé moyen de Kem Kem (Serenio et al., 1996). Les récentes découvertes dans le Jurassique inférieur donnent des renseignements utiles sur la diversification des dinosaures au début du Jurassique (Allain et al., 2007). A ces restes osseux s'ajoutent ceux de nombreux ichnofossiles, (empreintes de pas de dinosaures), très abondants dans le Haut Atlas.

Les restes d'un dinosaure sauropode, ont été récemment découverts dans les dépôts rouges du Jurassique moyen du bassin d'Aït Hani (Bathonien, Haut Atlas). Il s'agit de sept vertèbres caudales en connexion, d'un ilion droit et d'un fémur droit.

Les vertèbres caudales présentent un caractère dérivé diagnostique des Titanisauriformes (position très antérieure des arcs neuraux sur les centra) et, en conséquence, elles sont provisoirement rattachées à ce clade (Zitouni, 2006). Il s'agit de la première mention d'un Titanisauriformes dans le Jurassique du Maroc, et d'un des plus anciens représentants de ce groupe. Cette découverte confirme la richesse des gisements marocains et leur importance pour l'étude de la diversification des dinosaures.

ALLAIN R., AQUESBI N., DEJAX J., MEYER C., MONBARON M., MONTENAT C., RICHIR P., ROOCHDY M., RUSSELL D. & TAQUET P. 2004. A basal sauropod dinosaur from the Early Jurassic of Morocco. *Comptes rendus de l'Académie des sciences, Paris*, 3: 199-208.

ALLAIN R., TYKOSKI A., AQUESBI N., JALIL N.E., MONBARON M., RUSSELL D. & TAQUET P. 2007. An abelisauroid (Dinosauria, Theropoda) from the Early Jurassic of the High Atlas mountains, Morocco, and the radiation of ceratosaurs. *Journal of Vertebrate Paleontology*, 27(3):610-624.

SERENO P.C., DUTHEIL D.B., LAROCHE M., LARSSON H.C.E., LYON G.H., MAGWENE P.M., SIDOR C.A., VARRICCHIO D.J. & WILSON J.A. 1996. Predatory dinosaurs from the Sahara and Late Cretaceous faunal differentiation. *Sciences*, 272: 921-1068.

ZITOUNI S. 2006. *Histoire et évolution des dinosaures du Maroc avec étude de nouveaux restes d'un Dinosaur sauropode de la région d'Aït Hani (Jurassique moyen, Bathonien, Haut Atlas)*. Mémoire de fin d'études pour l'obtention du DESA, 61pp.



PRÉSENTATIONS AFFICHÉES : CÉNOZOÏQUE
/
POSTER PRESENTATIONS: CENOZOIC



EXTENSION GEOGRAPHIQUE DE LA FORMATION CONTINENTALE EOCENE DU GLIB ZEGDOU ET RECONSTITUTION PALEOENVIRONNEMENTALE DE SA FAUNE DE MAMMIFERES (EOCENE INFERIEUR A MOYEN, ALGERIE)

ADACI Mohammed¹, RAMDARSHAN Anusha², MEBROUK Fateh³, BENSALAH Mustapha¹, MAHBOUBI M'hammed⁴, ZAOUI Djamilia¹, MARIVAUX Laurent² & TABUCE Rodolphe²

¹Laboratoire de recherche n°25, Département des Sciences de la Terre, Université Abou Bekr Belkaïd, B.P. 119 Tlemcen 13000, Algérie, m_adaci@yahoo.fr ; ²Institut des Sciences de l'Évolution, cc064, Université Montpellier II, place Eugène Bataillon, 34095 Montpellier cedex 05, France, anusha.ramdarshan@univ-montp2.fr, laurent.marivaux@univ-montp2.fr, rodolphe.tabuce@univ-montp2.fr ; ³Département des Sciences de la Terre, Faculté des Sciences, Université de Jijel, B.P. 98 Ouled Aïssa, 18000 Jijel, Algérie, mus_bensalah@yahoo.fr, da_zaooui@yahoo.fr, mebrouk06@yahoo.fr ; ⁴Laboratoire de Paléontologie stratigraphique et Paléoenvironnement, Université d'Oran, B.P. 1524 El M'naouer, Oran 31000, Algérie, mahboubi.mahammed@caramail.com

Des prospections géologiques et paléontologiques ainsi que le levé d'une dizaine de coupes lithologiques, sur les affleurements continentaux paléogènes de la région des Gour de la Hammada du Dra (Algérie) nous ont permis de mettre en évidence plusieurs sites à vertébrés, sur une étendue de plus de quarante kilomètres.

La faune de vertébrés est constituée de dipneustes, d'actinoptérygiens, de chéloniens et plus particulièrement de mammifères associés à des oogones de charophytes indiquant un âge Éocène inférieur à moyen.

Les nombreux mammifères récoltés ont une préservation exceptionnelle pour le Paléogène ancien arabo-africain et permettent une reconstitution paléoenvironnementale réalisée par la méthode des cénogrammes et par l'analyse de la diversité écologique.

L'abondance des espèces de petite taille (insectivores, primates, rongeurs), la présence d'espèces de taille intermédiaire (hyracoïdes) et la rareté des grandes espèces (hyracoïdes) mettent en évidence un milieu forestier fermé. Par ailleurs, les données sédimentologiques indiquent un milieu fluvio- (lacustre). L'analyse de la diversité écologique va à l'appui de l'hypothèse d'un milieu fermé mais ne permet pas de rejeter l'hypothèse de milieux plus ouverts sous climat tropical à saisons sèches en présence d'un système fluvial (et lacustre) où auraient pu proliférer les charophytes qui apparaissent particulièrement abondantes dans certains niveaux.

Mots clés: Eocène, Gour Lazib, Algérie, Mammifères, Cénogramme, Analyse de la Diversité, Ecologique, Paléoenvironnements.

LES FAUNES QUATERNAIRES DE GUENFOUDA, (MAROC ORIENTAL)

AOURAGHE H.¹, OUCHAOU B.², BAILON S.³, HADDOUMI H.¹ & EI HAMMOUTI K.¹

¹Université Mohamed I^{er}, Centre Universitaire de Recherches en Archéologie, Oujda, Maroc; ²Université My. Ismail, Faculté des Sciences, Meknès, Maroc; ³UMR 7209 – UMR 7194 du CNRS, Dép. EGB, Bât. Anatomie comparée, CP55, 75005, Paris, France

Les fouilles menées depuis 2004 dans la grotte de Guenfouda, située dans les Monts d'Oujda, ont permis de mettre en évidence un matériel faunique riche et varié, associé à une industrie lithique abondante.

Les amphibiens sont représentés par 4 taxons : *Discoglossus pictus*, *Bufo mauritanicus*, *Bufo viridis* et *Rana* sp.. Parmi les reptiles au moins 13 taxons semblent être présents : *Testudo* sp. et *Emys* ou *Mauremys* parmi les chéloniens ; *Trogonophis wiegmanni* parmi les amphibéniens, et les squamates *Chamaeleo chamaeleon*, *Agama* cf. *bibronii*, cf. *Eumeces*, *Chalcides* sp., *Malpolon* sp., *Coronella* cf. *girondica* et *Natrix maura*, ainsi que des éléments appartenant aux familles Geckonidae et Lacertidae non déterminés.

Les carnivores sont représentés par : *Canis familiaris* et *Vulpes vulpes*. Les herbivores sont très abondants et représentés par : *Equus* sp. (*mauritanicus* ?) et *Equus asinus*, *Sus scrofa* ou *Sus scrofa* cf. *domestica*, *Bos primigenius*, *Alcelaphus buselaphus*, *Ammotragus lervia*, *Ovis aries*, *Capra hircus* et au moins deux espèces de *Gazella*.



Les rongeurs sont en cours d'étude, *Hystrix cristata* est bien représenté dans le site, par ses restes osseux et par ses traces de morsures caractéristiques. *Oryctolagus* ou/et *Lepus* représentent les lagomorphes.

Les oiseaux sont en cours d'étude, cependant, signalons la présence de fragments de coquilles d'œufs attribués à *Struthio camelus* et parfois transformés en rondelles pour la fabrication de colliers.

Les insectivores sont représentés par *Erinaceus algirus*.

Les mollusques, notamment les gastéropodes terrestres, sont très abondants.

D'après les données paléontologiques et archéologiques, ces faunes sont d'âge Holocène. Le caméléon commun et l'agame de Bibron fossiles, identifiés pour la première fois au Maroc, caractérisent la faune de Guenfouda.

DYNAMIQUE DE RECOLONISATION POST-CRETACE PAR LES SELACIENS DU BASSIN DES GANTOUR (MAROC).

ARIA Cédric¹, ADNET Sylvain¹, CAPPETTA Henri¹, CHAKIR M.² & AMALIK M.²

¹UMR 5554. ISE-M, Université Montpellier 2, Place E. Bataillon, 34095 Montpellier Cedex 5 –France; ²Centre de Youssoufia & Benguerir : Groupe OCP, 4 Rue Al Abtal, Hay Erraha -BP 5196 – Casablanca (Morocco)

Les bassins phosphatés du Maroc (en particulier des Ouled Abdoun et Gantour) ont déjà livré une riche faune de sélaciens fossiles (Requins et Raies) du Maastrichtien et du Paléogène (Arambourg, 1952 ; Noubhani & Cappetta, 1997). Les études de ces faunes ont permis de définir, entre autre, que la recolonisation post crise K/T (avec 96% d'espèces éteintes) s'est faite par un renouvellement faunique massif durant le Danien (Cappetta, 1987 ; Noubhani & Cappetta, 1997) qui semble s'être poursuivi jusqu'au Thanétien. L'échantillonnage récent d'une subdivision du Danien en deux entités fossilifères (C1 et C0) dans le bassin des Gantour permet d'entrevoir la possibilité de mieux définir cette subdivision (Danien-Sélandien?) à partir des faunes de sélaciens et surtout de mieux comprendre la dynamique de recolonisation après la crise majeure qui marque la fin du Crétacé.

SELACHIAN TURNOVER AFTER THE KT CRISIS IN THE GANTOUR BASIN (MOROCCO)

Phosphatic basins of Morocco (especially Ouled Abdoun and Gantour) have delivered a rich fossil selachian fauna (sharks and rays) from Maastrichtian and Palaeogene (Arambourg, 1952; Noubhani & Cappetta, 1997). The previous studies allowed to highlight a massive turnover of selachian taxa during the Danian (with 96% of extinct species at the KT crisis) and until the Thanetian. The preliminary analysis of fossil of selachian faunas in two distinct fossiliferous levels (named C0 and C1), recently sampled in the Danian of the basin of Gantour, renew the debate about a possible biostratigraphic subdivision of Danian (Selandian?) in Morocco. Moreover these new data increase our knowledge about the dynamics of recolonization after the major crisis at the end of Cretaceous.

LES VERTEBRES FOSSILES DE TUNISIE A TRAVERS LES TEMPS GEOLOGIQUES

BEN HAJ ALI Nébiha¹ & MEMMI Lucia²

¹Faculté des Sciences de Tunis, Université Tunis El Manar, Campus Universitaire, 2093, Tunis, chittanebiha1@yahoo.fr; ²20, Avenue du 2 Mars 1934- 2025, Salambô, Tunisie.

Durant l'histoire géologique de la Tunisie et dès le Permien marin, affleurement le plus ancien, les vertébrés sont les plus présents en particulier dans le Sud, dépendance du continent saharien. Dans les grès de Cheguimi (Permien supérieur de Tebaga de Médenine), une ichnofaune attribuée à des Pélycosaures, est à ce jour, l'indice le plus ancien connu. Au Mésozoïque, le Trias supérieur (Carnien inférieur du J. Rehach) et le Bathonien de Jeffara livrent des restes de Poissons et de Reptiles. Le Toarcien de la Dorsale



tunisienne et l'Axe Nord-Sud a fourni des Poissons (*Leptolepis*). Au Crétacé inférieur du Sud, deux niveaux sont remarquables :

- Hauterivien supérieur-Barrémien (fm. Asfer pp.) qui livre de nombreux Reptiles: crocodiliens, chéloniens et des Dinosauriens Théropodes (*Carcharodontosaurus*, *Elaphrosaurus*) et Sauropodes (*Rebbachisaurus*) ;

-Albien inférieur (fm. Chenini à Tataouine) connu surtout par des dents, épines et plaques de sélaciens (*Protolamna*, *Cretodus*) de Dipneustes (*Neoceratodus africanus*, cf. *Hybodus*) et de reptiles.

Les vertébrés sont par contre rares dans le Crétacé supérieur. Seul un poisson *Diplomystus solignaci* est décrit du Sénonien d'El Hama (Gabès).

Les marnes phosphatées de L'Eocène recèlent de nombreux sélaciens, crocodiliens (*Crocodylus phosphaticus*) et chéloniens (*Chelonia*)...Un remarquable Pleuronectiforme, *Numidiopleura enigmatica* provient de l'Eocène de Tunisie Centrale. Au Miocène supérieur, la formation Béglija a fourni à Bled Douarah (Moularès, Gafsa) un riche matériel réparti sur deux niveaux :

- les sables inférieurs avec des poissons, des chéloniens (*Trionyx*), des crocodiles associés à des oiseaux à habitat palustre,

- un niveau supérieur à *Hipparion primigenium* associé à une faune de savane, Antilopes (*Pachytragus*), Rhinocéros, Mastodontes...

Au « Villafranchien », des mastodontes peuplaient le Nord de l'Ichkeul et Hamada Damous (Grombalia) : *Elephas africanus*, *Ananus osiris*. A Kébili (Aïn Brimba), *E. africanus* est associé à des restes de tigre à dents de sabre. Plus récemment, le Tyrrhénien de Douira (Mahdia) a fourni *Elephas iolensis*. Enfin, le plus vieux site archéologique tunisien, Sidi Zin (Kef) du Paléolithique inférieur (Acheuléen) recèle une industrie lithique associée à une faune tropicale tchado-zambézienne à restes de rhinocéros, zèbres, gazelles, éléphants.

A MIOCENE EUSELACHIAN ASSEMBLAGE FROM MOGHRA, EGYPT

COOK Todd D.¹, MURRAY Alison M.¹, SIMONS Elwyn L.², ATTIA Yousry S.³ & CHATRATH Prithijit²

¹Department of Biological Sciences, University of Alberta, Edmonton, AB T6G 2E9 Canada; tdcook@ualberta.ca, ammurray@ualberta.ca ; ²Division of Fossil Primates, Duke University Primate Center, 1013 Broad Street, Durham, North Carolina, 27705, USA; ³deceased, formerly of the Egyptian Geological Survey and Mining Authority, Cairo Geological Museum, Cairo, Egypt

The fossil bearing beds of Moghra, Egypt, have been known for well over 100 years, but the ichthyofaunas have not been examined since the early 1900s. Moghra, on the northern rim of the Qattara Depression, preserves early Miocene (18-17 Ma) fluvio-marine sediments with fossils of wood, invertebrates and vertebrates. The Moghra site is faunally similar to the Libyan Gebel Zelten site, at least in terms of the fossil mammals. The fossil-bearing localities in the Moghra Formation number about 40, and span a distance of about 50 km. There is likely more than one depositional environment represented. The fish previously reported from Moghra include two teleosts, *Synodontis* (Mochokidae, squeaker catfish) and *Lates* (Latidae, Nile perch relatives), as well as the elasmobranchs, *Pristis* (Pristidae, sawfish), *Myliobatis* (Myliobatidae, eagle ray) and *Sphyrna* (Sphyrnidae, hammerhead shark).

Several more recent expeditions to the Moghra localities recovered abundant euselachian remains. This rich assemblage included species from the genera *Carcharocles* (Otodontidae, extinct megatoothed shark), *Cosmopolitodus* (Lamnidae, extinct white shark), *Carcharias* (Odontaspidae, sand tiger shark), *Carcharhinus* and *Galeocerdo* (Carcharhinidae, requiem sharks), *Hemipristis* (Hemigaleidae, snaggletooth shark), *Pteromylaeus* (Myliobatidae, bull ray), *Aetobatis* (Myliobatidae, bonnet ray), and *Myliobatis* (Myliobatidae, eagle ray). With the additional taxa from these collections, we can build a more comprehensive understanding of the Moghra fauna and environment.



**DEUX NOUVEAUX TELEOSTEENS DES GISEMENTS DES PHOSPHATES DU MAROC
(BASSIN DES OULED ABDOUN, EOCENE) : ANATOMIE ET SYSTEMATIQUE**

ELHOUSSAINI DARIF Khadija¹, JALIL Nour-Eddine, BOUYA Baadi² & AMAGHZAZ Mbarek².

¹Laboratoire « Biodiversité & Dynamique des Ecosystèmes », Dépts. Géologie et Biologie, Faculté des Sciences Semlalia, Université Cadi Ayyad, Marrakech, Maroc; ²Groupe Office Chérifien des Phosphates, Service minier de Khouribga, Maroc.

Le bassin des Ouled Abdoun, au Maroc, est constitué d'une série phosphatée continue du Maastrichtien à l'Yprésien, documentant ainsi une période de plus de 25 millions d'années. Parmi les nombreux vertébrés fossiles des gisements des phosphates, les Actinoptérygiens y présentent une importante composante faunique constituée par au moins 11 familles appartenant aux Pycnodontes et aux téléostéens Aulopiformes, Ichthyodectiformes, Albuliformes, Osteoglossiformes et Perciformes. Cette diversité est sans cesse augmentée par les nombreux travaux de terrains effectués dans le cadre d'un projet de coopération franco-marocaine. Les deux nouveaux taxons décrits ici en sont une illustration.

Le premier taxon est représenté par un spécimen : un toit crânien subcomplet, écrasé latéralement. Il provient de l'intercalaire Thanétien-Yprésien et partage de nombreuses synapomorphies avec *Phosphichthys thomasi* (Perciformes, Serranidae de l'Eocène inférieur de Metlaoui, Tunisie), telles des crêtes pariétales courtes, un prootique bien développé. Le taxon marocain se distingue par son neurocrâne moins large et l'ornementation moins prononcée de ses frontaux.

Le second taxon est représenté par deux neurocrânes bien préservés, qui proviennent du Danien. Il est attribué ici aux Megalopidae (Elopiformes, Elopomorpha) et présente de nombreux points communs avec les genres *Protarpon* et *Promegalops* (Yprésien, London Clay, Angleterre) : pariétaux unis par une ligne médiane, ptérotiques et fosses post-temporales bien développés. La comparaison avec le Megalopidae actuel, *Megalops atlanticus*, est également proposée.

Il s'agit de la première mention de Megalopidae dans les Phosphates d'Afrique du Nord et du premier Serranidae dans les Phosphates du Maroc.

Mots clés. Anatomie crânienne, Megalopidae, Serranidae, Systématique, Eocène, Bassin des Oulad Abdoun.

**THE DISCOVERY OF AVIAN EGG AND BONE REMAINS FROM THE GOUR LAZIB,
(EOCENE, ALGERIA)**

GARCIA Géraldine¹, ADACI Mohammed², BENSALAH Mustapha², MEBROUK Fateh³, JAEGER Jean-Jacques¹, MOURER-CHAUVIRÉ Cécile⁴, SUDRE Jean⁵, VALENTIN Xavier¹, MAHBOUBI M'hammed⁶ & TABUCE Rodolphe⁵

¹IPHEP, UMR 6046, Université de Poitiers, 40 avenue du recteur Pineau, 86022 Poitiers cedex, France, geraldine.garcia@univ-poitiers.fr, jean-jacques.jaeger@univ-poitiers.fr, xavier.valentin@univ-poitiers.fr; ²Laboratoire de recherche n°25, Département des Sciences de la Terre, Université Abou Bekr Belkaïd, B.P. 119 Tlemcen 13000, Algérie, m_adaci@yahoo.fr, mus_bensalah@yahoo.fr; ³Laboratoire de Paléontologie stratigraphique et Paléoenvironnement, Université d'Oran, B.P. 1524 El M'naouer, Oran 31000, Algérie, mebrouk06@yahoo.fr; ⁴PEPS UMR 5125, Université de Lyon, 2 rue Raphaël Dubois, 69622 Villeurbanne cedex, France, Cecile.Mourer@univ-lyon1.fr; ⁵ISEM, UMR 5554, Université Montpellier II, cc064, place Eugène Bataillon, 34095 Montpellier cedex 05, France, jean.sudre@wanadoo.fr, rodolphe.tabuce@univ-montp2.fr; ⁶Département des Sciences de la Terre, Faculté des Sciences, Université de Jijel, B.P. 98 Ouled Aïssa, 18000 Jijel, Algérie, mahboubi.mahammed@caramail.com.

Numerous avian eggshells and one well-preserved small ovoid-shaped egg (32 x 28 mm) were collected in the Gour Lazib area from three localities (HGL10, 51 and 62); these sites are dated from the early to early middle Eocene by both the charophyte assemblages and associated mammalian fauna (e.g., primates, rodents and hyraxes) (Adaci et al. 2007). The scanning electron microscopy (SEM) study of the eggshells led to attribute them to neognathous birds. These eggshells are characterized by a thin shell (less than 0.5 mm thick) with a prismatic microstructure composed of three structural layers. Moreover, the richest mammalian site HGL50, which is located one meter below the eggshells found on HGL51, yielded



an avian carpometacarpus belonging to the Presbyornithidae. This discovery suggests that the egg remains found on the Gour Lazib area may be referred to this bird family, which is so far unknown in the Paleogene deposits of the Afro-Arabian continent.

ADACI M., TABUCE R., MEBROUK F., BENSALAH M., FABRE P.-H., HAUTIER L., JAEGER J.-J., LAZZARI V., MAHBOUDI M., MARIVAUS L., OTERO O., PEIGNE & TONG H. 2007. Nouveaux sites à vertébrés paléogènes dans la région des Gour Lazib (Sahara nord-occidental, Algérie). *C.R. Palevol* 6: 535-544.

FOSSIL AGAMID LIZARD REMAINS FROM THE EARLIEST OLIGOCENE OF EGYPT

HOLMES Robert B.¹, MURRAY Alison M.¹, CHATRATH Prithijit², ATTIA Yousry S.³ & SIMONS Elwyn L.²

¹Department of Biological Sciences, University of Alberta, Edmonton, AB T6G 2E9 ; Canada; holmes1@ualberta.ca, ammurray@ualberta.ca; ²Division of Fossil Primates, Duke University Primate Center, 1013 Broad Street, Durham, North Carolina, 27705, USA; ³deceased, formerly of the Egyptian Geological Survey and Mining Authority, Cairo Geological Museum, Cairo, Egypt

Agamid lizards, a group of 54 genera in two subfamilies, are found in Africa, Asia, and Australia. Together with the Chamaeleontidae and some extinct basal forms, they comprise the Acrodontia, lizards with acrodont dentition. The Acrodontia have been suggested to have a Gondwanan origin, with the oldest members found in the Triassic of India. Early agamids are known from the Late Cretaceous of Asia.

Few agamid lizard remains have been recovered from Africa. A single jaw fragment bearing acrodont dentition, possibly attributable to Agamidae, has been reported from the Palaeogene of Morocco, and material identified as agamid was reported from the Oligocene of Oman. We here add to the African record several agamid jaws with attached teeth from earliest Oligocene deposits of the Jebel Qatrani Formation in the Fayum Depression, Egypt. The teeth are in the form of short cylinders, with a very rounded labial surface; shearing edges are concave lingually and the shearing tip is crescentic; accessory cusps are absent. In these characteristics, they most closely resemble the teeth of *Uromastyx*. Species of *Uromastyx* currently inhabit the Saharan and Somalian regions of Africa and adjacent Arabia.

Living agamids are diurnal lizards generally found in terrestrial and arboreal habitats, with only a few species being semi-aquatic. If the Fayum fossil agamid had similar habitat preferences it might explain the paucity of remains found in the predominantly fluvial sediments of the Fayum deposits.

NEW RODENT ASSEMBLAGES FROM THE EOCENE DUR AT-TALAH ESCARPMENT (SAHARA OF CENTRAL LIBYA): SYSTEMATIC, BIOCHRONOLOGIC AND PALEOBIOGEOGRAPHIC IMPLICATIONS

MARIVAUX Laurent

Département de Paléontologie, Institut des Sciences de l'Évolution (ISE-M), UMR-CNRS 5554, Université Montpellier 2, CC64, Place Eugène Bataillon, F-34095 - Montpellier Cedex 05, France, Laurent.Marivaux@univ-montp2.fr

In the framework of a Franco-Libyan paleontological project, surveys in the Idam Unit of the Dur At-Talah escarpment (Sahara of Central Libya) have led to the discovery of several microfossil concentrations. Screen washings have yielded diverse assemblages of aquatic and terrestrial vertebrates, together with terrestrial mammals (rodents, bats, creodonts, marsupials, elephant shrews, hyraxes, primates). From isolated teeth, five rodent taxa belonging to the Phiomyidae (Hystricognathi) have been identified, being distributed among three genera (*Phiomys*, *Protophiomys*, and *Talahphiomys* gen. nov.) with three new species. These rodent assemblages suggest a late middle Eocene age for the Idam deposits. Other mammals, especially Proboscidea, which occur in the same sedimentological unit, substantiate this age hypothesis. Interestingly, the dental patterns of *Protophiomys* and *Talahphiomys* have somewhat stronger affinities with South Asian hystricognath baluchimyines than with Fayum phiomyids. It is clear that baluchimyines and phiomyids have a common ancestry, and that dispersal occurred between Asia and



Africa during the middle of the Paleogene. However, it is not clear if both groups can be strictly separated in two distinct natural groups inasmuch as some baluchimyines appear as phiomyid-like, and some early members of phiomyids are baluchimyine-like. S-Asia and N-Africa represent two centres of adaptive radiation of early hystricognathous rodents. The strong dental resemblances between early Asian and African forms are perhaps the result of subsequent convergent evolution after an initial dispersal from Asia. Otherwise, either the systematics of these rodents has to be entirely revised, or we must consider that their historical biogeography is much more complex.

MARIVAUX L. & JAEGER J.-J. in press. New rodent assemblages from the Eocene Dur at-Talha escarpment (Sahara of Central Libya): systematic, biochronologic and paleobiogeographic implications. *in* JAEGER J.-J., MARIVAUX L., SALEM M., BILAL A.A., CHAIMANEE Y., MARANDAT B., VALENTIN X., DURINGER P., SCHUSTER M., BENAMMI M., MÉTAIS E. & BRUNET M. *Zoological Journal of the Linnean Society*