International Journal of Global Science Research **ISSN: 2348-8344 (Online)**
Vol.3, Issue 6, October 2016, pp. 347-353
***Available Online* at www.ijgsr.com**

Research Paper

Global Discovery of Dinosaur Fossils in Syria

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Received: 02/06/2016
Revised: 06/07/2016
Accepted: 02/08/2016

Abstract: Vertebrates fossils from Jurassic and Cretaceous deposits in Syrian coastal range are the first clear evidence of dinosaurs from Syria. Egg of dinosaurs in Besmalekh Village and impression of indeterminate carnivore dinosaur embryo fossils were discovered in a cherty layer in Middle Cenomanian marine Bab Abdallah formation in Alamoud Village, north of coastal range. These two discoveries affirmed that Syria was home for dinosaurs in Mesozoic time and add important record to scarce dinosaur fossils in the Levant Region.
Keywords: amphibious dinosaur fossils, first discovery, Syrian Coast

INTRODUCTION

Although dinosaur remains are known worldwide, there are few dinosaurs localities in the Middle East Region despite an abundance of well exposed Mesozoic sediments. There are several localities were dinosaur remains have been reported. Dinosaur footprints were discovered in Cenomanian rock in Palestine; an indeterminate theropod was reported from probable Cenomanian-Senonian rocks in Qallamon Hill near Damascus in Syria; a fragment of limb bon, possibly of ornithopod, was found in Maastrichtian marine deposits in Jordan. According to Al-Azki (2001), many dinosaur remains have been reported in Syria. A pterosaur was reported for the first time from a Cenomanian marine sediment in Lebanon; two sauropod teeth from an Early Cretaceous (Neocomian) fluviodeltaic sandstone are the first nonavian dinosaur remains reported from Lebanon; dinosaur remains (lithostrotian titanosaur caudal vertebrae) in Northwestern Saudi Arabia have been documented from Campanian-Maastrichtian deposits; large theropod postcranial elements and indeterminate sauropod limb material from Maastrichtian

rocks in Oman provided accounts of both undefined sauropod body fossils, and sauropod and ornithopod footprints from Jurassic-Cretaceous (Bathonian-Berriasian) strata in Yemen (Avnimelech, 1962; Kear *et al.*, 2013; Martill *et al.*, 1996; Weishampel, 1990).

Until recently, in Syria, records of Mesozoic vertebrates were very scarce. Only an indeterminate theropod was reported from probable Cenomanian-Senonian rocks in Qallamon Hill near Damascus; fish remains have also been recorded from the Senonian phosphates of the Palmyrides Chain; researches in the latest Cretaceous phosphates of the Palmyra area has yielded a significant and diverse assemblage of marine vertebrates, including chondrichthyans (sharks and rays), osteichthyans (actinopterygians), squamates (mainly mosasaurids), plesiosaurians, chelonians and crocodilians (Al Maleh & Mouty, 1994; Arambourg *et al.*, 1959; Atfeh, 1989; Bardet *et al.*, 2000; Dubertret, 1963, 1966; Hooijer, 1968; Ponikarov *et al.*, 1967).

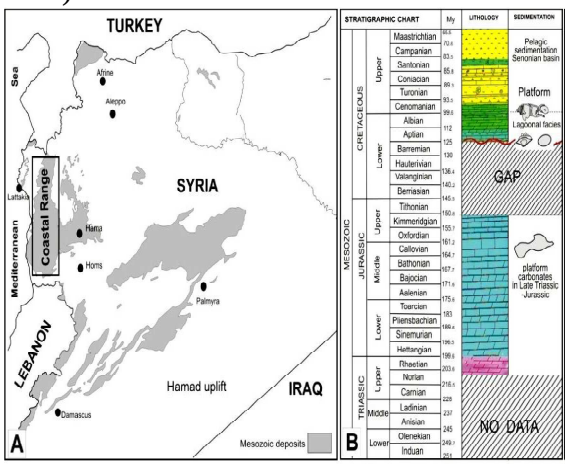

Figure 1: A - Position geographic of the Syrian coastal range; B - its stratigraphic column with dinosaurs fossil locations (original)

In the coastal range at West of Syria, there were no records of Mesozoic vertebrates. Mesozoic vertebrates in this region present the aim of this paper. From 2001 until 2011, I discover many vertebrates fossils related to dinosaurs in Jurassic and Cretaceous deposits: a humerus of probable sauropod dinosaur in Middle Jurassic; egg of dinosaur and part of cervical vertebra of undefined sauropod dinosaur in lower Cretaceous continental deposits, and impress of carnivore dinosaurs embryo in Middle Cenomanian marine deposits.

Coastal Range in Western Syria is situated in northwestern part of the Arabian Peninsula. It was covered by a carbonate platform during Mesozoic, and it present widely in outcrop marine carbonate deposits (Figure 1A) (Mouty 1967, 2000). During this period, this land was situated relatively far to the south and south-west of Arabian Peninsula, except the latest Jurassic-lower Cretaceous time where the Arabian Peninsula was uplifted and emerged (Philip *et al.*, 1993; Saint-Marc, 1978). These paleogeographic situations were clearly shown in coastal range stratigraphy (Figure 1B), and created favorable conditions to continental life in the lowermost Cretaceous.

MATERIAL AND METHODS

During the research carried out between 2001 and 2011, there were widely used field observations and photographs taken by me, and collecting of material from the region, during the field trips.

Specimens were taken from marine and continental deposits belonging to the Cretaceous and Jurassic Periods.

They were then examined in the laboratory of “Dr. Fawaz Azki” Geological Museum, Kismin - Lattakia, Syria. The fossils was prepared in DAGM: number DAGM101 PAL, and number DAGM102 PAL.

The data processing is according to the data from scientific literature.

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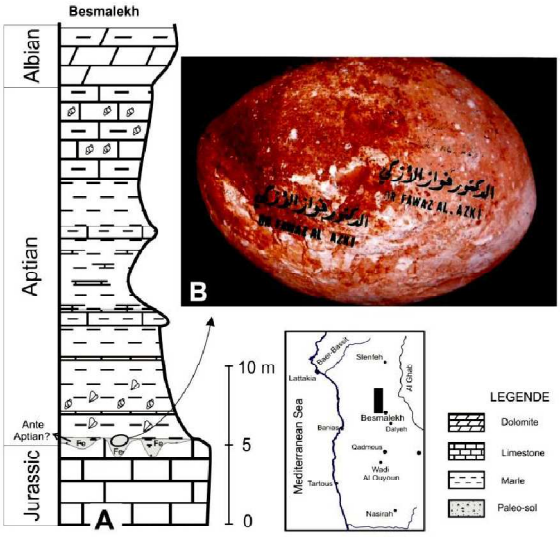

Figure 2: A - Stratigraphic position of concretion egg fossil; B - concretion egg of dinosaur, lower face (original)

RESULTS AND DISCUSSION

Two Fossils were discovered in the coastal range Mesozoic deposits:

1. Concretion Egg of Dinosaur. It was located in Besmalekh Village at the centre of the Coastal range, 4 km southeast of Hamam Alkrahleh Village, 7 km west of Khraeb Salem Village. This fossil was discovered in 2001 in the paleo-soil deposits (Figure 2A) between Upper Jurassic limestone and Bab-Janneh formation which is Aptian lagoonal deposits. I reported this paleo-soil to Neocomian with preservation. In the coastal range, Aptian deposits overlie Upper Jurassic with erosion surface and discordance (Ponikarov, 1966). Paleo-soil in Besmalekh Village filled the erosional cavities of Jurassic limestone.

Description. It was discovered in it place and appears of yellow color at upper face, lower face in red color from continental soil (Figure 2B), maximum diameter 165 mm, minimum diameter 117 mm, a rest of crust with thickness 1-2 mm consists of $CaCO_3$. The egg interior is silicatic. It has weight 3600 grams and volume 1200 cm^3, so it has density of 2.8 $gr./cm^3$.

2. Impressed Embryo of Dinosaur. It was located in Alamoud Village 6 km western Slenfeh City. This fossil was discovered in 2001 at Bab Abdallah formation (Figure 3A) from Middle Cenomanian marine deposits (Youssif, 1979). Impressed embryo of dinosaur (Figure 3 B, C) was located in the lower part of Bab Abdallah formation which presented a pelbioclastic micritic limestone and dolomites with chert deposited in higher offshore under condition of storms waves (Filak, 2002). Dinosaur embryo fossil was discovered in a cherty layer, under this embryo, in chert. It can be seen part of white crust of dinosaur egg.

Description. This specimen represents impression of carnivore dinosaur embryo, inside broken egg. Embryo shows length of 230 mm, width of 111 mm, maximum diameter of head 55 mm and minimum diameter 42 mm, maximum diameter of eye 8 mm and minimum diameter 4 mm, front limbs length 45 mm, femur width 41 mm, tails length 58 mm, body length 63 mm, body width 58 mm, and egg crust thickness 8 mm.

Dinosaur fossils are extremely scarce in the Arabian Peninsula and Levant Region of the Middle East. Published occurrences include many arguments of dinosaur fossils in the Levant Region especially in Cretaceous time and no one include its in Jurassic deposits. In Syrian Coastal range, undefined sauropod dinosaur humerus fossil present the first argument of dinosaurs in the region in Jurassic time. Although dinosaurs remains in Jurassic coastal range found in marine deposits, and paleo-geographic position in Callovian Age shows that its position was not far away from land where western and northwestern Arabian Peninsula was continental except Palmyra basin and Lebanon which present shallow-marine clastics and evaporates deposits (Dercourt *et al*., 1994). Massive beds of micritic and pelbiomicritic limestone with brachiopods

and echinoids in Kharaeb Salm Village have formed shallow marine deposits (Mouty, 1997). So I can interpret dinosaur fossils existence in marine environment by possibility that the animal lived on parts of the carbonate platform that emerged as islands.

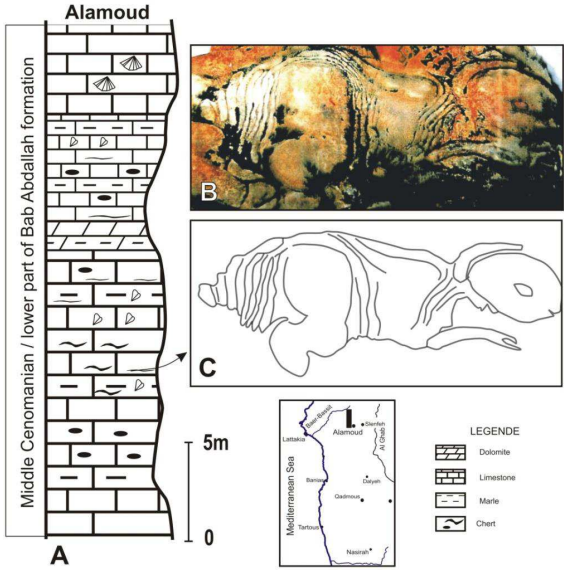

Figure 3: A - Stratigraphic position of dinosaur embryo fossil; B - Dinosaur embryo fossil in posterior view; C - an explicative drawing (original)

In the end of Jurassic and beginning of Cretaceous time, Arabian Peninsula was emerged and relatively continuous sedimentation took place in Oman but most other parts of the Arabian Plate were affected by a late Valangian Unconformity (Ziegler, 2001). Terrigenous sand-dominated environment in the north of the Arabian Plate is suggestive of active uplifting. These conditions were favorable to continental life, thus researchers discovered many dinosaurs fossils in Lower Cretaceous deposits: isolated teeth and bones of Cretaceous brachiosaurid (Neocomian) from Lebanon, feather inclusions in amber from the Early Cretaceous (Neocomian) of Lebanon, provided accounts of both undefined sauropod body fossils, and sauropod and ornithopod footprints from Jurassic-Cretaceous (Bathonian - Berriasian) strata in Yemen (Buffetaut *et al*., 2006; Jacobs *et al*., 1999; Schlee, 1973; Schulp *et al*., 2008a, b). In Lower Cretaceous deposits of Syrian coastal range, tow remains of dinosaurs were discovered; concretion egg of undefined dinosaur in Besmalkh Village and part of cervical vertebra of undefined sauropod dinosaur in Dalyeh Village. The base of Bab-Janneh formation from Lowermost Aptian present continental (lake) and deltaic deposits. At same stratigraphic position and few kilometers to the north of Besmalkh Village a fossilization wood in basaltic deposit was discovered in Khrbet Alsendianeh Village (Al-Azki, 2014). This observation affirm the existence of continental life in lowermost Cretaceous time.

In the Cenomanian-Maastrichtian period, northern Arabian Peninsula presented shallow and open marine carbonate shelf (Rusk, 1978; Sharland *et al*., 2001). Although the land was faraway to the south of Levant Region, near Rutbah High and to the west of Arabian Plate, dinosaurs remains were discovered in marine deposits: remains of titanosaurian in phosphate Maastrichtian from Jordan, sauropod limb material and large theropod postcranial elements from Oman in Maastrichtian, fragment of ornithopod in Maastrichtian remains from Jordan (Schulp *et al*., 2000; Wilson *et al*., 2006). The partial skeleton of an enantiornithine bird has also been documented from Cenomanian of Lebanon (Dalla Vecchia & Chiappe, 2002). In Syrian coastal range, impressed embryo of dinosaur was discovered in Alamoud Village in Middle Cenomanian marine deposits (lower part of Bab Abdallah formation). This part of formation presented an high offshore under condition of storm waves. This conditions explicate why dinosaur embryo was discovered in a cherty layer! Dinosaurs

lived on parts of the carbonate platform that emerged as islands battered by storms waves arriving to the islands. They found evidence of their existence on the seabed, such as eggs and trees remains. It is the case in Barmaya Village where fossilization wood piece in cherty layer was found, in the same position of the impressed embryo of dinosaur in Alamoud Village.

Conclusion: The data presented in this work were compiled from field and laboratory studies conducted in 2001 - 2011. They presents original data on discoveries made me in the present territory of Syria today - the remains of dinosaurs in the Mesozoic Era. The findings were made in Syria's coastal mountains series.
Future research will enable me reconstitution amphibious dinosaurs whose remains were discovered in above-mentioned period, and its palaeo-environments.
Also these fossils that have been discovered in this area gives me the possibility of palaeo-environments reconstitution in this region (and also in the whole Syria) correlated with current environments, and also of the natural history in Syria.
These fossils are part of the fossils collections of the "Dr Fawaz Azki" Geological Museum, Kismin - Lattakia, Syria.

REFERENCES

Avnimelech M. A. (1962) Dinosaur tracks in the Lower Cenomanian of Jerusalem. Nature. 196, 264.

Kear B. P., Rich T. H., Vickers-Rich P., Ali M. A., Al-Mufarreh Y. A., Matari A. H., Al-Massari A. M., Nasser A. H., Attia Y., and Halawani M. A. (2013) First Dinosaurs from Saudi Arabia. Plos One. 8, 12: e84041. doi:10.1371/journal.pone.0084041.

Martill D. M., Frey E., and Sadaqah R. M. (1996) The first dinosaur from the Hashemite Kingdom of Jordan. Neues Jahrbuch fur Geologie und Palaontologie, Monatshefte. 147-154.

Weishampel D. A. (1990) Dinosaurs distribution. California Press, p. 733.

Al Maleh A. K., and Mouty M. (1994) Lithostratigraphy of Senonian phosphorite deposits in the Palmyridean region and their general sedimentological and paleogeographical framework. Proceedings of the 29th International Geological Congress. Part C. In: Lijima A, Abed A M, and Garrison R E (eds.). Siliceous, Phosphatic and Glauconitic sediments of the Tertiary and Mesozoic, Urecht; VSP: 225-232.

Arambourg C., Dubertret L., Signeux J., and Sornay J. (1959) Contributions à la stratigraphie et à la paleontology du Crétacé et du Nummulitique de la marge NW de la Péninsule arabique. Notes et Mémoires sur le Moyen-Orient. 7, 193-251.

Atfeh S. (1989) The phosphorites resources of Syria. In: Notholt A J G, Sheldon R P and Davidson D F (eds.). Phosphate deposits of the world. Phosphate rock resources, Cambridge, U.K.; Cambridge University Press: 2: 357-362.

Bardet N., Cappetta H., Suberbiola X. P., Mouty M., Al Maleh A. K., Ahmad A. M., Khrata O., and Gannoum N. (2000) The marine vertebrate faunas from the Late Cretaceous phosphates of Syria. Geological Magazine. 137(3), 269-290.

Dubertret L. (1963) Lexique stratigraphique international. vol. 3: Asie, fasc. 10 c1: Liban, Syrie, Jordanie. Centre National de la Recherche Scientifique, Paris.

Dubertret L. (1966) Liban, Syrie et bordure des pays voisins. Tableau stratigraphique avec carte géologique au millionième. Notes et Mémoires sur le Moyen-Orient. 8, 251-358.

Hooijer D. A. (1968) A Cretaceous dinosaur from the Syrian Arab Republic. Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen. 71, 150-152B.

Ponikarov V. P., Kazmin V. G., Mikhailov I. A., Razvaliayev A. V., Krasheninnikov V. A., Kozlov V. V., Soulidi-Kindratiyev E. D., Mikhailov K. Y., Kulatov A. V., Faradzhev V. A., and Mirzayev K. M. (1967) The Geology of Syria. Part I. Stratigraphy, Igneous rocks and Tectonics, Damascus; Ministry of Industry.

Mouty M. (1967) Results of the stratigraphical study of the Alaouite Mountains. Rapport inédit du Ministèr des pétroles (langue arabe).

Mouty M. (2000) The Jurassic in Syria: an overview. Ithostratigraphic and biostratigraphic correlations with adjacent areas. In: Crasquin-Soleau S and Barrier E (eds.). New data on PeriTethyan sedimentary basins. Memoires du Muséum National d'Historie Naturelle, PeriTethys Memoir, Paris; France. 5, 159-168.

Philip J., Bellion Y., Babinot J.-F., Tronchetti G., Fourcade E., Ricou L.-E., Guiraud R., Bellion Y., Herbin J.-P., Combes P.-J., Cornee J.-J., and Dercourt J. (1993) Late Cenomanian (94 to 92 Ma). In: Dercourt J., Ricou L. E., and Vrielynck B (eds.). Atlas Tethys palaeoenvironmental maps, Gauthier Villars, Paris; France: pp. 153-178.

Saint-Marc P. (1978) Arabian peninsula. In: Moullade M and Nairn A E M (eds.). The Phanerozoic geology of the world II. The Mesozoic, Amsterdam; Elsevier: pp. 435-461.

Ponikarov V. P. (1966) The geology of Syria. Explanatory Notes on the Geological Map of Syria, scale 1:200 000. Ministry of Industry, Syrian Arab Republic.

Youssif Sh. (1979) The geology of Syria. Explanatory Notes on the Geological Map of Al- Haffeh, scale 1:50 000. Ministry of petroleum and resources of the Syrian Arab Republic.

Filak J. M. (2002) Les plates-formes carbonates d'âge crétacé moyen à supérieur de la Chaîne Côtière de Syrie. Thèse Doct; Université de Provence-Aix Marseille I.

Dercourt J., Fourcade E., Cecca F., Azema J., Enay R., Bassoullet J.-P., and Cottereau N. (1994) Palaeoenvironment of the Jurassic system in the Western and Central Tethys (Toarcian, Callovian, Kimmeridgian, Tithonian): An overview. Geobios. 17, 625-644.

Mouty M. (1997) Le Jurassique de la Chaîne Côtière (Jibal As-Sahilyeh) de Syrie: essai de biozonation par les grands foraminifères. Science de la terre et des planets, C. R. Acad. Sci. Paris. 325, 207-213.

Ziegler M. (2001) Late Permian to Holocene Paleofacies Evolution of the Arabian Plate and its Hydrocarbon Occurrences. GeoArabia. 6 (3), 445-504.

Buffetaut E, Azar D., Nel A., Ziade K, and Acra A. (2006) First nonavian dinosaur from Lebanon: a brachiosaurid sauropod from the Lower Cretaceous of the Jezzine District. Naturwissenschaften. 93, 440-443.

Jacobs L. L, Murry P. A., Downs W. R., and El-Nakhal H. A. (1999) A dinosaur from the Republic of Yemen. In: Whybrow P J and Hill A (eds.). Fossil Vertebrates of Arabia, New Haven; Yale University Press, U.S.A.: pp. 454-459.

Schlee D. (1973) Harzkonservierte fossile Vogelfedern aus der Untersten Kreide. J. Ornithology. 114, 207-219.

Schulp A. S., Al-Wosabi M., and Stevens N. J. (2008) First Dinosaur Tracks from the Arabian Peninsula. Plos One. 3, 5: e2243. doi:10.1371/journal.pone.0002243.

Schulp A. S., O'Connor P. M., Weishampel D. B., Al-Sayigh A. R., Al-Harthy A. (2008) Ornithopod and sauropod dinosaur remains from the Maastrichtian AKhod Conglomerate, Sultanate of Oman; Sultan Qaboos University Journal of Science. 13, 27-32.

Al-Azki F. (2014) New geological data in the Syrian Coastal range. "Al Baath" University Journal. 36(12) (in Arabic).

Rusk R. (1978) The geology of Syria. Explanatory Notes on the Geological Map of Al- Qrdaha, scale 1:50 000. Ministry of petroleum and resources of the Syrian Arab Republic.

Sharland P. R., Archer R., Casey D. M., Davies R. B., Hall S. H., Heward A. P., Hourbury A. D., and Simmons M. D. (2001) Arabian plate sequence stratigraphy. GeoArabia Special Publication. 2.

Schulp A. S., Hanna S. S., Hartman A. F., Jagt J. W. M. (2000) A Late Cretaceous theropod caudal vertebra from the Sultanate of Oman. Cretaceous Research. 21, 851-856.

Wilson J, Mustafa H., Zalmout I. (2006) Latest Cretaceous reptiles from the Hashemite Kingdom of Jordan. Journal of Vertebrate Paleontology Supplement. 26: 140A.

Dalla Veccia F, and Chiappe L. M. (2002) First avian skeleton from the Mesozoic of northern Gondwana. Journal of Vertebrate Paleontology. 22, 856-860.