Disponible en ligne sur
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com/en

Revue de micropaléontologie

Revue de micropaléontologie 58 (2015) 57–83

Original article

Revised fusulinid biostratigraphy of the Middle–Late Permian of Jebel Tebaga (Tunisia)

Révision de la biostratigraphie par fusulines du Permien moyen et supérieur du Djebel Tebaga (Tunisie)

Wissal Ghazzay [a,*], Daniel Vachard [b], Saloua Razgallah [a]

[a] *UR13/ES26, Campus Universitaire El Manar, Département de Géologie, Tunis 2092, Tunisia*
[b] *Université de Lille 1 (Sciences & Technologies), UMR 8198 Evo-Eco-Paléo, Cité Scientifique, SN5, 59650 Villeneuve d'Ascq, France*

Abstract

Most carbonate series of Jebel Tebaga (Tunisia) are assigned to the Capitanian (last stage of the Middle Permian); however, their accurate correlation with the El Capitan stratotype in the USA and with contemporaneous Tethyan localities remains unclear. With the intent to establish more accurate lithostratigraphic and biostratigraphical divisions, (1) we re-sampled bed-by-bed the classical field sections of Jebel Tebaga; (2) we revised the lithostratigraphical units E-I to E-VI, and (3) we selected 9 fusulinids in order to characterize more precisely local bioevents. We have therefore studied 3 giant genera (*Chusenella*, *Neoschwagerina* and *Yabeina*), 3 medium-sized taxa (*Dunbarula*, *Rauserella* and *Yangchienia*), and 3 small size genera (*Lantschichites*, *Codonofusiella* and *Reichelina*). The first group was known to synchronously disappear at the time of the end-Guadalupian mass extinction. The thirth group was generally considered to be characteristic of the early Late Permian, after a Lilliput effect among the fusulinid groups, during which the dwarfs replaced the giants. Our data show that, in Jebel Tebaga, the so-called Wuchiapingian small forms *Codonofusiella* and *Reichelina* appear very early in the Late Capitanian. In some hills of the Tebaga area (i.e., Baten Beni Zid and Jebel Seikra), *Codonofusiella* and *Reichelina* even dominated the fusulinid assemblages during two short episodes. The first episode is located near the base of the Capitanian series; the second one, although located near its top, remains Capitanian in age, because it took place before the local disappearance of the three giants *Neoschwagerina*, *Yabeina* and *Chusenella*. As the sequence becomes sandier after this bioevent, the boundary with the Wuchiapingian (first stage of the Late Permian or Lopingian) cannot be well positioned. The end-Guadalupian event is only marked by this sedimentological modification. Because the Late Permian Cheguimi sandstone is entirely devoid of foraminifers and conodonts, no local subdivisions can be proposed in this series.

Keywords: Tebaga; Fusulinids; Microfacies; Biostratigraphy; Late Capitanian; Perigondwanan margin

Résumé

L'appartenance au Capitanien (dernier étage du Permien moyen) de la plupart des séries carbonatées affleurant dans le Djebel Tebaga, en Tunisie, est à présent bien établie. Cependant, la corrélation exacte de ce Capitanien local avec le stratotype des États-Unis ou avec divers affleurements téthysiens manquait de précision. Afin de combler cette lacune : (1) les coupes classiques du Tebaga ont été revues de manière détaillée ; (2) les unités lithostratigraphiques E-I à E-V y ont été révisées avec précision ; et (3) neuf genres locaux de fusulines ont été choisis afin de mieux caractériser les bioévénements enregistrés dans ces unités. Ces genres de fusulines sont, d'une part, trois formes géantes : *Chusenella*, *Neoschwagerina* et *Yabeina*, d'autre part, trois genres de petites fusulines : *Lantschichites*, *Codonofusiella* et *Reichelina*, et enfin trois genres de taille moyenne : *Dunbarula*, *Rauserella* et *Yangchienia*. Cette sélection par groupes de taille a surtout été guidée par le fait que, pendant la crise fini-guadalupienne, les fusulines géantes étaient toutes censées disparaître, tandis que les petites fusulines survivantes s'octroyaient leur place par effet Lilliput. Il s'est avéré que ces petites fusulines, notamment *Codonofusiella* et *Reichelina*, souvent présentées comme caractéristiques du Permien supérieur (ou Lopingien), apparaissaient tôt dans le Capitanien supérieur du Djebel Tebaga. Elles y dominaient même lors de deux épisodes à Baten Beni Zid et au Djebel

* Corresponding author.
E-mail address: wissalghazzay@yahoo.fr (W. Ghazzay).

http://dx.doi.org/10.1016/j.revmic.2015.04.001
0035-1598/

Seikra. Après chaque épisode à *Codonofusiella* et à *Reichelina*, les fusulines géantes, qui réapparaissent, parfois assez massivement, indiquent que l'on reste dans le Capitanien. Par contre, on ne peut établir précisément pour l'instant si les niveaux à *Dunbarula* et à petits foraminifères, qui succèdent au dernier retour des *Neoschwagerina*, *Yabeina* et *Chusenella*, correspondent à l'extrême sommet du Capitanien ou à l'extrême base du Wuchiapingien. Rien d'autre qu'une sédimentation progressivement plus sableuse ne vient en effet marquer au Tebaga la grande crise de la limite du Permien moyen et du Permien supérieur. On n'enregistre en Tunisie, et sans doute dans tout le fond du cul-de-sac téthysien, que les effets d'une baisse progressive du niveau marin et de l'augmentation croissante d'apports siliciclastiques ; deux types d'influences qui pourraient n'être dus qu'à des phénomènes locaux. L'unité E-VI, ou grès de Cheguimi, représente probablement l'ensemble du Lopingien, mais, étant totalement dépourvue de foraminifères ou de conodontes, elle n'a pu être datée plus précisément. Au Tebaga, comme dans beaucoup de régions périgondwanes et cimmériennes, les foraminifères ne réapparaîtront qu'à la fin du Trias inférieur.

Mots clés : Tebaga ; Fusulines ; Microfaciès ; Biostratigraphie ; Capitanien supérieur ; Marge périgondwane

1. Introduction

The outcrops of Jebel Tebaga (Fig. 1) are famous because they are the unique Permian carbonate series in Africa (Miller and Furnish, 1957; Driggs, 1977; Termier et al., 1977). Furthermore, they correspond to the western extremity of the Tethys' cul-de-sac (Aljinovic et al., 2008) and to the westernmost extension of the Perigondwanan shelves of this ocean (Fig. 2).

The age of outcrops of Tebaga was discussed by numerous authors: Douvillé, 1934; Ciry and Mathieu, 1947; Miller and Furnish, 1957; Mathieu, 1949; Newell et al., 1976; Termier et al., 1977; Khessibi, 1985; Memmi, 1986; Lys, 1988; Chaouachi, 1988; Vachard, 1991; Vachard and Razgallah, 1993; Benzarti and Crasquin, 1998; Vachard et al., 2002; and Angiolini et al., 2008. In contrast, the overlying siliciclastic series (Cheguimi sandstone) remained poorly studied (Figs. 3 and 4). It is now well established that the majority of the Tebaga outcrops are Capitanian in age (Angiolini et al., 2008); nevertheless, the exact regional Capitanian biozonation and its accurate correlation with the US stratotype subdivisions, remains to be done. On the other hand, the age of the top of the Permian series, i.e., the interval located between the disappearance of giant fusulinids like *Yabeina* and *Chusenella* and the appearance of the Triassic facies, was questionable, and possibly was either still Capitanian or corresponding to the whole local Late Permian, or even including only some parts of the stages Wuchiapingian and/or Changhsingian (Fig. 5) of this period.

We tried to revise more accurately the lithostratigraphy and biostratigraphy of the Tebaga series, whether their lithology is carbonate or siliciclastic. More specifically, we re-investigated four field sections: Baten Beni Zid, Jebel Seikra, Oudjh El Ghar, and Halq Jemal (Fig. 1), which were sampled bed-by-bed and studied by means of thousands of thin-sections. We also tried to investigate the PTB boundary interval (work in progress), which was never accurately studied before, in order to understand the possible regional, biostratigraphical extension of the Late Permian. On the other hand, the former, industrial Tebaga boreholes, previously analyzed by Glintzboeckel and Rabaté (1964), Hamaoui (1984), and Lys (1988) were re-examined thanks to the authorization of the SEREPT Company. This first paper is devoted to the accurate establishment of the FO and LO (with FO = first regional occurrence; LO = last occurrence) of three giant fusulinids, which proliferate in the Tethyan and Panthalassan Capitanian: *Chusenella*, *Neoschwagerina* and *Yabeina*, and those of smaller fusulinids: *Reichelina* and *Codonofusiella*, the acme zone of which is generally interpreted as Late Permian (Henderson et al., 2012). Additionally, a medium-sized fusulinid group, composed of *Dunbarula*, *Rauserella* and *Yangchienia*, was analyzed.

The objectives of this paper consist of a revised the high-resolution biostratigraphy of Tebaga and a better definition of the lithostratigraphic units, as well as the characterization in the field and/or in microfacies of the late and latest Capitanian. Another purpose is to describe the ecological and biostratigraphical aspects of nine genera of fusulinids, with the intention to indicate the constraints upon giant and small fusulinids in Jebel Tebaga.

2. Geological setting

The Jebel Tebaga is located in the vicinity of the Dkhilet Toujane village, 30 km west-north-west of Medenine town in southernmost Tunisia (Fig. 1). This 15 km-long monoclinal structure is oriented ENE-WSW, it dips gently 30° to the South-South-East, and it is affected by numerous faults (see Ben Ayed and Khessibi, 1981; Khessibi, 1985; Ben Ayed, 1986; Bouaziz, 1986). A spectacular angular unconformity, discovered by Mathieu (1940), separates the Permian monoclinal succession from the overlying horizontal Jurassic to Cretaceous strata.

Geologically explored for the first time in 1932 (Douvillé et al., 1933), the Jebel Tebaga was rapidly made famous by the highly fossiliferous character of its strata. These macrofaunas were studied in numerous monographies by Termier and Termier between 1955 and 1975 (with all the references in Driggs (1977) and Termier et al. (1977)), whereas different aspects of the reefal bioconstructions were emphasized by Newell et al. (1976), Driggs (1977), Vachard and Razgallah (1988a), Vachard et al. (1989) and Razgallah and Vachard (1991). Several petroleum boreholes drilled during the fifties and sixties years traversed the Permian beds of the Jebel Tebaga area. They encountered in subsurface a series, which was divided in three informal parts by Glintzboeckel and Rabaté (1964): a lower "Ensemble inférieur"; the middle "Ensemble moyen"; and the upper "Ensemble supérieur". Only the "Ensemble supérieur"