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Paleobiogeographic implications of Paleocene ostracods from Senegal and related West and North Africa basins

Implications paléogéographiques des ostracodes du Paléocène du Sénégal et des bassins voisins d'Afrique de l'Ouest et du Nord

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Abstract

This work summarizes biostratigraphic and paleogeographic data on Paleocene ostracods from the Senegalese-Mauritanian, West African and North African basins. In the Senegalese-Mauritanian basin, late Paleocene ostracods of high diversity suffered a mass extinction in the early Eocene. Comparison between Senegalese faunas and others of the Gulf of Guinea, Sahara and North African basins shows great similarities, with 10 common species identified: *Bairdia ilaroensis* Reyment and Reyment, *Buntonia apatayeriyerii* Reyment, *B. fortunata* Apostolescu, *B. tichittensis* Apostolescu, *Cytherella sylvesterbradleyi* Reyment, *Dahomeya alata* Apostolescu, *Isohabrocythere teiskotensis* Apostolescu, *Phalcoythere vesiculosa* (Apostolescu) *Quadracythere lagahiroboensis* (Apostolescu) and *Trachyleberis teiskotensis* (Apostolescu). *I. teiskotensis* and *P. vesiculosa* are restricted to the upper Paleocene and are good stratigraphic markers for these basins. Faunal exchanges between West African, trans-Saharan and North African basins are highlighted. The directions of migration of some species are specified. Many West African species migrated to North Africa at the end of the Paleocene-Early Eocene. Migrations are related to climatic and paleobathymetric changes of the Paleocene-Eocene Thermal Maximum (PETM) that occurred during the Paleocene-Eocene transition.

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Keywords: Ostracods; Senegal; Paleocene; West African; Trans-Saharan and North African basins; Paleogeography; Paleocene-Eocene Thermal Maximum (PETM)

Résumé

Ce travail fait la synthèse des connaissances biostratigraphiques et paléogéographiques sur les ostracodes du Paléocène des bassins sénégal-mauritanien, ouest et nord-africains. Dans le bassin sénégal-mauritanien la diversité maximale des ostracodes du Paléocène supérieur est suivie par une extinction massive au début de l'Eocène. La comparaison des faunes du Sénégal avec celles des bassins du golfe de Guinée, du Sahara et d'Afrique du Nord montre de grandes similitudes avec 10 espèces communes identifiées: *Bairdia ilaroensis* Reyment et Reyment, *Buntonia apatayeriyerii* Reyment, *B. fortunata* Apostolescu, *B. tichittensis* Apostolescu, *Cytherella sylvesterbradleyi* Reyment, *Dahomeya alata* Apostolescu, *Isohabrocythere teiskotensis* Apostolescu, *Phalcoythere vesiculosa* (Apostolescu), *Quadracythere lagahiroboensis* (Apostolescu) et *Trachyleberis teiskotensis* (Apostolescu). Les espèces *I. teiskotensis* et *P. vesiculosa* se limitent au Paléocène supérieur et sont de bons repères stratigraphiques dans ces bassins. Les échanges de faunes entre les bassins Ouest-africains, transsahariens et nord-africains ont été mis en évidence et le sens de migration de certaines espèces précisés. Un grand nombre d'espèces ouest-africaines ont migré en Afrique du Nord à la fin du Paléocène-début de l'Eocène. Ces migrations sont liées aux changements climatiques et paléobathymétriques du Maximum Thermique Paléocène-Eocène (PETM) survenu au passage Paléocène-Eocène.

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Mots clés : Ostracodes ; Paléocène ; Bassins ouest-africains ; Transsahariens et nord-africains ; Paléogéographie ; Maximum Thermique Paléocène-Eocène (PETM)

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1. Introduction

In the last decades, ostracods have been studied in West and North African sedimentary basins and their paleogeographic relations are often discussed (Hamdi and Latranche, 2013; Shahin and Elbaz, 2013).

Barsotti (1963) first showed affinities of the Sirte Basin (Libya) ostracods with those of West African basins in the Paleocene. He found 20 common species of which 6 are also present in Mali and West African basins.

Later works on ostracods of North African basins were extended to Morocco (Andreu, 1996), Algeria (Grékoff, 1969; Damotte and Fleury, 1987), Tunisia (Esker, 1968; Benson, 1977; Donze et al., 1982; Said-Benzarti, 1998; van Itterbeeck et al., 2007; Morsi et al., 2011), Libya (Salahi, 1966; El-Waer, 1992; Keen et al., 1994) and Egypt (Bassiouni, 1971; Bassiouni and Luger, 1990; Khalifa et al., 1984; Ismail, 1992, 1996; Elewa and Ishizaki, 1994; Morsi, 1999; Shahin, 2000; Morsi and Speijer, 2003; Morsi et al., 2008; Morsi and Scheibner, 2009). Ostracods of the Atlantic basins of SW Morocco and Tarfaya-El Ayoun (Western Sahara) are still unknown.

Ostracods of the trans-Saharan basins were studied in Mali (Apostolescu, 1961; Damotte, 1991; Carbonnel and Monciardini, 1995), Niger (Carbonnel et al., 1990) and the Sokoto basin of NW Nigeria (Ficarelli, 1976; Foster et al., 1983; Reyment, 1980, 1981; Reyment and Reyment, 1980).

The Gulf of Guinea ostracods were studied in Côte d'Ivoire (Apostolescu, 1961; Babinot, 1982; Digbehi et al., 1994), Togo (Apostolescu, 1961; Damotte, 1982; Carbonnel, 1990; Carbonnel and Johnson, 1989), Benin (Apostolescu, 1961; Carbonnel and Oyédé, 1991) and Nigerian coastal basin (Reyment, 1960, 1963, 1964, 1965; Foster et al., 1983; Okosun, 1989).

Senegalese-Mauritanian basin ostracods were studied in Western Senegal (Apostolescu, 1961; Brancart, 1977; Ducasse et al., 1978; Diop et al., 1982; Sarr, 1992, 1998, 1999, 2012, 2013), the Southern basin (Casamance and Guinea Bissau) (Carbonnel, 1986), Mauritania (Carbonnel, 1988a,b) and North of Senegal (Carbonnel, 1989).

Barsotti (1963) hypothesized the existence of a trans-Saharan Sea connecting the Sirte basin to the Gulf of Guinea during Paleocene and early Eocene. On the basis of the presence of *Buntonia* species in Libya he supported the migration of ostracods from West to North Africa.

Reyment's works on the Iullemeden and coastal basins of Nigeria (Reyment, 1964, 1977, 1980; Reyment and Reyment, 1978, 1980) allowed supporting this view. These authors listed 19 Nigerian species in common with West African, trans-Saharan and North African basins. Using multivariate analysis on 5 species from Nigeria and Libya they concluded that they migrated from the Gulf of Guinea to Libya by the trans-Saharan Sea. But, they did not exclude that few species could have migrated in North Africa along the West African coast. The work of Carbonnel et al. (1990) on Paleocene ostracods from Niger and Mali supported this opinion. They provided evidence that ostracods of this area belong both to Tethyan and Guinean provinces. They distinguished 3 groups of migrants in

the Iullemeden basin: among them few species came from Libya to Mali but they did not reach Niger in the South; a large number of species migrated from the Gulf of Guinea to NW Nigeria and Niger but they did not reach Mali and Libya; few species as *Bairdia ilaroensis* and *Phalcoythere vesiculosa* are both present in Libya, the Iullemeden and the Gulf of Guinea basins. Lack of biostratigraphic information on their occurrence did not allow establishing if they migrated from the North or from the South. Carbonnel and Monciardini (1995) gave more details on ostracods from Mali and their relations with Niger, Libya, Senegal and the Gulf of Guinea.

Bassiouni and Luger (1990) distinguished in the Paleocene and early Eocene of South Egypt basin 2 types of common faunas with West and North African basins: Esna Type and Afro-Tethyan Type. The "Esna Type fauna" is characteristic of deeper open sea, yielding in Senegal ostracods such as *Leguminocythereis lokossaensis*, *Reticulina proteros*, *R. sangalkamensis* and *Soudanella laciniosa triangulata* Apostolescu. The "Afro-Tethyan fauna" characterizes internal to littoral deposits with *Isohabrocythere teiskotensis* and *Nucleolina tateuliensis* in Senegal. Authors claimed marine connection between the South Tethyan Province and the Gulf of Guinea Province by the trans-Saharan Sea. This connection allowed migration of the Afro-Tethyan epineritic faunas both from the North and from the South. This shallow marine sea formed a barrier to deeper dwelling species and therefore caused the maintenance of different infraneritic ostracods assemblages. Deep-water species as *Dahomeya alata anteroglabrata*, *L. lokossaensis* and *Soudanella laciniosa triangulata* probably migrated northwards around Western African coast. Bassiouni and Luger (1990) observed that the change on ostracods association consisted on gradual but complete replacement of the South Tethyan fauna (*Dahomeya*, *Soudanella*) by species of the Esna Type during the high stand of the upper Paleocene transgression. Some species of the Afro-Tethyan Type known in the Gulf of Guinea from the *Morozovella pseudomenardii* Zone (planktonic biozone P4) appeared for the first time in Egypt in the late *Morozovella velascoensis* Zone (planktonic biozone P5) (Bassiouni and Luger, 1990).

Palaeobiogeographical study of West African and North African ostracods by multivariate analysis allowed Elewa (2002) to distinguish 2 provinces connected by the trans-Saharan Sea. The South Tethyan Province (South Tethyan Type fauna of Bassiouni and Luger, 1990) extends from Algeria to Jordan in the Middle East; the West African Province (West African Type of Bassiouni and Luger, 1990) comprises the Gulf of Guinea and the trans-Saharan basins. He advocates modifications on water depth, temperature, oxygenation and current directions as causes of migration.

Speijer and Morsi (2002) and Morsi and Speijer (2003) supported faunal exchanges between the South Tethyan and the West African provinces. Dissimilarity between ostracods of Morocco and Western Algeria led them to exclude the migration route along the West African coast. They observed that species in common between Southern Tethys Province and West Africa are merely shallow marine. This supports a shallow water trans-Saharan seaway through which only shallow marine species

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