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General Palaeontology

Reptile skin remains in the Cretaceous amber of France

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Abstract

Two fragments of a reptile skin have been discovered in the Early Cretaceous (Late Albian) amber of Charente-Maritime (southwestern France). Their systematic attribution is discussed according to the contemporaneous skeleton remains of reptiles discovered in the same region and squamate skin fragments described from other Cretaceous ambers (Lebanon, Myanmar). The preservation of a reptile skin in amber from Charente-Maritime provides further elements for the taphonomic analysis of the amber deposit. **To cite this article:** V. Perrichot, D. Néraudeau, *C. R. Palevol* 4 (2005).

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Résumé

Peau de reptile dans l'ambre crétacé de France. Deux fragments d'une peau de reptile ont été découverts dans l'ambre du Crétacé inférieur (Albien terminal) de Charente-Maritime (Sud-Ouest de la France). L'attribution systématique est discutée en fonction des restes squelettiques de reptiles squamates découverts dans la même région, ainsi que des peaux de squamates connues dans d'autres ambres crétacés (Liban, Myanmar). La présence de peau de reptile dans l'ambre de Charente-Maritime apporte de nouveaux éléments pour la taphonomie du gisement d'ambre considéré. **Pour citer cet article :** V. Perrichot, D. Néraudeau, *C. R. Palevol* 4 (2005).

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La découverte de vertébrés ou restes de vertébrés dans l'ambre reste exceptionnelle. Ce type de restes correspond généralement, soit à des plumes isolées, soit à des fragments de peau. Dans ce dernier cas, les quelques spécimens découverts à ce jour proviennent des ambres crétacés du Liban [1] et du Myanmar [5], de l'ambre éocène de la Baltique [3] et de l'ambre oligomiocène de République dominicaine [2,4,6,15]. Les deux fragments de peau décrits ici proviennent de l'ambre des sables lignitifères de l'Albien terminal d'Archingeay–Les Nouillers (Charente-Maritime, Sud-Ouest de la France) [8], qui sont érosifs sur les calcaires marins du Tithonien [7].

Ces deux fragments, d'aspect identique et fossilisés dans un même morceau d'ambre, sont très probablement issus d'un même individu. Les structures observées indiquent qu'il s'agit d'une peau de reptile. La préservation en deux fragments pourrait signifier qu'il s'agit des restes d'une mue. La nature très fragmentaire de cette peau limite les conclusions quant à l'attribution systématique précise de ce fossile. Toutefois, compte tenu de la géométrie des écailles (Figs. 1–2), ce matériel est clairement différent des fragments de peau reptilienne découverts dans les ambres crétacés moyens du Liban et du Myanmar. Par ailleurs, les seuls squamates connus par des restes squelettiques dans l'Albo-Cénomaniens charentais se résument à un serpent marin côtier, *Simoliophis*, et un lézard également marin, *Carentonosaurus* [9,13,16,17]. La présence des fragments de peau dans un ambre typique d'une forêt araucarienne [10,11] ne permet d'attribuer ces restes à l'un ou l'autre de ces taxons de squamates marins que s'ils vivaient en domaines littoraux ou de mangroves, susceptibles d'exposer leurs mues aux résines des Araucarias. La découverte d'inclusions d'origine marine est surprenante dans de l'ambre, mais pas impossible, comme l'ont déjà montré Perrichot et al. [18], avec la description de punaises aquatiques marines de la famille Gerridae dans le même gisement d'ambre. Il n'est cependant pas exclu que cette peau appartienne à un lézard ou à un serpent encore inconnu.

La présence de peau dans l'ambre implique des conditions de piégeage particulières. S'il s'agit bien d'une mue, deux mécanismes peuvent expliquer la fossilisation de cette peau dans l'ambre de Charente-Maritime. Soit des restes de la mue ont été englués par

de la résine tombée directement au sol, soit le reptile avait encore des fragments de cette mue attachés au corps et se serait frotté à de la résine coulant le long d'un arbre. L'état de dégradation avancé des fragments de peau s'accorderait plutôt avec la première hypothèse, confirmant l'observation de Perrichot [10,11] sur la forte proportion d'ambre de litière pour le gisement albien d'Archingeay–Les Nouillers. Les autres inclusions fossilisées dans le morceau d'ambre avec la peau sont d'ailleurs abondantes dans la litière des sols de forêts (acariens, thysanoptères, strepsiptères).

Les peaux découvertes dans différents ambres depuis quelques années demeurent des témoignages uniques de la biodiversité passée, notamment pour le Crétacé, qui constitue une période charnière dans l'évolution des dinosaures, des oiseaux et des squamates [12,14].

1. Introduction

The find of fossil vertebrate remains in amber is rather rare, even in abundant and rich Cainozoic ambers. Four classes occur: Mammalia, Amphibia, Aves and Reptilia. However, only these two last classes are known in Mesozoic ambers, represented by isolated feathers of birds or dinosaurs or by fragments of skin.

Besides the putative feathered dinosaurs mentioned above, the fossilization of reptiles in amber is extremely rare. Few specimens preserved in complete or sub-complete form (skeleton and skin) were described from Tertiary ambers: some lizards of the genus *Anolis* in Oligocene/Miocene Mexican and Dominican ambers [4,6,15], a gecko of the genus *Sphaerodactylus* in the Dominican amber [2], and a fossil lizard genus, *Succinilacerta*, in the Eocene Baltic amber [3]. Incomplete remains of reptiles were found more recently in Cretaceous ambers. Arnold et al. [1] described the skin and claws of a hind limb attributed to a fossil lizard genus *Baabdasaurus* in the Neocomian Lebanese amber, and fragments of an undetermined reptile skin are figured in the Albian/Cenomanian amber of Myanmar [5]. Thus the skin discovered in Charente-Maritime is the oldest occurrence of such a material in amber for Europe.

2. Geographical and geological settings

The amber containing the vertebrate remains described herein was excavated from the deposit of Arch-

ingey–Les Nouillers, in the Charente-Maritime region (southwestern France), 30 km east from Rochefort-sur-Mer, and already provided numerous arthropods, mainly insects [10,11]. It is derived from Cretaceous estuarine and coastal sand, which is erosive on marine limestone of Tithonian age [7]. The basal part of the sand yields lignitic and clayey lenses with fossil plants and numerous amber pieces, and was dated as Uppermost Albian (100 Myr) by a palynological study [8].

The botanical source of this amber is thought to be araucarian (*Agathoxylon*) based on both the analysis of the fossil wood remains and an infrared spectroscopic analysis of the amber. However, other conifers of the fossil family Cheirolepidiaceae (*Brachyoxylon*, *Protopodocarpoxyton*) could also have contributed to the resin production [10].

3. The reptile skin remains

Two fragments of skin were initially preserved in a single piece of amber together with 11 arthropods (five Strepsiptera, three Diptera, one Thysanoptera, and two Acari). The amber piece was fragmented in order to have a better view of all inclusions. Remains of skin are now referenced as MNHN ARC 237.1 and MNHN ARC 237.5 and deposited in the ‘Département Histoire de la Terre’ of the ‘Muséum national d’histoire naturelle’ in Paris.

Description. Fragment MNHN ARC 237.5 (Fig. 1) is 5.7 mm in its biggest length and 2.7 mm in its big-

gest width. Scales are present but translucent so that only their imprints are clearly visible, showing 29 regular lines disposed in diagonal. A 0.04-mm space separates each line, whereas imprints of a single line are joined. All imprints are of equal size, 0.25×0.15 mm, and are of rhomboid form, with opposite angles of about 70° . A weak bulge can be distinguished in some imprints by varying the light, which corresponds to the scales.

The second fragment (MNHN ARC 237.1) is smaller, 3.4×2.5 mm in size, and its structure is better visible. Scales are clearly distinct, three-dimensionally preserved, showing their overlapping disposition, and a tiny scale is visible between the larger ones (Fig. 2).

Discussion. Both fragments are fossilized in a same piece of amber and probably originate from a single individual. The fragmentary nature of the material limits putative conclusions about the systematic position of this fossil. However, the structures that can be observed suggest a reptile. The preservation in two fragments could be interpreted as sloughing remains.

The structure of this skin is clearly distinct from that described in the Lebanese amber and attributed to a lizard of the group *Autarchoglossa* [1]. Scales on the Lebanese specimen are of variable size, rectangular on tail and more rhomboid on the hind limb. The undetermined reptile skin figured by Grimaldi et al. [5 (fig. 14d)] in the Albian amber of Myanmar is much more similar: scales are not clearly visible, but their imprints are disposed in diagonal lines, the main dif-

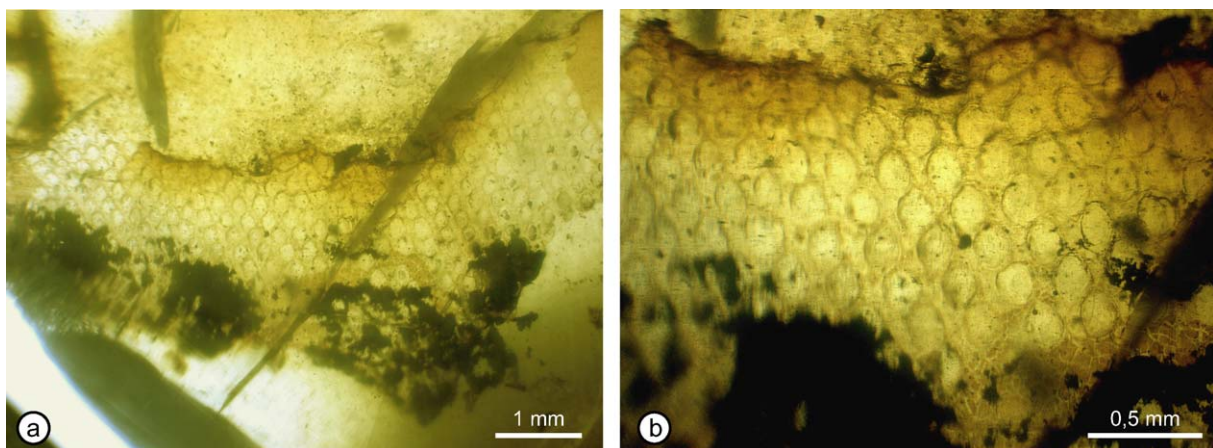


Fig. 1. Reptile skin in the Albian French amber of Archingey–Les Nouillers, fragment MNHN ARC 237.5. (a) General view; (b) microscopic detail showing the imprints of scales and their disposition in diagonal lines.

Figure 1. Peau de reptile de l’ambre albien d’Archingey–Les Nouillers, fragment MNHN ARC 237.5. (a) Vue générale ; (b) détail au microscope, montrant les empreintes des écailles disposées en files diagonales.

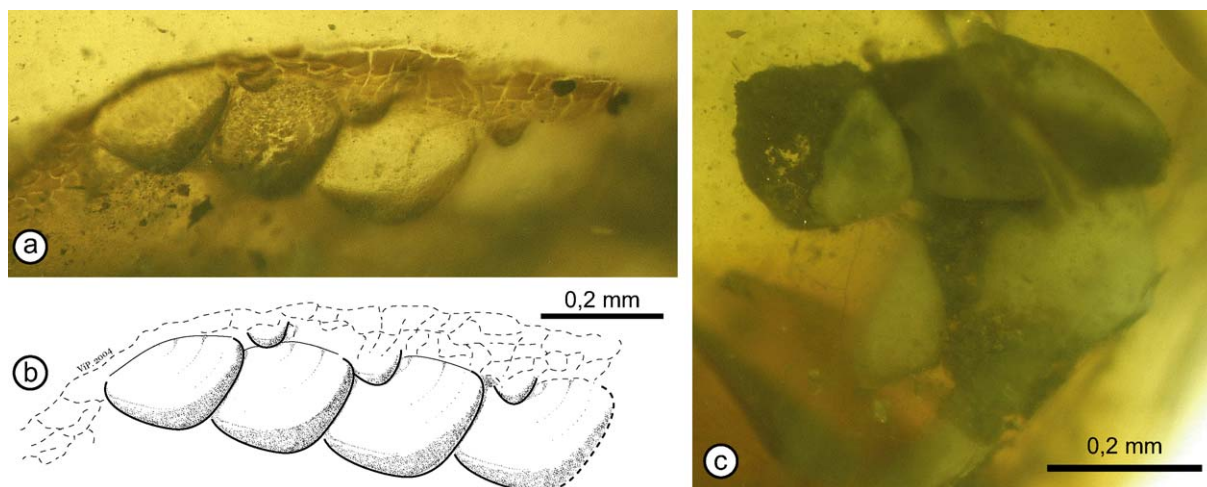


Fig. 2. Second fragment of skin in the Albian French amber of Archingeay–Les Nouillers, fragment MNHN ARC 237.1. (a) Detail showing three large scales and the adjacent smaller ones; (b) reconstruction; (c) detail showing the overlapping disposition of the scales.

Fig. 2. Second fragment de peau dans l'ambre albien d'Archingeay–Les Nouillers, fragment MNHN ARC 237.1. (a) Détail montrant trois grandes écailles et leurs écailles adjacentes plus petites ; (b) reconstitution ; (c) détail montrant la disposition des écailles en chevauchement.

ference with the skin of France being that imprints are more rectangular and are of variable size – reality or artefact due to the elongation of the skin by resin flow?

Nevertheless, according to the structure and the size of the scale imprints on the sloughing, the reptile that lost these skin pieces was probably a small-size lizard or snake. Beside this, in the fossil record of southwestern France, only few small squamates are known by skeleton remains in the contemporaneous Late Albian–Early Cenomanian series. No lizard or snake taxa occur in the Late Albian, but several Early Cenomanian outcrops yielding assemblages of vertebrate microremains have been discovered in the region of Charentes during the last twenty years, and most of them contain vertebrae of the aquatic coastal snake *Simoliophis*. That is the case for the quarry of Archingeay–Les Nouillers, which has provided the amber with the skin remains under study. In this quarry, the Upper Albian lignitic sand yielding the amber is located about 10 m below the Lowermost Cenomanian shelly sand yielding the vertebrae of *Simoliophis* [16]. *Simoliophis* is the single squamate known in the youngest Cenomanian strata from western France [9,17] and it extinguished in the Early Late Cenomanian, during which the aquatic coastal lizard *Carentonosaurus mineau* appeared [13]. However, Rage and Néraudeau [13] also mentioned two vertebrae possibly attributed to *Carentonosaurus* in the Early Cenomanian of Charente-Maritime (Les Re-

nardières quarry), although this material is too poorly preserved for a precise attribution.

Finally, the reptile skin remains from the Late Albian amber of France are clearly distinct from that described in the ambers from Lebanon and Myanmar. The only contemporaneous squamates known in the Charentes by skeleton remains are *Simoliophis*, a marine snake, and *Carentonosaurus*, a marine varanoid lizard. The association of the skin fragments with arthropods typical of a litter fauna and araucarian pieces of wood [10] shows that these vertebrate remains were trapped on a soil of a coniferal forest close to a fluvial or an estuarine area. Thus, the reptile sloughing from the French amber could possibly belong to *Simoliophis* or *Carentonosaurus* if these marine reptiles lived close to the araucarian forest, or to a non-aquatic squamate still unknown by this time. The find of inclusions of marine origin in amber is surprising, but not impossible, as already shown by Perrichot et al. [18], who described some marine bugs of the family Gerridae in the same amber deposit.

4. Conclusions

The presence of a reptile skin in amber implies peculiar conditions of trapping. In case of a sloughing, two mechanisms can explain the fossilization of this skin in the French amber. Either remains of the sloughing were

embedded in a resin that fell directly on ground, or a reptile having still fragments of sloughing attached on body would have rub on a resin flow along a trunk. The poor state of preservation of the skin rather agrees with the first hypothesis, confirming the observation of Perrichot [11] on the exceptionally high proportion of ‘litter amber’ for the Albian deposit of Archingeay–Les Nouillers. Moreover, other inclusions preserved together with the skin in the amber piece are common inhabitants of the ground litter of forests (Acari, Thysanoptera, and Strepsiptera).

Although amber is a selective trap mainly embedding small size organisms, particularly insects and other small arthropods, delicate remains of larger organisms can exceptionally be preserved. Skins found for few years in ambers are unique insight into the past diversity, and particularly into the Cretaceous, which is a key-period in the evolution of dinosaurs, birds, and squamate reptiles [12,14]. The present discovery is the first evidence of an Albian reptile skin in Europe.

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