

Upper Cretaceous amber from Vendée, north-western France: Age dating and geological, chemical, and palaeontological characteristics



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ABSTRACT

The Upper Cretaceous lignite deposits of La Garnache, Vendée (north-western France), consist of two lignitic clay series, Garnache 1 and Garnache 2, separated by a fault. The first series cropped out to the south of the fault during road works until 2002 but is now covered by an embankment. It has provided numerous pieces of amber containing arthropod and micro-organism inclusions. The second lignitic series, exposed to the north of the fault, is rich in fossil wood but devoid of amber. Palynological analysis of Garnache 1 revealed several Normapolles species belonging to the genera *Atlantopollis*, *Complexiopollis*, *Osculapollis*, *Plicapollis* and *Trudopollis*, but larger forms typical of Senonian deposits are absent. By contrast, Garnache 2 proved to be dominated taxonomically and numerically by spores (*Appendicisporites*, *Camarozonosporites*, *Gleicheniidites*, *Patellasporites*, *Stereisporites*), associated with a few gymnosperm (*Cerebropollenites*, *Phyllocladites*, *Classopollis*) and angiosperm (*Liliacidites*, *Retitricolpites* and a single specimen of the Normapolles *Complexiopollis*) taxa. Garnache 1 is, therefore, younger than Garnache 2, the latter being clearly Cenomanian in age whereas Garnache 1 is more likely to be Turonian. Lignitic clay of Garnache 1 contains numerous translucent, orange to red, pieces of amber. Vendean amber is rich in aquatic arthropods, such as tanaids and epicarideans (Crustacea), as well as marine or brackish siliceous micro-organisms such as diatoms and sponge spicules. These aquatic inclusions indicate that resin-producing trees grew along and close to the seashore. The amber-bearing clay was deposited in a calm, estuarine or lagoonal, muddy environment.

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1. Introduction

Many Cretaceous amber-bearing deposits have been known in western France since the beginning of the 19th Century. The main localities are in Charentes (Lacroix, 1910; Schlüter, 1978; Néraudeau et al., 2002, 2003, 2005, 2008; Perrichot et al., 2007, 2010), Sarthe (Lacroix, 1910; Girard et al., 2013), Maine-et-Loire (Lacroix, 1910; Néraudeau et al., 2013), and Dordogne (Saint-Martin et al., 2013b). Lacroix (1910) mentioned that amber had been reported

from Carboniferous and Cretaceous lignites in Vendée by several authors (Cavoleau, 1818; Rivière, 1840, 1842; De la Fontenelle de Vaudoré, 1844) but even the precise descriptions of Cenomanian lignites from the south of Challans by Rivière (1842) and Louail (1984, p. 226) made no mention of amber despite noting the presence of very small crystals of gypsum and pyrite. Similarly, the mineral inventory of the department of Vendée by Cavoleau (1818), supplemented by De la Fontenelle de Vaudoré (1844), listed many things including fossil plants (lignite, coal) and ambergris from cetaceans, but not amber or its equivalents “succin” and “retinasphalt”. Hence, amber in Vendée was effectively unknown until 2002 when many small pieces were found in a deposit exposed during a period of road works near the village of La Garnache.

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Although mainly consisting of mm- to cm-sized pieces, they are among the most fossiliferous of Cretaceous ambers from France.

The physical, chemical, and palaeontological characteristics of the amber that was recovered are described and, combined with consideration of the geological background (Figs. 1, 2) and the recovery of palynomorphs from the associated sediments, its age and palaeoenvironmental significance are discussed in this paper.

2. Material and methods

2.1. Locality

The amber-bearing deposit is located at La Robinière, near the village of La Garnache in Vendée (Fig. 1). Amber was collected during 2002 and 2003 (mainly by F. Dupé and D. Graves) from a first outcrop named “Garnache 1”. This consisted of grey clay with lignitic lenses (Anfray, 2004) and was limited to a few decimetres temporarily exposed by works along departmental road D32 between La Garnache and Challans (Fig. 2A, B). The exposure was on the right-hand side of the road to Challans at around 300 m from a bridge over it. The few observable *in situ* strata occurred in a trench dug into the road embankment (Fig. 2B). Amber and fossil wood were collected from the lignites (Fig. 2C, D).

Further field work was realized between 2005 and 2014, although by then the amber-rich layer had been removed by the road works or was covered by vegetation, the embankment and the

road itself. In collaboration with the Departmental Road Agency of Challans, five excavations were carried out using a mechanical shovel in June 2011 along a 300-m-long transect from Garnache 1 to a second outcrop named “Garnache 2” (a few metres from the bridge mentioned above) at the base of the road embankment (Fig. 2E). No additional amber was found, nor could the amber-bearing bed be identified. Only more or less disturbed sand and lignites were encountered.

Currently the right-hand side of the road to Challans only exposes lignitic sand in the upper-middle parts of the embankment, corresponding to Garnache 2 (Fig. 2F, G), which is entirely devoid of amber.

For palynological, micropalaeontological, and palaeobotanical analyses and a further search for amber, a total of 10 kg of lignitic sand and clay from Garnache 2 were collected and analyzed. By comparison, only a few dozen grams of lignitic sand and clay coating amber and wood were available from Garnache 1 for palynological analysis.

2.2. Preparation and analytical techniques

2.2.1. Amber

The amount of material from Garnache 1 provided by the collectors comprises 5700 pieces of amber totalling 305 g only. Most of the pieces are 3–10 mm in size, but rare larger pieces up to 35 mm were also found. They are clear yellow to orange in colour (Fig. 3),

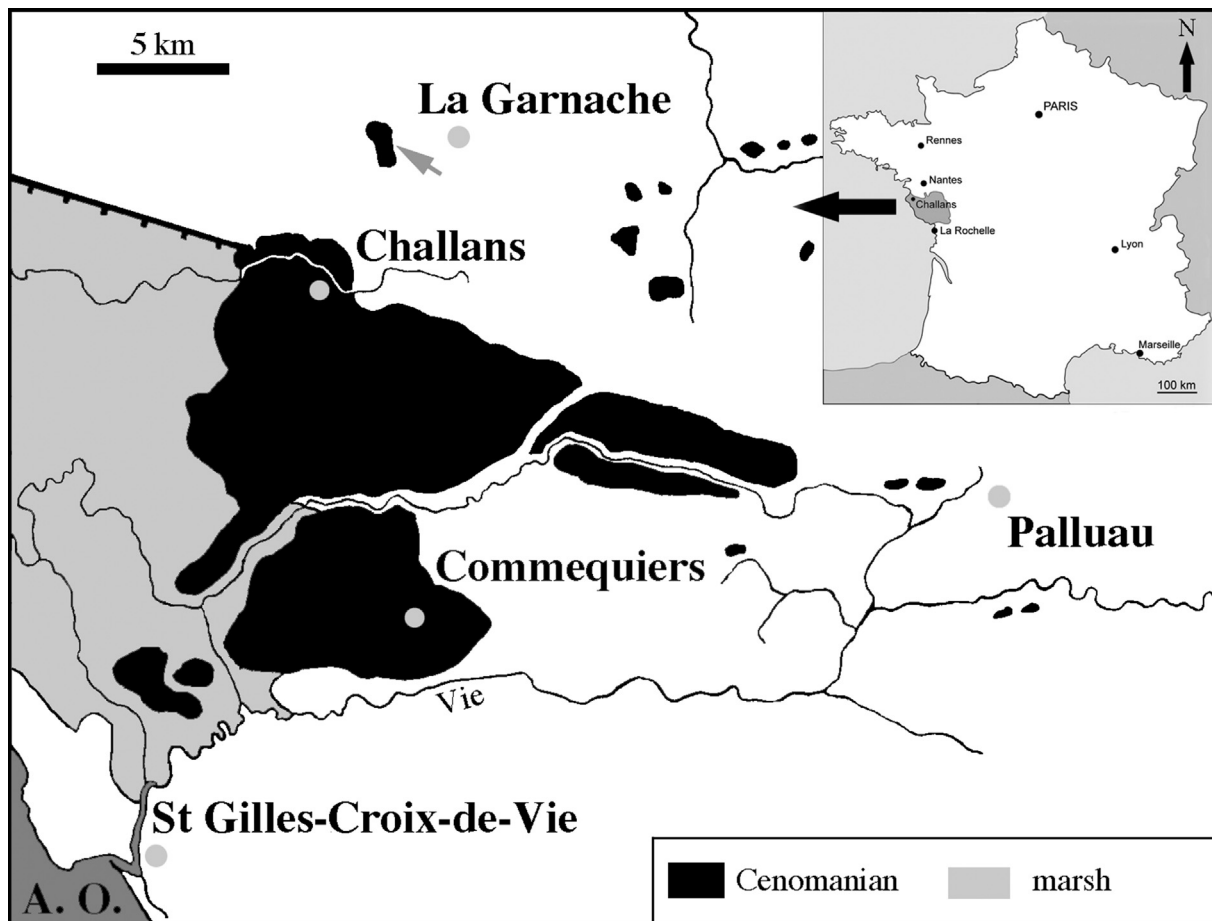


Fig. 1. Simplified geological map of the Challans-Commequiers Basin showing the Cenomanian outcrops (in black) according to Ters (1961). The Turonian amber deposit (grey arrow) is very small and in contact with Cenomanian outcrops (A.O. = Atlantic Ocean).

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