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Territories on the move. Changes in seashell procurement areas and strategies between the Solutrean and the Badegoulian in the west of France

Des territoires en mouvement. Variations dans les espaces et les stratégies d'approvisionnement des coquillages entre le Solutréen et le Badegoulien dans l'Ouest de la France

Territorien in Bewegung. Gebiete und Strategien der Beschaffung von Mollusken zwischen Solutréen und Badegoulien im Westen Frankreichs

Caroline Peschaux

Abstract: On account of their limited geographic origins, mollusc seashells (from the active shoreline and in fossil form) used as ornamental elements provide precious information on the procurement areas of Palaeolithic human groups. Procurement strategies (choice and acquisition modes, according to main areas of diffusion) are studied by assessing geographic (resource accessibility), quantitative (proportions in archaeological assemblages) and qualitative parameters (diversity of the represented taxa, manufacturing techniques, etc.). Here, after a description of the available seashell resources in France, we present an inventory and analysis of the seashells discovered at several sites in the west of France dating from the end of the Solutrean and from the Badegoulian (24-21 ka cal BP). Marked discontinuities in seashell procurement are observed between the two techno-complexes and are interpreted as evidence of territorial redistribution and a reorganisation of social networks. These results provide evidence of the changes impacting ornaments and, by extension, the socio-symbolic sphere, and confirm the accepted idea of a profound cultural shift between the Solutrean and the Badegoulian.

Keywords: Seashells, Ornaments, Solutrean, Badegoulian, Procurement, Territories.

Résumé : En raison de leurs origines géographiques restreintes, les coquilles de mollusques marins utilisées comme objets de parure fournissent de précieuses informations sur les espaces d'approvisionnement des groupes humains paléolithiques (*e.g.*, Fischer, 1879 ; Taborin, 1993). Outre l'identification des sources d'approvisionnement utilisées (rivages maritimes actifs et gisements fossilifères datés début du Cénozoïque ; fig. 1), la prise en compte des paramètres géographiques (accessibilité des ressources, selon des espaces de diffusion préférentielle), quantitatifs (proportions dans les assemblages archéologiques) et qualitatifs (diversité des taxons représentés, techniques de fabrication, *etc*.) permet de discuter de la nature des acquisitions (directes ou indirectes) et de l'existence de variations

dans les stratégies d'approvisionnement et les constructions territoriales qui en découlent. Cet article présente les résultats obtenus sur plusieurs sites de l'Ouest français et datés de la fin du Solutréen et du Badegoulien (24-21 ka cal BP) où de fortes discontinuités sont observées dans les approvisionnements en coquillages et témoignent d'une redistribution territoriale et d'une réorganisation des réseaux sociaux entre ces deux techno-complexes durant le *DMG (Dernier Maximum Glaciaire)*.
Pour le Solutréen, il est défini que les espaces d'approvisionnement en coquillages sont larges, avec des spectres conchyliologiques partagés entre plusieurs origines : rivages atlantiques, faluns miocènes d'Aquitaine et d'Anjou-Touraine (tableau 1, fig. 2 et 3). Les fortes proportions et la variété des taxons représentées impliquent des possibilités d'acquisitions massives pour ces trois origines, mêlant probablement des collectes directes sur gîtes et des échanges inter-groupes réguliers de grandes quantités de coquillages avec une circulation de proche en proche. Il se dessine ainsi un vaste espace solutréen dans le quart sud-ouest de la France, qui traverse les interfluves en comprenant les bassins de la Loire, de la Charente, de la Dordogne et de la Garonne, dans lequel les coquillages paraissent circuler facilement et abondamment. En complément, de rares coquillages méditerranéens, exclusivement composés de grandes coquilles de *Semicassis saburon*, ont fait l'objet de modalités d'acquisition à part pouvant correspondre à des échanges ponctuels et très spécifiques avec des populations solutréennes plus orientales et/ou méridionales. Il est également constaté qu'il n'y a aujourd'hui aucune coquille originaire des gisements fossilifères du Bassin parisien qui soit strictement attribuée à une occupation solutréenne, cela peut-être en raison d'une inaccessibilité de ces ressources à cette période.
Pour le Badegoulien, il est observé que l'apport atlantique est un peu moins conséquent qu'au Solutréen (passant de 50 à 20 % de l'ensemble des coquillages) au profit de compositions plus ciblées vers les ressources fossilifères (tableau 2, fig. 4 et 5). La distribution des coquillages fossiles conduit à percevoir deux grands espaces de circulation badegouliens. Au sud, dans les sites du nord de l'Aquitaine (bassins de la Dordogne et du Lot), les coquillages proviennent en majorité des ressources du Miocène inférieur de Gironde (jusqu'à 95 % des assemblages) dont la proximité suggère des acquisitions directes sur gîtes. La découverte d'une coquille de *Semicassis saburon* au Cuzoul de Vers indique le maintien de contacts ponctuels avec des populations plus orientales et/ou méridionales. Au nord, la diffusion des coquilles fossiles éocènes du Bassin parisien forme un vaste espace de circulation s'étendant sur au moins 450 km et reliant les bassins de la Loire et de la Seine. Les fossiles éocènes utilisés sont très variés et constituent au moins 50 % des assemblages dans le bassin de la Loire et entre 90 % et la totalité des assemblages dans le bassin de la Seine, impliquant des possibilités d'acquisitions massives, mêlant probablement des collectes directes sur gîtes et des échanges inter-groupes abondants et réguliers, ayant permis une diffusion à cette grande échelle. De plus, il est constaté une absence généralisée des fossiles d'Anjou et de Touraine dans les sites badegouliens. Bien que cette ressource soit accessible, elle semble avoir ont été oubliée ou délaissée à cette période, parfois au profit d'autres plus lointaines.
Au terme de l'étude, les différences constatées suggèrent la transformation d'un vaste espace occidental solutréen dans lequel les coquillages issus de plusieurs horizons circulent facilement et abondamment en un espace badegoulien au moins bipartite qui a eu tendance à cloisonner la diffusion des coquillages, notamment celle des fossiles. Cette réorganisation des réseaux d'approvisionnement est particulièrement visible dans les sites du bassin la Loire, qui sont soumis à une influence méridionale durant le Solutréen puis à une influence septentrionale durant le Badegoulien. Les axes de circulation identifiés pour les coquillages correspondent globalement à ceux décrits pour les matières lithiques, ce qui implique des aires d'approvisionnement et des réseaux sociaux communs pour les deux matériaux. Toutefois, silex et coquillages répondent à des normes et des stratégies d'acquisition qui leurs sont propres (pour le Solutréen, stricte sélection des silex *versus* utilisation de toutes les ressources conchyliologiques disponibles dans l'environnement ou par interactions sociales ; pour le Badegoulien, hétérogénéité et flexibilité des contextes lithologiques exploités *versus* recherche de coquillages spécifiques, en dépit de ressources plus accessibles ; *cf.* Renard et Ducasse, 2015 ; Ducasse *et al.*, 2019). L'apparition du Badegoulien coïncide avec la phase de réchauffement climatique du GI-2 (*sensu* Rasmussen *et al.*, 2014 *in* Ducasse *et al.*, 2019) qui pourrait avoir autorisé une occupation plus pérenne des territoires septentrionaux. L'élargissement de l'aire occupée et l'accès retrouvé aux ressources nordiques (comme les coquilles fossiles du Bassin parisien) a ainsi pu entrainer le développement de nouveaux enjeux territoriaux et économiques ayant alors conduit à revoir les modalités d'occupation de l'espace. De plus, ces transformations interviennent au moment où, à l'échelle du Paléolithique supérieur, les pratiques de décorations corporelles se renouvellent (recomposition des assemblages et apparition de nouvelles solutions techniques ; *cf.* Peschaux, 2017), ce qui pourrait signaler une crise identitaire profonde comprenant une refonte globale des interactions sociales intra- et inter- groupes.

Mots-clés : Coquillages, Parures, Solutréen, Badegoulien, Approvisionnement, Territoires.

Zusammenfassung: Aufgrund ihrer begrenzten Verbreitungsgebiete liefern Molluskenschalen (von der Küste und aus fossilen Lagerstätten), die als Schmuckobjekte verwendet wurden, wertvolle Informationen über die Gebiete ihrer Beschaffung durch paläolithische Menschengruppen. Beschaffungsstrategien (Auswahl- und Beschaffungsmodi nach Verbreitungsbereichen) können durch geographische (Ressourcenzugänglichkeit), quantitative (Anteile in archäologischen Inventaren) und qualitative Parameter (Diversität der repräsentierten Taxa, Bearbeitungstechniken, usw.) untersucht werden. Hier werden, nach einer Beschreibung der verfügbaren Mollusken-Vorkommen in Frankreich, die Inventare und Analysen von Muscheln aus einigen Fundstellen West-Frankreichs präsentiert, die in den Zeitraum vom Ende des Solutréen bis zum Badegoulien datieren (24-21 ka cal BP). Zwischen den beiden Technokomplexen lassen sich deutliche Diskontinuitäten bei der Beschaffung von Muscheln beobachten, die als Beweis für territoriale Neuordnung und Reorganisation sozialer Netzwerke interpretiert werden. Diese Ergebnisse liefern Hinweise auf Veränderungen, die sich auf Körperschmuck und damit auf die sozio-symbolische Sphäre auswirken, und bestätigen die akzeptierte Idee eines tiefgreifenden kulturellen Wandels zwischen Solutréen und Badegoulien.

Schlüsselwörter: Muscheln, Schmuckobjekte, Solutréen, Badegoulien, Beschaffung, Territorien.

INTRODUCTION

Mollusc shells found in archaeological contexts were mainly used as ornamental objects, with proven social and symbolic values, and as a result, are particularly propitious for studying past cultural territories and communication networks (e.g., Bar-Yosef, 1989; Newel et al., 1990; Taborin, 1993 and 2004; Lock and Symes, 1999; Kuhn and Stiner, 2006; Vanhaeren, 2010; Choyke, 2013; Rigaud et al., 2015 and 2018; Peschaux, 2017). Indeed, their potential to shed light on the zones frequented by prehistoric populations was identified very early on, at the end of the nineteenth century, when Paul Fischer established a list of malacofaunal taxa found in the caverns of Liguria and the south of France, bringing to light the existence of long-distance circulation routes as early as the prehistoric period (Fischer, 1876a and 1876b). Since then, the provenance of seashells has been actively studied, often alongside analysis of flint sources, in order to determine procurement areas (e.g., Fischer, 1879; Rivière, 1887, 1904a and 1904b; Fischer, 1896 and 1897; Strobl and Obermaier, 1909; Jackson, 1917; Cordier, 1956; Bosinski and Hahn, 1973; Bahn, 1977 and 1982; Rähle, 1981, 1983 and 1987; Gamble, 1982; Taborin, 1985, 1993 and 1996; Sacchi, 1986; Floss, 2000; Álvarez Fernández, 2001 and 2002; Fullola et al., 2007; Taborin and Valladas, 2008; Estrada et al., 2010; Mangado et al., 2014a).

The range of seashells used for ornamental purposes remained relatively consistent throughout the Upper Palaeolithic in so far as the choice of taxa and the lack of diversity within that selection (only a few hundred species were used out of the thousands available) were repeated from one chronocultural entity to another, probably signifying the persistence of symbolic meanings conferred on certain forms of shells. Against this general background of consistency, variations in the choices made (e.g., a clear increase in the use of scaphopods from the Badegoulian onwards: Peschaux, 2017) and in the manner in which the various types of shells were associated or positioned on the body (Newell et al., 1990; Vanhaeren and d'Errico, 2006; Rigaud et al., 2015 and 2018) as well as fluctuations in seashell procurement strategies may indicate evolutionary dynamics linked to territorial and social transformations. In order to comprehensively assess the question of seashell procurement, it is essential not only to identify procurement sources, but also to take account of other parameters – geographic (accessibility of resources), quantitative (proportions in the assemblages), and qualitative (diversity of the taxa represented, manufacturing techniques, etc.) – in order to attempt to discriminate between direct and indirect acquisition and to bring to light variations in the respective procurement strategies and territorial ranges.

In the west of France, the transition between the Solutrean and the Badegoulian (24-21 ka cal BP) is considered to be a period of technological and socio-economic break (Breuil, 1913; Cheynier, 1939; Aubry, 1991; Renard and Ducasse, 2015), which affected most material productions (lithic and osseous industries, ornaments: cf. synthesis in Ducasse et al., 2019). The Solutrean and Badegoulian techno-complexes are differentiated, in particular, in terms of lithic material procurement, with a clear decrease in long-distance materials in Badegoulian assemblages implying that a reduction in procurement areas occurred between the Solutrean and the Badegoulian (Aubry, 1991; Bracco, 1992 and 1997; Turq, 1992; Cretin, 2000 and 2007). Recent work proposes that this difference be interpreted as a reflection of a change in the techno-economic management of lithic equipment, viz. a transition from a Solutrean model where the technical and lithological emphasis on hunting weapons (i.e., shouldered points and laurel-leaf points) required the establishment of wide-ranging procurement networks for the acquisition of selected high-quality materials, to a Badegoulian model where more flexible and versatile knapping methods allowed for the exploitation of varied lithological contexts of disparate quality, resulting in the increased use of local resources (Renard and Ducasse, 2015; Ducasse et al., 2019). These changes in procurement strategies clearly had repercussions for territorial occupation, leading to the devaluing of hunting weapons (and thus of the status of the hunter: Renard and Geneste, 2006; Pelegrin, 2013), but could also signify a deeper renewal of societies, affecting value systems as much as social relations (Ducasse et al., ibid.).

Is this transformation perceptible in seashell procurement? As seashells were intended for making ornaments and had their own symbolic and technical sphere, the acquisition of seashells may have depended on independent social networks and responded to specific evolutionary mechanisms (Peschaux, 2017). The inventory and analysis of the seashells discovered in Solutrean and Badegoulian sites in the west of France show that, in spite of their specific social role, seashell productions did not escape this mutation. Indeed, marked discontinuities were observed in the procurement areas exploited and in patterns of seashell gathering, suggesting a territorial reorganisation during the Last Glacial Maximum (LGM).

SEASHELL RESOURCES ON FRENCH TERRITORY

Most of the shells used as ornaments during the Palaeolithic were seashells. Two types of sources can be distinguished: fossiliferous sources, which correspond to the remains of ancient seas conserved in geological formations, and active maritime shorelines, which unlike the former, supply live molluscs in addition to empty shells strewn across beaches. Both of these sources supply resistant seashells in good condition, but they present differences in terms of colour (shells are generally white in fossiliferous deposits and of varied colour on the shorelines), and especially in terms of malacofaunal type. Malacological spectra are linked to geological period and/or biotope, and differ widely from one source to another. This is what enables us, after taxonomic determination, to identify the origin of the seashells found in archaeological contexts.

The fossiliferous sites

The main fossil seashell sources in France are found inland and were formed during the oceanic transgressions of the beginning of the Cenozoic era (66-2.6 Ma) in boundary basins (Paris, Loire, and Aquitaine basins). As fossil seashells lived in tropical climates, they belong to a 'warm' malacofauna, elements of which are found today, in the form of other varieties, in regions of the world with similar climates (Africa, Indo-Pacific, etc.). As the sea did not retreat at the same time everywhere, each basin contains outcrops with geological formations and conchological spectra corresponding to maritime episodes of different ages. Due to erosive events and the burial of geological formations at inaccessible depths, fossil seashell procurement areas for Upper Palaeolithic communities were limited to portions of valleys where fossiliferous sediments were (and are) exposed:

– In the Paris Basin, the available fossil seashells date mainly from the Eocene (Ypresian, Lutetian, Bartonian; 56-33.9 Ma; fig. 1, n^os^ 1 to 5), more rarely from the Lower Oligocene (33.9-27.82 Ma; Stampian = local Rupelian; fig. 1, n^o^ 6). Here, outcrops of fossiliferous formations are quite extensive and accessible in most of the tributary valleys of the Seine (Eure, Oise, Marne, etc.). The Eocene (and in particular the Lutetian) is considered to be the most fossiliferous period and yields a very well conserved and extremely varied marine fauna with tropical affinities, related to an open, rather shallow (archipelago-type) environment (with more than 1,500 identified gastropod species: Merle, 2008, fig. 83, p. 177). Oligocene sites are less rich and diversified (about 200 gastropod species; Merle, 2008, ibid.) and consist mainly of taxa from lagoon-lacustrine environments marking the end of the maritime episode in this region (Fischer, 2000; Lozouet, 2012).

– In the Aquitaine Basin, fossil seashells date, on one hand, from the Lower Miocene (23.03-15.97 Ma; Aquitanian and Burdigalian) and, on the other, from the Middle Miocene (13.82-11.63 Ma; Serravellian). The former are present, in particular, in the northeast of the Gironde, in tributary valleys of the Garonne, over a 70 km long stretch of the basin between Bazas and Bordeaux (fig. 1, n^os^ 11 to 13). The latter are primarily found in the Eyre Valley and the Adour Basin (fig. 1, n^os^ 14 to 17). The Miocene is considered to have been the warmest period of the Cenozoic, witnessing the emergence of a clearly tropical, abundant, and diversified malacofauna (with nearly 700 gastropod species; Merle, 2008, ibid.). The fossils available in Gironde derive from the malacofauna of lagoon-lacustrine environments (Lozouet, 2004).

– In the Loire Basin, fossil seashells date from the Middle and Upper Miocene (Dollfus and Dautzenberg, 1902; Glibert, 1949; Courville and Bongrain, 2003). In Touraine, they belong to the Langhian stage (15.97-13.82 Ma; the only period when the sea reached that region; fig. 1, n^os^ 7 and 8), which distinguishes them from those from Aquitaine, where that stage is practically absent. In Anjou, the fossils date from the Serravellian to the Messinian (13.82-5.33 Ma; fig. 1, n^os^ 9 and 10). The Langhian fossils from around Tours correspond to a subtropical malacofauna (slightly less 'warm' than during the Lower Miocene), from an open environment (with about 380 available gastropod species: Merle, 2008, ibid.).

Active maritime shorelines

From the Pleistocene onwards (2.58 Ma), shorelines more or less corresponded to present-day shores, but were nonetheless marked by very clear retreats during glaciation phases (absence of the Channel for example; cf. fig. 1) and, in particular, during the climatic phase of the Last Glacial Maximum largo sensu – contemporaneous with the Solutrean and the Badegoulian – when the sea level was at least 120 m below the current level (Gersonde et al., 2005; Peltier and Fairbanks, 2006). From the beginning of the Pleistocene onwards, 70 % of malacological fauna and faunal distribution were the same as today (Fischer, 2000). The differences between present-day fauna and fossil malacofauna resulted from the introduction of 'cold' species into the Atlantic and the development of an endemic malacofauna in the Mediterranean. During the Solutrean and the Badegoulian, Nordic species reached the Atlantic during the long Würm glaciation, and, as a result of the harsh climatic conditions at that time, even spread to the outskirts of the Mediterranean Sea, without however entering it. There is little chance of Austral Mediterranean species being found on the Atlantic coast, as most of them are very sensitive to the cold. In this way, each maritime shoreline yields a typical malacofauna:

– The Atlantic malacofauna is characterized, in particular, by the presence of 'cold' species, such as Littorinae, *Nucella lapillus* and whelks (Buccinidae) with Nordic affinities. The long French Atlantic coastline, stretching, in the Upper Palaeolithic, from the mouth of the Channel River to the Bay of Biscay, formed a large western procurement area.

– The Mediterranean malacofauna is characterized by the presence of endemic species, including some derived from evolved Miocene and Pliocene forms that took refuge in the Mediterranean Sea, such as *Tritia neritea*, *Homalopoma sanguineum*, and *Semicassis saburon*. On French territory, access to the Mediterranean shore is limited to the south-eastern quarter.

A wide range of taxa are also found in both the Atlantic and Mediterranean maritime domains. From the end of the Miocene onwards, the appearance of a highly adaptive malacofauna, supporting different climatic variations, led to the establishment of a very extensive common Atlantic-Mediterranean malacological fauna. When found in archaeological contexts, the origin of these seashells cannot be clearly established, but can be inferred from the rest of the assemblage. For example, if Atlantic taxa abound in an assemblage with no Mediterranean markers, it is highly probable that any species that could potentially derive from either shoreline are from the Atlantic procurement zone.

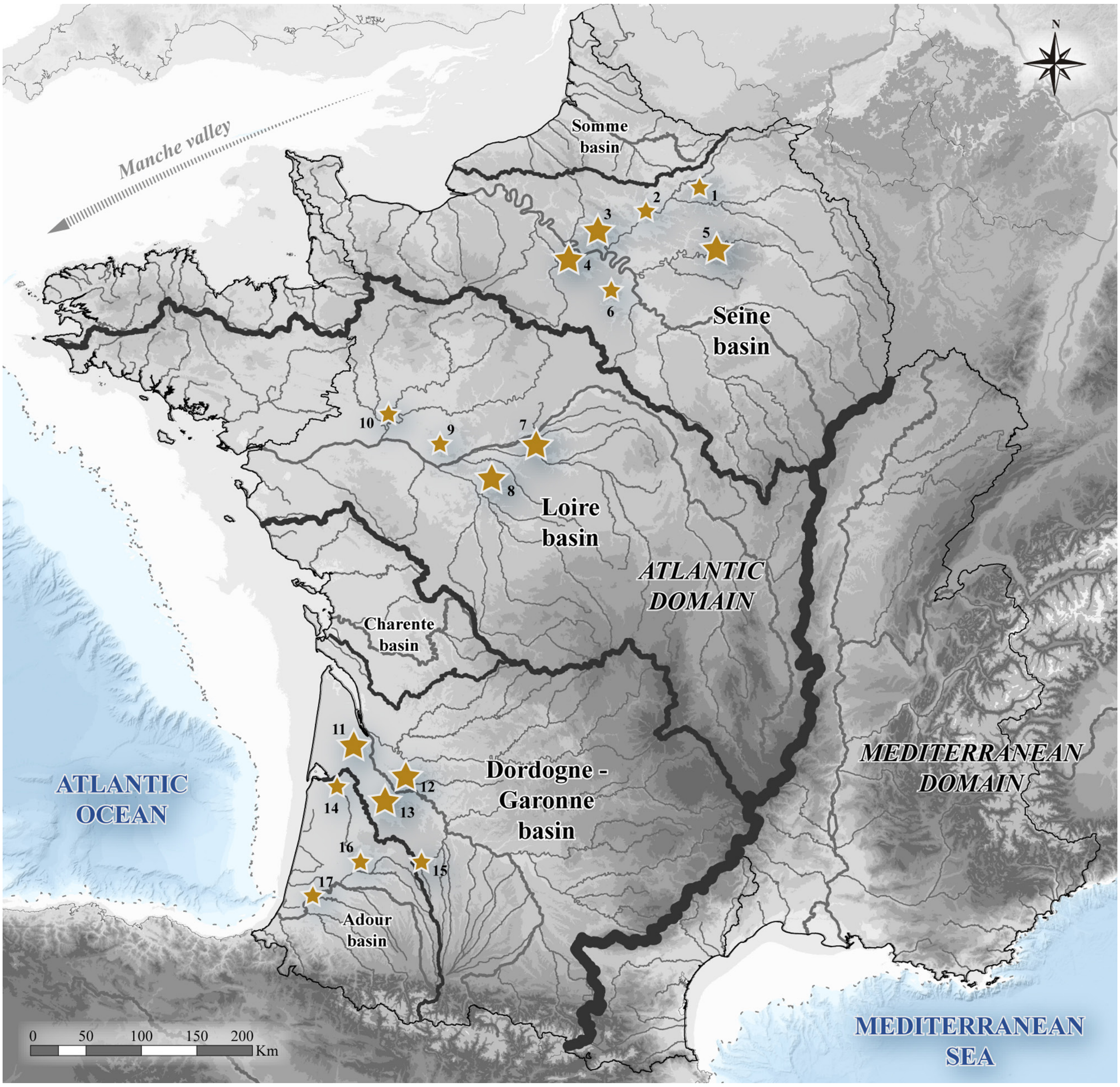

Fig. 1 – Location of the main sources of seashells in France and the watersheds separating preferred areas of diffusion. Map base: GIS G. Encelot; Sources: The GEBCO Grid (seabed), SRTM 4.1 (relief). 1: Soissons and Laon sectors; 2: Oise valley; 3: French Vexin area; 4: Mantes sector; 5: Marne valley; 6: French Gâtinais area; 7: Blois sector; 8: south Touraine; 9: west Touraine; 10: Haut-Anjou; 11: Bordeaux sector; 12: Entre-Deux-Mers; 13: Bazas sector; 14: Eyre valley; 15: Gélise valley; 16: Mont-de-Marsan sector; 17: Bas-Adour.

***Fig. 1** – Localisation des principales sources en coquillages du territoire français et lignes de partage des eaux délimitant des espaces de diffusion préférentielle. Fond de carte : SIG G. Encelot ; Sources : The GEBCO Grid (fond marin), SRTM 4.1 (relief). 1 : Soissonnais et Laonnais ; 2 : vallée de l'Oise ; 3 : Vexin français ; 4 : Mantois ; 5 : vallée de la Marne ; 6 : Gâtinais français ; 7 : Blésois ; 8 : Touraine-sud ; 9 : Touraine-ouest ; 10 : Haut-Anjou ; 11 : Bordelais ; 12 : Entre-deux-Mers ; 13 : Bazadais ; 14 : vallée de l'Eyre ; 15 : vallée de la Gélise ; 16 : Pays de Marsan ; 17 : Bas-Adour.*

***Abb. 1** – Hauptvorkommen von Mollusken in Frankreich und Grenzen ihrer hauptsächlichen Verbreitungsräume entlang von Wasserscheiden. Kartengrundlage: GIS G. Encelot; Quellen: The GEBCO GRID (Meeresboden), SRTM 4.1 (Relief). 1: Soissons- und Laon-Sektor; 2: Oise-Tal; 3: Französisches Vexin-Gebiet; 4: Mantes-Sektor; 5: Marne-Tal; 6: Französisches Gâtinais-Gebiet; 7: Blois-Sektor; 8: südliche Touraine; 9: westliche Touraine; 10: Haut-Anjou; 11: Boreaux-Sektor; 12: Entre-Deux-Mers; 13: Bazas-Sektor; 14: Eyre-Tal; 15: Gélise-Tal; 16: Mont-de-Marsan-Sektor; 17: Bas-Adour.*

MODELS OF ACQUISITION AND DIFFUSION

Preferred areas of diffusion and scale of procurement

Geographic factors played a preponderant role in the division of past cultural territories. Certain physical elements (such as relief, glaciers, and deserts) acted as barriers, whereas others, like river valleys and maritime coasts, on the contrary, provided natural circulation routes for goods and people (Djindjian, 1994 and 2009; Bertran et al., 2012 and 2013; Floss, 2014; Hussain and Floss, 2014). Various studies of the distribution of flint and seashells during the Palaeolithic have shown that diffusion routes developed along water courses, for instance, the Rhone Valley (Floss, 2000; Álvarez Fernández, 2001) and the Ebro Valley (Fullola et al., 2007). The main rivers and their catchment basins thus formed genuine communication networks, facilitating the circulation of goods. Therefore, the main European watershed divisions may denote preferred diffusion areas (fig. 1). The territories in the west of France were part of the Atlantic domain and should thus logically have benefitted from a supply of seashells from the Atlantic shoreline. In addition, as hydrographic routes cut through geological levels rich in fossil seashells, the latter were also diffused in these inland catchment basins. Thus, the characterization of the scale of procurement cannot be estimated solely on the basis of the distance between the place of origin and the place of discovery but should also take account of the ease of circulation within the main area of diffusion. Therefore, seashell procurement is considered as:

– local, if seashells could have been gathered in the immediate vicinity of the site or within a day's walk (Binford, 1982), i.e., within a maximum radius of 30 km (the distances considered vary from one author to another: cf. Delvigne, 2016, p. 142-144);

– regional, if the place of origin of the seashells is situated in the same catchment basin, which generally represents several hundred square kilometres. A distance of 300 km is generally considered as the maximum procurement radius for groups of hunter-gatherers (Wobst, 1976; Kelly, 1983; Féblot-Augustins and Perlès, 1992; Féblot-Augustins, 1999).

– extra-regional, if the place of origin of the seashells is situated outside the catchment basin; the maximum circulation distances of seashells is estimated at 800-1000 km for the Upper Palaeolithic (Taborin, 1993; Álvarez Fernández, 2001).

Acquisition modes: direct or indirect?

Since the ornaments were standardized, maintained, and worn by a significant number of individuals, large quantities of seashells must have had to be acquired. The direct collection of these objects, along with collection of food resources and lithic material, would have been the most reliable means of meeting most of the demand. However, interaction between human groups, often characterized by the exchange of resources, provided another possible form of acquisition. We distinguish two basic acquisition modes: direct acquisition (i.e., collecting resources in procurement zones, with no intermediaries involved) and indirect acquisition (i.e., obtaining resources via exchanges with intermediaries who exploit the procurement sources). Indirect acquisition modes were very varied and included regular exchanges of large quantities of diverse material goods, or conversely, more occasional exchanges of a limited number of goods (Earle and Ericson, 1977; Ericson and Earle, 1982; Renfrew and Bahn, 1996; Dillian and White, 2010).

The study of seashell procurement systems builds on work carried out on flint, integrating a technological approach with parameters of distance and quantity in order to optimise data related to the circulation of resources (e.g., Geneste, 1985 and 1992; Féblot-Augustins and Perlès, 1992; Féblot-Augustins, 1993; Delvigne, 2016). An interpretative framework, based on the correlation of four criteria, is proposed to help to discriminate between the different modes of acquiring shells:

– distance: in the case of direct acquisition, the procurement source would have been on the territory of the groups in question and the seashells obtained in this way would thus have been of local or regional origin. Conversely, exchanged objects would have been absent or rare in the accessible environment; being easily recognisable as being of extra-regional origin, they would have acquired value from their scarcity.

– quantity: according to C. Renfrew (1975 and 1977), the frequency curve of the occurrence of a material in relation to the distance from its source always decreases steadily. Thus, acquisition from procurement sources represented by a high proportion of seashells would probably have been direct. Conversely, a procurement source represented by a low number of seashells would probably have been some distance away or else the shells were procured by indirect means.

– diversity: this criterion is closely associated with the previous one. If a particular procurement source is represented by a high diversity of taxa, this suggests that it would have been easily accessible. On the other hand, if a procurement source is represented by a low diversity of taxa, then access would have been limited. This criterion can be blurred by selection processes orienting acquisitions towards one or two forms of seashells. In such cases, the quantity criterion is dominant.

– techniques: a correlation between the origin of the seashells and manufacturing techniques (in this case, perforation) may reflect processing differences dependent on procurement sources. The technical procedures applied to seashells obtained by direct means would have been predominant. Conversely, the seashells with a weakly represented extra-regional origin and worked by lesser-used procedures may have been produced by outside groups, as has already been suggested for perforated teeth (Vanhaeren and d'Errico, 2005).

RESULTS: COMPOSITION AND ORIGIN OF SEASHELL ASSEMBLAGES

Solutrean

The Solutrean sites in the west of France yielded more than 200 seashells whose origin could be identified (table 1). The sites are concentrated in north Aquitaine (Dordogne and Lot basins) and the south of the Charente Basin and are present, but rare, in the Loire Basin. Most of these sites are attributed to a recent phase of the Solutrean (i.e., middle, recent, and final Solutrean). Many of them were excavated a long time ago (first half of the twentieth century: Badegoule, Laugerie-Haute, Fourneau-du-Diable, Pech-de-la-Boissière, Les Jamblancs, Le Placard, etc.), which implies that seashell documentation was subject to significant bias (stratigraphic mixing, absence of fine fraction, etc.), making a critical evaluation of these assemblages is essential. However, the records are better for some Solutrean sites, either because they were excavated using recent methods and sieving (for example, Grotte Rochefort), or because seashells seem to have been very carefully recovered (for example, Abri Lachaud).

During the Solutrean, the contribution of Atlantic sources to seashell collection was at its highest, representing more than half of the pieces. Atlantic seashells were present at most of the Solutrean sites considered here (fig. 2A), in variable proportions (between 10 and 90 %). The composition of this Atlantic component was varied (14 gastropod taxa and 6 bivalve taxa identified) and consisted mainly of Littorinae (*Littorina obtusata*, *Littorina saxatilis*, *Littorina littorea*; fig. 3, nº 5), *Nucella lapillus* (fig. 3, no 10), whelks (*Buccinum undatum*, *Colus gracilis*, *Colus jeffreysianus*, *Neptunea contraria*; fig. 3, nº 11), and scallops (mainly *Pecten maximus*), cockles (mainly *Cerastoderma edule*) and Glycymerididae (mainly *Glycymeris glycymeris*; fig. 3, nº 15).

Fossil seashells from the Aquitaine Basin were well represented, in variable proportions (between 10 and 60 %), in assemblages from sites in the north of Aquitaine and Charente (fig. 2B). The composition of this component was varied (13 gastropod taxa and 3 bivalve taxa identified), with a pronounced emphasis on Neritina shells, in particular *Vitta picta*. These brackish water gastropods, with small spherical shells (less than 10 mm), often retained their original colours and patterns, making them particularly attractive for ornamental purposes. *Vitta picta* were numerous in layer 6 of Abri Lachaud (Cheynier, 1965; Peschaux, 2017; fig. 3, nºs 1 and 2) and several other Neritina shells were recorded at Badegoule (Taborin, 1993) and in layer 10 of Peyrugues (Allard, 2016). The fossils chosen corresponded to Lower Miocene species (from Aquitaine and Burdigalian), indicating probable origins in the shelly sands of Gironde (Bordelais, Entre-Deux-Mers, Bazadais).

Fossil seashells from Anjou and Touraine were present at the sites of the Loire Basin (fig. 2C). At Grotte Rochefort in Mayenne, the conservation status of the shells indicated possible origins in the shelly sands of Haut-Anjou (Peschaux and Courville, 2020). At Abri Fritsch (Indre), the only seashell that could be attributed to the Solutrean was a perforated *Mitrella turonica* shell (layer 8c; fig. 3, nº 7) from the geological levels of the Langhian in the shelly sands of Touraine (Blésois and south Touraine; Peschaux, 2017). Touraine fossils were also present in Dordogne, 200 km from the procurement sources, in layer 6 of Abri Lachaud, where this origin was indicated by the combined presence of *Mitrella turonica* (fig. 3, nº 6), *Astraea granosa* and *Calliostoma tauromiliare* shells and represented 30 % of the assemblage (Peschaux, 2017).

Finally, a slight Mediterranean contribution was identified at several Solutrean sites in the west of France (fig. 2D). This was exclusively indicated by the presence of large robust shells of *Semicassis saburon*. They were present, in small quantities, at Placard (layer 7 of Chauvet; Taborin, 1993), Lacave (layer 3; Viré, 1905), and Fourneau du Diable (upper terrace, S.S. III; Taborin, 1993; Peschaux, 2017; fig. 3, nº 14), to which we can possibly add a specimen from Badegoule whose attribution to the Solutrean or the Badegoulian has not been firmly established (coll. Hardy; Taborin, 1993).

Solutrean seashells were perforated to allow them to be used as objects of ornament. Perforation methods were similar at all of the analysed sites. They consisted of creating an offset perforation at the back of the shells (dorsal face) using techniques involving either sawing or pressure or both (Peschaux, 2012). These methods could be identified on seashells from all horizons.

Badegoulian

The Badegoulian sites in the west of France yielded approximately 550 seashells whose origin could be identified (table 2). This does not take into account scaphopod shells (apart from a few exceptions) as, although they were plentiful (or even the predominant species) at most of the Badegoulian sites, they were too worked or degraded and their anatomic characteristics were too ubiquitous to indicate their origin. Badegoulian sites are present in all the main catchment basins of the west of France. As in the case of Solutrean sites, the quality of the information pertaining to seashells varied from one site to another, as some of the sites were excavated a long time ago (in Dordogne and Charente, the Badegoulian sites are mostly the same as the Solutrean sites), while several assemblages came from more recent excavations (1970s to 2010s) carried out using modern methods (for example, Cuzoul-de-Vers, Abri Fritsch, Mont Saint-Aubin at Oisy, and Le Colombier at Chézy-sur-Marne). Atlantic shells were circulated widely during the Badegoulian (fig. 4A) but appeared to be less significant than during the Solutrean, only representing 20 % of all the seashells considered. The composition of this component was very varied (11 gastropod taxa and 3 bivalve taxa) and the spectra were comparable to Solutrean spectra, with numerous Littorinae shells (*Littorina littorea*, *Littorina obtusata*, *Littorina saxatilis*, fig. 5, nº 2), *Nucella lapillus* (fig. 5, nº 1), *Tritia reticulata* (fig. 5, nºs 4 and 5), and various bivalves.

	Abri Fritsch (layer 8c)	Abri Lachaud (layer 6)	Badegoule (c. III-IV ; B2)	Cabrerets (grand abri)	Fourneau du Diable (up. terr.)	Grotte Rochefort (layers 4)	La Bigote	La Chèvre	Lacave (layer 3)	Laugerie-Haute (layer 11 to 12)	Le Placard (layer 7)	L'Église	Les Bernous	Les Jamblancs	Mazerat	Pech de la Boissière (layer 1)	Roc de Sers	Roquebécude
ATLANTIC OCEAN																		
Acanthocardia echinata (B)	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Aporrhais pespelecani (G)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–
Buccinum undatum (G)	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Cerastoderma edule (B)	–	–	–	–	–	–	–	–	1	–	11	–	–	–	2	–	–	–
Cerithium vulgatum (G)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–
Chlamys islandica (B)	–	–	–	–	1	–	–	–	–	–	1	–	–	1	–	–	–	–
Colus gracilis (G)	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1
Colus jeffreysianus (G)	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Flexopecten glaber (B)	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–
Glycymeris glycymeris (B)	–	–	–	–	1	–	–	–	–	1	3	–	–	–	–	–	–	–
Littorina sp. (G)	–	2	9	1	4	–	2	1	–	–	–	–	–	2	–	–	–	–
Neptunea contraria (G)	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Nucella lapillus (G)	–	1	–	–	1	–	–	–	1	1	–	–	–	2	–	–	–	–
Pecten maximus (B)	–	–	16	–	1	–	–	–	1	–	12	–	2	1	–	2	–	–
Tritia reticulata (G)	–	3	4	–	–	–	–	–	–	–	–	–	–	1	–	6	1	–
Trivia sp. (G)	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
Turritella communis (G)	–	2	2	–	–	–	–	–	x	–	–	–	–	–	–	x	–	–
AQUITAINE																		
Anazola clavula (G)	–	1	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–
Ancilla glandiformis (G)	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	–
Cardita jouanetti (B)	–	2	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Flabellipecten burdigalensis (B)	–	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Glycymeris pilosa (B)	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
Granulolabium plicatum (G)	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	x	–	–
Mitraria dufresni (G)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Natica helicina (G)	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–
Natica pseudoepiglottina (G)	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–
Natica sp. (G)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–
Neritidae (G)	–	–	14	–	–	–	–	–	–	–	–	–	–	3	–	–	–	–
Potamides tournoueri (G)	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Trona leporina (G)	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Turritella eryna (G)	–	–	1	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–
Turritella terebralis (G)	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Vitta picta (G)	–	39	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
ANJOU-TOURAINE																		
Astraea granosa (G)	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chlamys sp. (B)	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Glycymeris sp. (B)	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
Mitrella turonica (G)	1	18	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Natica tigrina (G)	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
MEDITERRANEAN SEA																		
Semicassis saburon (G)	–	–	1?	–	1	–	–	–	1	–	3	–	–	–	–	–	–	–

Table 1 – Solutrean seashells whose origin could be identified. Data: Viré, 1905; Taborin, 1991 and 1993; Peschaux, 2017; pers. obs. (B): Bivalve; (G): Gastropod; x: present, without indication of number.

Tableau 1 *– Composition des coquillages solutréens renseignant d'une origine. Données : Viré, 1905 ; Taborin, 1991 et 1993 ; Peschaux, 2017 ; obs. pers. (B) : Bivalve ; (G) : Gastéropode ; x : présent, sans indication du nombre.*

Tabelle 1 – *Zusammenstellung von Mollusken aus Solutréen-Kontexten mit Informationen zu deren Herkunft. Daten: Viré, 1905; Taborin, 1991 und 1993; Peschaux, 2017; pers. Beob. (B): Bivalve; (G): Gastropod; x: gefunden, aber keine Anzahl festgehalten.*

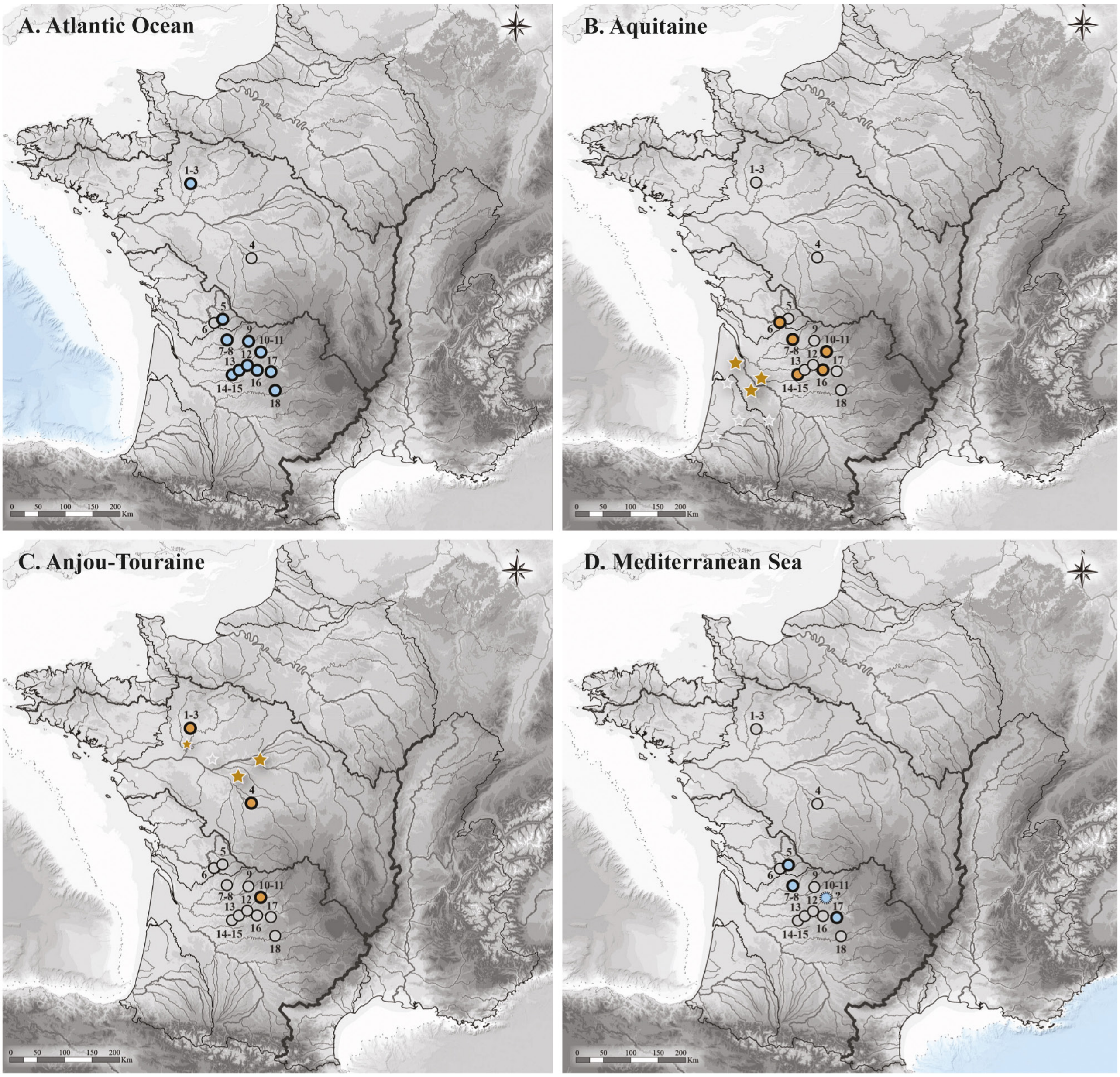

Fig. 2 – Distribution of Solutrean sites yielding seashells from the Atlantic Ocean (A), Miocene shelly sands in Gironde (B), Miocene shelly sands in Anjou and Touraine (C) and the Mediterranean Sea (D). Map base: GIS G. Encelot; Sources: The GEBCO Grid (seabed), SRTM 4.1 (relief). 1: Grotte Rochefort; 2: La Bigote; 3: La Chèvre; 4: Abri Fritsch; 5: Le Placard; 6: Roc de Sers; 7: Fourneau du Diable; 8: Les Bernous; 9: L'Eglise; 10: Badegoule; 11: Abri Lachaud; 12: Laugerie-Haute; 13: Roquebécude ; 14: Les Jamblancs; 15: Mazerat; 16: Pech de la Boissière; 17: Lacave; 18: Cabrerets.

***Fig. 2** – Répartition des sites solutréens ayant livrés des coquillages de l'océan Atlantique (A), des faluns miocènes de Gironde (B), des faluns miocènes de l'Anjou et de la Touraine (C) et de la mer Méditerranée (D). Fond de carte : SIG G. Encelot ; Sources : The GEBCO Grid (fond marin), SRTM 4.1 (relief). 1 : Grotte Rochefort ; 2 : La Bigote ; 3 : La Chèvre ; 4 : Abri Fritsch ; 5 : Le Placard ; 6 : Roc de Sers ; 7 : Fourneau du Diable ; 8 : Les Bernous ; 9 : L'Eglise ; 10 : Badegoule ; 11 : Abri Lachaud ; 12 : Laugerie-Haute ; 13 : Roquebécude ; 14 : Les Jamblancs ; 15 : Mazerat ; 16 : Pech de la Boissière ; 17 : Lacave ; 18 : Cabrerets.*

***Abb. 2** – Verteilung der Solutréen-Fundstellen mit Mollusken aus dem Atlantischen Ozean (A), den miozänen Muschelsanden der Gironde (B), den miozänen Muschelsanden von Anjou und Touraine (C) und dem Mittelmeer (D). Kartengrundlage: GIS G. Encelot; Quellen: The GEBCO Grid (Meeresboden), SRTM 4.1 (Relief). 1: Grotte Rochefort; 2: La Bigote; 3: La Chèvre; 4: Abri Fritsch; 5: Le Placard; 6: Roc de Sers; 7: Fourneau du Diable; 8: les Bernous; 9: L'Eglise; 10: Badegoule; 11: Abri Lachaud; 12: Laugerie-Haute; 13: Roquebécude; 14: Les Jamblancs; 15: Mazerat; 16: Pech de la Boissière; 17: Lacave; 18: Cabrerets.*

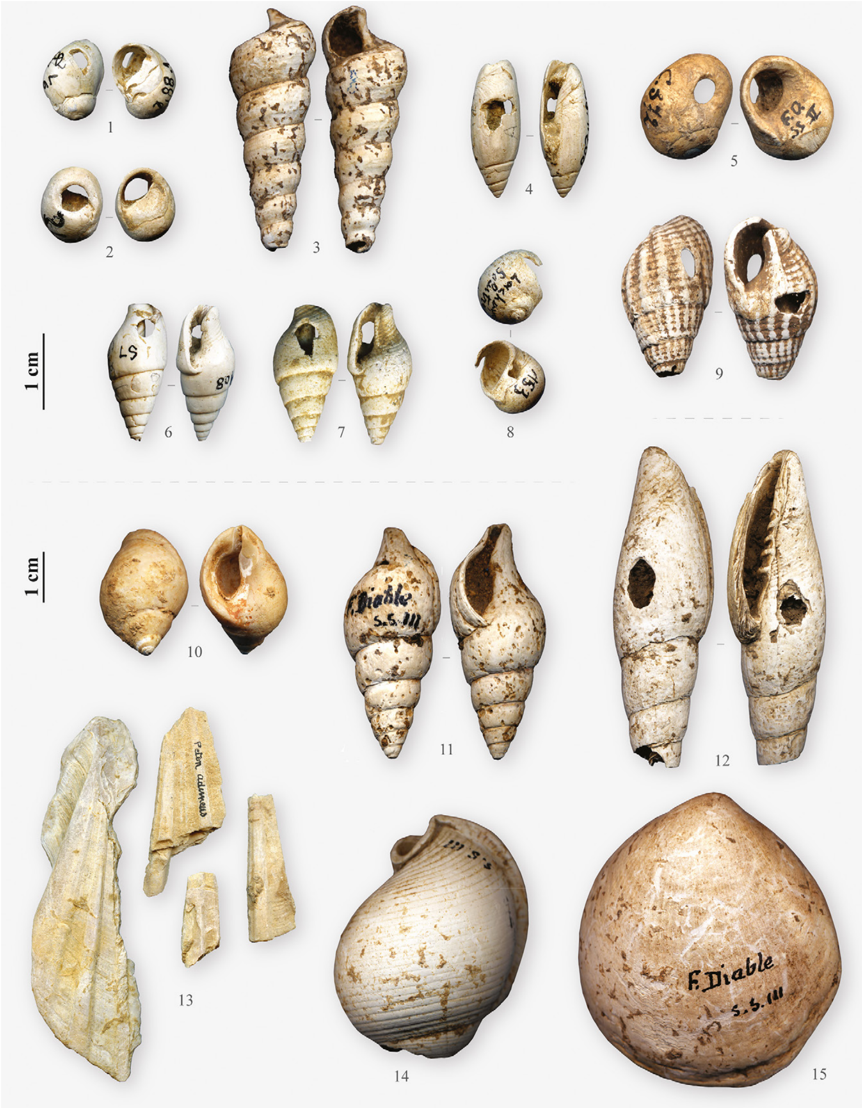

Fig. 3 – Mollusc seashells discovered at Solutrean sites (doc. C. Peschaux). 1, 2: *Vitta picta,* Abri Lachaud (layer 6), coll. Cheynier; 3: *Turritella eryna*, Fourneau du Diable (upper terrace), coll. Peyrony; 4: *Anazola clavula*, Abri Lachaud (layer 6), coll. Cheynier; 5: *Littorina obtusata*, Fourneau du Diable (upper terrace), coll. Peyrony; 6: *Mitrella turonica*, Abri Lachaud (layer 6), coll. Cheynier; 7: *Mitrella turonica*, Abri Fritsch (layer 8c), coll. Allain; 8: *Natica tigrina*, Abri Lachaud (layer 6), coll. Cheynier; 9: *Tritia reticulata*, Pech de la Boissière (layer 1), coll. Peyrony; 10: *Nucella lapillus*, Laugerie-Haute, coll. Blanc; 11: *Colus gracilis*, Fourneau du Diable (upper terrace), coll. Peyrony; 12: *Mitraria dufresni*, Roc de Sers, coll. Henri-Martin; 13: *Flabellipecten burdigalensis*, Abri Lachaud (layer 6), coll. Cheynier; 14: *Semicassis saburon*, Fourneau du Diable (upper terrace), coll. Peyrony; 15: *Glycymeris glycymeris*, Fourneau du Diable (upper terrace), coll. Peyrony.

***Fig. 3** – Coquilles de mollusques marins découvertes dans les sites solutréens (doc. C. Peschaux). 1, 2 :* Vitta picta*, abri Lachaud (couche 6), coll. Cheynier ; 3 :* Turritella eryna*, Fourneau du Diable (terrasse supérieure), coll. Peyrony ; 4 :* Anazola clavula*, abri Lachaud (couche 6), coll. Cheynier ; 5 :* Littorina obtusata*, Fourneau du Diable (terrasse supérieure), coll. Peyrony ; 6 :* Mitrella turonica*, abri Lachaud (couche 6), coll. Cheynier ; 7 :* Mitrella turonica*, abri Fritsch (couche 8c), coll. Allain ; 8 :* Natica tigrina*, abri Lachaud (couche 6), coll. Cheynier ; 9 :* Tritia reticulata*, Pech de la Boissière (couche 1), coll. Peyrony ; 10 :* Nucella lapillus*, Laugerie-Haute, coll. Blanc ; 11 :* Colus gracilis*, Fourneau du Diable (terrasse supérieure), coll. Peyrony ; 12 :* Mitraria dufresni*, Roc de Sers, coll. Henri-Martin ; 13 :* Flabellipecten burdigalensis*, abri Lachaud (couche 6), coll. Cheynier ; 14 :* Semicassis saburon*, Fourneau du Diable (terrasse supérieure), coll. Peyrony ; 15 :* Glycymeris glycymeris*, Fourneau du Diable (terrasse supérieure), coll. Peyrony.*

***Abb. 3** – Mollusken, die in Solutréen-Fundstellen entdeckt wurden (dok. C. Peschaux). 1, 2:* Vitta picta*, Abri Lachaud (Schicht 6), Slg. Cheynier; 3:* Turritella eryna*, Fourneau du Diable (obere Terrasse), Slg. Peyrony; 4:* Anazola clavula*, Abri Lachaud (Schicht 6), Slg. Cheynier; 5:* Littorina obtusata*, Fourneau du Diable (obere Terrasse), Slg. Peyrony; 6:* Mitrella turonica*, Abri Lachaud (Schicht 6), Slg. Cheynier; 7:* Mitrella turonica*, Abri Fritsch (Schicht 8c), Slg. Allain; 8:* Natica tigrina*, Abri Lachaud (Schicht 6), Slg. Cheynier; 9:* Tritia reticulata*, Pech de la Boissière (Schicht 1), Slg. Peyrony; 10:* Nucella lapillus*, Laugerie-Haute, Slg. Blanc; 11:* Colus gracilis*, Fourneau du Diable (obere Terrasse), Slg. Peyrony; 12:* Mitraria dufresni*, Roc de Sers, Slg. Henri-Martin; 13:* Flabellipecten burdigalensis*, Abri Lachaud (Schicht 6), Slg. Cheynier; 14:* Semicassis saburon*, Fourneau du Diable (obere Terrasse), Slg. Peyrony; 15:* Glycymeris glycymeris*, Fourneau du Diable (obere Terrasse), Slg. Peyrony.*

	Abri Fritsch (layers 6 to 2)	Abri Lachaud (layers 2 to 4)	Badegoule (layers VI-VII ; D)	Cassegros (layers 9 to 10)	Chemin-de-l'Évangile 3 (level P)	En-Creusilly	Laugerie-Haute	Le Colombier	Le Cuzoul-de-Vers (layers 27 to 1	Le Placard (layer 4)	Les Jamblancs	Mont saint-Aubin	Rond du Barry (layer F2)
ATLANTIC OCEAN													
Aporrhais pespelecani (G)	–	–	–	–	–	–	–	–	–	–	1	–	–
Cerastoderma edule (B)	–	–	–	–	–	–	–	–	–	5	–	–	–
Cerithium vulgatum (G)	–	–	3	–	–	–	–	–	–	–	–	–	–
Gibbula sp. (G)	–	–	–	–	–	–	–	–	–	–	–	1	–
Glycymeris sp. (B)	–	–	2	–	–	–	–	–	–	14	–	–	–
Littorina sp. (G)	–	–	–	–	–	–	–	–	4	2	2	4	–
Nucella lapillus (G)	–	1	–	–	–	–	–	–	–	6	2	–	–
Pecten sp. (B)	–	–	1	–	–	–	–	–	x	5	1	–	–
Tritia incrassata (G)	–	3	–	–	–	–	–	–	–	–	–	–	–
Tritia reticulata (G)	18	–	–	2	–	–	–	–	–	9	–	–	1
Trivia sp. (G)	2	–	–	–	–	–	–	–	–	–	–	–	–
Turritella communis (G)	–	–	–	–	–	–	–	–	–	–	2	–	–
AQUITAINE													
Anazola clavula (G)	–	–	–	1	–	–	–	–	–	–	–	–	–
Ancilla glandiformis (G)	–	–	–	–	–	–	–	–	–	1	1	–	–
Glycymeris nummaria (B)	–	–	–	–	–	–	–	–	–	2	–	–	–
Granulolabium plicatum (G)	–	32	–	2	–	–	–	–	2	–	–	10 ?	–
Terebra acuminata (G)	–	–	1	–	–	–	–	–	–	–	1	–	–
Trona leporina (G)	–	–	–	1	–	–	–	–	–	–	–	–	–
Turritella eryna (G)	–	–	–	–	–	–	1	–	–	–	–	–	–
Turritella terebralis (G)	–	–	–	1	–	–	–	–	–	–	–	–	–
Turritela sp. (G)	–	–	–	–	–	–	–	–	1	–	–	–	–
Vitta picta (G)	2	62	–	10	–	–	–	–	5	–	–	–	–
PARIS BASIN													
Ampullina parisiensis (G)	2	–	1 ?	–	–	–	–	3	–	6	–	24	–
Athleta bulbula (G)	–	–	–	–	–	–	–	–	–	–	–	4	–
Batillaria sp. (G)	1	–	–	–	1	–	–	–	–	–	–	5	–
Bayania lactea (G)	2	–	–	–	x	–	–	–	–	–	–	56	2
Brotia melanioides (G)	–	–	–	–	–	–	–	1	–	–	–	–	–
Editharus vasseuri (G)	–	–	–	–	–	–	–	–	–	–	–	2	–
Fissidentalium grande (S)	12	–	–	–	–	–	–	6	–	–	–	15	–
Granulolabium substriatum (G)	2	–	–	–	x	–	–	–	–	–	–	29	–
Haustator sp. (G)	–	–	–	–	–	–	–	–	–	–	–	1	–
Hipponix cornucopiae (G)	–	–	–	–	–	–	–	1	–	–	–	1	–
Melanopsis laubrierei (G)	–	–	–	–	–	–	–	1	–	–	–	–	–
Naticidae (G)	–	–	–	–	–	–	–	3	–	–	–	11	–
Olividae (G)	3	–	–	–	2	1	–	15	–	–	–	34	3
Rimella fissurella (G)	–	–	–	–	–	–	–	–	–	–	–	1	–
Serratocerithium sp. (G)	–	–	–	–	–	–	–	8	–	–	–	–	–
Strepsidura turgida (G)	–	–	–	–	–	–	–	–	–	–	–	1	–
Sycostoma bulbiforme	–	–	–	–	–	–	–	1	–	–	–	–	–
Terebralia thiara (G)	–	–	–	–	–	–	–	–	–	–	–	1	–
Torquesia terebellata (G)	–	–	–	–	–	–	–	10	–	–	–	–	–
Turricula transversaria (G)	–	–	–	–	–	–	–	–	–	–	–	1	–
Tympanotonos sp. (G)	–	–	–	–	1	–	–	–	–	–	–	2	–
Venericor planicosta (B)	–	–	–	–	–	–	–	32	–	–	–	–	–
MEDITERRANEAN SEA													
Semicassis saburon (G)	–	–	1 ?	–	–	–	–	–	1	–	–	–	–

Table 2 – Badegoulian seashells whose origin could be identified. Data: Taborin, 1991, 1993 and 2012; Leuzinger, 1992; Peschaux, 2017; Connet et al., 2019; Montoya et al., 2019; pers. obs. (B): Bivalve; (G): Gastropod; (S): Scaphopod; x: present, without indication of number.

***Tableau 2** – Composition des coquillages badegouliens renseignant d'une origine. Données : Taborin, 1991, 1993 et 2012 ; Leuzinger, 1992 ; Peschaux, 2017 ; Connet* et al.*, 2019 ; Montoya* et al.*, 2019 ; obs. pers. (B) : Bivalve ; (G) : Gastéropode ; (S) : Scaphopode ; x : présent, sans indication du nombre.*

***Tabelle 2 –** Zusammenstellung von Mollusken aus Badegoulien-Kontexten mit Informationen zu deren Herkunft. Daten: Taborin, 1991, 1993 und 2012; Leuzinger, 1992; Peschaux, 2017; Connet et al., 2019; Montoya et al., 2019; pers. Beob. (B): Bivalve; (G): Gastropod; (S): Scaphopod; x: gefunden, aber keine Anzahl festgehalten.*

The proportion of Atlantic seashells was very variable from one site to another, high at some sites (80 % in layer 4 at Placard; 45 % in layers 6 to 2 at Abri Fritsch), at others very marginal (2 % at Mont Saint-Aubin) or even absent (Colombier in Chézy-sur-Marne), showing the highly contrasting importance of Atlantic acquisitions depending on the geographic area under consideration.

Fossil seashells from the Aquitaine Basin were especially frequent and numerous at sites in the north of Aquitaine (Dordogne and Lot basins; fig. 4B) where they represented between 60 and 95 % of assemblages. There again, the Aquitanian and Burdigalian ages of the identified fossils indicated probable origins in the Lower Miocene shelly sands of Gironde (Bordelais, Entre-Deux-Mers, Bazadais). The composition of this component was varied (8 gastropod taxa) but dominated by two species: *Vitta picta* and *Granulolabium plicatum*. These shells were identified at Cuzoul de Vers (Taborin, 2012), Cassegros (Leuzinger, 1992; Taborin, 1993; pers. obs.), and at Abri Lachaud (Cheynier, 1965; Peschaux, 2017). At the latter site, these fossils were clustered in two 'deposits' (layer 4: Cheynier, 1965, p. 46), the first of which contained 37 *Vitta picta* (fig. 5, n^os^ 8 and 9) and 32 *Granulolabium plicatum* (fig. 5, n^o^ 11), most of which were coloured red but none of which were worked, and the second containing 24 *Vitta picta* shells which were all perforated. These two species were also identified outside Aquitaine, but in small quantities: level 5b of Abri Fritsch contained two *Vitta picta* shells, and ten *Granulolabium plicatum* shells were discovered at Mont Saint-Aubin (Peschaux, 2017). The latter could possibly have come from Aquitaine but are more likely to have originated in the Oligocene terrains of Gâtinais in the Paris Basin (due to the shape of shells; Lozouet, 2012).

The Eocene fossil seashells of the Paris Basin were widely circulated during the Badegoulian (fig. 4C). They were particularly numerous at sites in the Seine and Loire basins, where they represented 50 % of the seashells at Abri Fritsch (Taborin, 1993; Peschaux, 2017), 93 % at Mont Saint-Aubin (Bodu et al., 2005; Peschaux, 2017), and the totality of the seashells at Colombier (Montoya et al., 2019) and Chemin de l'Évangile (Connet et al., 2019). The conchological spectrum was very diversified (25 gastropod taxa, at least one bivalve taxon, and at least one scaphopod taxon), but a selection of preferred forms could be seen, with a recurrence of *Bayania lactea* (fig. 5, n^o^ 13), *Ampullina depressa parisiensis* (fig. 5, n^os^ 16 and 18), Naticidae (*Euspira lorioli*, *Neverita semiclausa*), and Olivids (*Amalda dubia*, *Amalda olivula*, *Ancillarina canalifera*, *Ancillus buccinoides*, *Olivancillaria parisiensis*; fig. 5, n^os^ 12, 14 and 17), as well as *Fissidentalium grande* (fig. 5, n^o^ 19), which is a large scaphopod species (10 mm maximum diameter and 100 mm long). The identified fossils did not come from the same geological formations, which implied that several procurement sources were used in the Paris Basin. On one hand, the presence at several sites of *Granulolabium substriatum* shells (fig. 5, n^o^ 15) – which originate exclusively from the middle Lutetian strata of the Houdan sector (Peschaux et al., 2015) – indicates that the Mantois region was one of the procurement sources used. On the other hand, *Fissidentalium grande* are found in lower Bartonian strata (Auversian) in the Marne Valley and the French Vexin (Fischer, 2000). Outside the Seine and Loire basins, *Ampullina depressa parisiensis* shells were indicated at Placard (layer 4 of de Maret; Taborin, 1993) and one *Ampullina* sp. shell from the Eocene was recorded at Badegoule, in a level presenting mixed Solutrean and Badegoulian industries (coll. Peyrony; Taborin, 1993).

The Mediterranean input of large *Semicassis saburon* shells may have continued during the Badegoulian (fig. 4D). In addition to the specimen from Badegoule, mentioned above and not definitively attributed to either the Solutrean or the Badegoulian, a specimen was brought to light in layer 11 of Cuzoul de Vers (Taborin, 2012).

Several perforation methods were identified for the Badegoulian (Peschaux, 2017). In the north Aquitaine sites (Abri Lachaud, Cassegros, Cuzoul de Vers), the preferred method consisted of creating an axial perforation in the side of the shell (columellar face). The chosen position, in an area where the shell is particularly robust, required the application of invasive techniques. At Abri Lachaud (layers 3 and 4), the location of the perforations was prepared by scraping, then the holes were created by light 'pecking' or, more rarely, by rotational scraping. At Cassegros and Cuzoul de Vers, preparation by sawing was followed by pressure, sometimes combined with a rotational motion. These methods were observed, in particular, on spherically shaped shells (*Vitta picta*, Littorinae). The example of *Semicassis saburon* from Cuzoul de Vers was perforated by simple sawing, at the back, beside the bulge of the labrum (Taborin, 2012). Further north (at Abri Fritsch, Mont Saint-Aubin, and Colombier), all the shells were perforated at the back (dorsal face), regardless of the shape or origin of the shells, in order to create offset ornaments. The technique used always involved pressure, which was, however, applied differently depending on the shape of the shell. On shells presenting a wide natural opening (*Bayania lactea*, *Granulolabium substriatum*, *Ampullina depressa parisiensis*, Natices), perforations were created directly by inserting the tool inside the shell and applying internal pressure. On shells with a naturally narrow opening (mainly Olividae) or a robust test (*Tritia reticulata*, *Ampullina depressa parisiensis* with large dimensions), pressure was applied externally following preparatory scraping (Peschaux, 2017).

DISCUSSION

Discontinuous exploitation of the different seashell resources

As expected, the Atlantic component was constant at the Solutrean and Badegoulian sites located in the Loire, Charente, and Dordogne-Garonne basins, or, in other words, in the areas directly linked to the ocean by the hydrographic network, with a maximum diffusion radius

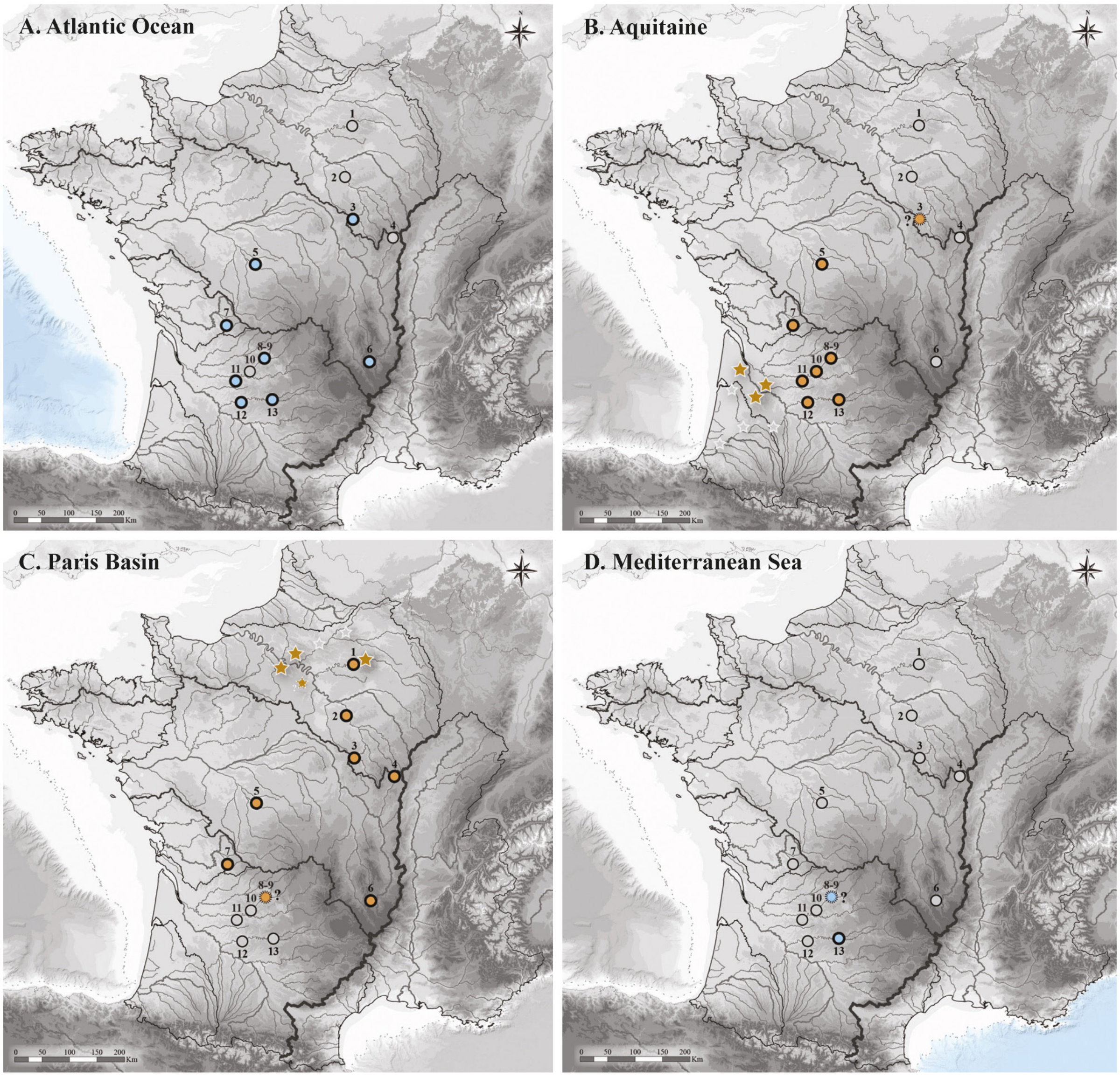

Fig. 4 – Distribution of Badegoulian sites yielding seashells from the Atlantic Ocean (A), Miocene shelly sands from the Aquitaine Basin (B), Eocene fossiliferous sites in the Paris Basin (C) and the Mediterranean Sea (D). Map base: GIS G. Encelot; Sources: The GEBCO Grid (seabed), SRTM 4.1 (relief). 1: Le Colombier; 2: Chemin de l'Evangile; 3: Mont Saint-Aubin; 4: En-Creusilly; 5: Abri Fritsch; 6: Rond-du-Barry; 7: Le Placard; 8: Badegoule; 9: Abri Lachaud; 10: Laugerie-Haute; 11: Les Jamblancs; 12: Cassegros; 13: Cuzoul de Vers.

***Fig. 4** – Répartition des sites badegouliens ayant livrés des coquillages de l'océan Atlantique (A), des faluns miocènes de Gironde (B), des gisements fossilifères éocènes du Bassin parisien (C) et de la mer Méditerranée (D). Fond de carte : SIG G. Encelot ; Sources : The GEBCO Grid (fond marin), SRTM 4.1 (relief). 1 : Le Colombier ; 2 : Chemin de l'Evangile ; 3 : Mont Saint-Aubin ; 4 : En-Creusilly ; 5 : Abri Fritsch ; 6 : Rond-du-Barry ; 7 : Le Placard ; 8 : Badegoule ; 9 : Abri Lachaud ; 10 : Laugerie-Haute ; 11 : Les Jamblancs ; 12 : Cassegros ; 13 : Cuzoul de Vers.*

***Abb. 4** – Verteilung der Badegoulien-Fundstellen mit Mollusken aus dem Atlantischen Ozean (A), den miozänen Muschelsanden aus dem Aquitaine-Becken (B), den eozänen fossilhaltigen Fundstellen im Pariser Becken (C) und dem Mittelmeer (D). Kartengrundlage: GIS G. Encelot; Quellen: The GEBCO Grid (Meeresboden), SRTM 4.1 (Relief). 1: Le Colombier; 2: Chemin de l'Evangile; 3: Mont Saint-Aubin; 4: En-Creusilly; 5: Abri Fritsch; 6: Rond-du-Barry; 7: Le Placard; 8: Badegoule; 9: Abri Lachaud; 10: Laugerie-Haute; 11: Les Jamblancs; 12: Cassegros; 13: Cuzoul de Vers.*

estimated at between 300-400 km (taking into account the approximate difference between current and Upper Palaeolithic shorelines). On the other hand, Atlantic seashells were rare in the Seine Basin, probably due to the long distance of the latter from the ocean (at least 600 km) and the fact that this zone was only indirectly connected to the ocean (as it was a sub-basin of the Channel River). The proportion of these resources in assemblages was very variable from one site to another, but current data seem to indicate that the Atlantic component was more significant during the Solutrean (50 % of all seashells) than the Badegoulian (20 % of all seashells).

Fig. 5 – Mollusc seashells discovered at Badegoulian sites (doc. C. Peschaux). 1: *Nucella lapillus*, Le Placard (layer 4), coll. de Maret; 2: *Littorina littorea*, Mont Saint-Aubin, coll. GRAPHN; 3: *Cerithium vulgatum*, Badegoule, coll. Peyrony; 4, 5: *Tritia reticulata*, Abri Fritsch (layer 5), coll. Allain; 6: *Tritia incrassata*, Abri Lachaud (layer 3), coll. Cheynier; 7: *Trivia* sp., Abri Fritsch (layer 4), coll. Allain; 8, 9: *Vitta picta*, Abri Lachaud (1st deposit, layer 4), coll. Cheynier; 10: *Ancilla glandiformis*, Le Placard (layer 4), coll. de Maret; 11: *Granulolabium plicatum*, Abri Lachaud (1st deposit, layer 4), coll. Cheynier; 12: *Ancillus buccinoides*, Mont Saint-Aubin, coll. P. Bodu; 13: *Bayania lactea*, Mont Saint-Aubin, coll. P. Bodu; 14: *Amalda olivula*, Le Colombier, coll. C. Montoya; 15: *Granulolabium substriatum*, Mont Saint-Aubin, coll. GRAPHN; 16: *Ampullina depressa parisiensis*, Abri Fritsch (layer 6), coll. Allain; 17: *Amalda dubia*, Mont Saint-Aubin, coll. P. Bodu; 18: *Ampullina depressa parisiensis*, Mont Saint-Aubin, coll. GRAPHN; 19: *Fissidentalium grande*, Le Colombier, coll. C. Montoya.

Fig. 5 *– Coquilles de mollusques marins découvertes dans les sites badegouliens (doc. C. Peschaux). 1 :* Nucella lapillus*, Le Placard (couche 4), coll. de Maret ; 2 :* Littorina littorea*, Mont Saint-Aubin, coll. GRAPHN ; 3 :* Cerithium vulgatum*, Badegoule, coll. Peyrony ; 4, 5 :* Tritia reticulata*, abri Fritsch (couche 5), coll. Allain ; 6 :* Tritia incrassata*, abri Lachaud (couche 3), coll. Cheynier ; 7 :* Trivia *sp., abri Fritsch (couche 4), coll. Allain ; 8, 9 :* Vitta picta*, abri Lachaud (1er dépôt, couche 4), coll. Cheynier ; 10 :* Ancilla glandiformis*, Le Placard (couche 4), coll. de Maret ; 11 :* Granulolabium plicatum*, abri Lachaud (1er dépôt, couche 4), coll. Cheynier ; 12 :* Ancillus buccinoides*, Mont Saint-Aubin, fouilles P. Bodu ; 13 :* Bayania lactea*, Mont Saint-Aubin, fouilles P. Bodu ; 14 :* Amalda olivula*, Le Colombier, fouilles C. Montoya ; 15 :* Granulolabium substriatum*, Mont Saint-Aubin, coll. GRAPHN ; 16 :* Ampullina depressa parisiensis*, abri Fritsch (couche 6), coll. Allain ; 17 :* Amalda dubia*, Mont Saint-Aubin, fouilles P. Bodu ; 18 :* Ampullina depressa parisiensis*, Mont Saint-Aubin, coll. GRAPHN ; 19 :* Fissidentalium grande*, Le Colombier, fouilles C. Montoya.*

Abb. 5 *– Mollusken, die in Badegoulien-Fundstellen entdeckt wurden (dok. C. Peschaux). 1:* Nucella lapillus*, Le Placard (Schicht 4), Slg. de Maret; 2:* Littorina littorea*, Mont Saint-Aubin, Slg. GRAPHN; 3:* Cerithium vulgatum*, Badegoule, Slg. Peyrony; 4, 5:* Tritia reticulata*, Abri Fritsch (Schicht 5), Slg. Allain; 6:* Tritia incrassata*, Abri Lachaud (Schicht 3), Slg. Cheynier; 7:* Trivia sp.*, Abri Fritsch (Schicht 4), Slg. Allain; 8, 9:* Vitta picta*, Abri Lachaud (erste Ablagerung, Schicht 4), Slg. Cheynier; 10:* Ancilla glandiformis*, Le Placard (Schicht 4), Slg. de Maret; 11:* Granulolabium plicatum*, Abri Lachaud (erste Ablagerung, Schicht 4), Slg. Cheynier; 12:* Ancillus buccinoides*, Mont Saint-Aubin, Slg. P. Bodu; 13:* Bayania lactea*, Mont Saint-Aubin, Slg. P. Bodu; 14:* Amalda olivula*, Le Colombier, Slg. C. Montoya; 15:* Granulolabium substriatum*, Mont Saint-Aubin, Slg. GRAPHN; 16:* Ampullina depressa parisiensis*, Abri Fritsch (Schicht 6), Slg. Allain; 17:* Amalda dubia*, Mont Saint-Aubin, Slg. P. Bodu; 18:* Ampullina depressa parisiensis*, Mont Saint-Aubin, Slg. GRAPHN; 19:* Fissidentalium grande*, Le Colombier, Slg. C. Montoya.*

Another constant feature observed was the use of Aquitaine fossils, and more precisely those from the Lower Miocene shelly sands of Gironde (Bordelais, Entre-Deux-Mers, Bazadais), at sites in north Aquitaine (Dordogne and Lot basins). Here the trend was reversed, as this resource seems to have been more frequently used during the Badegoulian (up to 95 % of seashell assemblages) than during the Solutrean (30 % of seashell assemblages). Finally, although the Mediterranean component was very minor in the west of France, it seems to have been more important during the Solutrean (5 % of seashells) than the Badegoulian (0.2 % of seashells). Although the importance accorded to seashells from the Atlantic, Gironde, and the Mediterranean appears to have varied over time, the selected taxa nonetheless remained similar between the Solutrean and the Badegoulian (for example, Atlantic Littorinae, Miocene *Vitta picta*, Mediterranean *Semicassis saburon*), confirming the persistence of a common traditional base for both of these chronocultural entities.

On the other hand, the absence of shells from certain sources in Solutrean and Badegoulian assemblages indicates clear discontinuities. First of all, we observed that no shells exclusively attributed to the fossiliferous sites of the Paris Basin were found in any Solutrean occupation[1], whereas those shells had been used during the Gravettian (Peschaux, in press), and were again in the Badegoulian (cf. supra) and the upper Magdalenian (Taborin, 1994). This absence could be explained by the inaccessibility of these resources during the Solutrean, due to the severe climatic context at the end of GS-3 (marked by the very cold and dry H2 event: *sensu* Heinrich, 1988) which extended the periglacial zone to the whole of the north of Europe, reaching as far as the Paris Basin (Renssen and Vandenberghe, 2003), rendering this geographic zone inhospitable for human settlement (Otte, 1990; Schmider, 1990; Straus, 1990; Weniger, 1990). There are, indeed, Solutrean sites in the Seine Basin, but they do not extend beyond the south of the Seine and the French Gâtinais (cf. synthesis in Bodu et al., 2014). These Solutrean human groups may have come into contact with fossiliferous resources south of the Île-de-France (those of the Lower Oligocene), but there is no evidence that they reached the rich fossiliferous Eocene sites in Mantois and north of the Seine. These observations are, of course, based on our current state of knowledge and patchy data. Conservation conditions may not have been favourable at Solutrean sites in the Paris Basin and elsewhere in the north, where no seashells have yet been found. Therefore, we cannot determine which supply networks these sites relied on.

We also observed an absence of Miocene fossil shells from Touraine and Anjou at Badegoulian sites, whereas they had been used during the Solutrean (cf. above), and were again during the lower (Peschaux, 2017) and middle Magdalenian (Cordier, 1956; Granger and Airvaux, 2010; Peschaux et al., 2017). Yet we know that Badegoulian human groups settled in the Loire Basin and could have had access to these resources. For example, Abri Fritsch is located just 30 km from the Miocene fossiliferous sites of south Touraine, but the Badegoulian levels, which contained abundant seashells, did not yield any fossils from those deposits. This overall absence appears to indicate a genuine interruption in the exploitation of fossiliferous resources from Touraine and Anjou during the Badegoulian. Multiple reasons could account for this interruption; procurement sources could have been temporarily forgotten, prohibited, or simply abandoned due to a lack of interest in their contents.

Seashell procurement areas and strategies

During the Solutrean, seashell procurement zones were extensive, with conchological spectra showing several origins (with more or less marked differences in proportions from site to site). These procurement zones covered a vast area in the southwest of France, incorporating interfluves including the Loire, Charente, Dordogne, and Garonne basins, where seashells seemed to be readily available and plentiful. Indeed, high proportions of Atlantic seashells and those from the shelly sands of Gironde and Anjou-Touraine were often represented by a variety of taxa, suggesting possibilities for massive acquisitions from these three areas of origin. This might suggest that seashells were acquired by direct collection from deposits, which would imply that Solutrean subsistence territories were very extensive. Another, perhaps more attractive scenario is that of indirect acquisition by means of regular inter-group exchanges of huge quantities of seashells and circulation from one hand to another. The existence of contacts between the Loire, Charente, and Aquitaine basins is recorded by the diffusion of lithic material, with hunting weapons made from Turonian flint from Touraine (originating from the Creuse and Cher basins) found as far afield as the sites of north Aquitaine (Mangado-Llach et al., 2014b; Allard, 2016; Delvigne et al., 2017). In addition, the rare Mediterranean seashells present in the west of France seem to have been procured by different acquisition modes. These seashells consist exclusively of large *Semicassis saburon* shells, indicating very targeted procurement, probably related to occasional and very specific acquisitions, resulting from exchanges with more eastern or southern Solutrean populations. The unity of the area between the Loire, Charente, and Aquitaine basins is also observed in gastropod perforation methods (recurrence of perforations on the dorsal face of shells, made by sawing and/or external pressure; Peschaux, 2012), as well as the distribution of several remarkable ornamental objects: for example, bracelet-rings in ivory, large oval-shaped pendants decorated with lateral notches, etc. (San Juan-Foucher, 2005; Baumann and Peschaux, 2014; Peschaux, 2017).

During the Badegoulian, seashell origins were still multiple, but the conchological spectra were more clearly dominated by a single provenance, denoting more targeted procurement areas. The distribution of fossil seashells points to two main circulation areas:

– In the south, at the sites in north Aquitaine (Dordogne and Lot basins), the overwhelming majority of shells were from the Lower Miocene of Gironde (up to 95 %

of assemblages) and were diversified (with a pronounced preference for *Vitta picta* and *Granulobium plicatum*). The geographic situation of these resources, located near the confluence of the Dordogne and the Garonne, undoubtedly facilitated their diffusion in this area via the hydrographic network, with shells circulating over at least 150 km radius. With this easy access, the Badegoulian populations in north Aquitaine could have acquired the shells directly, collecting them in massive quantities on site from the Gironde shelly sands. In this area, the rest of the assemblages are made up of Atlantic seashells, probably acquired by similar modes to those practised in the Solutrean – i.e., direct collection or regular inter-group exchanges with hand-to hand diffusion – but in proportions that seem to indicate less frequent or less abundant acquisitions than during the Solutrean. In addition, the discovery of a *Semicassis saburon* shell at Cuzoul de Vers suggests that occasional contacts were maintained with more eastern and/or southern populations.

– In the north, the diffusion of Eocene fossil shells from the Paris Basin over at least 450 km radius, indicated a vast circulation area linking the Loire and Seine basins. At sites in this area, the majority of the shells were varied Eocene fossils (including numerous gastropods and *Fissidentalium grande*). They constituted at least 50 % of assemblages in the Loire and between 90 % and the totality of assemblages in the Seine Basin. These high proportions point to the possibility of massive acquisitions, probably by direct collection at deposit sites combined with abundant and regular inter-group exchanges, leading to widescale diffusion. Indeed, the identification of several of the procurement sources used in the Paris Basin (among others, the fossiliferous strata of the middle Lutetian in the region of Houdan and those of the lower Bartonian in the French Vexin and/or the Marne Valley) suggests the existence of a complex circulation network that may have involved several acquisition modes. In this area, the Atlantic component varied from one basin to another, being rather significant at the sites in the Loire Basin (up to 45 % at Abri Fritsch) but very rare at sites in the Seine Basin (only identified at Mont Saint-Aubin, in very low quantities). This disparate distribution can be explained by diffusion capacities linked to the hydrographic networks (the Loire Basin was directly linked to the ocean, unlike the Seine Basin), but also demonstrates that diffusion currents between the two basins were mainly unidirectional, with large quantities of Eocene fossils spreading towards the south and only limited quantities of Atlantic seashells moving north.

This bipartition of the French territory during the Badegoulian was also observed in seashell perforation methods. In the south, perforations were located in an axial position on the side of shells (columellar face) and made using invasive techniques (sawing, scraping, ‘pecking’, rotational scraping), at least on spherically shaped shells (*Vitta picta*, Littorinae), whereas in the north, perforations were offset, made in the back of the shells (dorsal face) using methods involving pressure and adapted to the morphology of the shell (cf. above). The existence of a ‘border’ in the region of the Seuil du Poitou, delimiting a northern area and a southern area, has also been proposed for the diffusion of lithic materials during the Badegoulian (Banks et al., 2011; Delvigne, 2016). A division of the Badegoulian territory into two main circulation zones has been observed at several levels, although this does not mean that there was no contact between them. The discovery of rare Miocene fossils from Gironde at sites in the Loire Basin (Abri Fritsch), even possibly as far away as the south of the Seine Basin (at Mont Saint-Aubin; however other provenances are considered more likely), as well as, conversely, the presence of several Eocene fossils from the Paris Basin in Charente (at Placard), and even possibly as far away as Dordogne (at Badegoule, but from a mixed context), attests to minor circulation between the two areas (in the form of occasional exchanges?). These north-south relations are also evidenced by the shared production of hemispherical beads in ivory and bone – identified at Cuzoul de Vers and Placard (Le Guillou, 2012) as well as at Abri Fritsch (Peschaux, 2017) – which shows that links existed between those sites and that Badegoulian zones were permeable.

Conclusion: what are the implications of a reorganisation of seashell procurement between the Solutrean and the Badegoulian?

The results obtained here have brought to light a reorganisation of seashell procurement areas and strategies between the Solutrean and the Badegoulian. The observed changes suggest the transformation of a vast western Solutrean procurement area, where seashells from several horizons circulated easily and abundantly, into (at least) two separate Badegoulian areas with different patterns of procurement and circulation of seashells, particularly fossil seashells. This reorganisation of procurement networks is particularly visible at the sites of the Loire Basin, which underwent a southern influence during the Solutrean (circulation routes linked with Charente and north Aquitaine), then a northern influence during the Badegoulian (circulation routes linked with the Paris Basin). Overall, the circulation routes identified for seashells correspond with those described for lithic materials, which implies that procurement areas for both materials were the same. However, distinct acquisition strategies may have been utilised for flint and seashells. In the Solutrean, all the accessible conchological resources in the environment (fossiliferous deposits and active shorelines) were employed, as well as those available via social interactions, whereas the choice of flint for the manufacture of hunting weapons was strictly selective (Renard and Ducasse, 2015; Ducasse et al., 2019). In the Badegoulian, on the other hand, not all the resources were exploited. Seashell acquisitions were generally dominated by a single provenance and certain accessible sites were totally abandoned in favour of other, more distant sites (for example, the shelly sands of Touraine), contrasting sharply with the heterogeneity and flexibility of the exploitation of lithological contexts (ibid.).

Thus, flint and seashells seem to have developed their own socio-economic value systems although they were part of the same subsistence areas and social networks.

The rupture announced by the transition from the Solutrean to the Badegoulian is thus also observed in the realm of seashell acquisition, supporting the idea of a period marked by overall societal change. It is often suggested that the driving force for these changes was environmental (Banks et al., 2008 and 2011). Indeed, the emergence of the Badegoulian at the onset of the LGM, during the GIS 2 phase (which paradoxically corresponds to a short warming period after the cold H2 event; *sensu* Rasmussen et al., 2014 in Ducasse et al., 2019), seems to have favoured more permanent settlement of the northern territories. The expansion of the occupied zone and access to northern resources (such as the fossil shells of the Paris Basin) could have led to the development of new territorial and economic strategies and a reconsideration of land use patterns. The differences observed in seashell acquisition strategies (the diversity of resources used during the Solutrean *versus* the selective use of resources during the Badegoulian) may be more indicative of modifications in ornamental traditions. At the scale of the Upper Palaeolithic, the transition from the Solutrean to the Badegoulian corresponds to a period of renewal of practices relating to the use of seashells as personal ornaments and of seashell productions (with a clear predominance of scaphopod shells in assemblages and the emergence of new technical solutions focusing on the axial zone of shells: cf. Peschaux, 2017). The observed territorial redistribution between the Solutrean and the Badegoulian thus took place at a time when new ways of thinking and ornamental representation were emerging, which could indicate a profound identity crisis involving the global reshaping of social interactions within and between groups.

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NOTES

(1) The possible presence at Solutrean sites of fossil shells from Eocene deposits in the Paris Basin is sometimes mentioned (Taborin, 1993; Peschaux, 2012; Baumann and Peschaux, 2014), but these shells always come from mixed chrono-stratigraphic contexts. For example, the site at Badegoule (coll. Peyrony) yielded an *Ampullina* sp. shell in a level containing Solutrean and Badegoulian industries (Taborin, 1993). A fragment of *Campanile giganteum* was discovered at Solutré (coll. Arcelin) in a level with mixed Solutrean and Magdalenian industries (Taborin, ibid.).

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