Investigate the Shore, Sound out the Past: Methods and Practices of Maritime Prehistory
Explorer la côte, sonder le passé : méthodes et pratiques de la préhistoire maritime
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Archaeology of Neolithic Island Networks: Diachronic and Paleo-Economic Approaches to Island Occupations through the Contribution of Ceramic Analysis

L'archéologie des réseaux insulaires néolithiques : contribution de l'analyse de la céramique à une approche diachronique et paléo-économique des occupations insulaires

Benjamin Gehres

Abstract: The study of economic systems is a central theme of anthropological and archaeological research. At the intersection of questions on human behaviour and issues related to material culture, this discipline opens up theoretical perspectives for reflection that can link artefacts, individuals and processes, such as changes in livelihoods or the intensification or impoverishment of relationships. This communication focuses on the development and adaptation of existing economic models to the diachronic and territorial issues of our research, focused on the islands of Brittany (western France), through the petrographic and chemical analysis of the raw materials of pottery. It is a question of observing the evolution of the island's economic and production system over a long period of time during the Neolithic period. These environments are in fact strongly influenced by the ocean, the exploitation of the marine environment, both for food and for the production of goods, and also by displacement by cabotage or open sea shipping. These populations were therefore able to develop economic, production and distribution systems that were different from those of their fully continental neighbours. The question is whether existing economic models are suitable for these populations and whether new models adapted to more accurate data, and directly attributable to these groups, are likely to emerge.
Keywords: Neolithic, Brittany, islands, ceramic analysis, socio-economic models.

Résumé : L'étude des systèmes économiques est un thème central de la recherche anthropologique et archéologique. À l'intersection des questions sur les comportements humains et des problématiques liées à la culture matérielle, cette discipline ouvre des perspectives de réflexion théoriques permettant de relier les artefacts, les individus et les processus tels que les changements de moyens de subsistance, l'intensification des relations ou leur appauvrissement. Cet article porte sur le développement et l'adaptation des modèles économiques existants aux enjeux diachroniques et territoriaux de notre recherche, centrée sur les îles de Bretagne (ouest de la France), à travers l'analyse pétrographique et chimique des matières premières de la poterie. Il s'agira d'observer sur une longue période de temps l'évolution du système économique et productif insulaire au Néolithique. Ce milieu est en effet fortement influencé par l'océan et l'exploitation du milieu marin, tant pour l'alimentation que pour la production de biens, mais aussi par le déplacement par cabotage ou par la navigation en haute mer. Ces populations ont donc pu développer des systèmes économiques de production et de distribution différents de leurs voisins entièrement continentaux. La question est de savoir si les modèles économiques existants sont recevables pour ces populations et si de nouveaux modèles adaptés à des données plus précises, et directement attribuables à ces groupes, sont susceptibles d'émerger.
Mots-clés : Néolithique, Bretagne, îles, analyse céramique, modèle socio-économique.

INTRODUCTION

The study of the socio-economic organisation of human groups is a central theme in anthropological and archaeological research. At the intersection of questions about human behaviour and issues of material culture, this discipline opens up theoretical perspectives for thinking about linking artefacts, individuals and processes such as changes in livelihoods, intensification of relationships or their impoverishment. For example, anthropological studies suggest that the unpredictability of food supply is correlated with extensive reciprocal exchange systems. Reciprocity is more common among hunters, fishers and farmers than among gatherers and pastoralists who exploit relatively predictable resources (Pryor, 1977). Where then does this leave island populations who are heavily dependent on fisheries resources? Their environments strongly influence their lifestyles, through their subsistence strategies, but also through their movements, which are necessarily carried out by boat (coastal or high seas).

To examine this, we will focus on the island populations of the Atlantic coast and their socio-economic organisations during the Neolithic. What were the relationships and structures of island societies? What types of economic systems existed between the islands and with the mainland? Can we observe differences with continental groups? The islands of Brittany are very good laboratories for exploring these issues (fig. 1). Indeed, they are characterised by a diversity of forms and settlements, from large, isolated islands such as Groix, to archipelagos such as the Molène or Glénan. They thus allow us to put into perspective the socio-economic relations of the populations with the morphology and the surface of the islands.

The approach we will use here is based on ceramics, from the origin of their raw materials to the technical traditions of preparation and treatment of the clay used in their production process. These everyday objects allow us to carry out analyses at the micro-territorial and macro-regional levels, in order to examine the functioning of domestic units and their exchanges. The use of ceramics in everyday life, in all communities and over time, makes it an excellent diachronic thread for looking at many aspects of the domestic and economic life of populations. Ceramics can be examined from different angles, such as the characterisation of anthropic actions on the raw materials, the organisation of production, and its distribution. Like all craft products, ceramics are not only material objects made of a raw material and shaped according to a technique. Ceramics also represent cognitive knowledge and motor habits that follow the potters throughout their lives (Arnold, 1985; Bril, 2002; Roux, 2010). The mechanisms of transmission of the technical traditions used by a potter are the result of a learning process ‘of actions observed within a social group’ (Roux, 2010, p. 6), which limit the possibilities of potters modifying by themselves the concepts and actions of the *chaîne opératoire* they will have learned (Bril 2002; Roux 2010). It is then possible to establish links between the actions of the *chaîne opératoire* and ‘communities of practice’ (Stark, 1998; Roux, 2010, p. 6), bringing to light the limits of extension of different technical traditions (Gosselain, 2008; Roux, 2010). The identification of these ‘ways of doing’ and the processes of transmission is therefore a gateway to social groups, their extensions, their interactions and their evolution over time.

1. METHODOLOGY

The approach developed in this research consisted in determining the origin of the raw materials of the ceramics discovered on island sites: local or exogenous. It is then possible to identify the degrees of openness and withdrawal of the occupations, and the links that may have existed between islands and with continental communities. These approaches are based on multiscalar analyses. Firstly, following the typo-technological studies, a macroscopic sorting of the pastes is made in order to carry out petrographic studies on the ceramics. These analyses are conducted by observing thin sections of the pottery under a polarising microscope and involve identifying not only the nature of the non-plastic inclusions within the clay matrix, but also the modifications made by the potters (addition of degreaser, purification of the paste, grinding of the clay, etc.). Greater detail on these approaches can be found in reference works dealing with this subject (Echallier, 1984; Rice, 1987; Convertini and Querré, 1998; Quinn, 2009 and 2013).

In order to accurately determine the origin of the granitic inclusion clays, chemical point analyses were performed by plasma mass spectrometry coupled with a laser ablation sampling system (LA-ICP-MS; Gehres and Querré, 2018). A plasma source quadrupole mass spectrometer (Agilent Technologies, 7700 Series), coupled to a 213 nm Nd:YAG laser ablation system (Cetac Technologies, LSX-213, G2) was used. The instrument was calibrated using international geological standards: DR-N, DT-N, UB-N (Govindaraju and Roelandts, 1989) and MICA-Fe (Govindaraju and Roelandts, 1988). In total, 46 elements were determined: Na, Mg, Al, Si, K, Ca, Ti, Mn, Fe, Li, Sc, V, Cr, Co, Ni, Cu, Zn, As, Rb, Sr, Y, Zr, Nb, Cd, Sb, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, Tl, Pb, Th and U. The aim of using this approach was to compare the chemical signature of one or more mineral species contained in the ceramic pastes and within the regional granites. We were able to demonstrate that biotite tablets allow the precise determination of the origin of clays with granitic inclusions (Gehres and Querré, 2018). Based on these approaches, it was possible not only to identify the geological and geographical origin of the raw clays, but also to characterise the technical traditions used by the potters during ceramic production.

2. RESULTS

The analyses were carried out on 191 ceramics, from origins spread over eight sites located on 12 islands, from Morbihan to the Channel Islands (table 1; fig. 1.).

2.1. Early and Middle Neolithic periods

The Early (4900-4700 B.C.) and Middle Neolithic I (4600-4300 B.C.) are poorly represented in the Brittany islands and thus difficult to understand. They are documented in the Channel Islands (fig. 1) at the Fouaillages site (Guernsey). However, these areas were still connected to the mainland during these periods. Production tends to be local with a low rate of imports, probably from the Paris Basin (Patton, 2001).

These data were obtained from petrographic and chemical analyses of ceramics discovered on four Middle Neolithic I and II (4200-3800 B.C.) sites (table 1; fig. 1) located on the island of Hoedic (Morbihan), Île aux Moutons (Finistère) and Herm (Channel Islands).

The pottery items are mainly made from granitic clay, resulting from the disintegration of the basement of the islands. These materials are characterised by mineralogical assemblages comprising mainly grains of quartz, potassium feldspar, plagioclase feldspar (acid) and mica tablets (muscovite and biotite). The treatment of the pastes was observed very little, and could only be observed for some pottery items from the sites of Le Douet and Groah Denn at Hoedic in the Middle Neolithic I. These were vessels made from a purified clay and tempered with sand grains (Gehres, 2018a). During this period, the addition of temper was more frequent on the mainland. This mainly involved the addition of grog to the paste (Hamon, 2003), a phenomenon found to be almost absent from island sites of this period (Gehres, 2018a).

The Middle Neolithic II is characterised by an increase in the practice of adding temper to mainland pastes, while this remains absent on the islands. These additions are mainly crushed bone fragments (Morzadec, 1995; Colas, 1996; Hamon, 2003), or the addition of sandy temper observed at the Er Grah site (Morbihan; Le Roux, 2006).

These observations correspond to a domestic production of ceramics. The rather occasional 'household' type of production is characterised by the use of a simple technology (Balfet, 1965). This was geared towards self-sufficiency, and the pottery produced is used within the household, and is hardly ever exchanged. The shape of the ceramics was not standardised, and the raw material was modified little or not at all (Rice, 1987). The communities were virtually autonomous and produced what they consumed.

There were a few diffusions between islands and with the mainland. These were mainly ceramics made from granitic clay. Their origins were determined from the comparison of the chemical signatures of the biotite tablets included in the pastes of the ceramics and those of the granitic rocks of the region, obtained by LA-ICP-MS (Gehres and Querré, 2018). These pottery items do not present any technical or decorative specificity in their assembly or in the preparation of the clay. They therefore seem to have been spread as containers during trade.

During the Middle Neolithic I on the island of Hoedic, the origins of these pottery items were located on Belle-Île-en-Mer (Morbihan) and on the mainland. During the Middle Neolithic II, on Île aux Moutons, some pottery came from the continent. Finally, on the island of Herm in the Channel Islands, we note that the Middle Neolithic is characterised by mainly local ceramics production, although we note the existence of transfers from the neighbouring island of Guernsey (fig. 1 and 2a). We can therefore observe that these exchanges are over short distances, of less than fifteen kilometres. These exchanges

Departement	Island	Site	Chronology	Amount of ceramic studied
Morbihan	Hoedic	Groah Denn	Middle Neolithic I - Late Neolithic	Mid. Neo. 13 - Late Neo. 13
Morbihan	Hoedic	Le Douet	Middle Neolithic I - Late Neolithic	Mid. Neo. 15 - Late Neo. 20
Morbihan	Houat	Er Yoh	Late Neolithic	54
Morbihan	Belle-Île-en-Mer	Le Lanno	Late Neolithic	12
Morbihan	Belle-Île-en-Mer	Castel Pouldon	Late Neolithic	1
Morbihan	Belle-Île-en-Mer	Ty-Seveno	Late Neolithic	1
Morbihan	Belle-Île-en-Mer	Les Quatre-Chemins	Late Neolithic	1
Morbihan	Belle-Île-en-Mer	Kerbellec	Late Neolithic	1
Finistère	île aux Moutons	Île aux Moutons	Middle Neolithic II	19
Finistère	Glénan archipelago	Saint-Nicolas	Late Neolithic	22
Finistère	Molène archipelago	Quéménès	Late Neolithic	6
Channel Island	Herm	Herm	Middle Neolithic	13

Table 1 – Summary table of the different sites studied and presented in this article.
Tabl. 1 *– Tableau synthétique des différents sites présentés et étudiés dans cet article.*

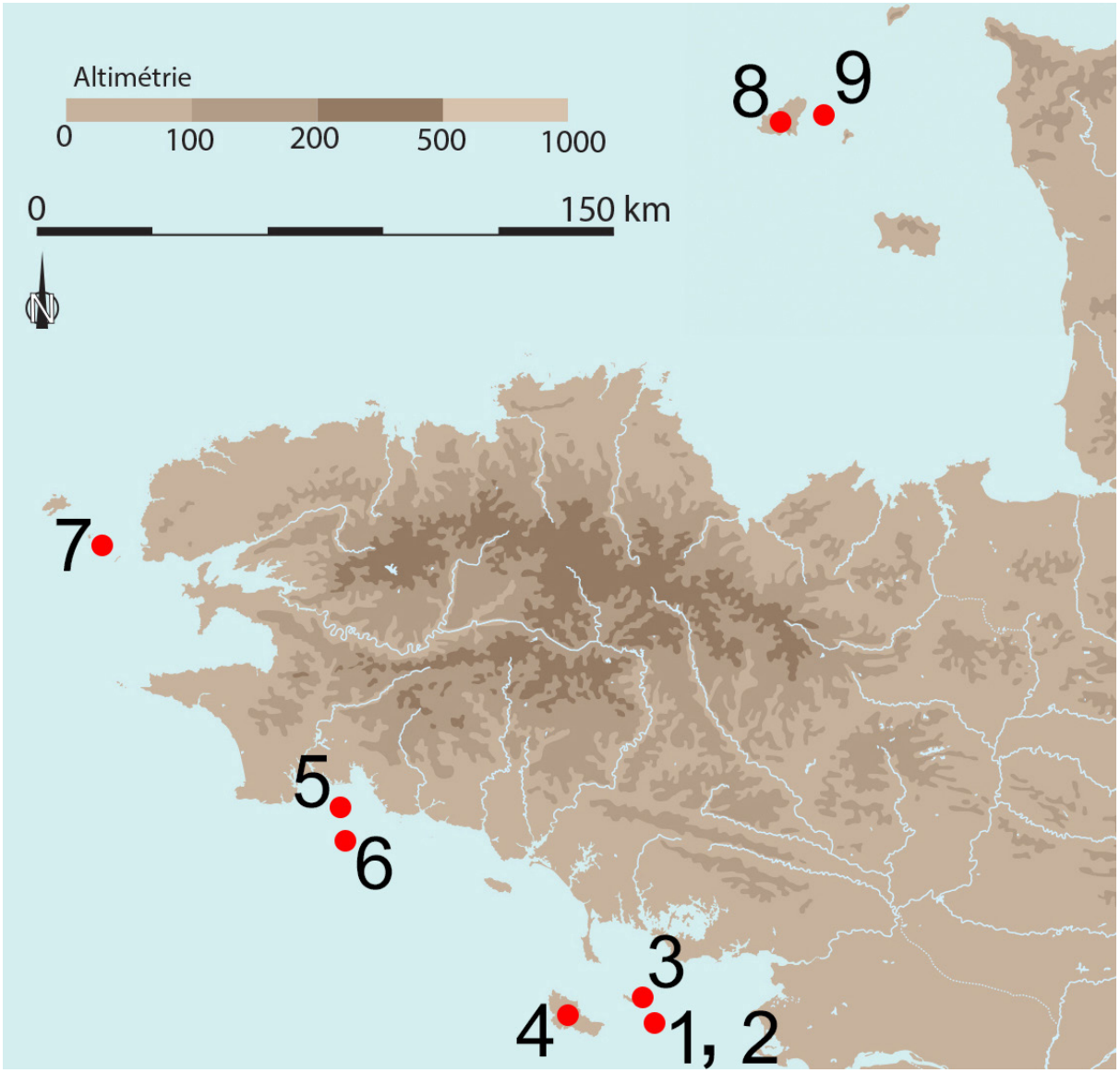


Fig. 1 – Locations of sites mentioned in the text. 1. Groah Denn (island of Hoedic, Hoedic); 2. Le Douet (island of Hoedic, Hoedic); 3. Er-Yoh (island of Er-Yoh, Houat); 4. Belle-Île-en-Mer (Castel Pouldon, Locmaria; Ty-Seveno, Locmaria; Les 4 chemins, Bangor; Kerbellec, Le Palais; Le Lanno, Sauzon); 5. Île aux Moutons (île aux Moutons, Fouesnant); 6. Saint-Nicolas (island of Saint-Nicolas, Fouesnant, Glénan Archipelago); 7. Quéménès (island of Quéménès, Le Conquet, Molène Archipelago); 8. Les Fouiallages (Bailiwick of Guernesey, Clos du Valle, Channel Islands); 9. Herm (Bailiwick of Herm, Channel Islands).

***Fig. 1** – Localisation des sites mentionnés dans le texte. 1. Groah Denn (île d'Hoedic, Hoedic) ; 2. le Douet (île d'Hoedic, Hoedic) ; 3. Er-Yoh (îlot d'Er-Yoh, Houat) ; 4. Belle-Île-en-Mer (Castel Pouldon, Locmaria ; Ty-Seveno, Locmaria ; les 4 chemins, Bangor ; Kerbellec, le Palais ; le Lanno, Sauzon) ; 5. île aux Moutons (île aux Moutons, Fouesnant) ; 6. Saint-Nicolas (île de Saint-Nicolas, Fouesnant, archipel des Glénan) ; 7. Quéménès (île de Quéménès, le Conquet, archipel de Molène) ; 8. les Fouiallages (Bailiwick de Guernesey, clos du Valle, îles Anglo-Normandes) ; 9. l'aéroport (Bailiwick d'Herm, îles Anglo-Normandes).*

were probably made directly between communities and based on reciprocity. These transfers can therefore be interpreted as exchanges allowing the creation and consolidation of social links between communities that were physically and socially close.

2.2. Recent and Late Neolithic (3600/3500-2800 BC)

Several island sites from the Late Neolithic were studied (table 1; fig. 1). During this period, we notice a different management of the production and distribution of ceramics compared with the Middle Neolithic. Indeed, an increase in transfers can be noted, both between the islands and with the mainland. This increase in transfers is particularly visible in the Glénan archipelago at the Saint-Nicolas site, and at Belle-Île-en-Mer (table 1; fig. 1). At Quéménèz (fig. 3a; Gehres, 2018a) and Beg Ar Loued (Convertini, 2019) sites in the Molène archipelago (Finistère), but also on Saint-Nicolas in the Glénan archipelago (fig. 3b; Finistère), the Douet and Groah Denn sites on the island of Hoedic, and Er-Yoh on the island

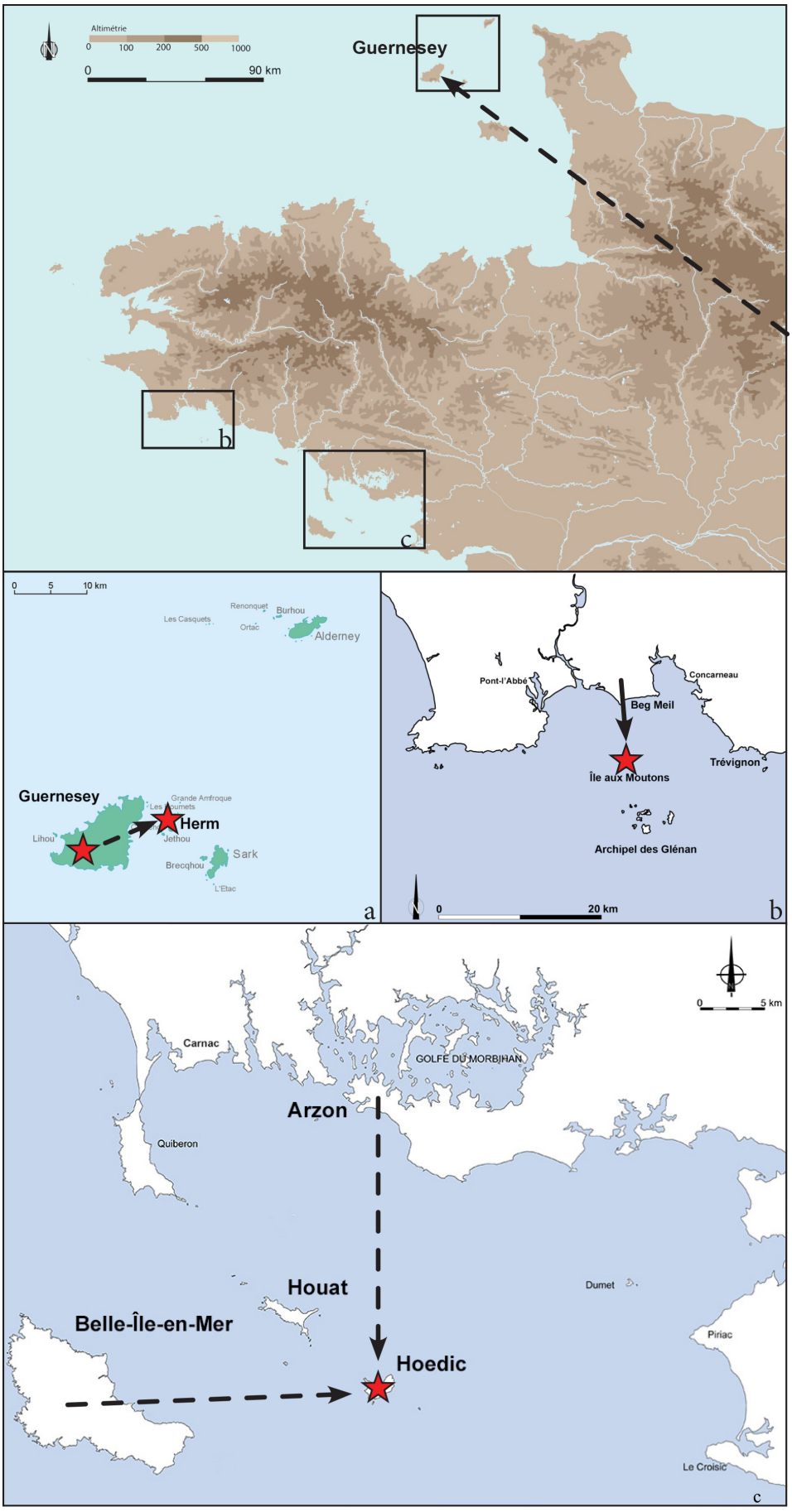


Fig. 2 – Origins of the different Early and Middle Neolithic ceramics studied (★ origin of the pottery raw material).

***Fig. 2** – Origines des différentes céramiques du Néolithique ancien et moyen étudiées (★ origine de la matière première des poteries).*

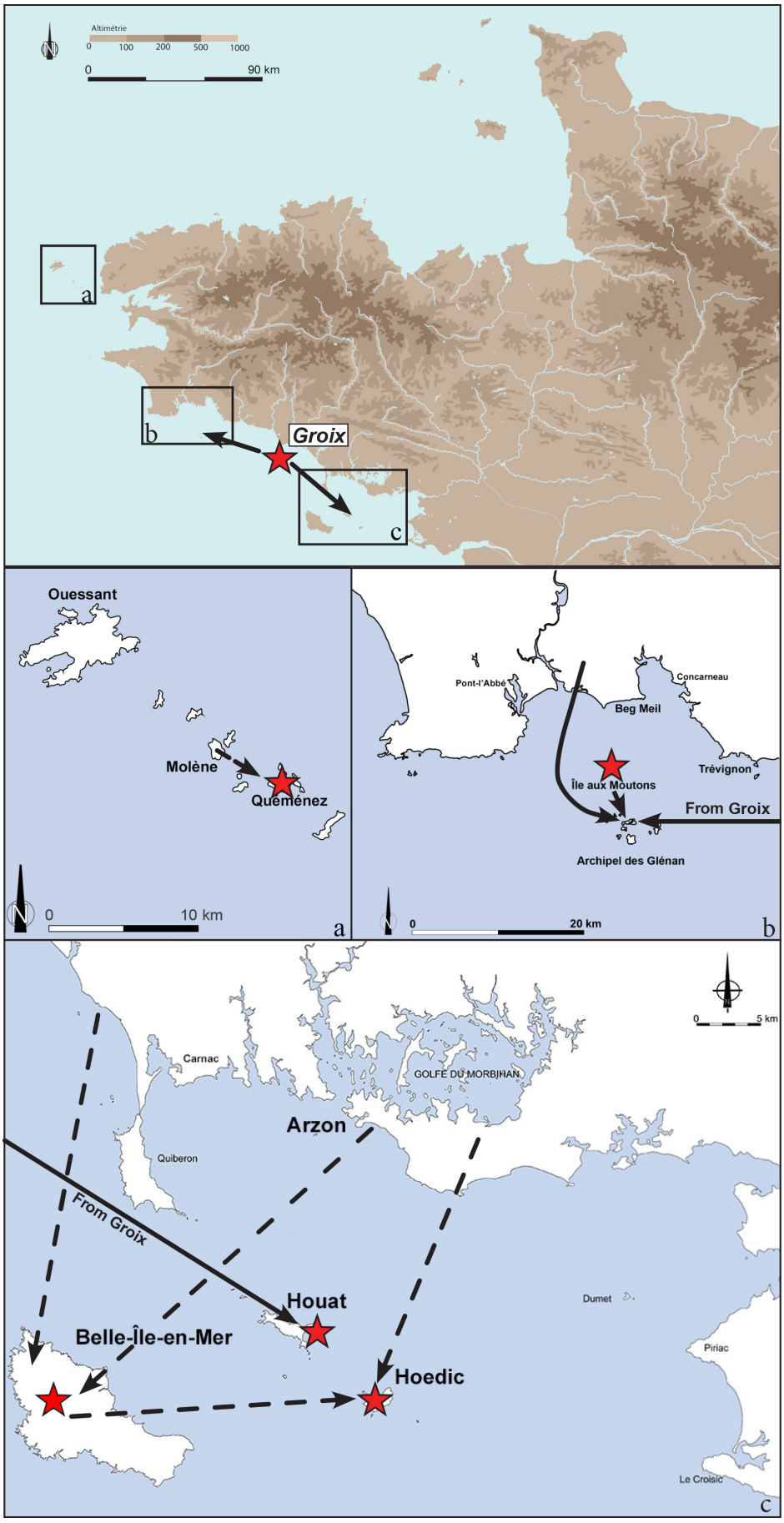


Fig. 3 – Origins of the different Late Neolithic ceramics studied (★ origin of the pottery raw material).
***Fig. 3** – Origines des différentes céramiques du Néolithique récent étudiées (★ origine de la matière première des poteries).*

of Houat (fig. 3c; Gehres, 2018a), the pottery items are mainly made with local clay, and no continental imports were observed despite a large corpus being analysed. Thus, the study of different island complexes has made it possible to highlight a mosaic of island socio-economic organisations.

2.2.1. Are majority mainland transfers an indication of a centralised island economy? The case of Belle-Île-en-Mer

The case of Belle-Île-en-Mer is special on several levels. On the one hand, the ceramics analysed all come from prospecting collections on the sites of Lanno (12 ceramics), Castel Pouldon (2 ceramics), Les Quatre Chemins (1 ceramic) and Ty-Seveno (1 ceramic; Locmaria), due to the lack of recent excavations on this island. However, their forms and decorations have allowed us to set a reliable chronological reference point for them. On the other hand, petrographic and chemical analyses, carried out within the framework of the PCR (Projet Collectif de Recherche) "Belle-Île-en-Mer : Espaces et territorialité d'une île atlantique" (Audouard and Gehres dir.), have identified a very high percentage of continental imports from different sources.

Of the 16 ceramics studied, one has mineralogical characteristics that can be linked to the particular geology of the island (fig. 4e and 4f). Indeed, this pottery is distinguished by grains of quartz and potassium feldspar (highly altered). These minerals are associated with grains of plagioclase feldspar and clay pellet in accessory quantities. The inclusions are sparse and mostly fine. Their shapes vary from subrounded to subangular, indicating the use of a mature clay. These observations may therefore correspond to the feldspathic sandstone from Belle-Île present in the southern part of the island.

One ceramic has gabbro-granitic inclusions, a rock not present on Belle-Île-en-Mer. This ceramic is characterised by a mineralogical assemblage mixing the main inclusions of granitic rocks such as quartz, potassium feldspar and micas (biotite and muscovite). To this are added elements of gabbroic rock such as grains of colourless and green amphibole and basic plagioclase feldspar. The origin of this ceramic is probably continental and seems to come from the Arzon region where a gabbroic massif is known to exist alongside granitic outcrops.

The remainder of the corpus, i.e. 14 pieces of ceramics, were all made from granitic clays (fig. 4a to 4d). Belle-Île-en-Mer has no granite outcrops, so these ceramics were made from materials exogenous to the island. LA-ICP-MS analyses were carried out in order to determine the chemical signatures of the biotite tablets in the ceramic pastes. These were compared with a reference framework made up of the chemical compositions of biotite tablets from the granite forming the Houat/Hoedic/Quiberon oceanic ridge, and of several Late Neolithic ceramics from the Douet excavation (Hoedic) and a pottery item from the Er-Yoh site (Houat). Thus, according to the model we developed (Gehres and Querré, 2018), the concentrations of lithium (Li) and vanadium (V) allowed us to distinguish the sources of materials. The results show a multiplicity of raw material origins: four sources of clay with granitic inclusions among the ceramics analysed (fig. 5).

- The first source corresponds to the granite taken from the island of Hoedic (Group 1 - Houat/Hoedic/Quiberon granite). According to BRGM geologists, the islands of Hoedic, Houat and as well as the Quiberon peninsula were formed by a single granite upwelling, and thus theoretically have common geochemical characteristics. This group is therefore linked to the granitic ensemble forming Houat/Hoedic/Quiberon. Within this group there are two ceramics from the Douet site (Hoedic) and as well as two ceramics (BI-PCR 27-1; BI-PCR 27-4) from collections at the Lanno site (Sauzon).
- A set of biotite minerals (Group 2 - Unknown Granite 1), including 2 ceramics (BI-PCR 17-3; BI-PCR 27-2) from the Lanno site (Sauzon), and a pottery item found during the survey at Castel Pouldon (Locmaria). The geographical origin of this group is probably continental but remains unknown at the current point in our research.
- A group of crystals brings together the materials used to make three ceramics (Group 3 - Unknown Granite 2), one from Lanno (Sauzon), one from the Quatre Chemins site (Bangor) and one from the site of Er-Yoh site (Houat island).
- The last group (Group 4 - Unknown Granite 3) corresponds to two pottery items from the Ty-Seveno (Locmaria) and Lanno (Sauzon) sites (BI-PCR 17-1). It is interesting to note that the biotites of the Lanno pottery (BI-PCR 17-1) present two chemical signatures. Indeed, several biotites belong to the latter group (Group 3 - Unknown Granite 2). This distribution between the two groups (Groups 3 and 4) of a Lanno ceramic, as well as the techno-petrographic observations, allow us to assume a mixing of the alterations of unknown granites 2 and 3, which is probably natural. Thus, we can think that these two granites are geographically close, and that the raw material was collected in a zone of convergence of the alterations of the two rocks.

Belle-Île-en-Mer is thus strongly distinguished from its neighbours by its very high rate of transfer of ceramics from many continental areas. The Neolithic populations of the island therefore seem to have had a more important and diversified contact with continental groups, and to have turned more rarely to the occupations of Hoedic and Houat. This observation is accentuated when we see that the majority of the ceramics from these islands are made from local clay. Mainland or Belle-Île productions are almost absent.

Belle-Île-en-Mer therefore appears to be distinct in terms of the origins of its ceramics. These ceramics, which do not have any specificities in their technical or, decorative characteristics or in the materials used to shape them, tend to demonstrate their transfer as con-

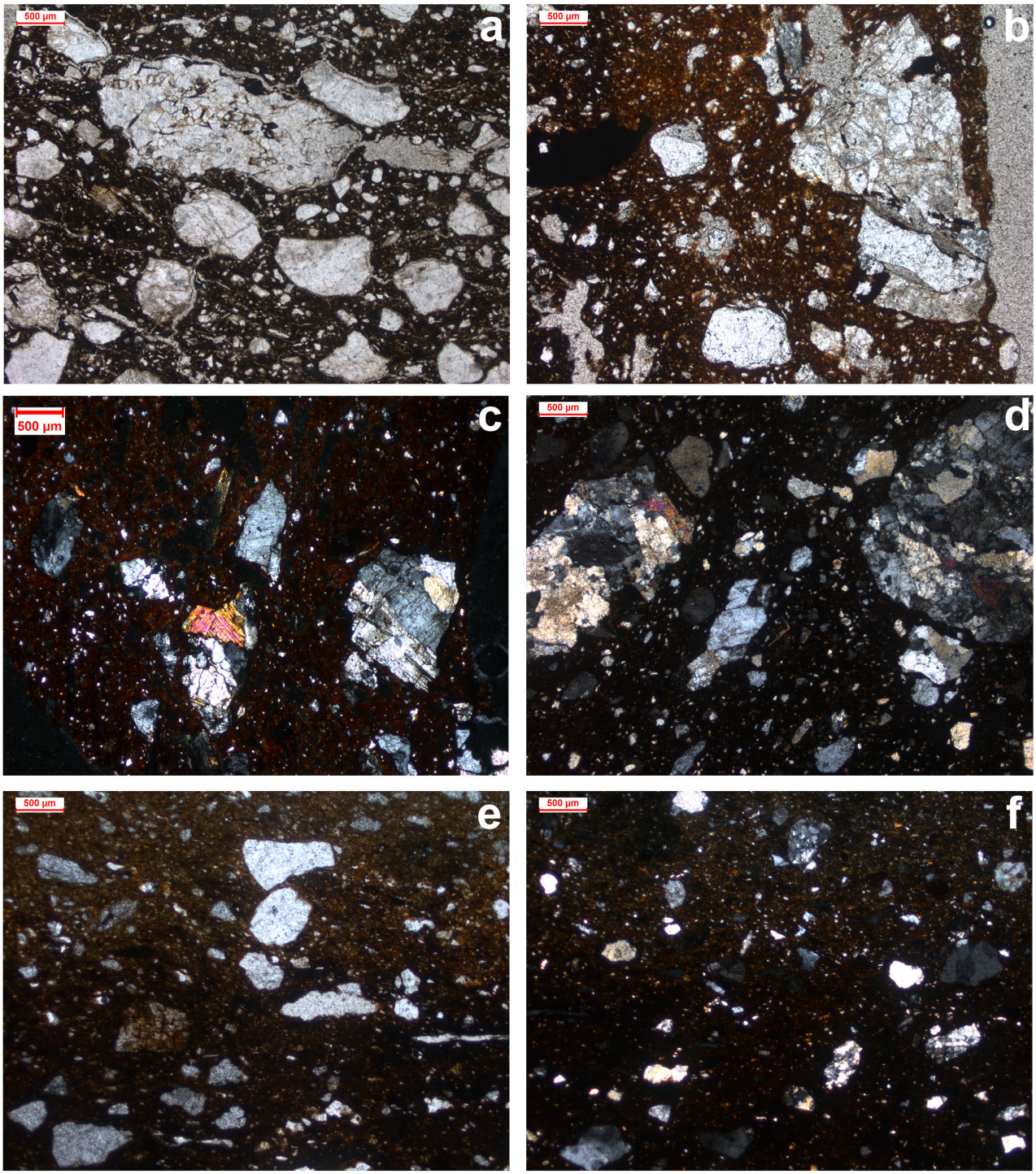
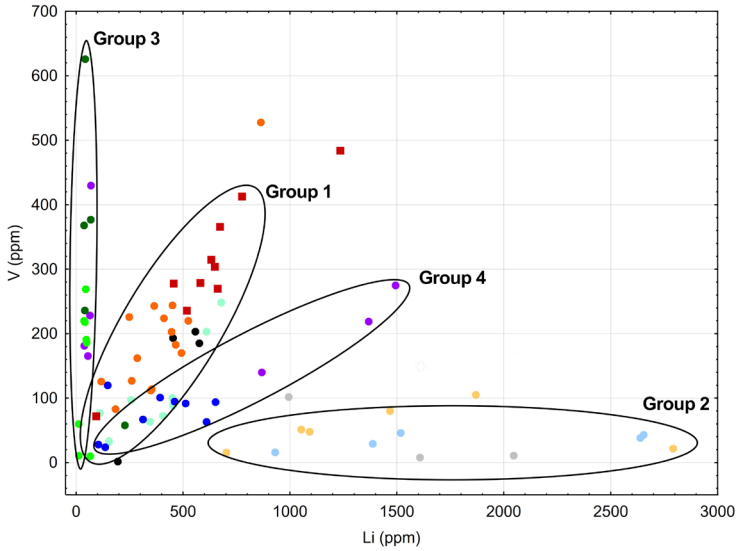


Fig. 4 – Micrographic sheet of thin sections of the different petrographic fabrics from the Late Neolithic sites of Belle-Île-en-Mer: a to d) granitic inclusion fabric; e and f) feldspathic inclusion fabric).

***Fig. 4** – Planche de micrographies des différents faciès pétrographiques observés en lame mince sur les sites du Néolithique récent à Belle-Île-en-Mer : a à d) pâte à inclusions granitiques ; e et f) pâte à inclusions feldspathiques.*

tainers. It Belle-Île-en-Mer thus seems to be a point of convergence of goods between island and continental populations. This hypothesis is particularly reinforced by the presence of 21 fragments of flint from the Grand Pressigny (Audouard, 2014 and 2016), the largest known concentration in the islands of Brittany. This attraction had already been highlighted by E. Ihuel concerning the Gulf of Morbihan (Ihuel, 2004). Thus, the geographical position, but also the morphology of the island and its numerous natural harbours, make Belle-Île-en-Mer an excellent central place within the exchange networks. Considering these aspects, the hypothesis of the existence of a centre for the accumulation of goods from the exploitation of the sea, but also from maritime traffic, with a redistribution towards the continent seems to emerge. This type of economy implies the existence of redistributing authori-



- Biotites from the granite sample taken on the island of Hoedic.
- Biotites from ceramics of le Douet occupation (Hoedic island).
- Biotites from a ceramic of Er-Yoh occupation (Houat island).
- Biotites from a ceramic of the 4 chemins site (Bangor, Belle-Île-en-Mer).
- Biotites from ceramics of the Ty-Seveno occupation (Locmaria, Belle-Île-en-Mer);
- Biotites from a ceramic of the Lanno occupation (BI-PCR 17-1; Sauzon, Belle-Île-en-Mer).
- Biotites from a ceramic of the Lanno occupation (BI-PCR 27-1; Sauzon, Belle-Île-en-Mer).
- Biotites from a ceramic of the Lanno occupation (BI-PCR 17-4; Sauzon, Belle-Île-en-Mer).
- Biotites from a ceramic of the Castel Pouldon occupation (Locmaria, Belle-Île-en-Mer).
- Biotites from a ceramic of the Lanno occupation (BI-PCR 17-3; Sauzon, Belle-Île-en-Mer).
- Biotites from a ceramic of the Lanno occupation (BI-PCR 27-2; Sauzon, Belle-Île-en-Mer).

- *Biotites présentes dans le prélèvement de granite réalisé sur l'île d'Hoedic.*
- *Biotites de céramiques du site du Douet (Hoedic).*
- *Biotites d'une céramique du site d'Er-Yoh (Houat).*
- *Biotites d'une céramique du site des 4 Chemins (Bangor ; Belle-Île-en-Mer).*
- *Biotites de céramiques du site du Ty-Seveno (Locmaria ; Belle-Île-en-Mer).*
- *Biotites d'une céramique du site du Lanno (BI-PCR 17-1 ; Sauzon ; Belle-Île-en-Mer).*
- *Biotites d'une céramique du site du Lanno (BI-PCR 27-1 ; Sauzon ; Belle-Île-en-Mer).*
- *Biotites d'une céramique du site du Lanno (BI-PCR 17-4 ; Sauzon ; Belle-Île-en-Mer).*
- *Biotites d'une céramique du site de Castel Pouldon (Locmaria ; Belle-Île-en-Mer).*
- *Biotites d'une céramique du site du Lanno (BI-PCR 17-3 ; Sauzon ; Belle-Île-en-Mer).*
- *Biotites d'une céramique du site du Lanno (BI-PCR 27-2 ; Sauzon ; Belle-Île-en-Mer).*

Fig. 5 – Diagram showing the lithium (Li) and vanadium (V) concentrations of the analysed biotite crystals. Each point corresponds to an analysis of a biotite crystal by LA-ICP-MS. Each colour corresponds to a ceramic. Several crystals are therefore analysed within each ceramic.

***Fig. 5** – Diagramme représentant les concentrations en lithium (Li) et vanadium (V) des cristaux de biotite analysés. Chaque point correspond à une analyse d'un cristal de biotite par LA-ICP-MS. Chaque couleur correspond à une céramique. Plusieurs cristaux sont donc analysés au sein d'une céramique.*

ties, whose role was to reallocate goods to other satellite occupations. This implies the formation of elite groups that would take control of production and regulate its distribution within a stratified society. However, given the current state of research, and the absence of any planned excavations on the island, it remains difficult to bring any elements of reflection to this proposal.

2.2.2. The Saint-Nicolas site: a seasonal occupation of the Glénan archipelago?

The ceramics studied come from a survey carried out in 2006 on the island of Saint-Nicolas (table 1; fig. 1) in the Glénan archipelago (Finistère) by G. Hamon (Hamon et al., 2006). The results of the excavation highlighted the existence of a Late Neolithic habitat (Hamon et al., 2006), as well as a strong presence of fusiform drills, fragmented or with a blunt edge suggesting the drilling of a hard material (Hamon et al., 2006). These tools are typologically comparable to those discovered at the Final Neolithic sites of Ponthezières and Beg ar Loued, where they were used to pierce shells for the manufacture of ornaments (Laporte, 2009; Dupont, 2019).

The petrographic study was carried out on a corpus of 22 pottery items (Gehres, 2018a). Two types of pastes could be distinguished by the analyses. The first set, consisting of 15 ceramics, is characterised by granitic inclusions (fig. 6), i.e. grains of quartz, potassium feldspar and acid plagioclase (albite and oligoclase) as well as mica tablets (biotite and muscovite).

Because the Glénan archipelago and the island of Saint-Nicolas are constituted of a granitic base, a local origin of the raw material appears likely (Béchennec et al., 1999). However, chemical analyses of the biotite tablets by LA-ICP-MS (Gehres and Querré, 2018), which allowed us to specify the origin of the clay, demonstrated that the majority of the ceramics with granitic inclusions were made from raw materials that could be linked to the granitic basement of the Île aux Moutons, 7 km to the north, and a minority from mainland clay. Thus, no ceramics were produced during the Late Neolithic from materials collected in the Glénan archipelago.

It is therefore necessary to question this absence of production and to identify its reasons. The study of the second petrographic group of paste and the origin of the materials used to make these ceramics can then shed light on these questions. Indeed, the second group is composed of seven pottery items, corresponding to a very unusual paste (fig. 7a and 7b). They are characterised by a large quantity of talc and clusters of colourless amphiboles constituting the main inclusions. This set of minerals is completed by more accessory quantities of quartz and

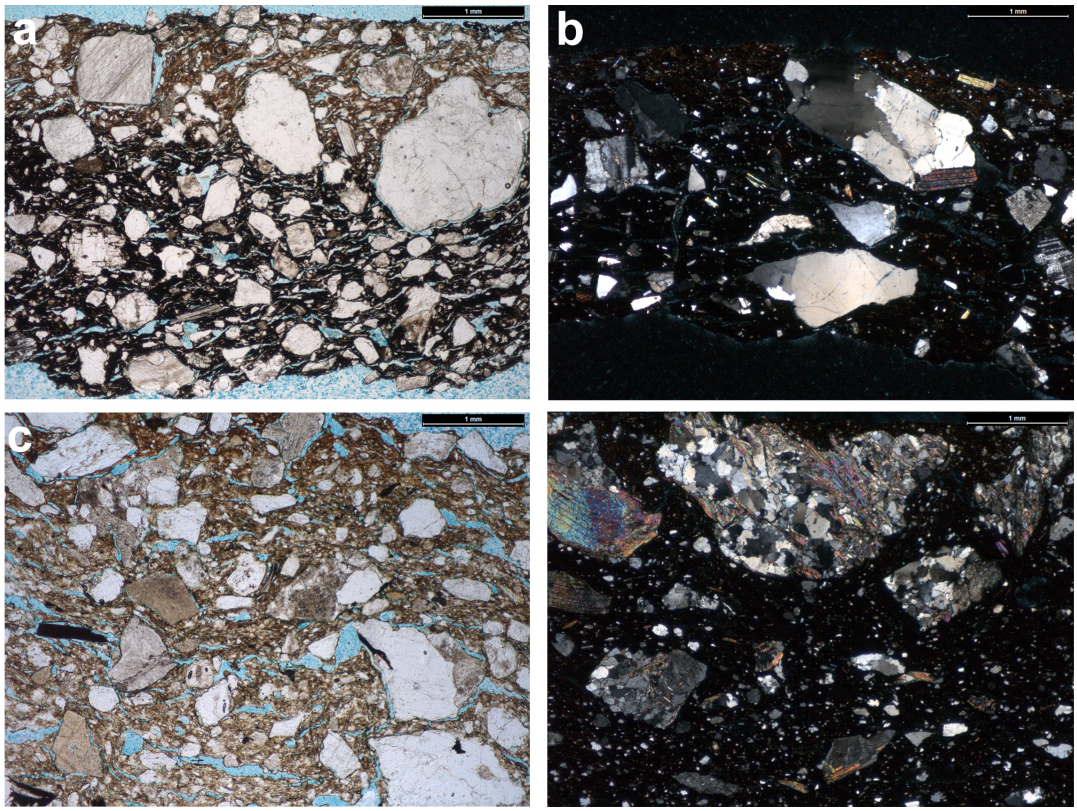


Fig. 6 – Micrographic sheet of thin sections of granitic facies from the Late Neolithic site of Saint-Nicolas in the Glénan Archipelago.
***Fig. 6** – Planche de micrographies des faciès granitiques observés en lame mince sur le site du Néolithique récent de Saint-Nicolas, dans l'archipel des Glénan.*

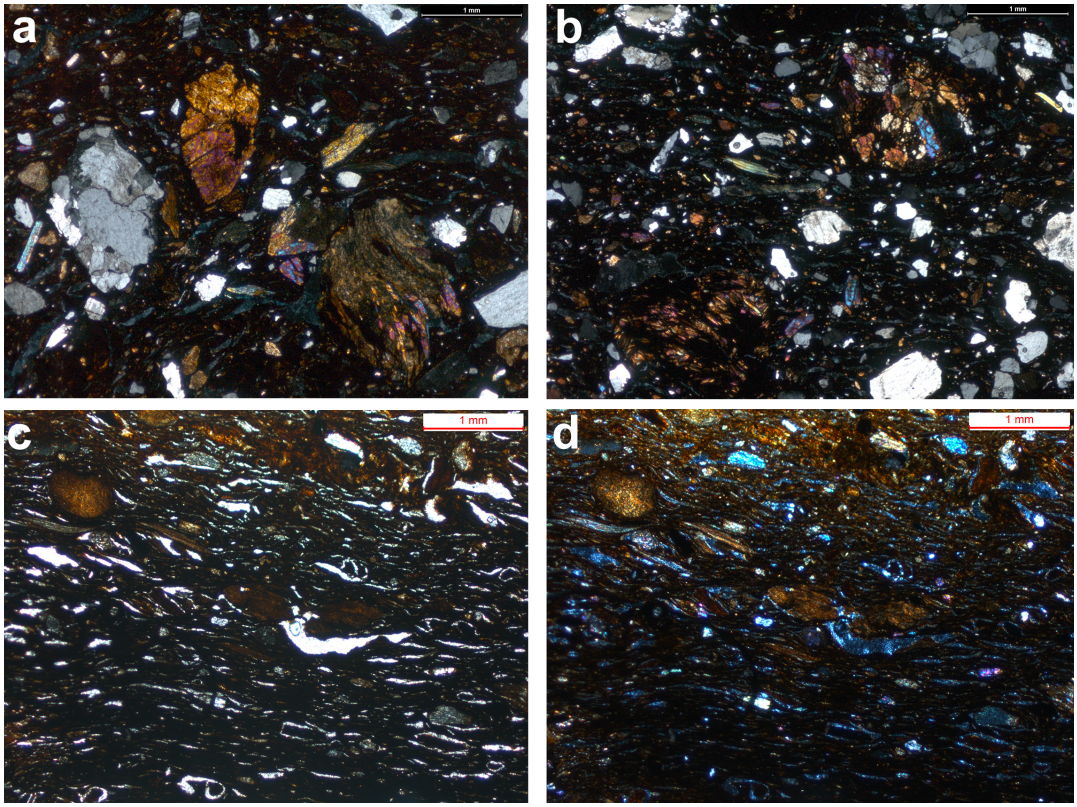


Fig. 7 – Micrographic sheet of thin sections of talcous facies from the Late Neolithic sites: a and b) Saint Nicolas (Glénan Archipelago); c and d) Er-Yoh (Houat island).
***Fig. 7** – Planche de micrographies des faciès talqueux observés en lame mince sur les sites du Néolithique récent : a et b) Saint Nicolas (archipel des Glénan) ; c et d) Er-Yoh (île de Houat).*

potassium feldspar grains, and glaucophane inclusions. The latter are fresh, poorly rolled and subautomorphic, which indicates that they have travelled little and have been trapped in clays not far from their place of formation. Their presence clearly indicates an origin on the island of Groix. Indeed, this mineral is only present in its natural state in France in Groix rocks or in certain rocks outcropping in the Alpine massif. The source of these clays is a magnesian schist (also called talcschist), located on the north-east coast of the island of Groix, on the points of Pen Men, Er-Fons, Bileric, at Sémaphore and Beg-Melen (Audren et al., 1993). This rock has the particularity of being composed essentially of ribbons of talc and clusters of colourless amphiboles. This mineralogical assemblage is identical to that found in the ceramics from the Saint-Nicolas site. Contacts must therefore have taken place between the island of Saint-Nicolas-des-Glénan and the island of Groix, more than 50 km to the east. This type of pottery was also observed at the Late Neolithic site of Er-Yoh (Houat Island, Morbihan; fig. 1) presented in the following section (fig. 7c and 7d). The existence of a value-added good status for these ceramics was due to the use of a material with physical and mechanical characteristics superior to common clays. Indeed, talc and amphiboles give these ceramics better impermeability and resistance to thermal shocks (Gehres, 2018b). A specific type of ceramic was therefore produced on the island of Groix and exported to other islands several dozen kilometres away. Analyses of the Glénan and Houat Island corpus has not identified other groups of wares from Groix. It is therefore a question of a preferential diffusion of these ceramics. The hypothesis of an exchange of talc-containing ceramics for other value-added goods to these workshop sites is therefore questionable.

The analysis of ceramic materials has shown that the pottery discovered in the Glénan archipelago were not the object of any particular technological investment. They do not have any specific characteristics and may have been made as part of domestic production. However, the fact that all the pottery studied was imported is an argument in favour of a possible seasonal occupation of the Glénan. The islanders were able to move from one island to another, depending on the accessibility and availability of resources and the seasons. These mobile groups were thus able to operate in a large maritime territory encompassing the Glénan archipelago and the Île aux Moutons. Their position allowed them to exchange sea products and their crafts over distances of several dozen kilometres with other island communities and continental groups.

2.2.3. Could a unique technical tradition at the Er-Yoh site (Houat island) be a sign of an insular retreat?

Analysis of the Er-Yoh ceramics has identified a very significant use of purified and tempered clay using dune sand and beach sand (fig. 8). This phenomenon is unique in the Brittany islands, and the addition of temper was rarely practised in the region on the mainland during the Late Neolithic.

This site, discovered at the end of the 19th century by Abbé Lavenot (Lavenot, 1886), was subsequently excavated by Z. Le Rouzic and M. and S.-J. Péquart from 1923 to 1924. Their investigations led to the discovery of post-holes and "a fairly regular pavement that seemed to have been made to level the top of the platform and on which the dwellings were established, around which the remains of the kitchen were thrown" (Le Rouzic, 1930). From the point of view of lithic and ceramic material, the Er-Yoh site is considered homogeneous (Guyodo, 1997 and 2007). The predominance of tools such as drills and scrapers on the Er-Yoh site has been interpreted as being the remains of specialised activities (Guyodo, 2007). Finally, we note the presence of eight fragments of daggers and a flint scraper from Grand Pressigny (Guyodo, 2007).

The petrographic analyses carried out on 54 pottery items (Gehres, 2018a) allowed the identification of three main types of paste. The first set corresponds to four pottery items, made from the clay resulting from the alteration of a granite, where large aggregates of clay of multi-millimetre size are detectable. Their origin seems to be due to the use of poor-quality clay, rather than to a voluntary act. The mineralogical assemblage accompanying these clays is mostly composed of inclusions of granitic origin, which could correspond to a local raw material.

The second group consists of 47 ceramics. It is characterised by the presence of well-sorted rounded grains of quartz and feldspar (fig. 8), corresponding to inclusions of beach and dune sand (Gehres, 2018a). As these clays are derived, in the Armorican massif, from the weathering of basement rocks, the absence of lithoclasts or unsorted elements usually present in this type of clay is an indication that the raw material was purified by the potters. The material once separated from these natural inclusions was subsequently tempered with sand.

This type of paste represents more than 95% of the corpus studied. This practice is known on the continent from the Middle Neolithic II on the continent, at the Er Grah site in particular (Le Roux, 2006), but has no known parallel in the Late Neolithic in the West.

The use of sand as temper can be considered a technically poor choice due to the higher expansion coefficient of quartz compared with clays (Rye, 1976; Woods, 1986; Gibson and Woods, 1990). The pottery loses strength and toughness with each firing. However, as shown in the recent work of N. Müller: "Quartz, which at 573 °C undergoes a reversible phase transition accompanied by a 7 vol % change, is frequently cited in discussions of strength reduction. However, the volume fractions of the quartz component in both temper types, as determined by XRD methods, are quite similar, reasonably low (0.26 for granite and 0.19 for phyllite), and cannot account on their own for the observed differences" (Müller et al., 2010, p. 2460). It is therefore difficult to determine whether the use of this sandy temper in Er-Yoh ceramics originates from a technical choice or a tradition. It is interest-

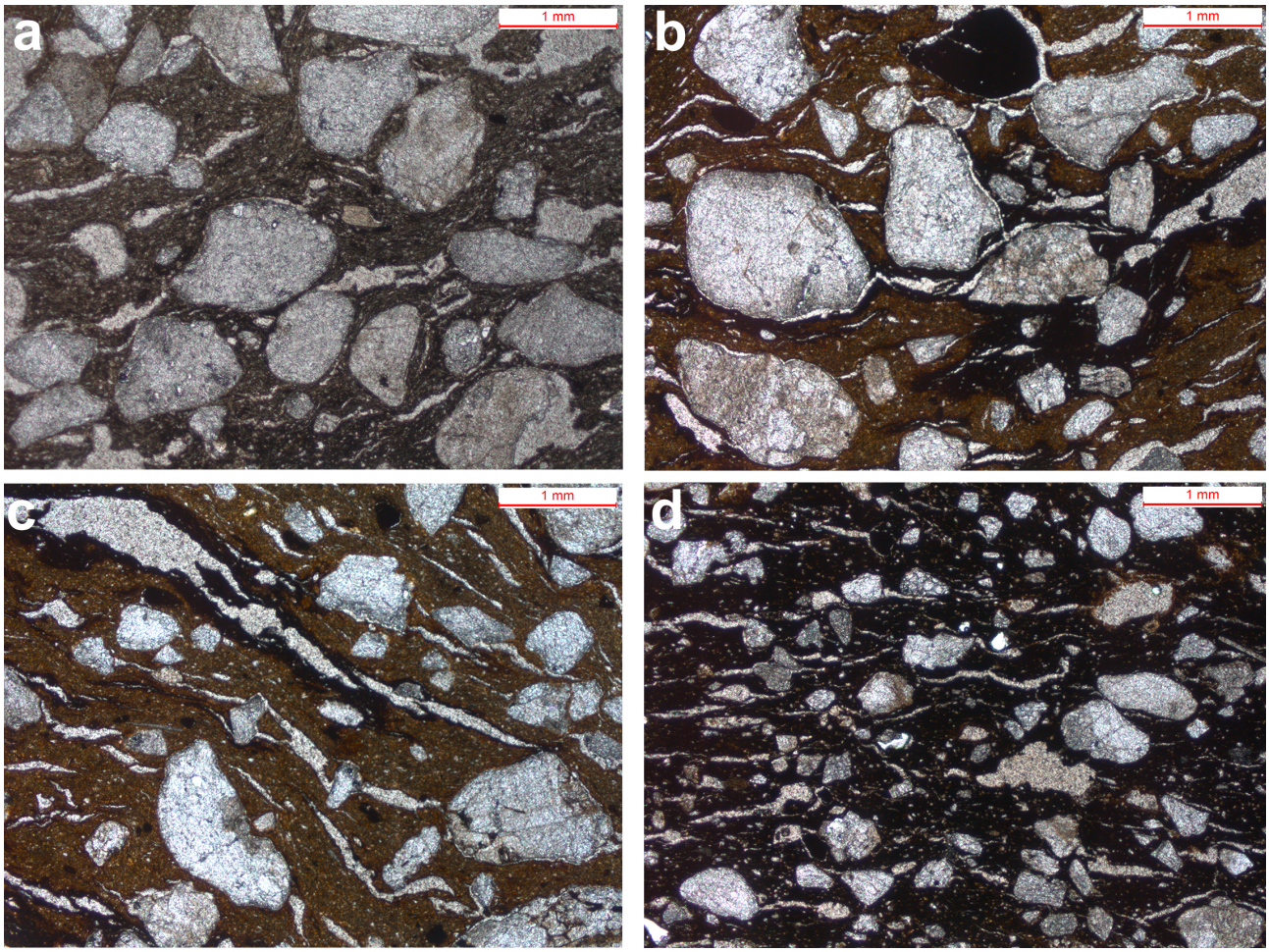


Fig. 8 – Micrographic sheet of thin sections of facies with sandy temper from the Late Neolithic site of Er-Yoh on the island of Houat.
***Fig. 8** – Planche de micrographies des faciès à dégraissant sableux observés en lame mince sur le site du Néolithique récent d'Er-Yoh, sur l'île de Houat.*

ing to note that no technical or ceramic transfer could be observed on the neighbouring and or contemporary sites.

Finally, the last set of three vases corresponds to the type of paste previously observed on the Saint-Nicolas site in the Glénan archipelago (fig. 7c and 7d). These pottery items present the same petrographic characteristics, i.e. a high rate of talc ribbons, but also numerous clusters of colourless amphibole. Finally, the presence of angular grains of glaucophane confirms Groix as the origin of these vases.

Er-Yoh seems less connected within the Houat/Hoedic/Belle-Île-en-Mer group, with the absence of transfer of ceramics produced in the region, but also by the use of a very specific pottery production process that is limited to this site. The lack of diffusion of this technique to other islands or continental sites raises the question of the mobility of populations between occupations, but also of the pressures that may have existed within the Er-Yoh group for the adoption of the community's technical traditions. This type of phenomenon has been described by ethnoarchaeology. O. P. Gosselain points out that when a Cameroonian potter uses recipes for preparation that differ from those of the group, the group could be openly denigrating toward them: "Social integration would require a certain conformism, while individual 'deviations' would be sanctioned by one or other form of segregation" (Gosselain, 2002, p 76). Such pressure could explain the homogeneity of practices on the Er-Yoh site.

This lesser connection is, however, relative, as shown by the discovery of fragments of dagger and a flint scraper from Grand Pressigny (Guyodo, 2007), but also by the presence of talcous ceramics from Groix. Like the occupants of the island of Saint-Nicolas, the inhabitants of Er-Yoh seem to have been well integrated into the communication and exchange networks of the Late Neolithic. This group seems to have developed craft skills that enabled them to access value-added goods and to acquire a certain independence from their neighbours.

2.2.4. Long-distance transfers

The transfer of ceramics over more than 50 km from the island of Groix raises questions about the status of these goods. Thus, we have proposed that these pottery items, whose raw material has superior qualities, should be considered as value-added goods (Gehres, 2018b). This has repercussions on for issues related to the man-

agement of the raw materials and the production of these ceramics. Indeed, the use of a rare, value-added raw materials tends to demonstrate the existence of a 'household industry' type of production (Balfet, 1965; Rice, 1987; Perlès, 2012). In this type of organisation, the technology used is simple, as shown by the absence of specific preparation of the paste (no addition of temper or grinding of the material). Ethnographic observations suggest that this type of system was practiced on a part-time basis, and that production was most often directed towards a consumer market wider than the community (Arnold III, 1991), which could be the case for the production of talcous pottery from Groix. Access to these quality deposits may therefore have been unequal due to control by hierarchical groups. Within this type of production system, ceramics no longer only have a use value, but also acquire an exchange value (Rice, 1987). The pottery is therefore the result of an intentional surplus of production, the aim of which is to feed an economy partially oriented towards the exchange of goods. It is then necessary that the production system be more organised at the level of the communities exploiting these deposits, notably by a management and control of the resource within a socially stratified society.

CONCLUSION

Based on the analysis of ceramic materials, it is possible to point out changes between the island groups of the Middle Neolithic and the Late Neolithic (fig. 2 and 3). The potters used more diverse materials for their ceramic production, which they modified less. On the one hand, the territories of the technical traditions in the stages of clay preparation of the clay are restricted and do not seem to have spread any further. On the other hand, the economic territories were expanding and exchanges between islands and with the mainland were increasing strongly, as were the distances over which these transfers took place. Some island occupations show high rates of importation, such as Saint-Nicolas in the Glénan archipelago, or several sites located on Belle-Île-en-Mer (fig. 3b and 3c). The ceramics were therefore transferred for their contents, but also for themselves as objects with added value linked to the quality of the raw materials used to shape them (Gehres, 2018b). The organisation of production, as well as that of the groups in which these value-added ceramics were produced, then subsequently tended to become more complex. There is currently no evidence for the existence of such a status in the Middle Neolithic.

Thus, we observe a change in ceramic production behaviour, but also in economic organisation. From the point of view of ceramic production and circulation, the Late Neolithic appears to have been a turning point between two socio-economic states in these islands. First, a heterarchical[1] status during the Middle Neolithic may have been in place in the island populations. The island groups would have been socially organised in a horizontal way, but with well-defined roles within society. Ceramics would have been produced within domestic units, without great technical investment, and would have been oriented towards use within the occupation. Their role was thus limited to being containers. Exchanges between the groups would seem to have been based mainly on family ties and relationships of trust. They would therefore have been restricted in space and have taken place among nearby islands.

The Late Neolithic appears to be different from the Middle Neolithic, as the mosaic of social organisations and ceramic production seems to have become more complex. Indeed, ceramic analyses have shown an increase in the volume of transfers between the islands and with the mainland, over distances of up to several dozen kilometres. This is particularly the case for the Late Neolithic sites of Belle-Île-en-Mer, where almost all the ceramics were produced on the mainland, or in the nearby islands (fig. 3c). This raises the question of whether Belle-Île-en-Mer had a role as a central and redistributive place within the exchange networks. Similarly, at the Saint-Nicolas site in the Glénan archipelago, all the vessels were imported (fig. 3b). The connections between the islands and with the mainland seem to have multiplied and the exchange networks strengthened.

The ceramics were produced in different contexts, mostly domestic but also as a household industry in the case of the value-added pottery from the island of Groix. The technology used was simple and practiced on a part-time basis with the production most often directed towards a wider consumer market (Arnold III, 1991). Ceramics no longer only had a use value but also acquired an exchange value (Rice, 1987). The ceramics were then the result of an intentional surplus of production, the aim of which was to feed an economy partially oriented towards the exchange of goods. The production system would have been more organised at the level of the communities exploiting these deposits, notably through the management and control of the resource. Such a system generally leads to a socially stratified society in a heterarchical or hierarchical way (Crumley, 1995).

These contacts allow us to propose a first scenario, concerning the coexistence of several socio-economic organisations within the island populations. The large islands such as Belle-Île-en-Mer and Groix could have had stratified organisations, with hierarchical groups. The smaller islands such as Houat, Hoedic, Ile aux Moutons or those of the Glénan archipelago could be a continuation of the less complex socio-economic organisations of the Middle Neolithic (fig. 2 and 3). Indeed, the extension of the surface area of the islands may have played an important role in the socio-economic organisation of the island populations. The groups present on the larger islands had access to more resources and developed a more extensive agro-pastoral economy.

Because of their size, these large islands were able to play the role of centres of gravity, attracting not only sailors but also goods. Belle-Île-en-Mer thus seems to

have been at the centre of exchanges, as shown by the large number of imported ceramics, but also by the numerous fragments of flint blades from Grand Pressigny (Audouard, 2014 and 2016), the largest known concentration in Brittany's islands. These particularities are exacerbated when compared with the very local productions of the neighbouring sites on Hoedic and Houat. Thus, the hierarchical organisation of Belle-Île could be contrasted with more heterarchical groups within the neighbouring islands, which may have been satellite occupations and interdependent with those of Belle-Île-en-Mer.

These questions allow us to introduce an important notion into our considerations of island occupations and their functional spaces. Indeed, for the Saint-Nicolas site in the Glénan archipelago, we saw that all the ceramics from the site were imported (fig. 3b). The vast majority of them came from the Ile aux Moutons, about 7 km to the north. This is the maximum distance, as defined by the work of D. Arnold, at which most of the materials necessary for the production of ceramics are collected (Arnold, 1985). Beyond this, the cost of supply is considered to be higher than the 'benefits'. This is referred to as a 'preferential exploitation territory' (Arnold, 1985). However, it should be noted that the notion of 'cost' is not necessarily comparable between companies. For example, the distance travelled at sea by island populations does not have the same 'cost' as that travelled on a mainland plain. It is therefore necessary to propose new models, adapted to the territories we are studying and to the impact of their geographies, but also to the means of travel. Indeed, as the distances between the islands are often greater than 7 km, the data resulting from the exploitation of the clayey raw materials of the islands do not always correspond to the distance models of resource exploitation proposed by D. Arnold (Arnold, 1985). These models are therefore not adapted to these territories, particularly those with multiple islands. The hypothesis of expeditions and movements from one island to another, or from the mainland, depending on the season and the raw materials sought, could correspond to the observations made. The territory of exploitation is then not limited to the island, but to a group of islands and the coast, as suggested by L. Marrou (Marrou, 2005), who proposed to use the term 'meritoire', the oceanic equivalent of the term for continental territory.

It is possible to propose the concept of a 'preferential exploitation area' adapted to the problems of material acquisition. This concept would be able to evolve with the improvement of navigation technologies and the socio-economic systems in place. It may function differently according to the layout of the islands, their size, and the distances that may separate them, or their distance from the coast. It is therefore essential to consider these marine populations as highly mobile groups, taking advantage of the biological and mineral resources of the different environments at their disposal. Ceramic transfers can therefore reflect contacts between different populations, but also the temporary movements and settlements of groups.

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NOTES

(1) "Heterarchy may be defined as the relation of elements to one another when they are unranked or when they possess the potential for being ranked in a number of different ways" (Crumley, 1995, p. 3).

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