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Flint sourcing revisited, the Bergerac (France) and Obourg (Belgium) cases

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Abstract

Studies on the origin of lithic raw materials have become increasingly important since the 1980s. Sourcing studies play a key role in appreciating territory management and group mobility, which are two major issues of the archaeology of prehistoric hunter-gatherer societies. Most approaches use only part of the potential information contained within archaeological lithic material. The improvement in our understanding of the nature of flint and its formation processes has allowed our interdisciplinary research-group to refine the methods used for its characterisation. A major aspect of this new approach is the 'evolutionary chain of flint' concept. Our work opens up new research directions such as the analysis of flint artefact surfaces which complements the taphonomic approach to archaeological sites in terms of assemblage integrity and site formation processes. We present here preliminary results of ongoing petrographical and geochemical analyses of geological flint samples from Bergerac (France) and Obourg (Belgium). Our approach aims to establish the geological history of flint prior to its collection by humans and to characterise the successive events which affected lithic artefacts after they were discarded. The multi-technical and multi-scale approach presented in this paper appears to be particularly applicable in reconstructing the litho-spaces of archaeological sites in order to contribute to more definition of prehistoric territories.

Keywords: flint, petro-archaeology, flint characterisation, evolutionary chain of flint, raw material sourcing, Bergerac, Obourg.

Résumé

Les études sur l'origine des matières premières lithiques ont gagné en importance depuis les années 1980. Elles jouent un rôle clé dans l'appréciation de la gestion du territoire et de la mobilité des groupes, deux enjeux majeurs de l'archéologie des sociétés préhistoriques de chasseurs-cueilleurs. La plupart des approches classiques n'utilisent qu'une partie de l'information potentielle contenue dans le matériel lithique archéologique. L'amélioration de notre compréhension de la nature du silex et de ses processus de formation a permis à notre groupe interdisciplinaire d'affiner les méthodes utilisées pour sa caractérisation. Un aspect majeur de cette nouvelle approche est le concept de « chaîne évolutive du silex ». Nos travaux ouvrent de nouvelles pistes de recherche telle que l'analyse des surfaces des artefacts en silex qui complète l'approche taphonomique des sites archéologiques en termes d'intégrité des assemblages et de processus de formation des sites. Nous présentons ici les résultats préliminaires des analyses pétrographiques et géochimiques en cours des échantillons géologiques de silex de Bergerac (France) et d'Obourg (Belgique). Notre approche vise à établir l'histoire géologique du silex avant sa collecte par l'homme et à caractériser les événements successifs qui ont affecté les artefacts lithiques après leur abandon. L'approche multi-technique et multi-échelle présentée dans cet article semble être particulièrement applicable à la reconstruction des litho-espaces des sites archéologiques afin d'apporter plus de définition aux territoires préhistoriques.

Mots-clés *: silex, pétroarchéologie, caractérisation du silex, chaîne évolutive du silex, approvisionnement en matière première, Bergerac, Obourg.*

1. INTRODUCTION

During the past decade, the study and characterisation of lithic raw materials have become increasingly important for the reconstitution of the subsistence economies of prehistoric humans. However, this interest is not new since researchers organised themselves to advance the research about silicites at the 'Flint symposium' at Maastricht in 1969. The following national and international conferences have covered numerous aspects of knapped stone raw materials including geological origins, mining, uses and laboratory analyses (ROOS *et al.*, 1971; SÉRONIE-VIVIEN & LENOIR, 1990).

The present short paper focuses on methods that may be used to distinguish between materials as well as on characterisation studies of specific raw material sources. Ultimately, the objective of our approach is to improve reconstructions of prehistoric technological decision-making and land-use/mobility strategies (e.g. DELVIGNE *et al.*, 2019).

2. METHODOLOGY

Most provenance studies use only a part of the potential information contained within geological samples and archaeological lithic objects. The classical petrological (MASSON, 1981; SÉRONIE-VIVIEN & SÉRONIE-VIVIEN, 1987) and geochemical methods (SIEVEKING *et al.*, 1972; BRESSY, 2002; SHACKLEY, 2008; MOREAU *et al.*, 2016) are based on the assumption that research on primary sources is archaeologically meaningful. However, this questionable assumption requires methodological adjustments and needs to take into consideration the concepts we developed over the past ten years (FERNANDES & RAYNAL, 2006; FERNANDES *et al.*, 2007); these are twofold: 1) a dynamic petro-archaeological methodology and 2) a dynamic geochemical methodology.

They both allow the association of the petrological and geochemical approaches in a reasoned way. Indeed, whether the diagnostics are petrological or physico-chemical, they require a high level of consideration to be given to the alteration processes generated by the redistribution of materials in the environment, processes which radically modify certain aspects of geomaterials in their role as archaeological objects (BESANÇON, 1982; HARDAKER, 2012). The methodologies are built on the notion of an 'evolutionary chain' of flint, which is a conceptual and methodological renewal, based on interdisciplinary and multi-scalar approaches, which together eliminate many dead ends in terms of sourcing siliceous materials (FERNANDES, 2012).

Our method of raw material characterisation is developed over a series of different scales. It is based upon the evolution of the mineralogical composition by using optical microscopy, scanning electron microscopy (SEM) and Raman spectroscopy; to this base is added the evolution of the microfacies characteristics identified using microscopy and SEM analysis, on the transformation of porosity established using image analysis and porosimeter readings, and on the presence and distribution of trace elements using LA-ICP-MS, XRF, Raman spectroscopy and SEM-EDS on both the surface and subsurface of geological and archaeological samples. The textures and chemical compositions are ruled by pedological processes and sedimentological environments to which the specimens have been subjected and tabulating these provides a reference catalogue for specific facies.

Silicites (flint, silcrete, chert and other siliceous rocks) are metastable materials in surface environments (THIRY *et al.*, 2014): their structures evolve as a function of the various environments through which they pass and each step of their travel is recorded by a particular physico-chemical signature. Primary flint may experience different geological pathways and travel through very different environments before its collection and use in prehistory. The distinct alterations that occur between different sedimentary contexts must be taken into consideration since they are the components of a single, phased and correlated sedimentary system.

Analysis of the pre-depositional surfaces of samples allows several petrographic facies and textures to be recognised. Micromorphology reveals the petrographic facies and textures of the object's surfaces. The spatial arrangement of these surfaces is the key to deciphering their respective transformations and the succession of environments through which the flint passed (Fig. 1).

Archaeologically, analysis of the post-depositional surfaces complements taphonomic studies. This research axis focuses on deciphering the chronology of post-depositional processes on objects (after their abandonment in an archaeological site). Once decoded, these characteristics become discriminating elements for reconstructing the histories of lithic objects. The effects induced by mechanical, physico-chemical or biochemical processes, connected to the indices of human activity therefore become complementary supports to a classical taphonomic approach.

This method is based on three observation grids for flint evolution, petrography, gitology and taphonomy, applied to the relevant stages, which leads to the construction of a database that delivers results of direct interest to archaeologists: the origin of raw materials, techno-economic behaviour of the users and the integrity and chronology of the archaeological units of a site.

3. Results

We present preliminary results of ongoing petrographical and geochemical analyses of geological samples of the Campanian Bergerac flint from Dordogne (France) and of the Campanian Obourg flint from Mons Basin (Belgium).

After an analysis (binocular and SEM) of the surfaces of the Campanian V limestone flint collected in secondary deposits in the alterites of the Montclard Forest (Bergerac, Dordogne, France), the sequence of the processes that modified the surface and sub-surface are revealed. The zones of transformation at the periphery of the samples indicate a polyphased and polygenetic mineralogical and geochemical history. The variability of compositions of the cortical and endocortical zones is more extreme than variations in the inner zone. Observable from the periphery to the inner zone are:

- a high porosity in the external neocortex with megaquartz, chalcedony and iron-rich clays;
- an inner neocortex with a lower porosity, low iron content, petaloid quartz and chalcedony spherolites;
- an interface (or endocortical zone) with a strong porosity, poor in quartz, composed of chalcedony and clay with iron compounds;

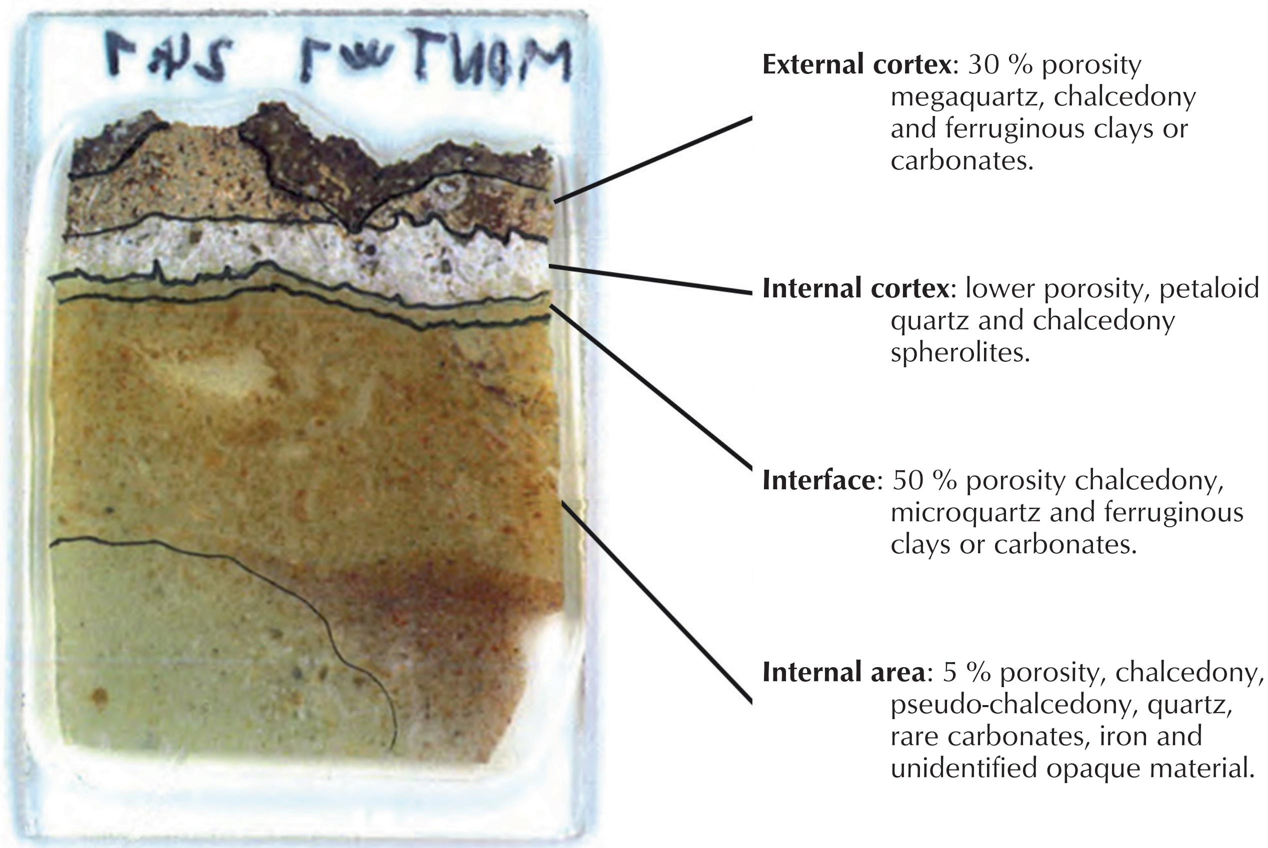

Fig. 1 – Commented thin section of a geological sample from Campanian flint (so called 'Bergeracois flint') from the 'clays with flint' at Forêt de Montclard (Dordogne, France).

- and finally, an internal zone, rich in chalcedony and pseudo-chalcedony, associated with detrital quartz grains, iron compounds and an unidentified opaque component.

Similarly, preliminary results of our analyses on Campanian Obourg flint derived from 'clays with flint' from the Mons Basin indicate that the distinction between cortical, endocortical and internal zones determined by LA-ICP-MS is again pertinent and useful. The chemical composition of cortical and endocortical zones varies considerably from that of the internal zone, regardless of the chemical elements taken into account. Interface 3 and the internal zone (Fig. 2) correspond to the same zone (primarily flint quartz and chalcedony) while 'interface 2' is a transitional zone, and 'interface 1' corresponds to a circulation zone of very high porosity, siliceous dissolution and recrystallisation processes.

From these observations, we conclude:

- the external cortex corresponds to dissolution processes and the recent acquisition of certain compounds;
- the internal cortex is characterised by the acquisition of various compounds, dissolution and recrystallisation processes;
- the composition of the internal zone does not vary greatly but, progressively, becomes significantly different from the signatures of the external and internal cortex.

4. CONCLUSION

Flint undergoes several transformations that allows its provenance to be traced across the landscape and that the alteration of its cortex/lithoclase must be considered as a temporal record of different pedological events. Given this perspective, the study of secondary, pre- and post-depositional transformations contributes to the identification of sources where raw materials have been collected by prehistoric humans and permits the degree of integrity of archaeological sites to be assessed. The multi-technical and multi-scalar approach initiated for Bergerac and Obourg flints appear to be particularly efficient in reconstructing the litho-space of each

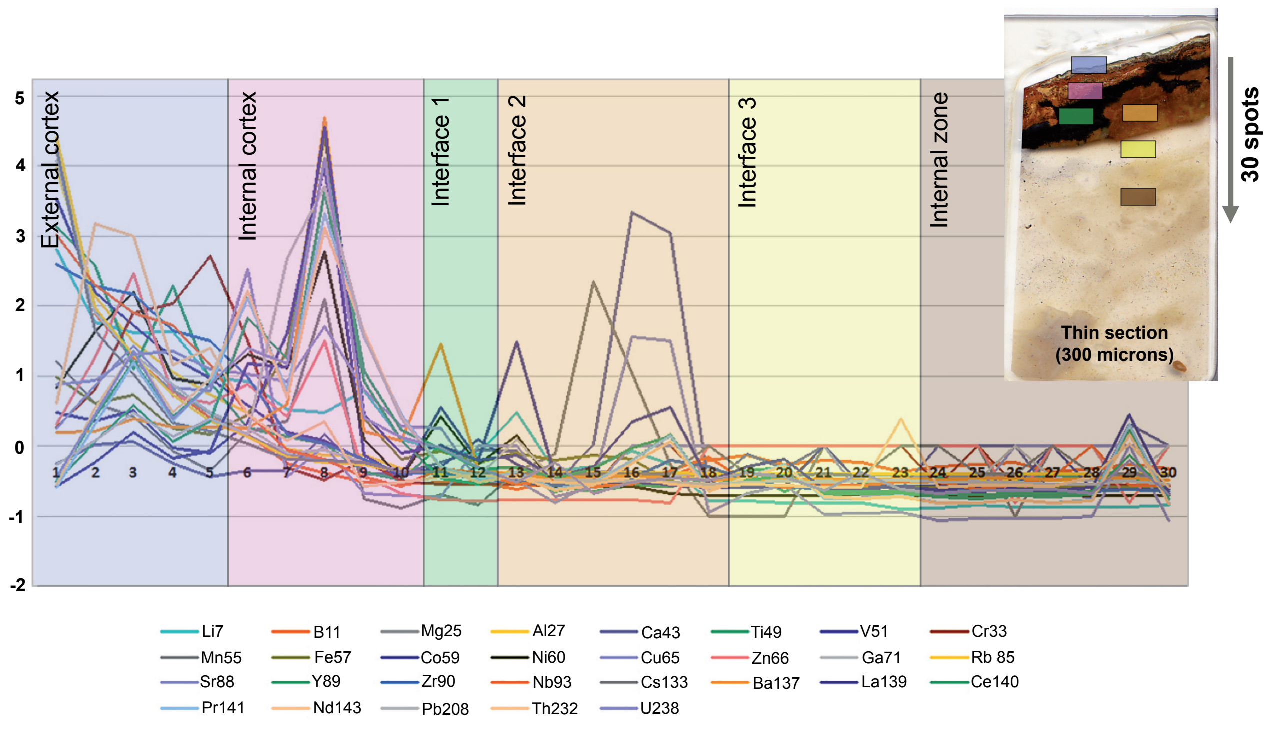

Fig. 2 – Geochemical analysis on Campanian flint from Obourg (Prov. Hainaut, Belgium), derived from 'clays with flint'.

archaeological site, with a further objective being to create a refined understanding of prehistoric exploitative territories. However, recrystallised areas within the specimens indicate polychronic and polygenetic mineralogical and geochemical histories, showing that compositional variability between the cortical and endocortical zones is significantly more pronounced when compared to the internal zone. Therefore, geochemical measurements can only be conducted when there is certainty about the zone of the object that is being examined.

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