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The flint path. Characterisation of raw materials to reconstruct the routes and relationships between groups of the Apulian Neolithic (Southern Italy).

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***Abstract* - We present the methodology and results of research carried out in the framework of a PhD thesis [1]. The aim is to reconstruct the itineraries and dynamics of the relationships between Neolithic groups, from the 6th to the 4th millennium BC, in central and southern Apulia (Italy). In this paper, we illustrate the characterization study of the regional flint, carried out with an interdisciplinary, palaeogeographic and territorial approach, through the concept of "flint evolutionary chain" (*sensu*Fernandes e Raynal 2006). The result is an operational and interpretative tool that can also be applied to other prehistoric contexts. It allows us to identify the environments in which prehistoric groups collected the raw material, and to follow the route of the raw material from 'producer' to 'consumer' sites.**

Key words*: *Neolithic, Apulia, flint, Gargano, flint evolutionary chain.

I. NATURE OF THE PROBLEM AND STATE OF THE ART IN THE FIELD OF INTEREST

The Neolithic period is distinguished from previous periods by the increasing development of technical and specialized skills and by a social organization based on ties and relationships between groups.

The study of lithic assemblages must be approached taking into account the new "technical" needs closely linked to socio-economic transformations [2].

For the Neolithic, it is essential to realise that different groups (producers/consumers/distributors?) can participate in the operational chain (from acquisition to management) in an increasing development of skills and specialisations.

Apulia is a pivotal region for the study of the circulation of lithic raw materials in the Neolithic, for the wealth of archaeological data, for the transformations over time of population dynamics and economic structures, for its morphology and geographical position and, finally, for the presence of the complex and articulated flint mining district of Gargano, in the north of the region, where organised and systematic mining activity has been documented dating to the 6th millennium BC.

Although the archaeological data are not homogeneous due to the history of research and the different degrees of visibility in the field, studies in recent years [3] highlight differences in the characteristics of the Neolithic at a regional level.

While there is abundant documentation on the exploitation of the Gargano flint mines [4], little data is available on the groups of "consumers" and the supply/management/circulation of the flint, especially for the territories farthest from the Gargano Promontory, i.e. between 100 and 150 km from central Apulia and about 300 km from southern Apulia.

Furthermore, one of the first critical problems in regional Neolithic studies is the lack of interdisciplinary studies (geological and archaeological), to map areas with potential outcrops and collecting environments for raw materials usable for knapping. There is also a lack of detailed regional characterization of flints to trace the dynamics of circulation and interaction between groups.

The interest in the characterisation of Gargano flint and other lithic resources in Apulia has been revived in recent years [5], [6], [7], [8], starting from the first experiments based on chemical analyses [9]. The research, from an interdisciplinary point of view, is still in at its infancy.

Within the framework of a technical-economic approach, and with the aim of learning useful methodologies for the characterization of flint, the study took as a reference point, in particular, the research carried out in the French context, which focused on the use of flint and the dynamics of circulation between the Palaeolithic and Neolithic periods in the Provençal [10], [11], [12] and Alpine [13], [14], [15], [16], [17], [18], [19], [20] areas.

From a methodological point of view, the articles cited above describe the development of an interdisciplinary petrological study model that led to the concept of the "flint evolutionary chain" [21], [22], [23], [24].

The approach, from a palaeogeographical and territorial perspective (lithic landscape approach), consists of increasing knowledge of the regional geology; establishing inventories and maps capable of organising and presenting spatially referenced alphanumeric data; lithic resources (regional lithotheques) which will serve as comparison collections for the characterisation of raw materials; analysing flints, according to an integrated and naturalistic multiscalar (macroscopic, microscopic) and geochemical approach.

II. DESCRIPTION OF THE CONTRIBUTION

In this contribution, we present the research methodology used for the characterisation of geological and archaeological flints, with the aim to reconstruct the path of flints from possible sourcing environments to "consumption" sites, in Apulia, from the 6th to the 4th millennium BC.

A large part of the project's development was devoted to finding a method that would highlight the discriminating characteristics of the raw material, allow the different types of flint present on the sites to be distinguished, and lead to the identification of the geographical and geological origin of the raw material.

Here we present the process of research and experimentation with the study method, carried out through interdisciplinary discussion, which led to the development of a useful tool for wider archaeological analysis.

In order to verify the validity of this methodology, and due to the lack of specific geological studies on primary (other than Garganic) and secondary flint outcrops in the region, a first "potential map of the Garganic flint outwash" was created, through the study of geological maps and publications and through targeted field surveys. The study was therefore oriented towards the characterisation of geological samples of Gargano flint in primary andsecondary deposits from different depositional environments (*Figg. 1-2*).

The geological sample analysed consists of 106 samples from Gargano flint outcrops, of which 27 from primary flint outcrops, 25 from sub-primary flint outcrops and 54 from secondary flint outcrops.

The characterization of the flints was developed according to the concept of the 'flint evolutionary chain' (ibid.), which consists of the observation of the traces that each sedimentary environment leaves on the raw material (under various depositional conditions) and the analytical identification of these traces.

Our approach is different and innovative in several ways: 1) it adds the perspective of weathering to the different scales of observation of a classical study and therefore, 2) it allows the subdivision of raw material categories by identifying not only the genetic type, but also all its redeposited and archaeologically derived types. Our analytical process follows the stages of different transformations recorded by the raw materials

In summary, flint, from primary to secondary outcrops, before being collected by prehistoric people, underwent a series of transformations (of a chemical, thermal and/or physical nature) which can be deciphered, in a palaeogeographical perspective, thanks to; knowledge of the regional geology, the inventory of regional geo-resource, the use of an image repository on the types of impacts and traces specific to flint, the macro-microscopic observation of the natural surface and the internal part of the flint, with a multi-scalar approach.

According to this approach, the methodology of flint characterisation requires a strongly interdisciplinary perspective with knowledge of sedimentology, geomorphology, micropalaeontology, petrography, petrology and mineralogy.

III. RESULTS OBTAINED AND THEIR APPLICABILITY

The methodological results of our research can be summarized as follows:

- the experimentation with a method of characterizing flint;
- the translation into Italian of an analysis protocol already used in France, and its application to the regional context, adapting for terminology and range of variability;
- the characterisation of Gargano flint and creation of a collection of images and maps that can be used by relevant scholars;
- the development of a data collection sheet that can serve as an initial tool for dialogue and comparison between archaeologists and geologists working on the characterisation of Apulian flints;
- the application of the method to a small archaeological sample with the further verification of its validity.

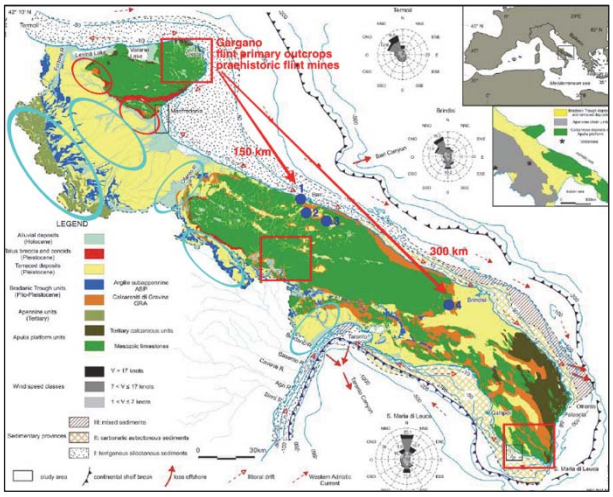

Fig. 1. Potential flint collecting areas, in primary (rectangles) and secondary (ovals) deposits in Neolithic Apulia. In red the outcrops of the Apula Platform, in light blue the outcrops of the Southern Apennine Chain and the Bradanica Valley. In blue the archaeological sites studied in this work: 1 Titolo; 2 Balsignano; 3 Madonna delle Grazie; 4 Sant'Anna di Oria. Overlay on geological sketch map of Apulia - Italy, with current coastal sediments and marine currents [25]

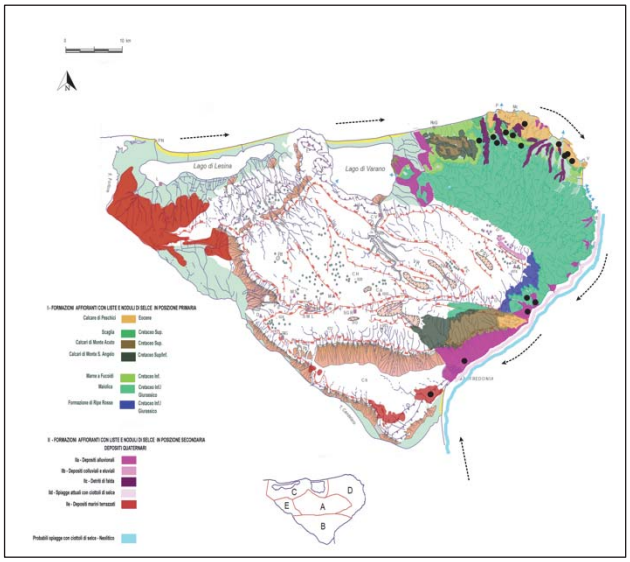

Fig. 2. Potential map of the Garganic flint outwash, with primary and secondary geological outcrops. Geological sampling points of this study and coastal currents. Overlay on geomorphological map [26]

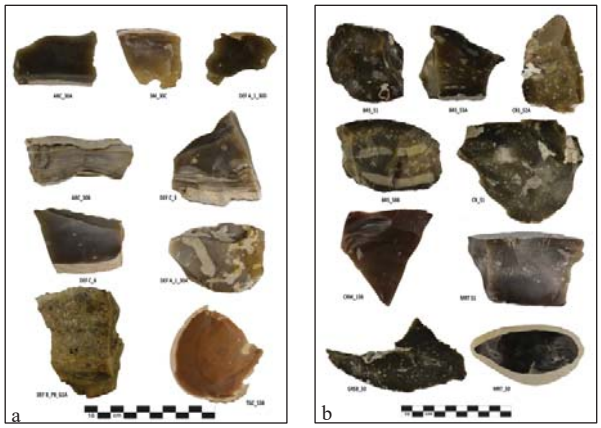

Fig. 3. Macrofacies, matrix. Primary and sub-primary geological samples, Peschici Limestone (a), Majolica (b)

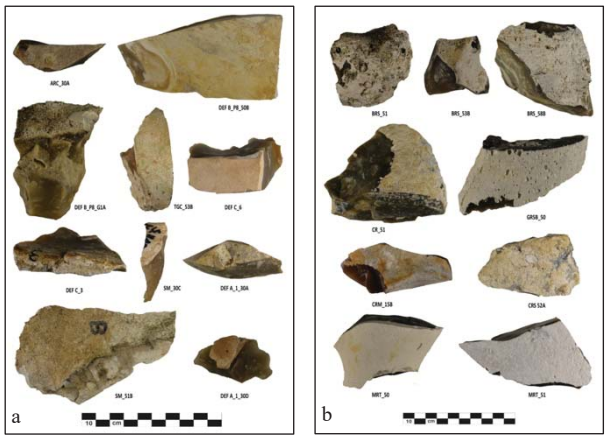

Fig. 4. Macrofacies, cortex. Primary and sub-primary geological samples, Peschici Limestone (a), Majolica (b)

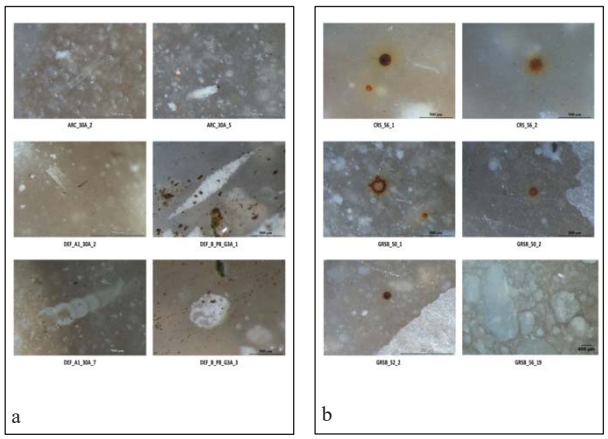

Fig. 5. Microfacies, matrix. Primary and sub-primary geological samples, Peschici Limestone (a), Majolica (b)

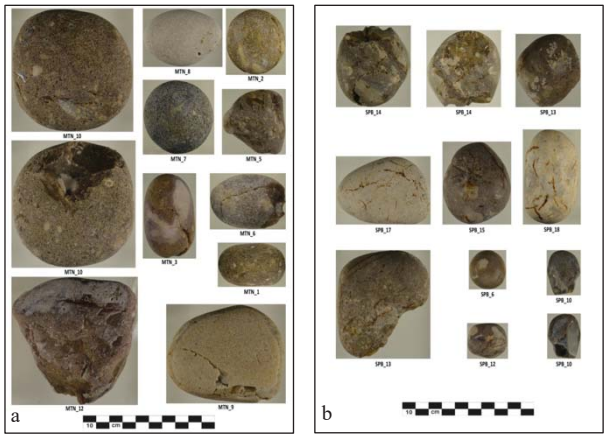

Fig. 6. Macrofacie, cortex. Secondary geological samples, Marine beaches (a), Terraced alluvial deposits (b)

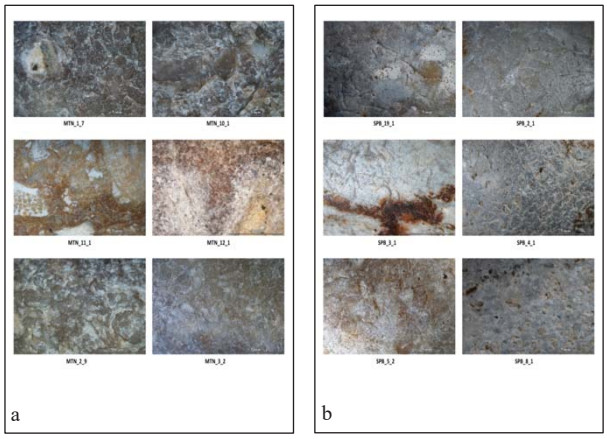

Fig. 7. Macrofacies, cortex. Secondary geological samples, Marine beaches (a), Terraced alluvial deposits (b). For the secondary samples, the discriminating variables depend mainly on the cortex

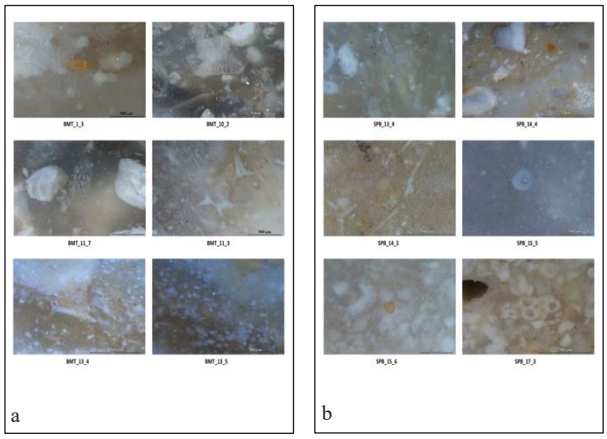

Fig. 8. Microfacies, matrix. Secondary geological samples, Marine beaches (a), Terraced alluvial deposits (b). It is not possible to distinguish the Majolica from the Peschici Limestone on the basis of the matrix

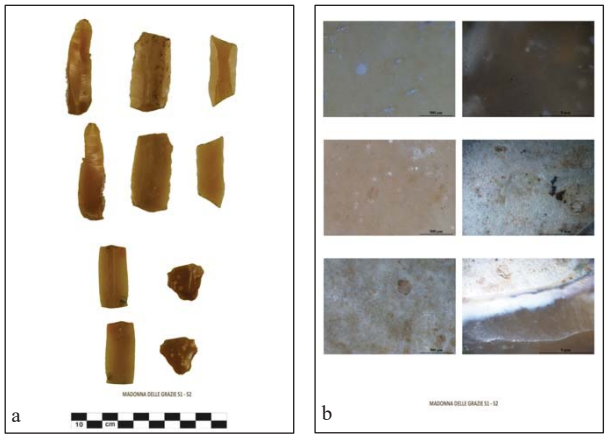

Fig. 9. Archaeological samples from the site of Madonna delle Grazie. Peschici Limestone (primary and secondary geological deposits).

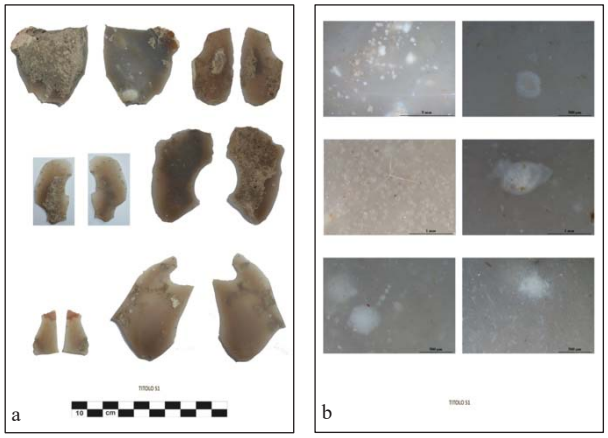

Fig. 10. Archaeological samples from the site of Titolo. Majolica (primary and secondary geological deposits).

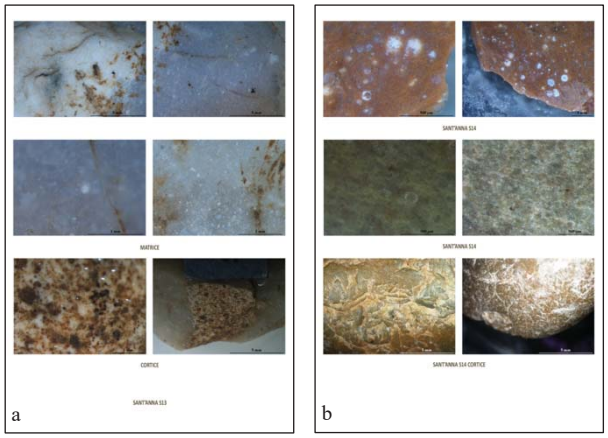

Fig. 11. Archaeological samples from the site of Sant'Anna di Oria. Secondary geological deposits of Garganic source - terraced alluvial deposits (a) and of non-Garganic source - marine beaches (b).

IV. CONCLUSIONS

In addition to the strictly methodological results, other results were obtained in the identification of parameters allowing the reconstruction of the "flint evolutionary chain":
- the elaboration of the "Potential map of the natural diffusion of Gargano flint", because of which it is possible to verify that, for the sites in south-central Apulia, Gargano flint (both in primary and secondary deposits) can be considered as exotic raw material:
-distinction, on a micropalaeontological and sedimentological basis, of the main mineralogical components characterising the "Maiolica" and "Peschici Limestone" outcrops (these outcrops, even if they do not represent all the variability of the Gargano outcrops, are the ones where most of the prehistoric mines are found) *(Figg. 3-5*);
- the recognition of the distinctive characteristics (based on the effects of mechanical processes, acquired morphology and weathering) of specific flint types in secondary deposits, recent marine deposits (Holocene beaches) and ancient deposits (Pleistocene) (*Figg 6-8)*;
- the creation of a first lithotheque made up of images (macroscopic and microscopic photographic documentation) and files of the analysed samples, which could serve as a starting point for a comparison with the archaeological flints of the region.
The method was tested, verifying its validity, on a sample of four important sites in the Neolithic area of central and southern Apulia: Balsignano - BA [27], Titolo - BA [28], Madonna delleGrazie - BA [29], S. Anna di Oria - BR [30]. For each site, the lithic industry was sampled (a total of 753 artefacts) and studied for the characterisation of the raw material *(Figg. 9-11)* and the analysis of the main technical-economic aspects.
The sites share a good quality of data but by rather different settlement, geographical, chronological and cultural typologies. It is likely that they had a different "role" within the Neolithic society at the territorial level.
The small number of sites does not allow us to reconstruct geographical dynamics and intercultural relations on a large scale, but the differences allow us to discuss possible patterns of supply, management and circulation of raw materials and, in some cases, to identify trends common to several sites, especially in the Middle Neolithic context.
By cross-referencing the results of the raw material analyses with those of the technologies, it was possible to;
- identify the types of flint and other raw materials at each site;
- distinguish between garganic and non-garganic flints;
- distinguish between primary and secondary deposits by tracing the type of collection environment;
- highlight, site by site, different methods of procurement and management of raw materials;
- identify types of raw materials or "types" of artefacts that can be linked to specific geographical directions and that seem to represent specific indicators for the reconstruction of the Neolithic cultural system of Apulia;
- propose hypotheses on the movements, circulation routes and possible interaction that may have affected the territory under study, comparing the results obtained with the known data on the Apulian Neolithic.
The hypotheses put forward will necessarily have to be verified on a larger number of archaeological sites in order to contribute to the reconstruction of the cultural dynamics of Neolithic groups on a regional and interregional scale.
This research also highlights the need to expand interdisciplinary and geological studies to map and analyse the availability of raw materials and the different settlement environments in the region.

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REFERENCES

[1] S. Sivilli, “Supply, Management and Circulation of Lithic Raw Materials: Neolithic, Central and Southern Apulia”, University of Salento, Cultural Heritage Sciences PhD XXX cycle, 2020.
[2] D. Binder, C. Perlés, M. Inizan, M. Lechevallier, "Stratégies de gestion des outillages lithiques au Néolithique", Paléo, 2, 1990, pp. 257-283.
[3] F. Radina, "Preistoria e Protostoria della Puglia. Studi di Preistoria" - 4. Bari: Edipuglia, 2017.
[4] M. Tarantini, A. Galiberti. "Le miniere di Selce del Gargano. VI-III millennio a.C. Alle origini della storia mineraria europea". Rassegna di Archeologia preistorica e protostorica, 24A, (2009-2011). Borgo S. Lorenzo , FI: All'insegna del Giglio, 2011.
[5] M. Tarantini, G. Eramo, A. Monno, I. Muntoni, "Gargano promontory flint: mining practices and archaeometric characterization". In A. Tomasso, D. Binder , G. Martino, G. Porraz, P. Simon, & N. Naudinot, Ressources lithiques, productions et transferts entre Alpes et Méditerranée. Proceedings of the Session of the Société Préhistorique Française, Nice, 28-29 March 2013. Paris : Société Préhistorique Française, 2016, p. 257-276.
[6] E. Dell'Università, "Multiparametric analysis and data processing of chert features: neolithic exchange reconstruction in adriatic region". Università di Bari, Dipartimento di Scienze della Terra e Geomabientali. Tesi di dottorato XXXI ciclo, 2018.
[7] E. Dell Università, I. Muntoni, G. Eramo, I. Allegretta, A. Monno, V. Festa, P. Acquafredda, "Cretaceous chert in the "Gravina di Matera" canyon (southern Italy) as primary source in prehistory? "6th International Conference: YOCOCU, Young people in cultural heritage conservation, Matera (Italy), 22-26 May 2018. Matera, pp, 273-276.

[8] E. Dell'Università, I. Muntoni, I. Allegretta, M. Tarantini, A. Monno, P. Maiorano, G. Eramo, "Development of a multiparametric characterisation protocol for chert investigation and application on the Gargano Promontory mines", Archaeological and Anthropological Sciences, 11, 2019, pp. 6037-6063

[9] F. D' Ottavio, "La caratterizzazione chimica della selce delle miniere preistoriche del Gargano. Proposta di un metodo archeometrico basato sulle analisi chimiche eseguite con la tecnica strumentale ICP-AES", Origini, XXIII,2001, pp. 111-143.

[10] D. Binder, "Recensement des disponibilités en matières premières lithiques dans la région PACA, rapport de prospection, inventaire, campagne de 1991. Feuille de Castellane", Aix-en-Provence: Service régional de L'Archéologie de provence-Alpes-Cote d'Azur, 1991.

[11] D. Binder, R. Guilbert, "Recensement des disponibilités en matières premières lithiques dans la région PACA. Rapport sur les prospections thématiques, synthèse du programme de recherche 1992-1994 Provence orientale et Provence alpine", Aix-en-Provence: Service régional de L'Archéologie de Provence-Alpes-Cote d'Azur, 1994.

[12] D. Binder, R. Guilbert, "Recensement des disponibilités en matières premières lithiques dans la région PACA, rapport sur les prospections thématiques en Provence rhodanienne", Aix-en-Provence: Service régional de L'Archéologie de provence-Alpes-Cote d'Azur, 1997.

[13] A. Masson, "Pétroarchéologie des roches siliceuses. Intérêt en Préhistoire", postgraduate thesis, University of Lyon I, 1981.

[14] J. Affolter, P. Bintz, C. Bressy, "Analyse et circulation des matières premières siliceuses au Mésolithique et au Néolithique ancien dans les Alpes du Nord", In A. Beeching, Circulations et identités culturelles alpines à la fin de la préhistoire - Matériaux. Programme CIRCALP 1997-1998, Travaux du Centre d'Archéologie Préhistorique de Valence, 1999, 175-181.

[15] J. Affolter, "Provenance des silex préhistoriques du Jura et des régions limitrophes", Archéologie neuchâteloise, 28 (2), 2002.

[16] C. Bressy, "Charactérisation et gestion du silex des sites mésolithiques et néolithiques de l'arc alpin. Une approche pétrographique et géochimique", Anthropologie sociale et ethnologie. University of Provence - Aix-Marseille, 2002.

[17] C. Bressy, "Characterisation and management of flint from Mesolithic and Neolithic sites in the north-western Alpine arc. A petrographic and geochemical approach" (Bd. 1114), British Archaeological Reports, International Series, 2003.

[18] J. Affolter, C. Bressy, "Les matières premières siliceuses: méthode d'études et ressources". In G. Pion, La fin du Paléolithique supérieur dans les Alpes du nord françaises et le Jura méridional. Projet collectif de recherche. French Prehistoric Society. Mémoire L., 2009, pp. 144-160.

[19] P. Fernandes, "Réseau de Lithothèques en Rhône-Alpes", Villard de Lans: Paléotime archéologie préventive, 2014.

[20] P. Fernandes, V. Delvigne, "Réseau des lithothèques en Auvergne - Rhône-Alpes", Villard de Lans: Paléotime archéologie préventive, 2017.

[21] P. Fernandes, J. Raynal, "Pétroarchéologie du silex: un retour aux sources", Palevol, 5, 2006, pp. 829-837.

[22] P. Fernandes, J. Raynal, "Silex: une pétroarchéologie refondée", Les c@hiers de Géopré - Silex et territoires préhistoriques. Avancées des recherches dans le Midi de la France, 1, 2010, pp. 68-81.

[23] P. Fernandes, "Itinéraires et transformations du silex", Bordeaux: Université Bordeaux-1, 2012.

[24] B. V. Delvigne, P. Fernandes, M. Piboule, A. Lafarged, J. Raynal, "Circulation de géomatières sur de longues distances au Paléolithique supérieur: le cas des silex du Turonien du Sud du Bassin parisien", Comptes rendus Palevol, 16, 2016, pp. 82-102.

[25] V. De Santis, M. Caldara, The 5.5-4.5 kyr climatic transition as recorded by the sedimentation pattern of coastal deposits of the Apulia region, southern Italy. The Holocene, 25 (8), 2015 pp. 1313-1329.

[26] L. Pennetta, Analisi fisica integrata del territorio della Provincia di Foggia. Piano Territoriale di Coordinamento della Provincia di Foggia, 2001.

[27] F. Radina, "La Preistoria della Puglia. Paesaggi, uomini e tradizioni di 8000 anni fa", Mario Adda, 2002.

[28] F. Radina, G. Aprile, P. D'Onghia, G. Russo, M. Sicolo, S. Sivilli, I. Tiberi, "Società neolitiche del sud-est italiano tra VI e V millennio a.C. Simboli e modelli di circolazione mediterranea nella documentazione funeraria". 51° Riunione Scientifica dell'Istituto Italiano di Preistoria e Protostoria - Italia tra Mediterraneo ed Europa: mobilità, interazioni e scambi. Forlì, in press.

[29] F. Radina, M. Sicolo, S. Sivilli, "Il contesto rituale del Neolitico finale di Madonna delle Grazie (Rutigliano-Bari) nella Bassa Murgia Barese", in F. Radinaed, "Preistoria e Protostoria della Puglia. Studi di Preistoria" - 4. Bari: Edipuglia, 2017, p. 277-283.

[30] I. Tiberi, "Sant'Anna (Oria - BR) Un sito specializzato del VI millennio a.C", Galatina, Lecce, Italia: Congedo, 2007.