Diet of ancient and middle Neolithic populations in the northwest of Mediterranean. Anthropological and isotopic studies.

Gwenaëlle Le Bras-Goude

ACI "Spaces and territories" 2005-2007
Final conference - Dijon, 23-25 june 2008

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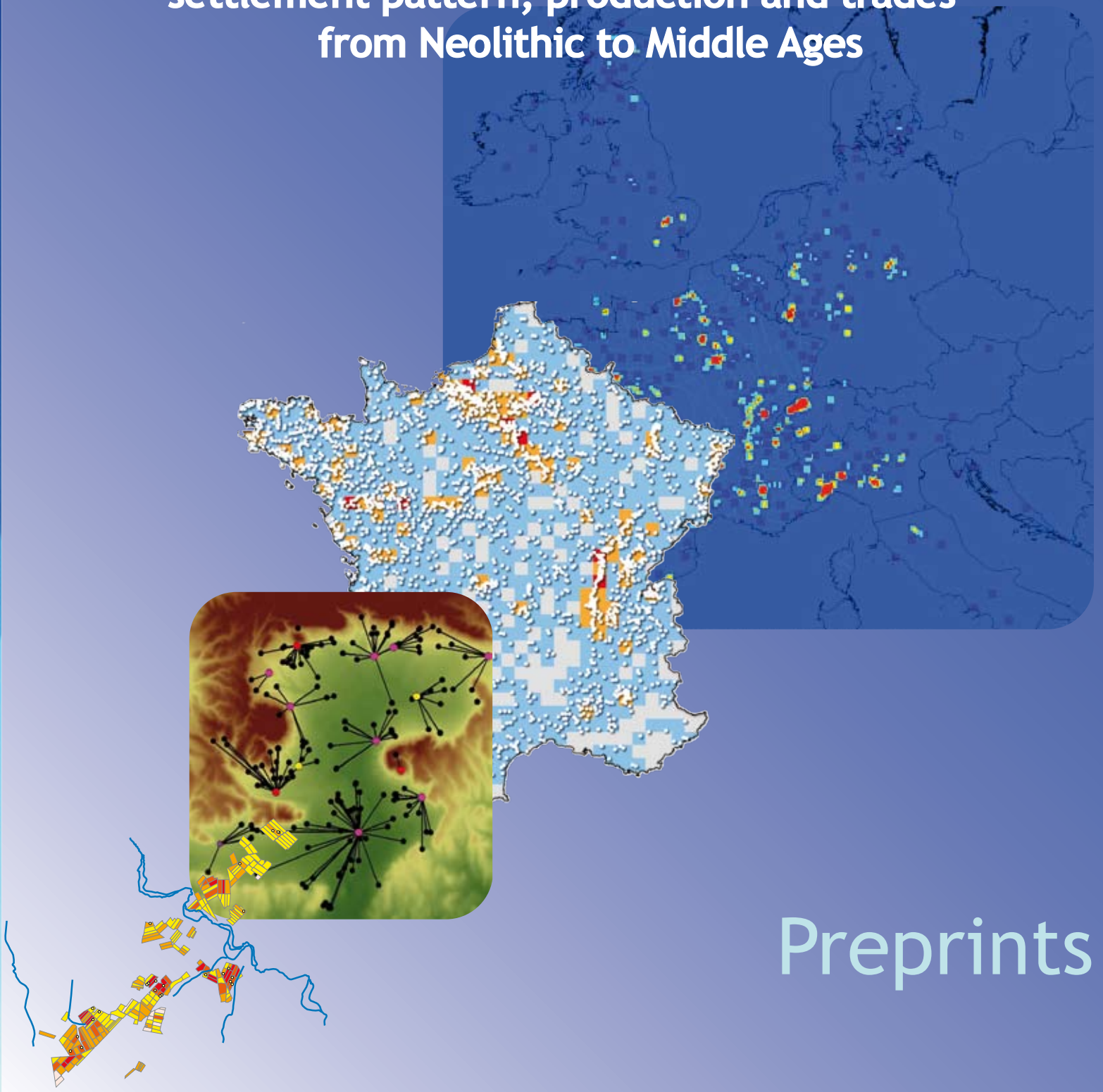
7 millennia of territorial dynamics

settlement pattern, production and trades from Neolithic to Middle Ages



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7 millennia of territorial dynamics

settlement pattern, production and trades from Neolithic to Middle Ages

Preprints

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DIET OF ANCIENT AND MIDDLE NEOLITHIC POPULATIONS IN THE NORTHWEST OF MEDITERRANEAN. ANTHROPOLOGICAL AND ISOTOPIC STUDIES.

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Abstract:

The aim of this communication is to characterize the individual and then the group diet of first Neolithic populations, and the ecosystem in which these populations drawn their resources. Isotopic analysis (δ13C and δ15N) was performed on one hundred human remains from early and Middle Neolithic sites in South of France and Liguria, and associated animal bones. Results indicate among others things that the difference observed may indicate an evolution of dietary choices through this period.

Key words : Neolithic, Diet, Mediterranean, Isotope, Palaeobehaviour

1. Introduction

At the end of the 7th millennium BC, social and economic changes occurred in the Northwestern Mediterranean linked with the introduction of Neolithic material culture into the region. A key change was the introduction of new methods of food production, particularly animal husbandry and agricultural techniques, as evidenced by archaeological, archaeozoological and archaeobotanic studies. These studies show that, in this geographical area, the diet of Early Neolithic populations is based on domestic (meat and milk of caprinae) and wild (*e.g.* marine molluscs) resources thought this of Middle Neolithic humans is predominantly based on domestic (vegetal and animal) one. Moreover, the social organisation of the middle Neolithic populations seems to be more organized into a hierarchy. The aim of this study is to bring complementary data about the individual and then the group diet of these populations. For this investigation, stable isotope ($\delta^{13}C$ and $\delta^{15}N$) method has been used, on human bone collagen and associated animal bones. This article synthesizes a set of results acquired during a Ph.D. about the foodstuff of northwestern Mediterranean Neolithic human groups (Goude, 2007).

2. Material and method

Eleven archaeological sites were studied in which hundreds of human bones and more of faunal remains were sampled. These sites are placed in various environments (close to the see, more inland, close to montains) between Liguria (Italy) and french Pyrenees. Chronologically they spread between the middle of VIth and middle of IVth millennium BC during the Ancient (Cardial, Fontbrégoua and VBQ cultures) and Middle Neolithic (Montbolo and Chasséen cultures) periods. For most of these sites, archaeological and archaeozoological information are available as anthropological (e.g. age, sex, stature) and funeral practices data. Altought the sites come from a wide region, all the Ancient Neolithic humans studied come from cave sites in Liguria and Provence. Besides, the sites dated to the Middle Neolithic come from open air sites in Languedoc and Pyrenees area.

Stable isotope method has been used for this study, because it provides direct dietary information on the protein sources in human diets, including the relative amounts of marine *vs*. terrestrial and animal *vs*. plant protein in diets (Ambrose, Norr, 1993; DeNiro, Epstein, 1978; Schoeninger *et al.*, 1983). The carbon and nitrogen isotope ratios ($^{13}C/^{12}C$: $\delta^{13}C$ and $^{15}N/^{14}N$: $\delta^{15}N$) are specific in plants

according to photosynthesis, environment and intrinsic parameters (Park, Epstein, 1960). The differences of isotope ratios in plants proteins are reflected in consumer's tissues synthesized with diet proteins (as bone collagen), with an increase in heavy isotope along the trophic web. The difference of isotope ratios in bone collagen between individuals from two successive trophic levels is +0,0 to +1,0 ‰ for $\delta^{13}C$ and +3,0 to +5,0 ‰ for $\delta^{15}N$ (DeNiro, Epstein, 1978; 1981; Minagawa, Wada, 1984). Thus, this method provides direct dietary information on the protein consumed, including the relative amounts of marine *vs*. terrestrial and animal *vs*. plant protein in diets. Moreover, the analysis of faunal remains is necessary to target known trophic level in the ecosystem studied for each site and then to suggest a relevant interpretation of data.

The bone collagen was extracted according to the Longin's protocol adapted particularly by Brown and colleague (Longin, 1971; Brown *et al*., 1988; Morlan *et al*., 1990; Nelson *et al*., 1986). The carbon and nitrogen contents and isotopic ratios are measured in 0.5 mg of freeze-dried collagen by IRMS (Isotope Ratio Mass Spectrometry, Thermo Finnigan Delta Plus XP) associated to an elemental analyzing (Flash EA System). The accuracy is 0.1 ‰ for both elements. Extraction and analysis were performed in the Department of Human Evolution (Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany).

3. Results and discussion

After checking out the preservation of extracted collagen, 70 humans[1] (27 for Ancient Neolithic and 43 for Middle Neolithic) and 91 faunal remains (54 for Ancient Neolithic and 37 for Middle Neolithic) are available and are include into the discussion (DeNiro, 1985; Bocherens *et al*., 2005a; 2005b). For Ancient Neolithic period, human isotopic results[2] range from -21.1 ‰ to -19.4 ‰ (-20.0 ± 0.4 ‰) for $\delta^{13}C$ and from 6.2 ‰ to 10.3 ‰ (8.9 ± 1.0 ‰) for $\delta^{15}N$ and faunal isotopic results range from -22.4 ‰ to -19.1 ‰ (-20.4 ± 0.7 ‰) for $\delta^{13}C$ and from 1.7 ‰ to 7.3 ‰ (4.8 ± 1.2 ‰) for $\delta^{15}N$. For Middle Neolithic period human isotopic results range from -20.8 ‰ to -19.2 ‰ (-19.8 ± 0.4 ‰) for $\delta^{13}C$ and from 4.7 ‰ to 12.1 ‰ (9.0 ± 1.2 ‰) for $\delta^{15}N$ and faunal isotopic results range from -21.1 ‰ to -17.9 ‰ (-20.0 ± 0.8 ‰) for $\delta^{13}C$ and from 4.4 ‰ to 7.5 ‰ (5.9 ± 0.9 ‰) for $\delta^{15}N$.

These results highlight two main features. Despite the relatively close proximity to the sea, there was no evidence of any significant consumption of marine foods, at once the first steps of neolithization fixed up in this region. Indeed, the expected $\delta^{13}C$ and $\delta^{15}N$ values for a marine resources consumer are higher than these recorded in the Neolithic population in south of France and Liguria (Chisholm *et al*., 1982; Schoeninger *et al*., 1983; Schoeninger, DeNiro, 1984; Richards, Hedges, 1991; Schulting *et al*., 2007). The main part of the protein comes from terrestrial environment and specifically from animals (meat and dairy products), and thanks to archaeozoological data, we know that most of these animal products are acquired in the sheep and goat breeding stock (Helmer, Vigne, 2004; Helmer *et al*., 2005; Vigne, 2007). Moreover, ranges of $\delta^{13}C$ of humans in both periods are similar; on the contrary range of $\delta^{15}N$ of humans is higher during the Middle Neolithic (7.4 ‰) than during the Ancient Neolithic (4.0 ‰) and the $\Delta\delta^{13}C_{human\text{-}fauna}$ and $\Delta\delta^{15}N_{human\text{-}fauna}$ are higher in Ancient Neolithic (4.1 ‰) than in Middle Neolithic period (3.1 ‰). These results suggest, first, that the consumption of animal proteins is more important during the Ancient Neolithic period, and second, that the diversity of diet is wider during the Middle Neolithic than the previous one. It may indicate an evolution of dietary choices through the first times of the Neolithic in the northwestern Mediterranean which could be in connection with the expansion of agricultural practices and perhaps migration (acquisition of food in different environments) during Middle Neolithic in Languedoc-Pyrenees region.

Stable isotope method allows the use of mathematical pattern (specifically in ecological fields) to estimate the proportion of specific animal protein in diet (e.g. Phillips, 2001; Phillips, Koch, 2002; Drucker, Henry-Gambier, 2005). But, in this study, the results were not included in this type of pattern for many reasons, particularly because isotopic values are not enough distinguished between animal species, and data from animals from different ecosystems are not available. Moreover, stable isotope method (C and N in collagen) is not currently suited to the establishment of a model linked to occupied territories during Neolithic periods in this area, among other things, because of lack of data (human and animal and also vegetal ones).

1. Individuals older than 3 years ago, to avoid the record of breastfeeding isotopic signal.

2. In consequence of their specificity (isotopic signature close to these of human), dogs are excluded of the discussion here.

Diet of Ancient and Middle Neolithic populations in the northwest of Mediterranean Anthropological and isotopic studies

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Introduction

At the end of the 7th millennium BC, social and economic changes occurred in the Northwestern Mediterranean. These changes are linked to the introduction of Neolithic material culture into the region as well as the introduction of new process of food production. The goal of this study is (1) to assess the food choices of human groups who lived in a diversified ecosystem and (2) to verify the modification of dietary practices through Neolithic periods (Ancient and Middle Neolithic; ca. 5500-3500 BC cal.). Stable isotope method has been used for this study because it provides direct dietary information on the protein sources in human diets, including the relative amounts of marine *vs.* terrestrial and animal *vs.* plant protein in diets, (Ambrose, Norr, 1993; DeNiro, Epstein, 1978; Schoeninger *et al.*, 1983). Isotopic measurements were performed on 70 human and 91 faunal remains from eleven Neolithic sites located between Liguria (Italy) and french Pyrenees (fig. 1.A). This work was carried out in a Ph.D. (Goude, 2007), granted by CNRS, Aquitaine region, Max Planck Institute and INRAP.

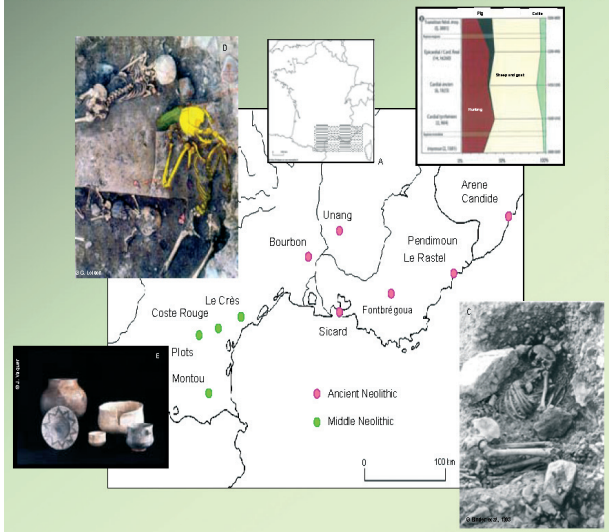


Fig.1. A: place of the archaeological sites; B: proportion of faunal remains in Ancient Neolithic sites (Vigne *et al.* 2007 p 258); C: Ancient Neolithic burial From Pendimoun; D: a Middle Neolithic burial from Le Crès; E: grave goods from Les Plots.

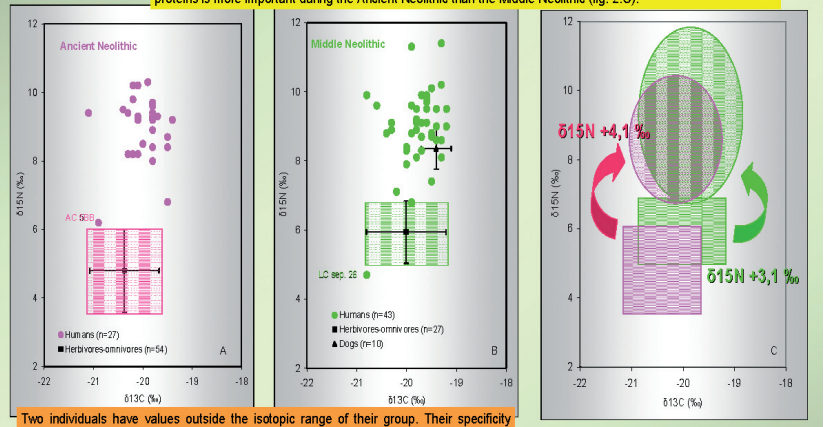
Archaeological context

Ancient Neolithic: sites are only in caves placed in Provence region. The livestock is dominated by sheep and goat (fig.1.B). The individuals are buried in flexed position in pits (fig 1.C)

Middle Neolithic: sites are mainly open air sites in Languedoc region. The livestock is dominated by cattle and sheep/goat. The funeral practices are very diversified (e.g. in silo-pits; fig. 1.D) with different laying out and goods (e.g. fig. 1. E).

Results

Human isotopic values are similar between both periods but it is not the case for animals (fig. 2. A , B). Range of δ15N values is higher for Middle Neolithic herbivores/omnivores than for Ancient Neolithic one. Thus, the relative difference between human and animal data is different between these periods. Thereby, the consumption of animal proteins is more important during the Ancient Neolithic than the Middle Neolithic (fig. 2.C).



Two individuals have values outside the isotopic range of their group. Their specificity could be related to their age, sex, geographic origin or pathology (fig. 2. A, B).

Fig.2: δ13C and δ15N of Ancient (A) and Middle Neolithic (B) humans and faunal remains and the place in the trophic web of humans from each period compared to the animals (C).

Modeling dietary practices ?

The Linear Mixing Model (LMM) performed by Phillips and Koch (2002) provides quantitative estimates of the proportions of food sources in consumer's diet. For its application, we need isotopic values of 3 different dietary poles. In this study we used known values of plants and meat (specific for each period) and data from literature for fish (Pouydebat, 1997).

Results (fig. 3) show that (1) there is no evidence of any significant consumption of marine foods and that (2) there is a difference of protein consumption between the two Neolithic groups.

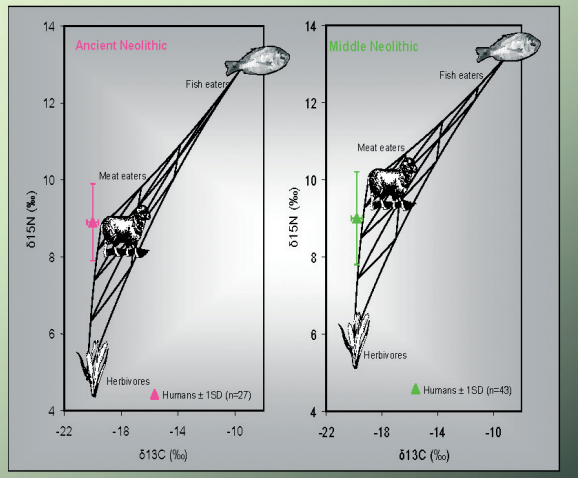


Fig.3. Application of the LMM (Phillips and Koch, 2002) to the Ancient and Middle Neolithic humans. Tops of the triangle represents 3 dietary poles.

Conclusion

The main part of the protein eaten by the Ancient Neolithic populations comes from terrestrial environment and specifically from animals (meat and dairy products). Most of these animal products are acquired in the sheep and goat breeding stock (Helmer, Vigne, 2004; Helmer *et al.*, 2005; Vigne, 2007). During Middle Neolithic, proteins come from a mixed diet (vegetal and animal) in which the part of the animal resources is varied according to the individual. Marine resources seem to be excluded or occasional of the diet of the first Neolithic populations. Results may also indicate changes of dietary choices through the first times of the Neolithic in the Northwestern Mediterranean which could be in connection with the expansion of agricultural practices and perhaps migration (acquisition of food in different environments) during Middle Neolithic in Languedoc region. Perspectives of research are to study other populations for increase the sample size and test with relevance possible correlation between isotopic results and biological features which could be related to social status for example (Le Bras-Goude *et al.*, 2006).

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