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New radiocarbon dates and isotope analysis of Neolithic human and animal bone from the Fontbrégoua Cave (Salernes, Var, France)

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Summary - *This article presents the results of stable carbon and nitrogen isotope analysis carried out on 12 human and 13 animal bones from the Neolithic cave of Fonbrégoua located in southern France. The stable isotope data shows that the humans had diets in which the protein sources were mainly from terrestrial animals. Six new radiocarbon dates on human bone indicate that the deposition of human remains at the site occurred during the Cardial phase (ca. 5450-5100 BCE cal.) as well as through to the transition to the middle Neolithic (ca. 5100-4800 BCE cal.). The isotopic human dietary patterns at Fontbrégoua are similar to other Neolithic sites in the South-east of France and in Liguria (Italy), indicating similar dietary adaptations in this area during this period. Radiocarbon dates on humans from the site indicate that human burial practices at this site occurred over a long time period.*

Keywords - *Neolithic, Diet, Stable Isotopes, Radiocarbon, Cannibalism, Burial customs.*

Introduction

In the last twenty years, stable carbon and nitrogen isotope analyses have been widely used to study dietary adaptations of Neolithic populations, mainly in northern Europe (e.g. Tauber, 1981; Richards & Hedges, 1999, 2000; Richards *et al.*, 2003; Lidén *et al.*, 2004). The ratios of both the stable isotope carbon ($^{13}C/^{12}C$) and nitrogen ($^{15}N/^{14}N$) measured on the organic fraction (i.e. collagen) of bone and teeth make it possible to evaluate the sources of dietary protein intake, especially to distinguish between marine *vs*. terrestrial foods (DeNiro & Epstein, 1978; Chisholm *et al.*, 1982; Schoeninger *et al.*, 1983). The relative importance of animal *vs*. plant protein in diets, which is indicative of the trophic level (DeNiro & Epstein, 1981; Minagawa & Wada, 1984; Bocherens & Drucker, 2003), can also be determined mainly through the

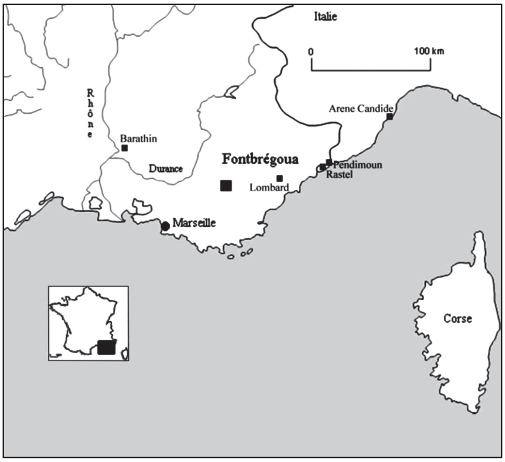

Fig. 1 - Location of the site of Fontbrégoua, and other Neolithic sites mentioned in the paper.

measurement of nitrogen isotopes. In bone, this method provides individual information about the diet of the last years of an individual's life (Ambrose & Norr, 1993). A number of studies have been conducted on Mesolithic and Neolithic sites located in the north-western Mediterranean (Francalacci & Borgognini Tarli, 1988; Richards *et al.*, 2001; Giorgi *et al.*, 2005; Garcia Guixé *et al.*, 2006; Le Bras-Goude *et al.*, 2006a,b) which revealed, among other things, the lack of marine resources in the Neolithic diet of coastal populations, as is the case in many other areas of Europe (e.g. Lillie & Richards 2000; Richards & Hedges, 2000; Richards *et al.*, 2003; Richards & Schulting, 2003).

In southern France, dietary inferences in the Neolithic period are mainly based on archeobotanical and zooarchaeological data (e.g. Helmer & Vigne, 2004; Bouby & Léa, 2006) and stable isotope analysis has only recently been applied to this area (Goude, 2007). This paper presents the results of one of the stable isotope studies on human and faunal remains, conducted on the French Mediterranean Neolithic sites, along with a series of new radiocarbon dates. Combined with the previous archaeological studies carried out at this site, these results aim to produce new information on human diets and funerary practices in this region during the Neolithic.

The site of Fontbrégoua

Fontbrégoua cave is located in the south-east of France, ca. 100 km from Marseille and the Mediterranean coast (Fig. 1). The site was excavated by André Taxil between 1948 and 1960 and then by Jean Courtin during the 1970s (Binder, 1987). The settlement is divided into three areas and was occupied from the Upper Palaeolithic to the end of the Neolithic. Most of the material was found in the Neolithic layers (ca. 5400-3600 cal. BCE). The Neolithic artefacts consist mainly of pottery, lithic and bone tools. However, charcoal, charred cereals and legumes are also found in the Neolithic deposits at the site (Courtin *et al.*, 1976).

Several studies have been carried out on the human and animal bones (Cheylan & Courtin, 1976; Helmer, 1979,Villa *et al.*, 1985; 1986, Villa & Courtin, 1991; Villa, 1992). The zooarchaeological studies reveal that both wild and domestic animals contributed to the diet during the Early Neolithic period (second half of the 6th millennium BCE). Wild animals represent 25% of the faunal assemblage, domestic animals 48% and undetermined remains 27% (Helmer, 1979). The frequency of wild game decreased by half during the Middle Neolithic period, probably due to the more intensive farming of domestic livestock (Helmer, 1979). Domestic animals were mainly sheep/goat, most likely herded in the cave, suggesting a seasonal occupation of the settlement (Villa *et al.*, 1985; 1986). Additionally, there are freshwater turtle remains (osseous blotch of *Emys orbicularis*) in the Early Neolithic layers, showing a regular consumption of this species during this period. However, the consumption of turtles seems to decrease sharply during the Middle Neolithic period (Cheylan & Courtin, 1976). Numerous cut marks on animal bones found in different pit structures were also studied in detail, and the data provide information about butchering techniques and food resource management (Villa *et al.*, 1985, 1986).

The site of Fontbrégoua is also well known for its human remains, which are also found in pit structures (designated H1, H2 and H3, Fig. 2).

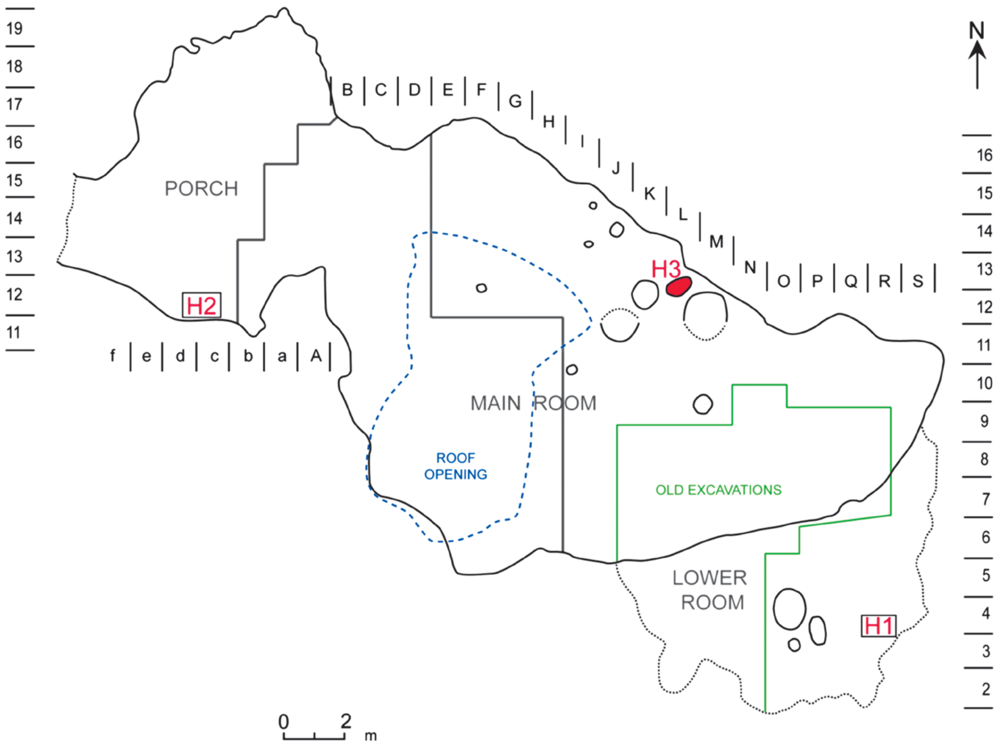

Fig. 2 - Plan of the cave of Fontbrégoua, from Villa* et al.*, 1988 (DAO A. Zemour).

The anthropological remains consist of six children, seven adults, an individual of unknown age, and a group of cranial and post-cranial remains from at least seven humans (*ibid*.). No information about sex, pathologies, or precise data about age at death is currently available. Most of the human remains have cut marks, which have been interpreted by several authors as evidence of human defleshing and potentially cannibalism (e.g. Villa *et al.,* 1985, 1986; Villa & Courtin, 1991; Villa, 1992). This last point, however, has been greatly debated (Bahn, 1990; Villa & Courtin, 1991).

Materials and Methods

The sampling of the human remains was undertaken minimising the damage to the bones, and was undertaken with the assistance of curators in charge of the collection in the Museum of Quinson. Casts of some of the sampled bones were also made in the Laboratory of Anthropology in Bordeaux (UMR CNRS 5199 PACEA-LAPP, France). For preservation reasons, only the anatomical part of adult bone remains without cutmarks were selected for the analysis: three individuals from pit structure H1 (non matched humeri), two individuals from H2 (two anatomically different fragments previously suspected to belong to the same individual; Villa *et al*., 1986), four individuals from H3 (left tibia selected), three fragments of individuals out from the structures (corresponding to at least two individuals: one fragment of cranium and two of right femur). Thirteen adult domestic and wild animal bones from the Early Neolithic layers (including sheep, cattle, pig, roe deer, and red deer) were also sampled to provide baseline data on the local ecosystem.

Bone collagen was extracted according to the modified Longin (1971) method (Richards & Hedges, 1999) with the addition of an ultra-filtration step (Brown *et al.,* 1988), from which the >30 KDa fraction was freeze-dried. The collagen (0.45-0.55 mg) was then analyzed in a ThermoFinnigan Flash EA coupled to a Delta Plus XL mass spectrometer, at the Department of Human Evolution (Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany). The analytical precision is ± 0.1 ‰ for both $\delta^{13}C$ and $\delta^{15}N$.

Stable isotope results

In order to assess the preservation state of the extracted collagen, different criteria were used. These were the carbon content greater or equal to 30% and nitrogen content greater or equal to 10% (Ambrose, 1990) and C/N ratios between 2.9 and 3.6 (DeNiro, 1985). Stable isotope data from collagen with lower elemental composition and C/N ratios out of this range were excluded. In this study, the extraction yield was not used as a criterion (Ambrose, 1990) of preservation state due to the use of an ultrafiltration technique which may considerably decrease the amount of extracted collagen in bone.

All the results are given in Table 1. Three human and one animal sample were poorly preserved and were therefore excluded. However, we kept the FH1-1 sample for which the C content is very close to 30% and the N content as well as the C/N are correct. The well-preserved samples have a carbon content of 40.5%, on average (± 3.2%, n = 21), and a nitrogen content of 14.7%, on average (± 1.2%) and C/N ratios ranging from 3.1 to 3.3. Table 1 shows $\delta^{13}C$ and $\delta^{15}N$ values for both faunal and human remains. The $\delta^{13}C$ values for domestic (-20.1 ± 0.5‰, n =7) and wild herbivores (-20.6 ± 0.1‰, n = 3) as well as pigs (-20.0 ± 0.0‰, n = 2) are within the range measured for these species feeding in the temperate terrestrial C_3 ecosystem. The lowest mean $\delta^{15}N$ values are those of wild herbivores (4.7 ± 0.4‰) followed by domestic herbivores (5.6 ± 1.0‰). The highest $\delta^{15}N$ values are found in the bone collagen of omnivorous species: pigs (6.1 ± 0.8‰). Human $\delta^{13}C$ values range from -20.4 to -19.8‰ (-19.9 ± 0.2‰, n = 9) and $\delta^{15}N$ values range from 9.2 to 9.7 (9.5 ± 0.2‰).

Discussion of stable isotope data

The $\delta^{13}C$ range of the faunal species (1.3‰) suggests that the domestic and wild animals probably fed in the same environment. On the other hand, the $\delta^{15}N$ range (2.8‰) indicates differences in food consumption according to the species. Statistical tests performed between each species show that sheep have significant lower $\delta^{15}N$ values (4.7 ± 0.3, n = 4) than cattle (6.5 ± 0.7, n= 3) (U Mann-Whitney test, p = 0.05).

As sheep and cattle are both herbivores, they are ruminants with similar digestive physiology - The difference in $\delta^{15}N$ could be related to a difference in diet, with sheep possibly consuming more ^{15}N-depleted plants (e.g. legumes like vetch, alfalfa, clover) than cattle. Legumes are able to fix atmospheric nitrogen and therefore their $\delta^{15}N$ values are lower than in non-nitrogen fixing plants (Virginia & Delwiche, 1982; Schoeninger & DeNiro, 1984). Hence, consumers of legumes have lower bone collagen $\delta^{15}N$ values than the consumers of non-nitrogen fixing plants. Therefore, it is possible that the sheep consumed more legumes than the cattle, which resulted in lower nitrogen isotope values.

However, considering the small sample size, this hypothesis needs to be supported with more data and the botanical remains found in the Neolithic layers at Fontbrégoua support the importance of cereals (wheat and barley) compared to legume species (vetch) (Courtin *et al.,* 1976; Courtin, 2000).

For the humans, both the carbon and nitrogen stable isotope ranges are very low (0.6‰ for C and 0.5‰ for N; n = 9), suggesting that all protein consumed came from the same resources and that all these individuals probably had a similar diet. The human stable isotope values do not show any statistical differences according to their placement

Tab. 1 - Measurements performed on bone collagen from Fontbrégoua (R: right and L: left)

N°SAMPLES	SPECIES	ANATOMICAL PART	$\Delta^{13}C$ / VPDB (‰)	$\Delta^{15}N$ / AIR (‰)	C/N ATOMIC	%C	%N	COLLAGEN YIELD (MG/G)
FH1-1	Human	Humerus L	-20.4	9.4	3.3	29.4	10.5	2.0
FH1-2	Human	Humerus	-19.8	9.5	3.2	41.5	15.2	91.7
FH1-3	Human	Humerus R	-19.8	9.4	3.2	42.7	15.5	94.8
FH2-9/10	Human	Fibula	-20.1	9.3	3.2	41.8	15.2	60.2
FH2-11	Human	Cranium	-20.2	9.2	3.3	43.3	15.4	90.1
FH3-A	Human	Tibia L	-19.8	9.8	3.2	43.6	15.7	53.5
FH3-B	Human	Tibia L	-19.8	9.2	3.1	37.8	14.1	48.3
FH3-C	Human	Tibia L	-19.8	9.6	3.1	42.4	15.8	30.6
FH3-D	Human	Tibia L	*-19.8*	*9.3*	*3.6*	*18.1*	*5.9*	*4.5*
FHS-5	Human	Cranium	-19.8	9.7	3.2	37.5	13.8	6.4
FHS-6	Human	Femur R	*-20.1*	*10.3*	*3.9*	*17.3*	*5.2*	*2.7*
FHS-7	Human	Femur R	*-19.7*	*8.4*	*3.0*	*9.4*	*3.7*	*5.2*
FB 1252	Sheep	Tibia	-19.8	4.5	3.2	42.5	15.5	65.9
FB 1081	Sheep	Metatarsus	-19.9	5.0	3.2	42.8	15.7	75.3
FB 1411	Sheep	Femur	-20.1	4.9	3.2	40.7	14.9	68.4
FB 1599	Sheep	Humerus	-19.7	4.5	3.2	40.7	14.9	81.9
FB 1488	Cattle	Mandibula	-20.1	6.1	3.2	43.0	15.6	79.2
FB 962	Cattle	Femur	-21.1	6.0	3.4	34.9	11.8	3.5
FB 473	Cattle	Metacarpus	-19.8	7.3	3.2	41.6	15.2	95.1
FB 875	Pig	Humerus	-20.0	6.7	3.2	41.2	15.1	56.7
FB 652	Pig	Tibia	-20.0	5.5	3.2	42.0	15.3	43.7
FB 313	Pig	Femur	*-19.9*	*8.9*	*3.5*	*20.5*	*6.7*	*6.7*
FB 1052	Red deer	Mandibula	-20.6	4.5	3.1	39.0	14.5	62.4
FB 447	Red deer	Metatarsus	-20.6	4.5	3.2	39.3	14.5	4.0
FB 1027	Roe deer	Omoplate	-20.8	5.2	3.5	42.2	14.1	4.9

in the structures (H1, H2, H3 and HS). Due to the nature of the deposit (the human remains were found deeply placed within pits; Villa, 1992; Villa & Courtin, 1991), the few anatomical connections do not allow any comparison between individual stable isotope data and anthropological information. Therefore, whatever the sex, age, or social distinctions of these individuals, all appeared to have the same dietary patterns.

Two fragments of human bone from the H2 structure that were believed to have belonged to the same individual, were sampled. Despite the fact that the isotopic results of these two samples are similar (FH2-9-10 and FH2-11, Tab. 1), we believe that these bones represent two different individuals due to their different radiocarbon dates, which we discuss below (Tab. 2).

The average isotopic enrichment between humans and animals (all species) is +0.3‰ for carbon and +4.1‰ for nitrogen. The $\delta^{13}C$ as well as $\delta^{15}N$ values do not indicate any measurable marine protein intake (Chisholm *et al.*, 1982; Schoeninger & DeNiro, 1984), which is in agreement with both the location of the site (ca. 100 km from the Mediterranean Sea) and the lack of fish remains at the site.

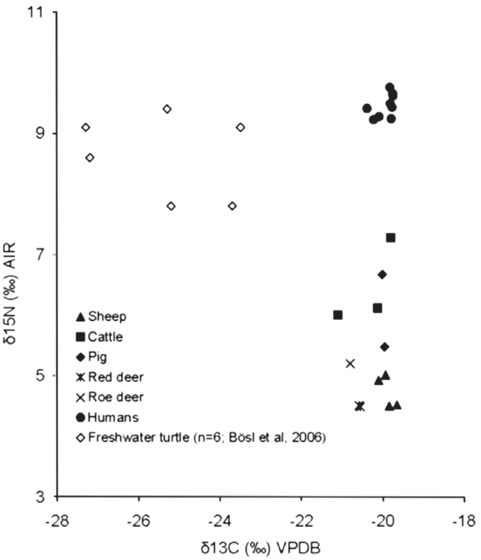

Fig. 3 - δ^{13}C and δ^{15}N values of bone collagen of humans and animals from Fontbrégoua, as well as of freshwater turtles (data from Bösl* et al.*, 2006).

The relatively high placement of humans in the food web and the relatively low δ^{13}C enrichment between humans and animals (less than 1‰) could hint at the consumption of another type of food such as the aquatic turtle (Fig. 3). Remains of *Emys orbicularis* were found in the site and the herpetological study (Cheylan & Courtin, 1976) shows that this species was commonly consumed during the Early Neolithic period with a decrease during the later phases of the Neolithic. The European pond turtle is a carnivorous species living in aquatic environments, which means it often has distinctive stable isotope values. It was not possible to sample turtle fragments at Fontbrégoua (due to their poor preservation), thus stable isotope values for this species are not yet available for the Neolithic period in the south of France. Some stable isotope data are available for other places in Europe. Bösl *et al.* (2006, Germany) showed the average values of the Neolithic (3800-3300 cal. BCE) European pond turtle to be -25.4‰ (± 1.6) and 8.4‰ (± 0.7; n = 6) for δ^{13}C and δ^{15}N respectively (Fig. 3). A sizeable consumption of these species with these isotope values would result in much higher δ^{15}N values and lower δ^{13}C values in human bone collagen than those measured at Fontbrégoua. If these isotope values were to be applied to Fontbrégoua, they would indicate that the consumption of the European pond turtle at this site was not in significant enough quantities to be an important source of dietary protein, but may have been a supplementary food resource, most likely consumed during periods of food shortage. However, this conclusion needs to be confirmed by the stable isotope analysis of contemporary turtles from the site.

The human stable isotope data indicate that the majority of protein intake came from terrestrial animals, and the zooarchaeological study shows that these animals were exploited for both flesh and dairy products (Helmer & Vigne, 2004). Domestic plants, such as the burnt cereals found in the site, were apparently not an important protein source in the diet. According to Villa *et al.* (1985, 1986), Fontbrégoua was probably visited seasonally, and the excavated structures represent butchering events from restricted periods. In Provence and Liguria, rock shelters and caves were generally used during the Impresso-cardial period (ca. 6th millennium cal. BCE) as seasonal herding or hunting places (e.g. grotte Lombard: Binder, 1991; abri Pendimoun: Binder *et al.*, 1993; Arene Candide: Maggi, 1997). The Cardial economy is therefore most likely based upon complementary activities with open-air villages at the centre of the territory (e.g. the site of Baratin-Courthézon: Sénépart, 1988), and seasonal shelters on the periphery, such as Fontbrégoua (Binder, 1991; Binder, 2000; Binder & Sénépart, 2004).

In the north-western Mediterranean area, and in particular southern France and Liguria, Italy, stable isotope studies have been conducted on Early (ca. 2nd half of the 6th millennium cal. BCE) and Middle Neolithic sites (ca. end of the 6th and first half of the 5th millennium cal. BCE) (Le Bras-Goude *et al.,* 2006a,b; Goude, 2007) (Fig. 1). These studies showed that the 3.4‰ to 4.4‰ δ^{15}N increase between herbivores and humans is similar to that found at Fontbrégoua. Additionally, in spite of the proximity of the sea

Tab. 2 - AMS dates performed on human bone collagen from Fontbrégoua (calibration using OxCal program Version 3.9, Bronk Ramsey, 2003).

N°SAMPLES	ANATOMICAL PART	LAB REF	RADIOCARBON DATE BP	CALENDAR INTERVAL (2Σ)	CALENDAR INTERVAL (1Σ)
FH2-9/10	Fibula	GrA-38336	6390 ± 40	5480 - 5300	5470 - 5310
FH2-11	Cranium	GrA-38334	6240 ± 35	5310 - 5060	5300 - 5080
FH1-3	Humerus	GrA-38522	6115 ± 35	5210 - 4850	5200 - 4950
FH3-C	Tibia	GrA-38332	6110 ± 35	5210 - 4850	5190 - 4950
FH1-2	Humerus	GrA-38335	6065 ± 30	5050 - 4840	5020 - 4850
FH3-B	Tibia	GrA-38329	6055 ± 35	5050 - 4800	5000 - 4850

for most of these sites, no marine food was consumed (*ibid.*). All of these results show that a diet dominated by a high proportion of terrestrial animal proteins appears to characterise the first stages of the Neolithic in this area and support the hypothesis of the prevalence of pastoralist practices over agricultural ones (Beeching *et al.*, 2000) during this period. However, the stable isotope results at Fontbrégoua are different from the other sites. Often humans have a wider range of stable isotope values, while at this site humans show a more restricted range. However, we must point out that the small size of the adult population at Fontbrégoua could introduce a bias.

Radiocarbon dates, archaeological contexts and cannibalism

We obtained six radiocarbon dates on human bone collagen from the site. As the stable isotope analysis indicates that the human collagen of the Fontbrégoua individuals was well preserved and did not provide any evidence for the significant consumption of marine or fresh-water foods, there should not be any reservoir effects on the radiocarbon dates. Six collagen samples were dated by accelerator mass spectrometry (AMS) at the Gröningen laboratory (The Netherlands) (Tab. 2). The radiocarbon measurements and contextual data clearly show distinct deposition events of human remains at the Fontbrégoua cave, through the Cardial phase and also during the transition to the middle Neolithic (Pre-Chassey Culture). The set of radiocarbon dates can be divided into two groups: one from the pit structure H2 and the other from the pit structures H1 and H3. Calibration and combined probabilities were obtained using the OxCal program Version 3.9 (Bronk Ramsey, 2003) (Tab. 2).

The pit H2 is close to the cave's vestibule, and human bones thought to belong to the same individual (Villa *et al.*, 1986) were discovered associated with a set of impressed wares, consistent with the classical Cardial stage. GrA-38336 and GrA-38334 date within the range of the Cardial Culture, the second stage of the Western Mediterranean Impresso-cardial complex (Binder, 2000), which evolved between ca. 5450 and ca. 5100 cal. BCE in the Provence region. The differences between both radiocarbon dates obtained from the pit H2 are too large to be interpreted as fluctuations of the radiocarbon calibration curve [χ^2-Test: df = 1, T = 7,983 (5% 3.8)]. This implies that (1) the dated bones probably do not belong to the same individual; (2) pit H2 was reused for human depositions after a significant interval of time.

The second group consists of a set of four dates obtained from the pit H1 (2 dates), localized to the rear of the cave, and from pit H3 (2 dates), close to its northern wall. The archaeological context of H1 remains unclear due to its topographical position and the mixing of soils caused by rainwater flows in this zone. However, pit H3 comes from a clear context linked to the very beginning of the Pre-Chassey culture sequence: a narrow chisel made of alpine green stone, a typical bifacial piercing arrowhead shaped by percussion (type PB.3.1 from Binder, 1987) and eight pieces of calcareous bracelets that belong to at least three rings were closely associated with the human bone deposit. H3 had previously provided a radiocarbon date on bone collagen (Villa *et al.*, 1986, note 12, p. 156: Ly.3748, 5880 ± 130 BP, 5100-4400 cal BCE / 2σ). While imprecise, the latter nevertheless fits with both AMS dates obtained for H3.

Concerning H1 and H3 dates, the two groups of dates are similar, with the same range of ages found within each pit. The combined probabilities identify the following periods of use:

- Samples FH1-2 and FH1-3: [5005-4940 cal BCE] with 53.2% confidence intervals or [5060-4910 cal BCE] with 88.8% confidence intervals for H [χ^2 Test: df = 1, T = 1.2 (5% 3.8); combined date: 6086±23 BP];
- Samples FH3-B and FH3-C: [5040-4940 cal BCE] with 66.0% confidence intervals or [5060-4910 cal BCE] with 87.78% confidence intervals for H3 [χ^2 Test: df = 1, T = 1.2 (5% 3.8); combined date: 6083±25 BP].

The human bone deposits in H1 and H3 should be considered as contemporary or at least very close in age. This result corresponds with the hypothesis that the structures H1 and H3 could have contained the remains of the same individuals, based upon the complementary profiles of the anatomic segments (Villa *et al.*, 1986, p.151, note 5; Boulestin, 1999, p.232).

The relatively insignificant differences in radiocarbon dates observed between the individual from the latter period could be due to either variations of the radiocarbon curve or it could confirm the theory of a unique use of the pits for the disposal of human remains after post-mortem manipulation and consumption. Nevertheless, considering the results obtained for H2, the hypothesis of reuse(s) of both pits H1 and H3 after a small interval of time cannot be totally rejected.

Many pit structures were dug into the Fontbrégoua dolomite sands and quickly covered over following the disposal of butchery wastes (Villa *et al.*, 1985). Some of these pits cut into each other and there is currently no evidence of the long use of such structures at Fontbrégoua. The archaeological evidence of reuse is not obvious, however, and needs a very precise analysis of 3D data, including refitting. Considering the hypothesis of H2 reuse for the disposal of processed human bones, the interpretation of Fontbrégoua practices previously developed by Villa and Courtin might need to be significantly modified. Reuse could mean that pit locations were known by people using the cave and perhaps even marked, or somehow signalled, within the landscape. The marking of Early Cardial burials has already been described at the Pendimoun shelter in the same area (Binder *et al.,* 1993). The hypothesis of pit reuse should also include the possibility of ritual activities. The interpretation of the cutmarked human bones at Fontbrégoua could move away from cannibalism towards mortuary practices, perhaps in the sense of Cl. Lévi-Strauss “Positive Anthropophagy” (Levi-Strauss, 1955). The “usual”, and in fact the most simple pattern known for this period and region consists of a primary inhumation in a pit with the body laid on the side and with limbs tucked near the trunk (e.g. sites of Pendimoun and Bourbon for the Cardial, Le Rastel and Arene Candide for the VBQ Middle Neolithic). However, current studies (Chambon, 2006; Zemour, in press) highlight burial pattern variability. Fontbrégoua could then illustrate another set of funerary practices and rituals, distinct from the typical burials. The data from the Adaouste cave (Mafart, Baroni & Onoratini, 2004), that show many parallels with H3 data and context, confirm this view.

The resolution of this set of questions requires new developments in archeo-anthropological studies in order to identify the distribution of individuals within the pits much more precisely (particularly H1 and H3). Future AMS and hopefully ancient DNA analyses will be useful for trying to clarify the internal chronology of each pit filling.

Conclusions

Our isotopic study at the site of Fontbrégoua (Salernes, Var, France) shows that the humans found in the pit structures, dating to the early phases of the Neolithic, consumed a diet where the protein sources were mainly from terrestrial animals. These data match those from the same period in southern France and Liguria, Italy.

This study also highlighted a strong homogeneity among the human stable isotope values. Despite the small size of the population, a frequent problem for sites of this period, all other known sites in this region do not show such a small variation in isotopic values. This data, therefore, indicates that whether or not there were social and/or biological (e.g. sex, age) distinctions between individuals at this site and in this time period, the humans we sampled all had the same dietary pattern.

Radiocarbon dates on humans from the site indicate that human burial practices at this site occurred over a long time period. The interpretation of the range of radiocarbon dates within the same structures and the testing of the hypothesis of pit reuse and the subsequent cultural meaning of these practices offer new issues that will require analytical developments.

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