Approach to the Absolute Chronology of the Human Settlement in the Oukaïmeden Valley, (High Atlas, Morocco). Some Comments

Aproximación a la cronología absoluta del asentamiento humano en el Valle de Oukaïmeden (Alto Atlas, Marruecos). Algunos comentarios

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Received: 16-06-2014
Accepted: 12-11-2014

Abstract

Twenty nine radiocarbon dates were obtained from different test pits in Oukaïmeden Valley. Most of them -13 dates- were performed over samples from the Neolithic site of Aougnin n'ait Ourigh, although those collected in 2012, provided an older chronology than others from the 2010 campaign. Regarding the kind of associated artefacs, the most plausible dating is Late Neolithic. Furthermore, other dates were obtained for the context 700 (Aougnin n'ait Ourigh,), two of which dated from the Bronze Age, matching with the associated ceramics. These samples allowed us to establish a relationship between rock carvings with certain weapons and others depicted or recovered in excavation in Europe and dated to Bronze Age. In the Elephants' Shelter, we obtained a date for an End-Neolithic- Copper Age context and another from the Almoravid-Almohad period. Four other samples from the Elephants' Frieze are discussed. The last five dates were obtained aiming to perform a paleoclimatic reconstruction of the valley. Along with the previous dates, we obtained a 6000 year record.

Key words: *C-14 dating, chronology, paleoclimatic reconstruction, Morocco.*

Resumen

Se han obtenido veintinueve fechas procedentes de diversos sondeos en el Valle de Oukaïmeden. La mayoría – 13 fechas – se obtuvieron sobre muestras del sitio Neolitico de Aougnin n'ait Ourigh, algunas de las cuales, tomadas en 2012, proporcionan una cronología más vieja que otras de las campañas de 2010 y 2012. De acuerdo con el material asociado, la cronología más probable es Neolitico Final. Además, otras fechas se obtuvieron en el contexto 700, (Aougnin n'ait Ourigh), dos de ellas correspondientes a la Edad del Bronce, lo que coincide con las cerámicas asociadas. Ello permite relacionarlo con algunos grabados de armas similares a modelos de la Edad del Bronce Europea. En el abrigo de los Elefantes obtuvimos una fecha para una ocupación de Neolítico Final-Edad del Bronce y otra para época Almohade-Almoravide. Se discuten otras cuatro fechas obtenidas en el Friso de los Elefantes. Las últimas cinco dataciones proceden de sondeos para reconstrucción paleoclimática. En total, poseemos un registro de cerca de 6000 años.

Palabras clave: *Datación radiocarbonica, reconstrucción paleoambiental, Marruecos.*

Introduction

Carbon-14 dating is the most common physico-chemical method used to determine the chronology of an occupation in prehistoric archaeological sites. It provides an independent measurement based on the radioactive disintegration rate of the 14C isotope found in the remains of organisms that lived in the past 50,000 years. Although it is possible to date any remains containing carbon atoms in their structure, archaeologists have to identify those elements that are undoubtedly connected with (association) and contemporary (synchrony) to the cultural process they desire to date. This guarantees the relevance of the results while interpreting the site (Waterbolk 1983; Van Strydonck *et al.*1999)

Two of the objectives established for the archaeological campaigns in the Oukaïmeden Valley aimed to find suitable materials to establish carbon-14 chronologies (Ruiz-Gálvez *et al.* 2011). The first objective was to excavate several rock shelters and burial mounds and obtain chronological information that would link the rock carvings to the human occupation of the territory, as well as to define its seasonality, regularity and impact on the transformation of the landscape. The second was to obtain pollen samples and perform a palaeo-environmental reconstruction by combining pollen and radiocarbon data from the wet areas and excavated sites. While a significant number of dates (29) were obtained, it must be highlighted that most of them were performed on carbonaceous sediments and small charcoal deposits without well-defined associated structures, due to the degree of erosion by snow and thaw processes undergone by the excavated shelters and mounds. Thus, it is difficult to obtain the appropriate degree of association and synchrony, and a greater effort is required to obtain a coherent explanation of the dates.

Methodology

During the several excavation campaigns of the project, a total of 29 samples datable by radiocarbon were obtained from the different test pits performed throughout the valley. The samples were processed in two different laboratories. Those presenting enough material to be dated following the standard procedure were processed in the *Laboratorio de Geocronología del CSIC*, using either a proportional counter for CO_2 or a liquid scintillation spectroscopy on benzene. Due to the scarcity of the material, only three samples were dated using this procedure. The rest (27 samples) were sent to the *Centro Nacional de Aceleradores* (Sevilla University - CSIC) to be dated with the AMS technique (Accelerator Mass Spectrometry).

Notwithstanding the differences between each technique, both laboratories applied the standard acid/alkali/acid procedures to the charcoal samples (Mook and Waterbolk 1985) to avoid contamination by carbonates and humic and fulvic acids. Bone samples (SU-204, SU-702 and SU-703) were smashed and ground until the grain size of the bone powder was less than 710 micron. The protein fraction was obtained by applying a sequential treatment of HCl 1.5 N (20 minutes) and NaOH 0.125 N (20 hours), both at room temperature. The insoluble material obtained was then treated with acidified water at pH=2.7 for 22 hours at 90ºC (Longin 1971; Brown *et al.*1988). The sample was repeatedly washed with distilled water between treatments to achieve neutrality.

Finally, several dates were performed on carbonaceous sediment. This is by far the most problematic material for the interpretation of results, because it contains different organic fractions that may or may not be related with the event we are seeking to date (Maniatis *et al*. 1995). The most common organic fractions found in sediments are undissolved carbon, humic and fulvic acids, lipids, amino acids and microfossil cellulose. One or several of these fractions are isolated and dated, depending on the type of chemical treatment applied. In general, there is no overall conclusion on what fraction or combination of fractions better reflect the date of the sediment. Each case -and even each sample- presents different problems because the quantities of each organic substance vary considerably between layers and locations. For the Oukaïmeden samples, the *Centro Nacional de Aceleradores de Sevilla* chose to perform a treatment that would only isolate the carbonaceous fraction -also known as humin- eliminating humic and fulvic acids (Santos, personal communication).

It should be noted that neither the conventional techniques -counting the disintegrations- or the direct measurement using AMS reveal the real ^{14}C content of the sample. Any measurement process is subject to an inherent variability that can be minimized to a certain level, but not deleted. All experimental evaluation has an associated error that can be determined by repeating the measurement of the magnitude of interest. This error should not be understood as a mistake, but as the level of uncertainty entailed in the performed estimate. It should also be noted that the analytical data generated by laboratories are based on results that must be inexcusably expressed by two numerical values $M \pm N$,

where M represents the best estimate made by the laboratory of the result being sought (in our case, age sample) and N expresses the degree of doubt of that estimate (Compañó and Ríos 2002). The value of M is related to accuracy as an analytical property, and how the estimate obtained adjusts to the actual value. As regards dating, this means the degree in which the estimated age adjusts to the real age of the sample. On the other hand, the value of N is related to the analytical accuracy and provides a range within which there is a certain probability of finding the measurement we seek.

During the measurement of sample 14C activity, laboratories have to face the fact that radioactive decay is a random process, which means that there is no way of knowing when a single ^{14}C nucleus will disintegrate. However, if the disintegration of a large number of nuclei is monitored over a relatively long time, the distribution of the results can be described by a probability function called Gaussian or normal distribution. This bell-shaped function is characterized by the arithmetic mean (m), which corresponds to the maximum value of the function (s) and the standard deviation.

To calculate the standard deviation associated with a date, laboratories must perform an estimate of all the possible sources of uncertainty: the activity of the sample, oxalic acid standard and instrumental background, isotopic fractionation, measurement conditions, etc. It should be pointed out that some studies show that laboratories underestimate the sources of uncertainty, although in general international inter laboratory comparison exercises show that the dates they provide are correct and accurate (Scott *et al*. 2003a)

After obtaining the dating results as conventional carbon-14 ages in years BP (Stuiver and Polach 1977; Rubinos 2009) the calibration procedure to convert them into real ages was performed using the 3.10 version of the OxCal program -from the University of Oxford- (Bronk-Ramsey, 1995) using the INTCAL09 calibration curve (Reimer *et al*. 2009). Results were calibrated using the 2 sigma value, as it provides more information at the cost of accuracy in the results. A probability distribution of the carbon-14 date in calendar years is obtained using this mathematical process. The date obtained is not symmetrical and presents an irregular profile and a longer or shorter time interval, depending on the magnitude of the standard deviation associated to the measurement and the profile of the calibration curve in the calculation period. The results and the calibration of each date are shown in the tables. When more than one interval is obtained, all the intervals are shown with the percentage corresponding to each. The percentage shows the probability that the real age of the sample will fall within that interval. We used international nomenclature to express dates, following the guidelines of the 12th International 14C Conference (Kra 1986) and the 2nd Congress of Iberian Archaeology (Peixoto 1995), which express 14C dates calibrated with the following abbreviations: cal AD (Anno Domini) or cal BC (Before Christ).

All the dates are the result of an analytic technique. Consequently, it must present the necessary conditions of accuracy (correspondence with the real date of the sample) and precision (temporal interval within which the true date could probably be found) (Mestres and Nicholas 1997). To achieve the required levels of accuracy, dating laboratories are subject to regular monitoring activities, both internally - control sample measurements- and externally -through intercomparison exercises. Of the latter, those coordinated by the University of Glasgow encompassed more than 80 laboratories around the world (Scott et al. 2003a, b). These results show that, in general, laboratories are accurate and precise over a wide range of dated materials, with no noticeable differences regarding the method of measurement.

Interpretation of Results

Aougnin n'ait Ourgih Neolithic Site. C-1300 OK1 area

The site has previously been described (See Chapter Excavations), suffice it to say that it was subject of two digging campaigns in 2010 and 2012 respectively. Both campaigns provided 13 carbon-14 dates, the results of which can be seen in table 1.

Sample (CNA-1162) comes from the 2010 excavation. It was taken at depth of 5 cm, from SU 1302, that was made up of compact yellowish soil. Although no traces of any structure associated with fire were found, a charcoal sample was collected in this layer. The date we obtained from it (CNA-1162) dates this SU between the 11th and 12th centuries, which clearly differs from the rest of the obtained dates.

Some other samples come from SU-1303, also made up of darkish soil with numerous stones of variable sizes, located at the verge of a yellowish soil. Several charcoal remains appeared at different depths in this layer. As they could be related either to an external structure still not defined inside the test pit, or they could be remains of a structure associated with a small stone wall that encircles this space towards the NE, five charcoal samples were collected at different depths, and dated from

UNIT	YEAR	MATERIAL	LAB CODE	C-14 AGE (years BP)	CALIBRATED AGE (years cal BC/AD)
SU-1302	2010	Charcoal	CNA-1162	893 ± 52	1020 - 1260 cal AD (95.4%)
SU-1303	2010	Charcoal	CNA-1163	4278 ± 50	3030 - 2850 cal BC (79.4%) 2820 - 2740 cal BC (12.8%) 2730 - 2690 cal BC (3.2%)
SU-1303	2010	Charcoal	CNA-1164	4296 ± 39	3030 - 2870 cal BC (95.4%)
SU-1303	2010	Charcoal	CSIC-2182	4303 ± 46	3090 - 3060 cal BC (2.6%) 3030 - 2870 cal BC (91.5%) 2810 - 2770 cal BC (1.3%)
SU-1303	2010	Charcoal	CSIC-2232	4476 ± 33	3340 - 3080 cal BC (87.6%) 3070 - 3020 cal BC (7.8%)
SU-1303	2010	Charcoal	CSIC-2181	4582 ± 45	3510 - 3420 cal BC (21.1%) 3380 - 3260 cal BC (37.7%) 3250 - 3100 cal BC (36.6%)
SU-1309	2010	Charcoal	CNA-1165	5147 ± 55	4050 - 3780 cal BC (95.4%)
SU-1322	2012	Charcoal	CNA-1649	6145 ± 35	5210 - 4990 cal BC (95.4%)
SU-1324	2012	Charcoal	CNA-1650	5980 ± 30	4980 - 4780 cal BC (95.4%)
SU-1325	2012	Charcoal	CNA-1652	6220 ± 30	5300 - 5190 cal BC (42.3%) 5180 - 5060 cal BC (53.1%)
SU-1325	2012	Charcoal	CNA-1653	6320 ± 30	5370 - 5220 cal BC (95.4%)
SU-1326	2012	Charcoal	CNA-1654	6115 ± 30	5210 - 4940 cal BC (95.4%)
SU-1326	2012	Charcoal	CNA-1655	8565 ± 30	7605 - 7540 cal BC (95.4%)

Table 1. Set of samples of C-1300.

SU-1303. They are all consistent with each other, falling within a range from the mid- Fourth Millennium calBC to the first third of the Third Millennium calBC. Three of the dates fall within the same range of the beginning of the Third Millennium calBC. Eventually, and also in the 2010 campaign, small remains of charcoal were collected from the SU-1309. This layer was considered by the archaeologists a possible soil preparation of a dwelling floor, that could be contemporary to the previously mentioned occupation, although the date obtained is clearly older (around the early Fourth Millennium calBC). As small stones and soil of SU-1309 were used to level the dwelling floor, we cannot

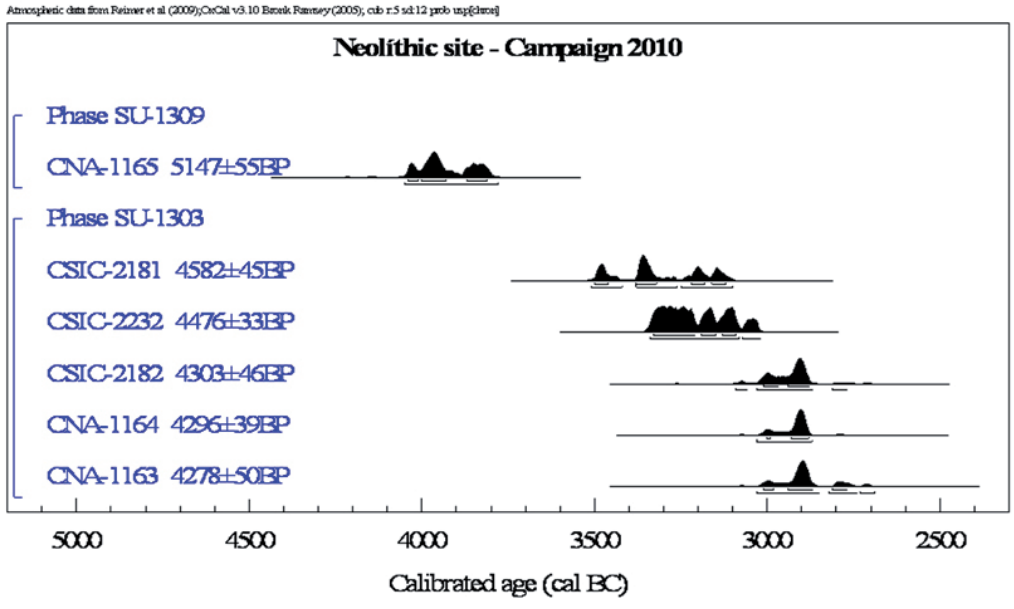

Fig. 1. Set of 14C dates of C-1300 from field campaign 2010.

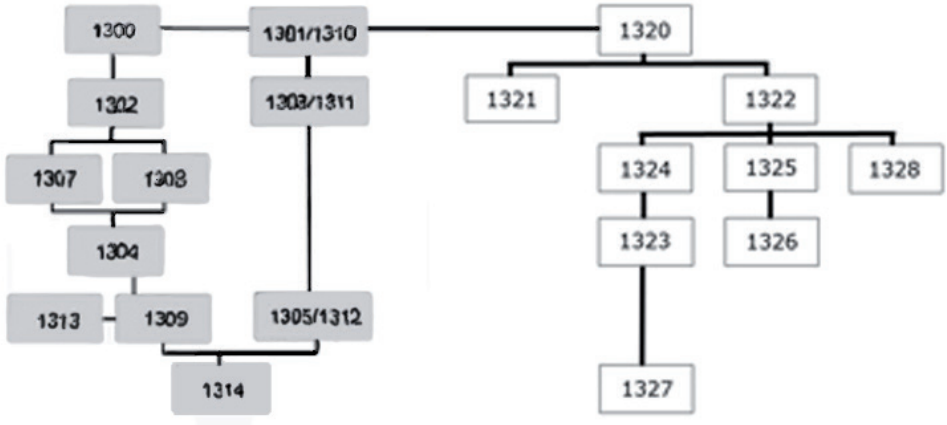

Fig. 2. Harris' matrix of C-1300. In shaded colour SU from field campaign 2010, and in pale SU from 2010 campaign.

rule out that mingle materials, some of them older, were used to this end.

Except for the dating obtained from UE-1302 (CNA-1162) -which is clearly anachronistic- the other group of dates obtained in this campaign show an internal coherence falling between the second half of the Fourth Millennium calBC and the beginning of the Third illennium calBC; in other words, Late Neolithic (fig. 1).

The 2012 campaign aimed to excavate the remainder of the *Aougnin'ait Ourigh* site to identify the possible presence of hearths outside the hut. Although no remains of hearths or storage units were documented, an almost circular structure was defined (SU-1323) over the rock bed, and encircling it. The inner area of that structure was labelled SU-1324, and provided the sample CNA-1650. The outer area was labelled SU-1325, and provided two samples: CNA-1652 and CNA-1653. A third one (CNA-1649) was collected from SU-1322, an accumulation of black earth located near the aforementioned hut. Also, sample CNA-1655 was collected from SU-1626, a small excavated sector in the centre of the profile and outside the structure, partially below its average depth (See table 1 and fig. 2).

Lithic artefacts and ceramic sherds were coherent with those from the previous year, so the dig-

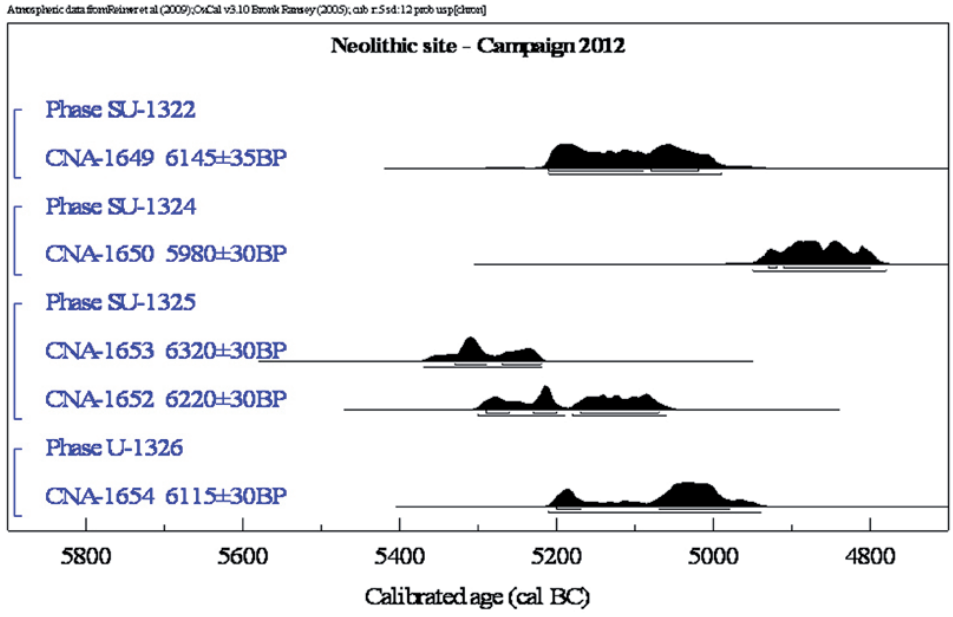

Fig. 3. Set of 14C dates of C-1300 from field campaign 2012.

UNIT	MATERIAL	LAB CODE	C-14 AGE (years BP)	CALIBRATED AGE (years cal BC/AD)
SU-703	Sediment	CNA-938	3200 ± 39	1610-1580 cal BC (2.4%) 1540-1400 cal BC (93.0%)
OAW-6	Sediment	CNA-940	3143 ± 31	1500-1370 cal BC (90.9%) 1340-1310 cal BC (4.5)
SU-703	Bone	CNA-809	1310 ± 30	650-780 cal AD (95.4%)
SU-702	Bone	CNA-808	1240 ± 30	680-880 cal AD (95.4%)

Table 2. Set of samples of C-700.

UNIT	MATERIAL	LAB CODE	C-14 AGE (years BP)	CALIBRATED AGE (years cal BC/AD)
SU-213	Charcoal	CNA-801	4009 ± 51	2840-2810 cal BC (2,9%) 2680-2340 cal BC (92,5%)
SU-209/211	Charcoal	CNA-937	1770 ± 32	130-350 cal AD (95,4%)
SU-205	Charcoal	CNA-800	947 ± 44	1010-1210 cal AD (95,4%)
SU-204	Bone	CNA-806	495 ± 35	1320-1350 cal AD (2,9%) 1390-1460 cal AD (92,5%)

Table 3. Set of samples of the Elephants' Shelter.

gers thought that the outside structure, discovered in 2012 was synchronous with the hut structures excavated in 2010, as they were located at the same depth. However, the charcoal samples collected and dated during this second campaign are certainly older than those from the hut, obtained during the 2010 campaign (fig. 3). It should be highlighted that, except for CNA-1655 (from SU-1326), which is much older than the rest (See table 1), all the dates obtained during this campaign are internally coherent in terms of their chronology and the possibility of a sample contamination or a mistake during the collection procedure do not seem plausible. Therefore, the existence of an old event, dated around mid Fifth Millennium- Early Fourth Millennium calBC cannot be ruled out, although we lack archaeological evidence to attribute so far, either an anthropic or natural origin. It should be borne in mind, that according to the archaeologists, what they dug up in the 2012 campaign were apparently just the foundations of what seemed to be a very obliterated building structure. These foundations could have been raised up upon a soil containing charred wood and charcoal from an older event, unknown to us.

As can be observed by comparing figures 1 and 3, there are two groups of dates. The dates of the 2012[1] campaign are more than a Millennium older than the samples collected in 2010, with the CNA-1165 date located between both groups. Given that both excavation campaigns reached the rocky outcrop, and that both the archaeological artefacts and the depths of the layers indicate that all the structures belong to the same moment, the older dates cannot be related to a paleo-soil of anthropic origin. In view that the digging reached the geological soil, that flint and ceramics of both campaigns are consistent with one another and that there are no evidences of a previous human presence in the spot, we can only conclude that these samples are dating a natural event of unknown nature. In any case, readers are reminded that wood and charcoal samples offer just a *post quem* date for the context within which they are found.

Lastly, the charcoal sample obtained from SU-1326 (CNA-1655) is much older than the others, being dated to the mid-Eight Millennium BC. The absence of other dates to support this dating led us to consider this information with caution. Thus, we think that the appearance of charcoal in this location is more likely to indicate a natural or accidental event than anthropic use of the site. As with the others, the

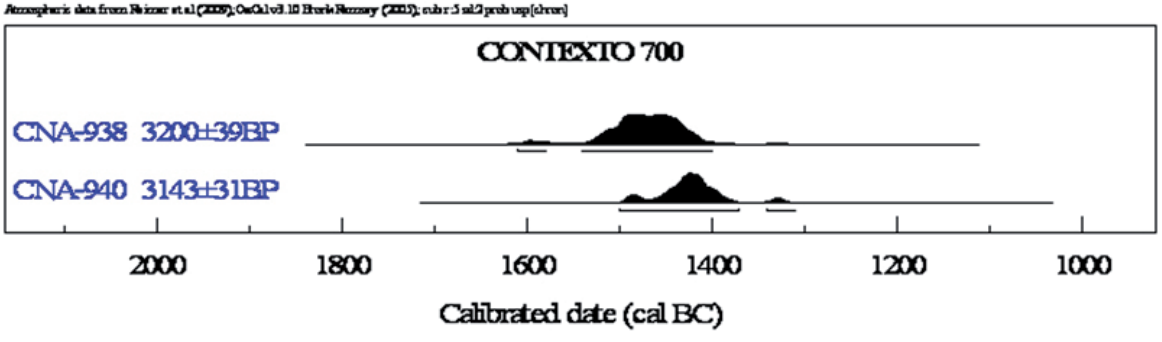

Fig. 4. 14C dates for SU-703 (above) and for OW-6 pollen sample of C-700 (below).

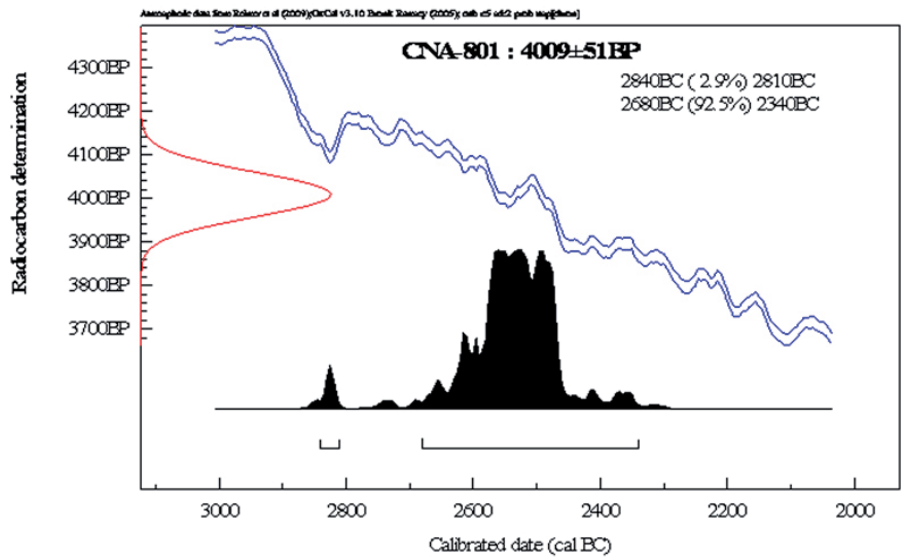

Fig. 5. 14C date for the Elephant's Shelter SU-213.

charcoal from which the sample was taken could have been mingled with the soil removed when laying the structure's foundations. In any case, SU-1326 is older than the stratigraphic packet formed by SUs 1321 to 1325, as is lying underneath.

Aougnin N'ait Ourigh C- 700. OK1' Area

As explained above, the C-700 was a small area sheltered by a huge boulder located at the upper platform of the *Aougnin* area. The site was chosen after some findings made on surface. As it is usual in the area the site was a flimsy shelter of only one and probably short dwelling, due the scarce thickness of the archaeological sediments. Ten stratigraphic units were identified, numbered from SU-701 to SU-710. Of these, SU-702 and SU-703 provided samples for carbon-14 dating. The first one (SU-702) corresponds to an 8 to 16 cm thick level, below the vegetation cover (SU-701), made

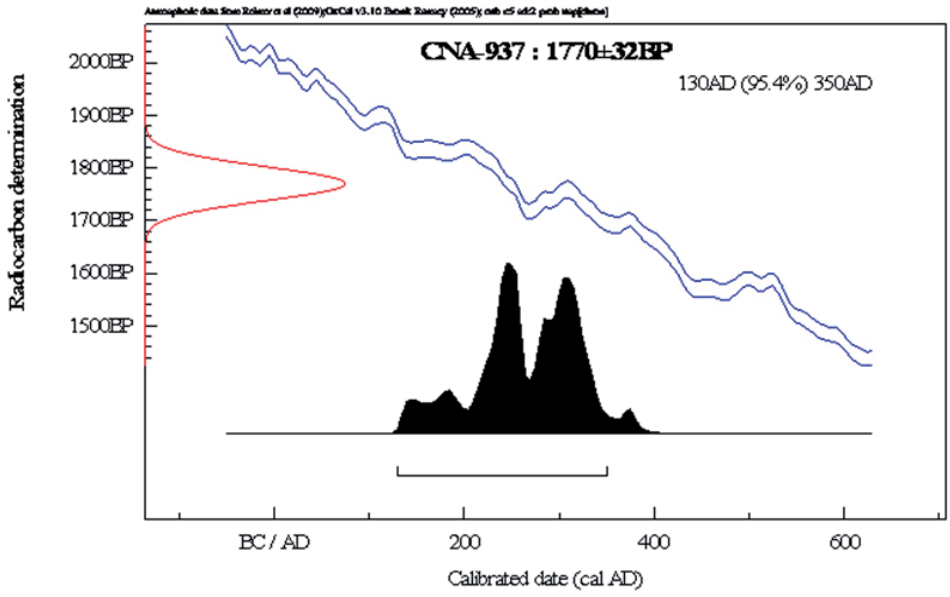

Fig. 6. 14C date for the Elephant's Shelter SU-209/211.

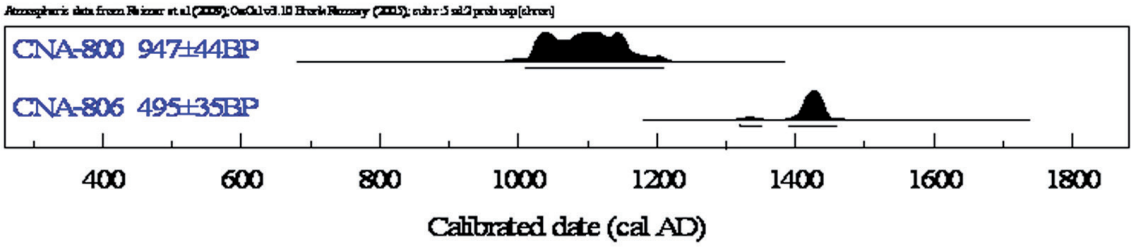

Fig. 7. Multiplot graphic of historic dates obtained in the Elephant's Shelter.

of sand of variable colour, with predominance of light brown. No habitation structures were documented, although several handmade sherds, with fingernail decoration and some lithics were collected there. A charred bone sample was collected in that SU, and dated in the *Centro National de Aceleradores*. It was labelled as CNA-808, and provided a date between 680-880 calAD. The SU-703 consisted of a darker and more compact stratum than the previous one, spreading throughout the test pit and was first considered by the archaeologists a possible dwelling floor, as it showed abundant stone and bone fragments, as well as charcoal, several sherds of hand-made ceramic decorated with a fingernail pattern and prehistoric appearance, similar to those coming from SU-702, and flint items, especially by-products. However, no structures were recovered and it was eventually concluded that all archaeological findings were in a secondary position.

Two samples from this unit were dated at *the Centro National de Aceleradores*; the first one (CNA-809) was a bone sample and provided a date ranging from 650 to 780 cal AD and therefore coeval to that obtained from the upper stratum. The second sample from SU-703 was performed on sediment with charcoal remains and labelled as (CNA-938). It provided a chronological range of 1610-1400 cal BC., that matches as much with the chronology granted for the ceramic sherds with fingerprint decoration, as with a third date, (CNA-940) 1500 – 1310 cal BC. also on a sample of sediment and charcoal, extracted at the same height than CNA-938, for a pollen column (OAW-6) (fig. 4).

Therefore, the inconsistency between samples on bone (CNA 808 and CNA 809) and on charcoal (CNA-938 and CNA-940), could be due to post-depositional phenomena caused by drag processes, and by the dip of the area where the C-700 shelter was placed. The two bone samples (CNA-808 and CNA 809) are practically coeval, but inconsistent with the ceramics of SU-702 and S-703, which are archaeologically similar and correspond to types well known in Northern Africa in Bronze Age contexts and that, on the contrary, are consistent with CNA-838 and CNA-840 dates (See table 2)

The importance of these two dates (CNA-838 and CNA-840) in the contextualization of rock art in the area must be highlighted. The only keys to date some of the rock art representations of the area are the similarities between the engraved weapons with daggers and halberds represented in the Oukaïmeden rock art and others of Europe. The possibility of connecting these two dates with the human seasonal dwelling in the Oukaïmeden Valley opens for the first time the way to contextualize these dagger and halberd representations within a Bronze Age chronology.

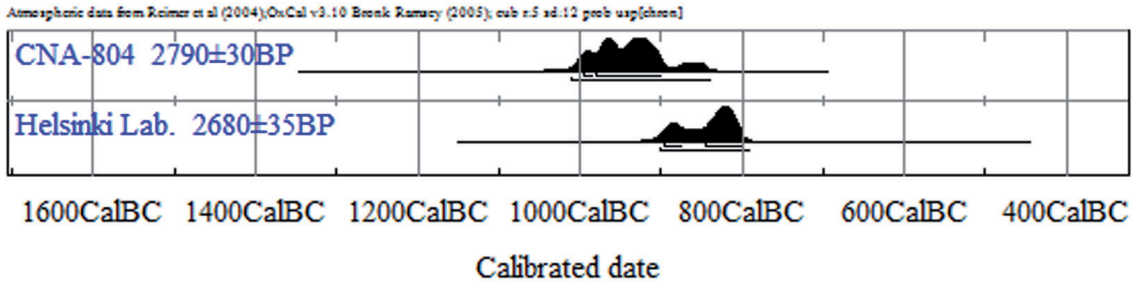

Fig. 8. Multiplot graphic comparing El Graoui's and ARPA's project dates for the Elephants' Frieze.

UNIT	MATERIAL	LAB CODE	C-14 AGE (years BP)	CALIBRATED AGE (yearscal BC/AD)
SU-806	Sediment	CNA-802	1560 ± 30	420-570 cal AD (95,4%)
SU-807	Sediment	CNA-803	1615 ± 30	380-540 cal AD (95,4%)
SU-808	Sediment	CNA-804	2790 ± 30	1010-840 cal BC (95,4%)
SU-809	Sediment	CNA-939	2470 ± 37	770-480 cal BC (85,0%) 470-410 cal BC (10,4%)

Table 4. Set of samples of the Elephants' Frieze.

Elephants' Shelter (Abadsan Shelter in Berber language). C-200, O-K7 area

Four samples were obtained -three from charcoal and one from bone- and dated by AMS in the *Centro Nacional de Aceleradores*, as shown in table 3.

The sample CNA-801 was collected from SU-213. This SU represents the deepest level - directly supported by the geological substrate -, where a large number of flint items were found. More than 600 pieces were recovered in just two square meters, many of them with retouch and some of them showing good quality. No dwelling structures were preserved, but some hand–made ceramic sherds were recovered. Most of them were shapeless, except for a neck fragment from a medium-sized vessel -probably ovoid- that could be similar to the pottery found in the *Skhirat* and *El Kiffen* Moroccan cemeteries (Bailloud and Boofzheim 1964; Bokbot 2005; Daugas e*t al.* 1989 and 1998; Lacombe 2004; Tixer *et al.*, 2008) dated to the Moroccan Copper Age. (See also Chapter 3.2). This sample provided a chronological range between 2840-2340 calBC (2σ) and furnishes a chronological *terminus post quem* context for the rock art in the shelter (See fig 5).

A second sample, labelled CNA-937, was recovered from SU 211, a sterile greyish unit, of plastic and clayish texture, and strong odour of decaying organic material, resulting from a flooding process. This was possibly due to the water and sediment carried by snow thaw and fallen from the top of the shelter. It contained many fallen stones and rocks and was probably part of the stratigraphic unit 209. Therefore these were labelled SU 209/211 and were set above unit 213. Sample CNA-937 offered a chronological range of 130-350 cal AD. Thus, the more than 2000 years separating both dates can only be explained by an absence of human inhabitation of the shelter. If such human presence occurred, it was sporadic and traceless (See fig. 6).

UNIT	MATERIAL	LAB CODE	C-14 AGE (years BP)	CALIBRATED AGE (years cal BC/AD)
OAW 6	Sediment	CNA-940	3143 ± 31	1500 - 1370 cal BC (90.9%) 1340 - 1310 cal BC (4.5%)
OO 80-85 cm	Sediment	CNA-942	1970 ± 38	50 cal BC-130 cal AD (95.4%)
OT 70-85 cm	Sediment	CNA-941	1013 ± 41	890-920 cal AD (3.6%) 940-1160 cal AD (91.8)
ORI-1 80-85 cm	Sediment	CNA-805	564 ± 44	1290-1440 cal AD (95.4%)
OIV 80 cm	Sediment	CNA-943	511 ± 28	1320-1350 cal AD (2.9%) 1390-1450 cal AD (92.5%)

Table 5. Samples for environmental analysis.

A third sample, labelled as CNA-800 dates a level of clearly anthropic origin, which results in the formation of a compacted floor, probably as a consequence of a rather long inhabitation of the shelter, although no preserved dwelling structures could be detected, while on the contrary, some flint *debitage* and non diagnostic sherds of wheel-made pottery were found. Drag processes caused by snow thaw and affecting SU 204 and SU 203, immediately above, are probably responsible for this lack of dwelling structures preserved. Anyway the date of CNA-800 - 1010 – 1210 cal AD - places this anthropic settlement layer at the Almoravid-Almohad Period.

It also provides a *terminus ante quem* for the falling of a rock with a horseman depiction. The block had fallen from a shelter wall, was turned laterally and semi buried in SU 203. The rock was lying on the previous SU-204, a flooded clayish level, without habitation structures. A fourth sample, this time on bone and labelled CNA-806, was extracted precisely from SU-204, that showed an age of 1320-1460 cal AD. (See fig. 7). In that way, the engraving on the fallen block could be dated between 1010-1210 AD and 1320-1460 AD, belonging most probably to the Almoravid-Almohad habitation of the shelter

The Elephants' Frieze. C-800. OK 4 Area

Four samples of sediment were obtained in the framework of the ARPA's[2] research project. A previous charcoal sample was got during Dr. El Graoui's digging (Graoui *et al* 2008) in the spot, and was dated by the laboratory of Helsinki. Although the date

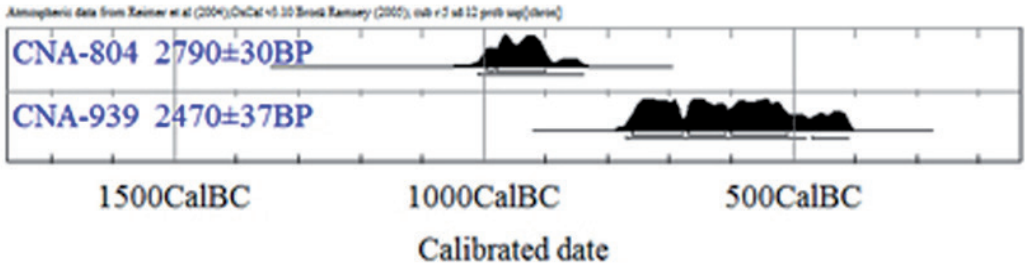

Fig. 9. Multiplot graphic of dates from SU-808 (above) and SU-809 (below) of the Elephants' Frieze.

obtained pointed to the First Millennium calBC, no anthropic rests were associated to the level from which the sample was taken.

The samples discussed here come from the digging performed by the ARPA's team in the field campaign 2009 (See table 4).

The oldest date corresponds to the sample CNA-804 and was obtained from sediment coming from a circular combustion structure (SU-808), containing small fragments of wood and charcoal. The date obtained, - 1010 - 840 cal BC - overlaps partially with the sample previously dated by the Helsinki's laboratory – 900-790 calBC - (see figure 8), and also comes from a sterile SU. Therefore, both dates are scarcely useful to date human activities in the area connected with rock art.

A second date, CNA- 939 - 770-410 cal BC -, comes from a shallow SU-809, made of badly defined charcoal accumulation, that, as SU-808, was lying directly above the geological rock outcrop (SU-810). As the previous stratigraphic unit, SU-808 was archaeologically sterile. If we compare both dates, they look to have been successive instead of coeval, although CNA-939 is affected by the so-called Hallstatt Plateau effect (fig. 9). In any case they do not offer information that could help to connect rock engravings and Libyan-Berber inscriptions with human presence in either one or other period of time dated by 14C.

Another two samples come respectively from SU-806 and SU-807 and are almost coeval (See table 4). Sample CNA-802 comes from the filling of a basin with traces of combustion, probably a bonfire as was interpreted by the archaeologists. Meanwhile the sample CNA-803 was taken from sediment compacted with bone fragments and flint *debitage*. They date as noted, a much latter event, in the First half of the Christian Era, 420-570 cal AD and 380-540 cal AD respectively.

As the pollen column taken of one of the test-pit profiles reflects pastoral activities in the area at depths corresponding to those radiocarbon dated, we must conclude that the lack of archaeological record associated to the units from which the samples were obtained, should be attributed either to post-depositional processes affecting to the site or to the fact that the site was never inhabited but just frequented.

Dates from samples of wet natural deposits and pollen columns taken for the palaeoenvironmental reconstruction of the Oukaïmeden Valley

The last five dates were performed exclusively on wet natural deposits and pollen columns to achieve the reconstruction of the vegetation landscape and the anthropic action it underwent. The results are published in the present volume (See Chapter Vegetation) (See table 5).

The first date was performed on the pollen column from C-700 in *Aougnin n'ait Ourigh* in OK1' Area (See also table 2). It provided a chronology in tune with the sediment sample from stratigraphic unit 703 -in a Bronze Age context-, the relevance of which has already been stressed.

Following a chronological order -from the oldest to the newest- the following dating (CNA-942), belongs to the pollen column obtained in a wet natural deposit or quagmire labelled as (OO). It is 85 cm thick and provided a total of 30 samples. The date was obtained on the deepest sediment, located to -80-85 cm below the surface. This dating corresponded approximately to the change of Christian Era, from the end of the first century BC to the middle of the second century AD and offers the oldest date for a quagmire formation.

Dating was then performed on a natural quagmire, near the the *Tiferguine* Stream (OT) which is 75 cm thick. A total of 28 samples were recovered. As in the previous case, the dating (CNA-941), was performed on the deepest sediment (70-75 cm), which provided a date range from the middle of the 10th century to the middle of 12th century AD (890-1160 cal AD) and therefore, partly coeval to the Almoravid-Almohad Period.

The last two dates were performed on the deepest strata (80-85 cm) of quagmire next to the *Irini* River (ORI), and also on a test pit located at the entrance of the *Irini* River in the valley before its junction with the *Tiferguine* Stream, labelled OIV. ORI-1 sample was taken within 85-80 cm deep. The latter dated sample (OIV) also came from the deepest strata, located 80 cm deep. Both cases provided similar date ranges, from the middle of the Fourteen century AD to the middle of the Fifteen century AD. These dates fall between an event of quick forest recession due to the increase of anthropic activity -probably involving punctual fires- and a change towards more humid climatic conditions that contributed to the recovery of the arboreal mass.

Summary

Although just a few of the samples taken from archaeological contexts were considered consistent with the context dated due to geomorphologic and climatic processes suffered by the Oukaïmeden Valley, we got anyway for the first time, proofs of an old human presence in the High Atlas area, from Late Neolithic to the Bronze Age. On the other hand, samples taken from wet areas or quagmires, proved that these formations are of a relatively late age. The consequences of it should be thoroughly discussed in chapter 4.2

Notes

1. Radiocarbon date CNA-1655 (SU-1326) is not included because it is very much older than the others.

2. Acronym that stands for *Arte, Paisaje y Poblamiento en el Alto Atlas*, as the Project was named in Spanish.