Climate Induced Mobility and the Missing Middle Neolithic of Morocco

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Summary

This paper deals with general trends of the Moroccan Neolithic: chronological framework, external influences and environmental impact. Particular focus is on the end of the 7th millennium calBP when a supposed Middle Neolithic should start. However, the paper shows that apparently no distinct chrono-cultural unit between Early and Late Neolithic is detectable, wherefore term and concept of a Middle Neolithic should be abandoned.

The Neolithic transition of Mediterranean Morocco itself is an integral part of the Neolithisation process within the Western Mediterranean as a whole. Neolithic innovations enter the Alboran territory via the range of the Ligurian Early Neolithic. Between the Southern Iberian Peninsula and Northwest Africa these innovations became distributed through Epipalaeolithic coastal networks, here called *"Coastal Epipalaeolithic"*. In the following, coastal groups start food production (*"Early Neolithic"*), depending on local environmental conditions on a very different scale. Cultivation and animal husbandry remained only one aspect of subsistence in the sense of a broad spectrum economy or low level food production. Through continental networks local foragers occupying the West-Mediterranean hinterlands (*"Continental Epipalaeolithic"*) adopt Neolithic inventions such as pottery and integrate them step by step in their way of life. Because food production is not yet recorded during the Early Neolithic period, these groups afterwards are called *"Epipalaeolithic in Transition"*.

Furthermore, the impact of climate and environmental change on cultural changes shall be evaluated. While the Neolithisation itself until now seems to have been triggered by socio-economic factors, the end of the Early Neolithic at 6.3 ka calBP, the enforced Saharan impact during the Late Neolithic from 6.0 ka calBP onwards and the end of the Neolithic as a whole at about 4.2 ka calBP correspond closely to supra-regional climate and environmental changes well documented in marine and terrestrial archives.

Introduction

The today's Morocco covers a vast territory which consists of manifold landforms and ecological zones. Even nowadays these zones with their particular resources demand specific adaptations and subsistence strategies from their inhabitants. Prehistoric occupation therefore can be understood as a succession of constantly recurring adaptations of groups to this patchy environment always influenced by global climate changes and events. Archaeological research of the last decades has also been patchy and could therefore largely focus on the local or regional processes, resulting in regional histories and chronologies. The elaboration of general trends of human settlement turns out to be a rather challenging task.

A major challenge for reconstructing general trends of the Moroccan Neolithic is the very inconsistent state of research in the different regions of the country. Regions better covered by archaeological research such as the Atlantic facade, the Tangier peninsula or the Eastern Rif are facing nearly unexplored areas such as large parts of the Mediterranean coast or the northern rim of the Sahara. Particularly problematic are the limited amount of new ^{14}C-ages with low standard deviation and the relative absence of economic data such as palaeobotanical and -zoological analyses. The latter problem often results in terminological blur because the lacking evidence of domesticated species prevents the recognition of a food producing economy and therefore the use of the term "Neolithic".

Current projects which contribute substantially to that topic are the Moroccan-Spanish cooperation of the *Institut National des Sciences de l'Archéologie et du Patrimoine* (INSAP) and the *Consejo Superior de Investigaciones Científicas* Madrid (CSIC) who re-examine the famous sites of El Khril and Kef That el Ghar under the direction of Y. Bokbot and L. Peña-Chocarro as well as excavations in the Temaras´ caves (El Harhoura 2 and El Mnasra) under the direction of M. A. El Hajraoui, R. Nespoulet, A. Debénath and H. Dibble.[1] Furthermore the fieldwork of the University of Cadiz in Ceuta and its surroundings and the revision of the Kef Taht el Ghar assemblage in cooperation with a Moroccan team must be mentioned.[2] Of particular importance are the investigations of Kef Taht el Ghar and Kef Boussaria by a Moroccan-French research team in the 1980 s and 1990 s whose results are still subject of recent publications.[3] Last but not least the Moroccan-German cooperation should be brought up which is doing research since 1995 in the eastern Rif area.[4]

1 El Hajraoui et al. 2012.
2 Ramos et al. 2008.
3 Ouchaou 2000; Daugas et al. 2008, Daugas et al. 2010; El Idrissi 2001, 2008; Ballouche – Marinval 2003; Ballouche – Marinval 2004; Ballouche et al. 2012.
4 Mikdad et al. 2000, Linstädter 2011, Linstädter et al. 2012a.

This paper deals with general trends of the Moroccan Neolithic: chronological framework, external influences and environmental impact. Particular focus is on the end of the 7th millennium calBP where there should be a Middle Neolithic at the transition Early to Late Neolithic as mentioned by several authors.[5] This paper will show that no Middle Neolithic cultural unit exists in Morocco and therefore the use of the term is not quite appropriate. Besides the lacking of an archaeological culture a closer look at radiocarbon data reveals a considerable decline in the amount of data from 6.3 ka calBP onwards. A very probable reason for this decline is supra-regional climate deterioration well documented in marine[6] and terrestrial archives[7].

Altogether the Moroccan Neolithic seems to consist of two major phases, an Early and Late Neolithic, which can be divided into further sub-phases. The Early Neolithic, dated between 7.6 and 6.3 ka calBP, is based on local forager societies who are part of a marine Western Mediterranean Epipalaeolithic network including the coasts of the Southern Iberian Peninsula and North-western Africa. Groups of this network borrow the knowledge about plant cultivation and animal husbandry probably through contacts with the Ligurian Neolithic and transfer these skills to continental Epipalaeolithic groups who inhabit the West Mediterranean hinterland. This transitional step-by-step-process lasts several millennia and results in a multifaceted economy based on hunting, gathering, small scale agriculture and animal husbandry throughout the area. The Late Neolithic is traceable after the aforementioned deterioration at about 6.0 ka calBP. Two major trends are visible: Contacts with the Iberian Peninsula still exist, recognizable by the appearance of undecorated and painted pottery of Iberian origin and traces of ivory trade on both sides of the Mediterranean.[8] The second aspect of the Late Neolithic seems to be a Saharan influence. Many inventories provide decorated pottery using combs but not applied in rocker-stamp technique. A frequently occurring type of decoration is the so-called herringbone motive. Most authors understand this pottery as an impact from the south. According to different environmental archives, the general desiccation of the Western Sahara starts after 5.5 ka calBP.[9] Already Nehren argues[10] that the appearance of this pottery at the Atlantic as well as the Mediterranean coast could be an evidence for people moving out of the Sahara towards the wetter coastal zones. To what extent the term "climate refugees" is an appropriate label is difficult to estimate. Thus, climatologists talk about an abrupt change released by declining radiation and amplified by several feedback processes. However, an understanding of the population dynamics requires valuable archaeological data, first of all from Northwest Africa's interior.

The Neolithic transition

The Neolithic transition of the Western Mediterranean appears as a very complex process influenced by natural environment, climate change and population dynamics. A particular feature of the process is its distinct regionalisation. Extensive effort has been made to work out the course of the transition and the character of the Early Neolithic throughout distinct regions such as the surroundings of Valencia[11], Murcia[12], Andalusia[13], Portugal[14], the Tangier peninsula[15] and the Eastern Rif[16], just to mention a few. Other studies are dedicated to particular aspects such as climate and environmental impact[17] or the development of pottery[18]. Still others summarise existing data and build up integrative models.[19]

They all share the involvement with the agents of the process. In the case of the Western Mediterranean both local Epipalaeolithic foragers and immigrants are concerned. The migratory aspect arises from the Eastern Mediterranean origin of the most important Neolithic innovations such as pottery and domesticated species. Recent genetical studies attest an advance of Neolithic settlers till the area of Valencia.[20] From here the knowledge of pottery making, animal husbandry and cultivation seems to have infiltrated into the Alboran Territory. The continued existence of local hunter-gatherers as it is proved first of all for Portugal and Northern Africa as well as the very local character of the Early Neolithic suggest a transfer and modification of Neolithic innovations by existing networks. This process takes place along the coasts without excluding a direct crossing of the Alboran Sea, and reaches later forager groups in the hinterland who adopt these innovations step by step (Fig. 1). Recent studies on the lithic assemblages of Ifri Oudadane show that "Coastal Epipalaeolithic" and "Continental Epipalaeolithic" differ in terms of blank production, raw material supply and tool composition. On the other hand a continuity concerning these features from the Coastal Epipalaeolithic to the Neolithic deposits could be shown.[21] Because the coastal sites provide all aspects of a Neolithic life style from about 7.6 ka calBP onwards, we call these assemblages the "Early Neolithic" in the following. In many cases their supporters continue forager strategies and food production only becomes part of a broad spectrum economy. This can be observed first of all in more arid environments.[22] The process of distributions via network seems to pass extremely rapid so that domesticated species reach Andalusia and Portugal already at 7.5 ka calBP[23] and the eastern Rif at 7.6 ka calBP.[24]

5 Daugas et al. 1998, 352; Linstädter 2004, Fig. 62.
6 Cacho et al. 2001.
7 Linstädter et al. 2012b; Zapata et al. 2013.
8 Banerjee et al. 2011; Schuhmacher et al. 2009.
9 deMenocal 2000.
10 Nehren 1992.
11 Cámalich Massieu – Martín Socas 1999; García Puchol – Aura Tortosa 2006; Bernabeu Aubán et al. 2009; García Borja et al. 2011.
12 Martínez Andreu 2002; Martínez Andreu – Sánchez Gómez 2005.
13 Ramos Muñoz – Lazarich González 2002; Aura Tortosa et al. 2009; García Borja et al. 2010.
14 Carvalho 2008; Carvalho 2010.
15 Ouchaou 2000; El Idrissi 2001; Daugas et al. 2008; Ballouche et al. 2012.
16 Rojo Guerra 2010; Linstädter 2011.
17 Carrión et al. 2010; López Sáez et al. 2010
18 Bernabeu Aubán et al. 2009; Binder 2010.
19 Zilhaõ 2001; Manen et al. 2007; Cortés Sánchez et al. 2012; Linstädter et al. 2012a.
20 Pinhasi et al. 2012.
21 Linstädter et al. 2015.
22 Morales et al. 2013.
23 Aura Tortosa et al. 2009; Carvalho 2010, Cortés Sánchez et al. 2012.
24 Linstädter – Kehl 2012.

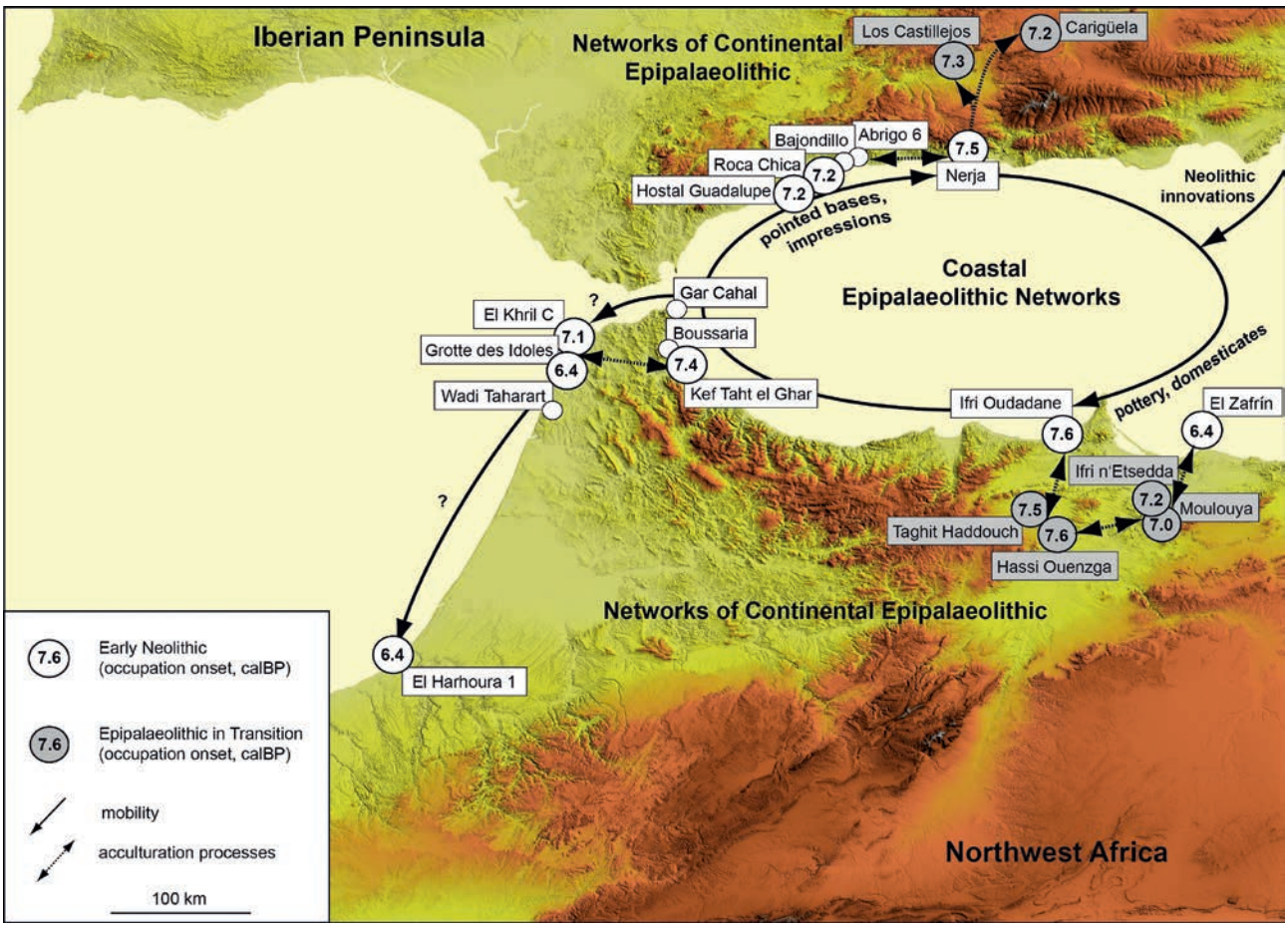

Fig. 1 The Early Neolithic of Morocco and the Atlantic facade. Centres of Neolithisation are located in the Eastern Rif and on the Tangier Peninsula. These areas are inhabited by Epipalaeolithic foragers who have contact to hunter-gatherer groups on the southern Iberian Peninsula. Through these networks, Neolithic innovations of Eastern Mediterranean origin such as pottery and domesticated species were distributed in Northern Africa during the middle of the 8th millennium calBP. Here pottery production, cultivation and herding were included in a broad economy able to cope with the uncertainties of a semi-arid environment. This figure makes no claim to be complete, however it provide the most important and securely dated sites. (Map based on SRTM data).

The Early Neolithic of Mediterranean Morocco

The earliest evidence of Neolithic innovation in Morocco comes from the Mediterranean littoral. One of the centres of the transitional process is the Eastern Rif. Archaeological research which yielded Early Neolithic material has been carried out by the University of Valladolid on the Chafarinas Islands under the direction of Manuel Rojo Guerra.[25] The open air site of El Zafrin is located on an island in front of the Moulouya delta and was still connected to the mainland in the Middle Holocene. Radiocarbon ages date the settlement to the second half of the 7th millennium calBP.

The second important project still working in the area is a cooperation of INSAP, German Archaeological Institute (DAI) and University of Cologne directed by Abdessalam Mikdad and Josef Eiwanger. Since 1995 several hundred sites have been surveyed and a few of them excavated. From the beginning the Neolithic transition has been the focus of the project. Early Neolithic assemblages such as those from Ifri Ouzabour and Ifri Oudadane or collections from Epipalaeolithic in Transition-sites, thus assemblages in Epipalaeolithic tradition, providing pottery but no indications for food production, such as Hassi Ouenzga, Taghit Haddouch, Ifri Armas, come from shelters and open air sites of the Moulouya alluvial deposits. Earliest ^{14}C-ages and well documented assemblages stem from Hassi Ouenzga and the coastal shelter of Ifri Oudadane.

Hassi Ouenzga well marks the Neolithic transition in the hinterland and represents a typical Epipalaeolithic in Transition-site. A Late Epipalaeolithic lithic assemblage in clear Epipalaeolithic tradition mixed with early pottery and a lack of domesticated species probably shows a late local hunter-gatherer community in contact with Early Neolithic groups. This contact phase is dated here between 7.6 and 6.8 ka calBP.[26] Pottery is abundant and has a very local character. *Cardium* shell impressions are rare; however, impressions of various unspecific tools prevail. Of particular interest are incised decorations providing clear connections to Early Neolithic sites of the Oran region (Western Algeria). Altogether the assemblage can be understood as part of the Western Mediterranean horizon of impressed pottery.

25 Rojo Guerra et al. 2010.

26 Linstädter 2004.

Ifri Oudadane is located west of the Melilla Peninsula and 5 km east from the Oued Kert River mouth. The rock shelter is located in a coastal cliff, about 50 m above the present day shoreline. Its 2 m deep deposits can be divided into Epipalaeolithic, Early and Late Neolithic levels, absolutely dated by nineteen ^{14}C-data.[27] The lithic assemblage is sparse and consists mainly of unspecific flakes. However, some notched flakes and blades, scrapers and typical Epipalaeolithic backed points are present.[28] The Neolithic transition occurred at about 7.6 ka calBP and is very well documented in the stratigraphy by the first appearance of pottery and domesticated species such as cereals, legumes and ovicaprides.[29] Large notched blades indicate changes in the lithic tool production. The rich pottery assemblage together with radiocarbon data allows a subdivision of the Early Neolithic into 3 subphases (ENA to ENC). During the initial phase of ENA single *Cardium* impressions dominate (Fig. 2) while during the main occupation phase of ENB they make way for impressions using rocker-stamp technique. The latter ones were first carried out with shells and later with the help of combs.[30] The Early Neolithic occupation ended at 6.3 ka calBP due to a general trend of climate degradation affecting all occupation within the arid and semiarid Northern Africa well visible in Ifri Oudadanes pollen assemblage.[31] Ifri Oudadanes lower deposits (older than 7.6 ka calBP) are a typical representative of a Coastal Epipalaeolithic site. Its upper layers provide all aspects of a Neolithic lifestyle and even though domesticated species are significantly numbered out by wild species, we call these assemblages "Early Neolithic" here. Epipalaeolithic and Early Neolithic subsamples do not differ significantly but distinguish themselves from the Continental Epipalaeolithic sites such as Hassi Ouenzga or Taghit Haddouch.

During the 1950 s the two most important cave sites of the eastern Tangier peninsula, Gar Cahal und Kef Taht el Ghar (KTG), were excavated by M. Tarradell.[32] In addition KTG was revisited between 1989 and 1994 by the "Mission préhistorique et paléontologique français au Maroc", and the INSAP. Daugas *et al.* propose a chronological framework on the base of the KTG deposit.[33] The bottom forms an Epipalaeolithic occupation dated by two ^{14}C-ages of 11.330±65 calBP (9.910±50 BP, Ly-7287) and 11.325±90 calBP (9.865±75 BP, Ly-7695) in the second half of the 12th millennium calBP. This Epipalaeolithic is followed by a so-called '*phase initiale*' dated likewise by two ^{14}C-ages of 9.853±237 calBP (8.765±176 BP, Rabat 66) and 7.970±162 calBP (7.136±156 BP, Rabat 65) between the 10th and the 8th millennium calBP. The respective layer yielded incised and *Cardium*-impressed pottery as well as a few fragments of domesticated plants. As already mentioned elsewhere, this layer, respectively its age determination, must be questioned.[34] At first up to now there is no model which could explain the appearance of pottery and domesticated species centuries before they emerge anywhere else in the Western Mediterranean. Also, as mentioned repeatedly by Ballouche *et al.* and Daugas *et al.*,[35] this part of the stratigraphy is heavily affected by bioturbation. Furthermore, a cereal sample found below the pottery of the initial phase gave an age of 7.286±94 calBP (6.350±85 BP, Ly 971) which fits significantly better into the picture of the Neolithisation in the area and therefore gives a more reasonable age to the archaeological context.

The Early Neolithic, here called *phase cardiale*, is divided into three *périodes*/periods. The first period is characterised by mainly well smoothed pottery, accompanied by channelled and shell impressed vessels. However, the corresponding ^{14}C-age of 7.970±162 calBP (7.136±156 BP, Rabat 65) seems too old. Period two is considered as the main occupation phase characterised by *Cardium*-impressed pottery accompanied by other impressed and plastic decorations. Two ^{14}C-ages of 7.424±106 calBP (6.520±120 BP, Ly 7288) and 6.936±163 calBP (6.050±120 BP, Ly 3821) made on charcoal place this period in the second half of the 8th millennium calBP. Domesticated plants and animals are well documented within this period. The above mentioned age of the cereal sample of 7.286±94 calBP (6.350±85 BP, Ly 971) can probably be assigned to this second period together with the archaeological material in between. The third period is not absolutely dated and because of bioturbation the archaeological material is hard to interpret. However *Cardium* impressions decline while channelled decorations increase. Plastic ornaments lack nearly completely.

Kef Boussaria, a small cavity of 13×11 metres is situated 10 km south southeast of Tetuan and only 2 km away from KTG.[36] The shelter was excavated from 1995 to 1997 and the nearly two metres thick deposit yielded a stratigraphy from the Early Neolithic up to the Protohistoric period. According to El Idrissi[37] the Neolithic is in general bipartite. The bottom of the deposit is characterised by an Epipalaeolithic-Neolithic transitional horizon called *phase initiale* with reference to KTG. From this layer stem some 17 potsherds whose decoration program is characterised by a complete lack of *Cardium* impressions. This layer 1 is dated by a single ^{14}C-age to 8.400±170 calBP (7.589±166 BP, Rabat 65). As already mentioned in the case of KTG, by accepting this early age, pottery would appear in the Tetuan area some 1.000 years before anywhere else in the Western Mediterranean. The following *phase cardiale* is not absolutely dated. Among this pottery impressed, incised, plastic and channelled decorations are attested. About 30 per cent of the decoration is held by *Cardium* impressions from which the major part is done using rocker-stamp technique.

All authors emphasise the conformity of the Tetuan area. Therefore a common scheme of occupation was developed.[38] Period 1 or *phase initiale* dated to the 9th to 8th millennium calBP is characterised by few pottery which carries impressed and incised decoration without the appearance of *Cardium* decoration. Blades and bladelets are produced using direct percussion technique. Period 2, the main occupation phase, dated to the second half of the 8th millennium calBP, is first of all characterised by *Cardium*-impressed pottery. Pressure technique is attested amongst the lithic assemblage. Well

27 Linstädter – Kehl 2012.
28 Gibaja et al. 2012; Linstädter et al. 2015.
29 Morales et al. 2013.
30 Linstädter – Wagner 2013.
31 Zapata et al. 2013.
32 Tarradell 1954; Tarradell 1955.
33 Daugas et al. 2008, 789.
34 Linstädter et al. 2012a.
35 Ballouche et al. 2012; Daugas et al. 2008, 789.
36 El Idrissi 2008, 398.
37 El Idrissi 2008, 410.
38 For example, Ballouche et al. 2012.

Fig. 2 Early Neolithic pottery from Ifri Oudadane. Single Cardium impressions (1–7), incisions (7–8), Cardium impressions using rocker stamp technique (9–13), impressions of non-denticulated shells set up as so-called "herringbone" motive (Photographs by J. Linstädter).

documented domesticated species prove the knowledge of food production. The final period 3 continues the tradition of period 2, divided first of all by a decline of *Cardium* impression and a tendency to a growing covering of surfaces.

Combining data from the Western and Eastern Rif, it can be said that common features prevail. The most striking difference seems to be the so-called *phase initiale* of the Tetuan area which places pottery and domesticated species in the 9th and early 8th millennium calBP. This phase needs to be reconsidered or proved by sufficient absolute data. However, it can safely be assumed that coastal sites of the Mediterranean facade dispose of the earliest evidence of Neolithic innovations in Morocco. Neolithisation therefore takes place in connection with the Western Mediterranean zone. This is furthermore proved by the similarity of archaeological assemblages on both sides of the Alboran Sea and the appearance of domesticated species which have their origin in the Eastern Mediterranean. Beside these common features some differences are also visible. The Early Neolithic of both core regions of the Mediterranean coast can be divided in several sub-phases which are, however, not comparable. The main feature used for subdivision is pottery which provides significant differences between these two areas. However, *Cardium* impressions dominate during the second half of the 8th millennium calBP; in the Tangier area mostly performed using rocker-stamp technique (*en "flamme"*) and covering large parts of the vessel body. Early pottery of the Eastern Rif predominantly carries single impressions and the rocker-stamp technique seems to appear not before the end of the 8th millennium calBP. After a short period the *Cardium* shell is being replaced by combs. Whether these diverse characteristics are the result of local developments or evidence for distinct relations to the Iberian Peninsula should be subject of future research.

The Early Neolithic of Atlantic Morocco

Early Neolithic sites are known from three distinct areas: Cape Ashakar near Tangier, the agglomeration of Rabat and Casablanca and the area around Cape Juby in the south. At Cape Ashakar on the western edge of the Tangier peninsula two groups of sites very close to each other are known: the three shelters of El Khril at the Oued Ashakar and the cave sites immediately south of Cape Ashakar (Mugharet es-Safiya, Mugharet el Aliya and Grotte des Idoles). Further south of Cape Ashakar the only open air site is located, Oued Tahadart.

The study of the Ashakar sites already started at the end of the 19th century. In the year 1875 the diplomat Tissot and the geologist Bleicher realised the existence of prehistoric deposits. The caves of El Khril were discovered in 1906 by G. Buchet.[39] One of these, the Mugharet el Khail, was excavated in 1947 by the American School of Prehistoric Research (A.S.P.R.).[40] Further research was undertaken in 1958 by A. Jodin, who named the sites of Oued Ashakar with the letters A to C.[41] Shelter A here is the Mugharet el Khail, excavated eleven years before by the A.S.P.R.[42]

Buchet started systematic excavations in the shelters south of Cape Ashakar at the beginning of the 20th century. He excavated several sites, amongst others the Grotte des Idoles[43], where his research was continued in the 1920 s by R. P. H. Koehler.[44] From 1936 onwards the American consul of Tangier, Hooker A. Doolittle and the physician J. R. Nahon excavated the upper layers and, inspired by their work, the archaeologist C. S. Coon later excavated the lower layers of Mugharet el Aliya. Further research was done by the A.S.P.R. in 1947 under the direction of H. O. Hencken. Beside Mugharet el Aliya also the deposits of Mugharet es-Safiya and the already mentioned Mugharet el Khail were studied.[45] The entire Neolithic assemblage of the A.S.P.R. projects was published by A. Gilman.[46]

From 1984 onward the sites of Grottes d'El Khril A–C and Grotte des Idoles were revisited by the "Mission préhistorique et paléontologique française au Maroc", to verify stratigraphic relations and to generate samples for absolute dating.[47] From Grotte d'El Khril C a *Cardium* decorated sherd from layer C was dated by thermoluminescence (TL) and yielded two ages of 5.920 BP (Cle-119) and 6.730 BP (Cle-118). However, these ages appear rather recent. Several authors underline that the stratigraphies of Ashakar are very similar.[48] Gilman has published the assemblage of Mugharet el Aliya, Mugharet es-Saifiya and Mugharet el Khail (the latter identical with Grotte d'El Khril A according to Jodin) and Jodin interprets Grottes d'El Khril A, B and C together because of their "identical stratigraphies": "*La céramique sera étudiée dans son ensemble, les trois grottes état considérées comme un seul et même gisement* ".[49]

Therefore general archaeological trends of the Ashakar-Region can be introduced together for all sites. Koehler[50] classifies the material in six groups according to temper, wall thickness, firing and colour. Form and decoration seem to play a subordinate role.[51] Jodin in contrast creates intuitive groups on the base of decoration features: "Cardial"-Ware, Channelled Ware, and Incised Ware.[52] The latter system was adopted later by H. Camps-Fabrer[53] and with some modifications also by A. Gilman.[54]

The open air site of Oued Tahadart, discovered in 1972, was excavated in 1984.[55] Both ^{14}C as TL- and OSL-ages date the site into the 7th millennium calBP.

39 Buchet 1907.
40 Howe 1967; Gilman 1975.
41 Jodin 1958/59.
42 Gilman 1975, 11.
43 Buchet 1907.
44 For example, Koehler 1931.
45 Hencken 1948; Howe 1949.
46 Gilman 1975.
47 Daugas et al. 1998, 350.
48 Gilman 1975, 8; Jodin 1958/59, 225.
49 Jodin 1958/59, 291.
50 Koehler 1931, 157.
51 Koehler 1931, 157–159.
52 Jodin 1958/59, 291–292.
53 Camps-Fabrer 1966.
54 Gilman 1975, 40–68, 157.
55 Daugas et al. 1989.

The region between the urban centres of Rabat and Casablanca is also one of the better known areas at the Moroccan Atlantic coast. Here the famous sites of Harhoura 1 & 2, Dar es-Soltan 1 & 2, Kef el Baroud, the Grotte de Contrebandiers as well as the necropolises of Rouazi and El Kiffen are located. The local research history is also characterised by early excavations between the 1930 s and 1950s, amongst others in Dar es-Soltan 1, six km south of Rabat[56], and the Grotte des Contrebandiers, ca. 17 km southeast of Rabat.[57] An outstanding site is the necropolis of El Kiffen south of Casablanca, discovered by P. Mieg de Boofzheim and later excavated by G. Bailloud.[58] Surface finds collected in 1951 are known from Ain Chok, the most important site with so-called "*ceramique avec anses funiculaires internes*".[59]

Further fieldwork was carried out in the 1970 s and 1980 s by the "*Mission préhistorique et paléontologique français au Maroc*" under the direction of A. Débénath in the course of which the sites Dar es-Soltan 2 (200 metres south of Dar es-Soltan 1)[60], El Harhoura 1 and 2,[61] ten km southwest of Rabat, as well as the settlement and necropolis of Rouazi[62] were studied. At all sites samples were taken for dating as well as palynological, zoological und sedimentological analyses.[63] The most important output of the "*Mission préhistorique et paléontologique français au Maroc*" is a first "*Essai chronologique*",[64] presenting a chronological framework of the Neolithic in the region of Rabat and Casablanca. This essay was later refined on the base of new ^{14}C-ages.[65] In Harhoura 2 fieldwork started again in 2002.[66] New radiocarbon ages were obtained, dating the Early and Late Epipalaeolithic deposits.[67]

According to Daugas *et al.*[68] the Early Neolithic ("*Néolithique ancien*") has to be dated between 7.3 and 6.9 ka calBP. Apparently layer 1 of El Harhoura 2 belongs to this phase[69], yielding Neolithic material of different ages. This would include pottery with impressed decoration whose affiliation to the "Cardial circle" is in doubt.[70] From layer 1 come two burials whose collagen gave an age of 6.846±258 calBP (5.980±210 BP, Ly-2149). Surrounding snails were dated to 6.626±169 calBP (5.800±150 BP, UQ-1601).

Impressed pottery is also known from the Grotte des Contrebandiers. A TL-dated sherd yielded an age of 6.570 BP (Cle-136).

Besides revisiting several sites the "*Mission préhistorique et paléontologique français au Maroc*" carried out excavations in Grotte d'El M'nasra for the first time, where a complete *Cardium*-decorated vessel was recovered.[71] Although Early Neolithic deposits are not very numerous, Daugas *et al.* postulate a distribution of the *Cardium*-decorated pottery up to the altitude of Rabat.[72]

The Moroccan Late Neolithic

The Moroccan Late Neolithic starts after about 6.0 ka calBP (Fig. 3). Pottery assemblages are characterised by the disappearance of shell, particularly *Cardium* impressions and the establishment of comb impressions. Rocker-stamp technique now disappears in favour of single comb impress mainly organised as "herringbone" motive. Already Nehren points out that these assemblages appear very similar and could be the result of a movement of populations out of the Western Sahara.[73] Associated decorated ostrich egg shells and ivory objects support this hypothesis. The displacement of population may have been triggered by the desiccation of the huge dune fields of Erg Iguidi and Erg Chech in Western Algeria and Northern Mali during that period of time.[74]

Sites providing this type of pottery are concentrated in four areas: The agglomeration of Casablanca and Rabat (e.g. the necropolises of Rouazi and El Kiffen as well as Kef el Baroud), the coastal area between the estuary of Oued Draa und Cape Juby including the region of Akka at the southern border of the Anti-Atlas, the Tangier peninsula and the Eastern Rif including the Oujda Mountains.

The best studied sample of Late Neolithic pottery of the eastern Rif comes from the shelter of Hassi Ouenzga.[75] A single ^{14}C-age dates the Late Neolithic layer to 5.790±87 calBP (5.029±47, UtC-6184), fitting well with the other Late Neolithic deposits of the area. The assemblage consists of 40 pottery units, here already labelled as "Sahara group". Bands of single comb impressions frequently arranged as so-called "herringbone" motive, not performed in rocker-stamp technique are the most frequent type of decoration. Further techniques which appear in much lower quantities are a wide zig-zag impression using rocker-stamp technique and lines of single impressions such as triangles made with the help of tools which cannot be further specified. The small cups, ovoid forms and round vessels with or without shoulder are distinctive due to their low rim thickness. Surfaces are well treated and temper is fine-grained. The predominantly inclining rims are rounded and of symmetric shape.

The shelter of Taghit Haddouch located ca. 11 km northeast of Hassi Ouenzga was also excavated by the DAI/INSAP mission and yielded a Late Neolithic assemblage very similar to the "Sahara group" of Hassi Ouenzga. The pottery is exclusively decorated with comb impressions arranged in horizontal bands below the rim.[76] The vessels are equipped with round as well as pointed bases.

56 Ruhlmann 1951.
57 Roche 1969.
58 Bailloud – Mieg de Boofzheim 1964.
59 Camps 1974.
60 Débénath 1978.
61 Débénath – Sbihi-Alaoui 1979; Débénath – Lacombe 1986.
62 Débénath et al. 1983/84.
63 Daugas et al. 1998, 350.
64 Daugas et al. 1989.
65 Daugas et al. 1998.
66 Nespoulet et al. 2008; Campmas et al. 2008.
67 Stoetzel et al. 2011.
68 Daugas et al. 1998.
69 Débénath – Sbihi-Alaoui 1979.
70 Daugas et al. 1989, 683.
71 Lacombe et al. 1991.
72 Daugas et al. 1998, 352.
73 Nehren 1992, 204.
74 deMenocal et al. 2000.
75 Linstädter 2004.
76 Mikdad et al. 2000, 138

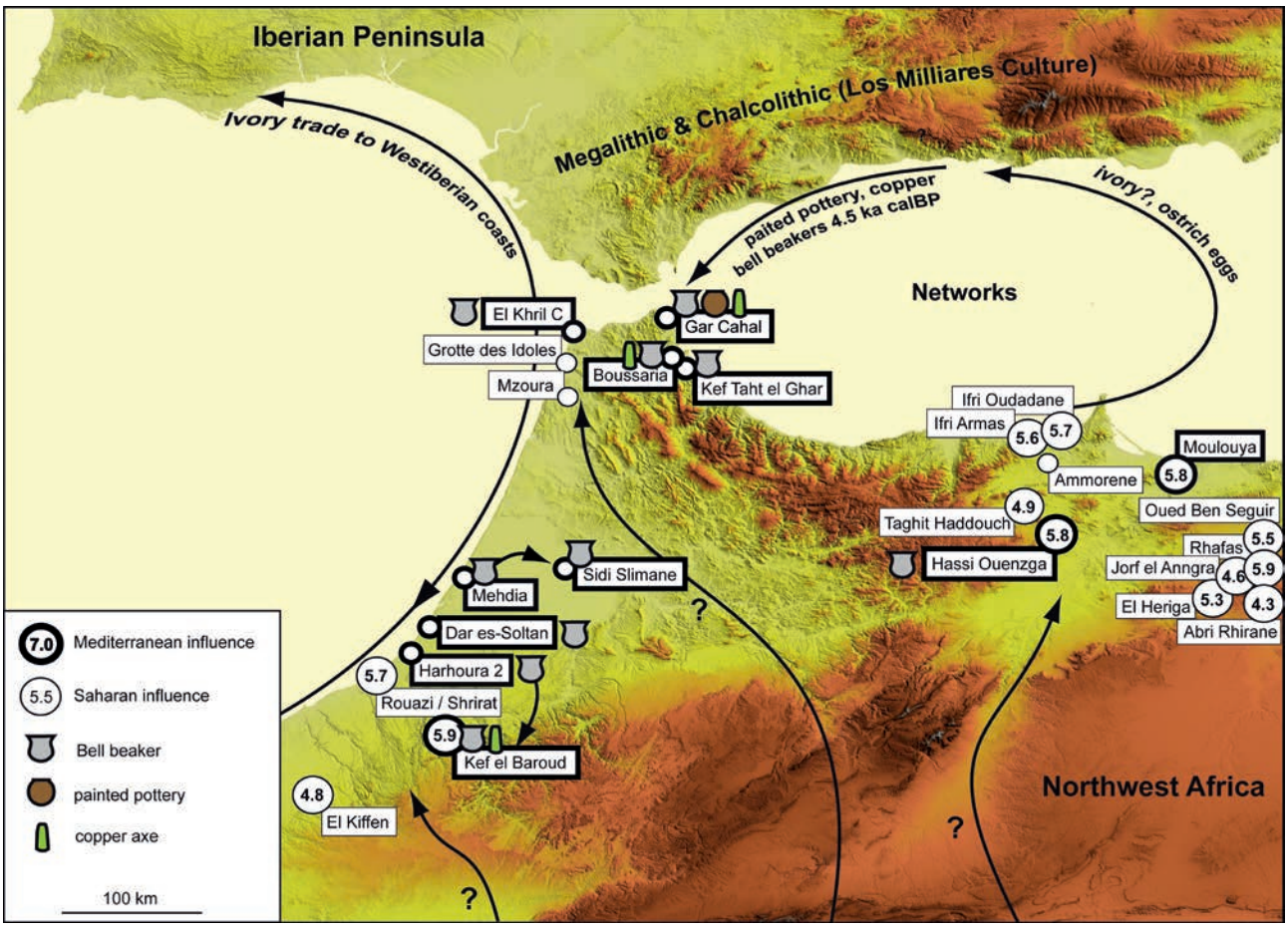

Fig. 3 The Early Neolithic of Morocco and the Atlantic facade. The Late Neolithic develops from 6.0 ka calBP onwards in a field of Saharan and Mediterranean influences. Due to the desiccation of the Sahara triggered by the end of the so-called "African Humid period" populations move to the coasts and more favourable habitats. At the same time trans-Mediterranean contacts prevail, namely the trade with ivory. These contacts become obvious first of all at the end of the Neolithic by the appearance of European Bell beakers and copper. The 4.2 ka RCC-event marks the end of the Moroccan Late Neolithic. Populations seem to decline and change to a more mobile lifestyle which makes them hardly detectable by archaeological methods. This figure makes no claim to be complete, however it provide the most important and securely dated sites. (Map based on SRTM data).

Little evidence comes from the shelter of Ifri Armas and the open air site of Ammorene. The upper layers of the rather disturbed deposits at the coastal site of Ifri Armas yielded a sherd which carries a herringbone motive using comb impression.[77] The two ^{14}C-ages of 5.507±128 calBP (4.798±108 BP, Erl 12422) and 5.661±47 calBP (4.915±50 BP, Erl 9994) can be attributed to this find. The open air site of Ammorene is famous for its Lower Palaeolithic stone industry.[78] During fieldwork also a scatter of comb-decorated sherds was documented, all of them providing herringbone motives (Fig. 4).

Because no Early Neolithic assemblage is known so far, the Oujda region seems to be settled not until the Late Neolithic.[79] From that period just a handful of sites is known, mainly discovered during the 1970 s and 1980 s by B. und L. Wengler.[80] Pottery is scarce and the sites are assigned mainly by ^{14}C-ages. Beside sites such as Jorf Akhdar, Oued Ben Séguir, Grotte de Rhafas, Oued Béni Méliárene or Jorf el Annaga, the most famous are the shelters of d'El Heriga, 45 km southeast and Abri Rhirane, ca. 20 km south of Oujda. The El Heriga pottery comes from the surface as well as from different parts of the shelter. Vessels are characterised by quartz and limestone temper as well as by black, roughly tempered surfaces. A few sherds provide incised decoration below the rim.[81]

Abri Rhirane pottery is exclusively undecorated.[82] Vessel surfaces show different colours from reddish-orange to greyish black. Temper is of different size and consists of quartz, schist and crushed snail shells.[83] Impressed and incised "herringbone" motives are also known from the cave site of El Arouia, NW-Algeria.[84]

The Late Neolithic pottery of the Cape Ashakar region is also known as so-called Ashakar-Ware labelled also as "*Céramique rouge lisse*" or "*Cerámica lisa*".[85] Gilman distinguishes between a red "polished ware" ("*Céramique rouge lisse*"[86]), fine tempered and hard fired; "ware with tunnel lugs" ("*Céramique*

77 Lorenz 2010, Fig. 11.5.
78 Jebb 2008.
79 Nehren 1992.
80 Wengler – Vernet 1992
81 Wengler 1983/84, 86.
82 Wengler – Wengler 1979/80; Wengler 1985.
83 Wengler – Wengler 1979/80, 42.
84 Vaufrey 1955, pl. LI; Aumassip 1971, Fig. 9)
85 Tarradell 1955, Fig. 6.
86 Jodin 1958/59.

Fig. 4 Late Neolithic pottery from the Eastern Rif. Comb impressions mostly applied as so-called "herringbone" motive: Hassi Ouenzga (1), Ifri Oudadane (2), Ifri Armas (3), Ammorene (4–9), (Photographs by J. Linstädter).

à anses tubulaires") and "decorated ware". The latter resembles the "red polished ware" concerning the rim-shaping but differs in firing, surface treatment and vessel forms. Gilman distinguishes between a "Dragged Comb Ware" and a "Pottery with fine comb impressions". The first one, also labelled as "*Céramique à décor incisé*" by Jodin[87], is characterised by grey to brownish quartz tempered vessels with short neck and decorated by incisions using a comb of four to five teeth. The "Pottery with fine comb impressions" is not clay-tempered and receives its decoration by vertical impressions of a ca. 1 cm long comb.[88]

The most important Late Neolithic sites are the necropolises of Rouazi (also Skhirat, or Skhirat-Rouazi) and El Kiffen. For the first time a new type of site is available: a burial ground. Early Neolithic burials are generally rare and, if preserved, to be found within cave deposits.[89] Unfortunately the necropolis of El Kiffen is dated by only one single ^{14}C-age: 4.876±128 calBP (4.300±80 BP, Auckland-W-1518). The 17 burials yielded 43 pottery vessels (according to other authors 45 vessels)[90]. The variability of shapes is considerable. The vessels are characterised by round or pointed bases and occasionally provide cylindrical necks and vertical cord lugs.[91] Furthermore simple bowls appear, also characterised by long cord lugs.[92] Surfaces are carefully polished and all decorations are restricted to the above mentioned cylindrical necks. Here comb impressions dominate, mostly designed as "herringbones". Beside the heterogeneity of forms all authors emphasise on the homogeneity of style within this assemblage. Theories about the origin of this material are discussed controversially. Y. Bensimon and M. Martineau[93] suggest an Iberian influence; others suppose a Saharan source.[94]

The 23 burials of Rouazi are dated by three ^{14}C-ages to the 6th millennium calBP: 5.702±168 calBP (4.950±150 BP, UQ-1557); 5.213±214 calBP (4.550±50 BP, Ly-4096); 5.140±248 calBP (4.481±190 BP, Ly-3087) and attract attention because of their richness of grave goods. The exterior impression is dominated by the red, well-polished surface. From 25 preserved vessels 23 are decorated by comb impressions. Therefore both surface treatment as well as decoration of El Kiffen and Rouazi are very similar and suggest an affiliation with the same cultural context.[95]

Finally, the site of Kef el Baroud 10 km east of Ben-Slimane should be mentioned. After small scale excavations from the 1950 s until the 1970 s by de Wailly[96], the cave was revisited in the 1990 s by an INSAP team under the direction of Abdessalam Mikdad[97]. Deposits of the Late Neolithic, the Bell beaker Culture and the Metal Ages were studied. Even here the Late Neolithic pottery shows the above mentioned single comb impressions arranged in horizontal bands.[98]

From the Oued Draa plain at the southern rim of the Anti-Atlas only two sites containing Late Neolithic material are known: the Adrar N'Metgourine, region of Akka[99] and the site of Tissint[100]. The Oued Tissint comes from a surface collection in 1953 and is poorly published. From Adrar N'Metgourine a pottery assemblage of 212 sherds, 165 of them decorated, is known. All sherds provide a very sophisticated surface treatment. Round forms with and without shoulder are reconstructed.[101]

Six different types of decoration are described, providing some varieties: simple bands of parallel impressions of combs, spatulas or straws[102], "herringbone" motives using combs and spatulas as well[103] and decorations named "parallel impressed channelled" by the author[104]. However, this decoration seems to be rather a narrow comb impression using rocker-stamp technique as it is also known from Hassi Ouenzga. Furthermore incisions appear, some as parallel lines[105], others as cross hatchings[106] and wide zig-zag impressions using rocker-stamp technique made with the help of combs or spatulas[107].

Further to the south between the Oued Draa mouth and Cape Juby a range of open air sites is known, described as "escargotière". The state of publication of these approximately 20 sites is rather insufficient. After some test excavations which took place at around the middle of the 20th century the major part of the sites was studied during the 1970 s and 1980s. It all began with D. Grébénart in 1971 and 1972[108] and continued under the direction of N. Petit-Maire in 1973 and 1974[109]. The last fieldwork was undertaken by Y. Bensimon und M. Martineau in 1985 and 1986[110].

Pottery decorated with incisions or impressions using combs is documented from seven sites (e.g. El Quaar-Site G und Megriou-Site H). Five of ten ^{14}C-ages come from sites owning pottery: El Quaar-Site G, Tarfaya-km 34 und Megriou-Site H. The latter, which yielded only undecorated pottery, is dated to 5.098±161 calBP (4.450±110 BP, Gif-2911). El Quaar-Site G gave an age of 5.729±114 calBP (4.950±100 BP, Mc-710). From the sites excavated by Y. Bensimon and M. Martineau no absolute ages exist. In their opinion the lithic assemblage (e.g. bifacially retouched arrow heads) reflects Saharan influence while pottery shows Maghrebian influence.[111]

87 Jodin 1958/59, 303, Pl. XI.
88 Gilman 1975, 57, Figs. 88–89. 91. 93–94; Jodin 1958/59, 299 Figs. 18–22. Pls. X–XI.
89 Débénath et al. 1983/84, 58.
90 Nehren 1992.
91 Bailloud – Mieg de Boofzheim 1964, Figs. 4.8. 5.1–5.
92 Bailloud – Mieg de Boofzheim 1964, Fig. 6.
93 Bensimon – Martineau 1987, 629.
94 Daugas et al. 1989, 685.
95 Débénath et al. 1983/84, 60.
96 de Wailly 1973/75.
97 Atki 1994.
98 de Waily 1975, Pl. XVIII.
99 Bensimon – Martineau 1987, 638; Grébénart 1995.
100 Camps-Fabrer 1966, 306.
101 Grébénart 1995, Figs. 2.1, 2.2.
102 Grébénart 1995, Fig. 3.
103 Grébénart 1995, Fig. 4.
104 Grébénart 1995, Fig. 5.1–4.
105 Grébénart 1995, Fig. 5.5–8.
106 Grébénart 1995, Fig. 5.6.
107 Grébénart 1995, Fig. 5.14–17.
108 Grébénart 1974; Grébénart 1995.
109 Petit-Maire – de Bayle des Hermens 1979.
110 Bensimon – Martineau 1987.
111 Bensimon – Martineau 1987, 640.

The Final Neolithic of Morocco

The final Neolithic of Morocco is represented by around twelve sites providing bell beaker assemblages. Distribution maps are shown by Souville[112] and Mikdad[113]. The Moroccan sample is completed by two east Algerian finds at Rhar Oum El Fernan[114] and Oued Saïda[115]. Four of them are located in the region of Rabat/Casablanca: Harhoura 2, El Menzeh, Mehdia, Dar es-Soltan and Kef el Baroud. According to Daugas *et al.*[116], all bell beakers are Iberian imports and belong to a developed phase of the bell beaker era.

Fragments of bell beakers were also found in Kef Taht el Ghar, layer II[117] and in Gar Cahal, layer IIIa[118]. In the case of Kef Taht el Ghar bell beakers follow an Early Neolithic characterised by "Cardial"- and "Channelled Ware", while in Gar Cahal they appear together with "polished and incised ware" (*Cerámica lisa* and *Cerámica incisa*) within the same layer. Jodin[119] describes sherds of El Khril, decorated in bell beaker style and associated with "*Poterie Rouge*", in his opinion well comparable to vessels found in Dar es-Soltan and Oued Merzeg. The fragment shown[120], however, appears as a typical Late Neolithic sherd, as it is typical of all other examples described above. This Late Neolithic horizon of comb decorated pottery has been linked with the successive bell beaker phenomenon to point out a possible continuity. The bell beaker era starts on the Iberian Peninsula earliest at about 4.9 ka calBP.[121] Rouazi and El Kiffen therefore are several centuries older. Out of this a theory of an African origin of the bell beaker phenomenon was developed and therefore an inversion of the up to now assumed innovation process. According to that theory the term "*Précampaniforme*" or "*Proto bell beaker*" was introduced and connected with the period of Rouazi and El Kiffen.[122] Elsewhere Daugas *et al.* mention the "*Style de Skhirat*" which the authors recognise also in the assemblages of El Khril, Grotte des Idoles, Gar Cahal, Kef Taht el Ghar and Kef Boussaria and understand this style as a genetical component of the Spanish bell beaker phenomenon.[123] Doubtless, ^{14}C-ages connected to early Moroccan bell beakers which would support this theory are lacking so far.

Discussion

The paper comments on three issues of the Moroccan Neolithic. Firstly to the term and concept of Middle Neolithic which apparently does not exist as an archaeological phenomenon, wherefore this label should not be applied anymore. In the second place the impact of climate and environmental change on cultural changes shall be evaluated. And thirdly, models should be formulated which reveal general trends in the development of the Early and Late Neolithic.

The supposed Middle Neolithic

The Moroccan Middle Neolithic has always been an elusive concept, rarely used such as recently by Jacobs *et al.*[124] in the case of the Temara caves. Daugas *et al.*[125] dedicate two small paragraphs to this phase. As a probable record belonging to this phase the collective burial of Harhoura 1 (Grotte Zouhrah) is mentioned, dated by a single ^{14}C-age to 6.184±316 calBP (Gif 5519[126]). The approximately 20 burials are poor in grave goods. Pottery is completely missing and the few lithic artefacts give no indication for dating. According to the chronological framework presented here the ^{14}C-age itself would belong to the late Early Neolithic, but because of its huge standard deviation it will be excluded from our considerations. Furthermore some finds of Harhoura 2 are assigned to the Middle Neolithic such as ovoid well smoothed vessels.[127] In addition Daugas *et al.*[128] mention the sites of Oued Mellah und Oued Merzeg. These sites are isolated discoveries published between 1929 and 1953 and therefore cannot contribute to the current discussion. With respect to Daugas *et al.*[129] the term was furthermore used in Linstädter (2004) by interpreting the stratigraphy of Hassi Ouenzga.[130] After Daugas *et al.* the Middle Neolithic is followed by the *Néolithique Moyen Récent,* a term also occasionally used.[131] According to them this phase starts at about 6.0 ka calBP and is characterised by the "*style céramique de Skhirat*" and the related sites of Skhirat and Rouazi. Furthermore the sites of Kef el Baroud, Dar es-Soltan, El Harhoura 2, El Mnasra, Grotte des Contrebandiers and the Neolithic sites of the Tangier peninsula were mentioned. According to the chronological framework presented here, this phase corresponds completely with the period which this paper calls the Late Neolithic.

Regional, supra regional and global events

If we confront the abundance of ^{14}C-data from archaeological sites with environmental and climate data of the global and regional archives some coincidences appear. These correlations between ^{14}C-data-frequency and shifts in aridity and temperature may suggest possible relations between environmental change and occupation dynamics (Fig. 5). The ^{14}C-ages are shown as cumulative probability plots of calibrated radiocarbon ages (Fig. 5 A, upper line: Mediterranean data,

112 Souville 1977, Fig. 3.
113 Mikdad 1997, Fig. 7.
114 Balout 1955.
115 Camps-Fabrer 1966.
116 Daugas et al. 1989, 586.
117 Tarrdell 1955, 320, Pl. IV.1.
118 Tarrdell 1954, 352.
119 Jodin 1958/59, 306.
120 Jodin 1958/59: Pl. XIII.4
121 Strahm 1995.
122 Daugas et al. 1989, Pl. 1.
123 Daugas et al. 1998, 352.
124 Jacobs et al. 2011, 379.
125 Daugas et al. 1998, 352.
126 Débénath – Sbihi-Alaoui 1979.
127 Daugas et al. 1998, 683.
128 Daugas et al. 1998, 352.
129 Daugas et al. 199.
130 Linstädter 2004, Fig. 62.
131 Daugas et al. 1998; e.g. El Idrissi 2008, Fig. 3.

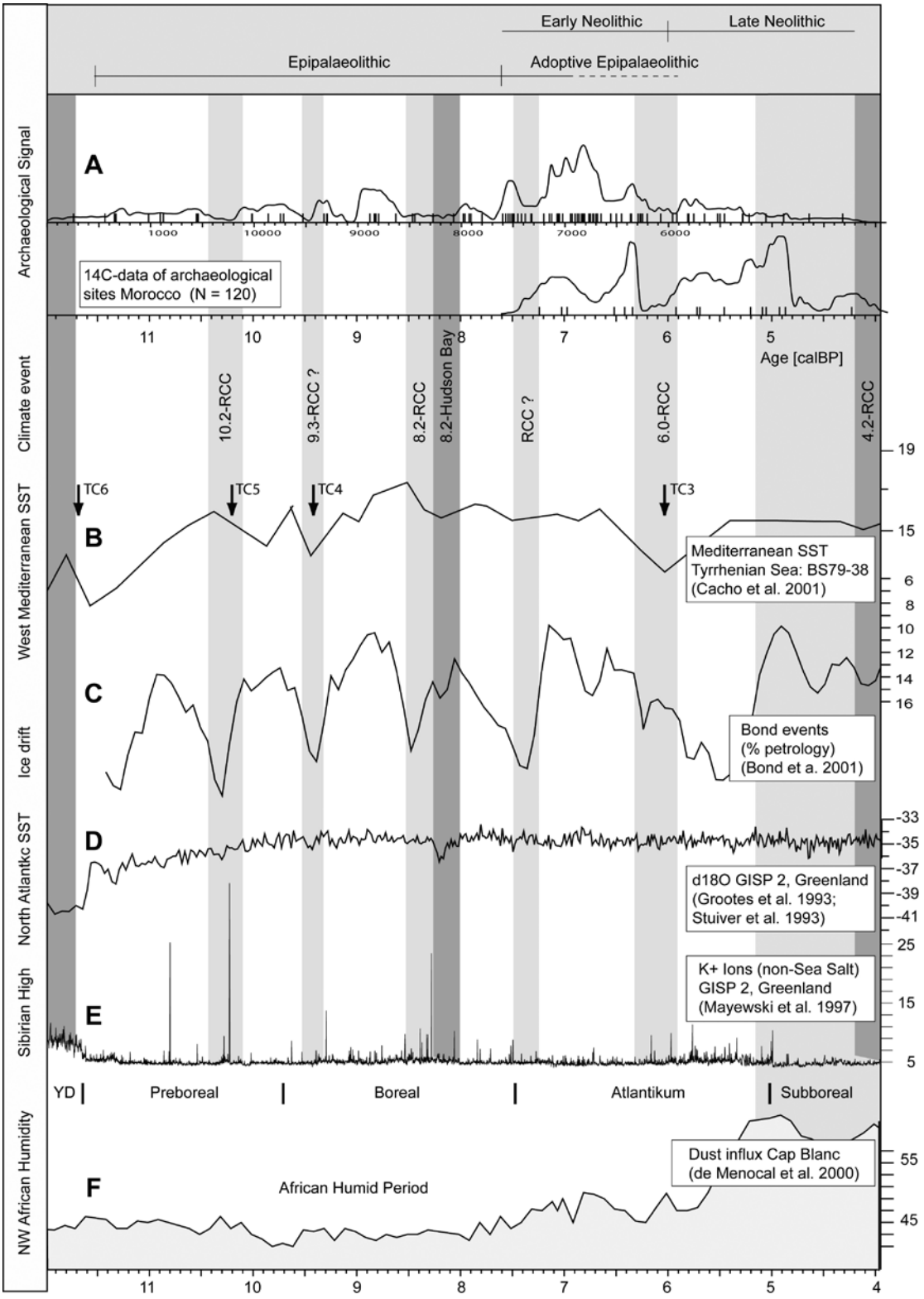

Fig. 5 Radiocarbon ages, regional and global climate archives. A) CALPAL cumulative probability plots of calibrated radiocarbon ages from Mediterranean Morocco (upper line) and the Atlantic facade (lower line). B) Sea surface temperature (SST) on the base of Alkenones from core BS79–38, Tyrrhenian Sea (Cacho et al. 2001). The arrows mark drops in SST. C) Bond events: fluctuations of ice-rafting debris measured by the amount of nonlocal clasts in marine sediments of the Northern Atlantic (Bond et al. 2001). High amounts mark increased ice drift and therefore lower temperatures. D) Reconstruction of the North Atlantic Sea surface temperature (SST) on the base of the relation of the oxygen isotopes ^{16}O and ^{18}O from GISP 2, Greenland (Grootes et al. 1993). E) This curve provides the amount of [K+] Ions in Greenland ice cores. The non-sea-salt [K+] potassium transport to Greenland is a proxy for the late winter-spring intensity of atmospheric high pressure over Siberia (Mayewski et al. 1997). [K+] potassium peaks therefore are indicators for cold winter events. F) The "African Humid period" (AHP) is defined by the amount of Saharan dust import in marine sediments off shore the Mauritanian coast (deMenocal et al. 2000). High values indicate high dust import due to low vegetation cover. Altogether several correlations between climate events and dips in ^{14}C-frequency are visible, e.g. at 10.2, 8.2 and around 6.0 ka. The ^{14}C-curve fades out during the 4th millennium calBP dust influx in the Atlantic which indicates general desiccation in Northern Africa. The 4.2 RCC-event marks the end of the Neolithic period (courtesy of J. Linstädter).

lower line: Atlantic data). It has to be considered that cumulative probability plots are no independent proxies because the frequency of data depends to a certain extent on research history and preservation conditions of datable material. Nevertheless these curves provide indication for occupation dynamics whose value becomes more and more robust with increasing data volume.

The appearance of Neolithic innovations does not correlate with any known environmental shift and therefore others triggers have to be considered. Early Neolithic data culminate at about 7.2 ka calBP. Hereafter the amount of ^{14}C-ages decreases and arrives at nearly zero at about 6.3 ka calBP. At this time several archives indicate a deterioration of environmental conditions throughout the Western Mediterranean. Cacho *et al.* reconstruct a sea surface temperature drop of the Tyrrhenian Sea at the location of BS79–38 exactly at the same time when the number of radiocarbon ages decline.[132] Low point of this sudden drop in temperature is at 6.0 ka calBP (Fig. 5 B).

Furthermore the global climate archives of the Atlantic Ocean provide correlations to the archaeological data. The so-called Bond events represent increases of ice-rafted debris within North Atlantic marine sediments. The rise in the percentage of lithic fragments is interpreted as increase of ice drift towards lower latitudes.[133] From 7.0 ka calBP onwards the data provide a continuous increase of ice-rafted debris until 5.5 ka calBP which indicates cooling of the Northern hemisphere (Fig. 5 C).

A further global proxy that provides correlations with Ifri Oudadane and the occupation of Northwest Africa in a broader sense is the amount of K+ Ions in Greenland ice cores (Fig. 5 E). The non-sea-salt [K+] potassium transport to Greenland is a proxy for the late winter-spring intensity of atmospheric high pressure over Siberia.[134] Extremely cold air masses enter Northern Eurasia from the polar region. Cold winds transport dust as far away as Greenland and the Northern Atlantic and influence the environmental conditions of Western Europe and Northern Africa. [K+] potassium peaks are visible at 10.2, 8.2 and around 6.0 ka calBP and therefore correlate with drops in the ^{14}C cumulative curve at the end of the Early Neolithic.

Convincing terrestrial evidence is documented within the alluvial deposits of the Moulouya valley, Northeast-Morocco. The sedimentation during the Early Holocene shows stable landscapes indicated by initial soil formation and very few flood events. Numerous Epipalaeolithic and Early Neolithic sites embedded in these alluvial deposits demonstrate intensive land use. This moist phase equally ends here no later than 6.3 ka calBP, indicated by a significant decline of sites and a general lacking of soil formation.[135] As the last terrestrial signal the pollen analysis of Ifri Oudadane has to be mentioned.[136] The change to the Late Early Neolithic (ENC) at 6.3 ka calBP is marked by a decrease of anthropic taxa together with botanical indicators for aridity, which announce the following phase of environmental disfavour.

During the following centuries data occur only sporadically within the Eastern Rif. The majority of data stem from the Chafarinas Island that represents an exceptional situation because of its proximity to the coast and the drinking water resources provided by the Moulouya River. Single data stem from Ifri Zarrouck and Taghit Haddouch (Plain of Gerrouaou) and Taoungat 7, likewise Moulouya valley.

After 6.0 ka calBP the frequency of ^{14}C-data rises again, above all at the Atlantic coast. Because of the rather low amount of data this fact should be considered with caution. At least the data of the Mediterranean zone seem to fade out during the 6th millennium calBP. This decline of data can be directly linked to the concept of the so-called African Humid period (AHP)[137], which ends at about the same time. The AHP is defined by the amount of Saharan dust import in marine sediments off shore the Mauritanian coast (Fig. 5 F). The increase of dust during the 6th millennium calBP is interpreted as the drying up of the Sahara and therefore as the end of the relative favourable conditions of the former AHP. The effect is traced back to fluctuations in solar insulation amplified by several feedback processes. Despite criticism that the concept of the AHP cannot be applied to the entire Sahara it still works for its western part.[138] As a kind of climate refugees, the drying up of the Sahara pushes populations to the continent rims, there forming the Late Neolithic.

The very end of the Moroccan Neolithic can be set to the end of the 5th millennium calBP, a moment when the Eastern Mediterranean is under the influence of the 4.2 ka RCC-event.[139] This event restrains the influence of the Mediterranean westerlies and possibly the Indian monsoon and therefore reduces seasonal precipitation.[140] Because indications of severe droughts are observable almost everywhere in Western Asia, the event has often been associated with changes in the archaeological record, such as the end of the Old Kingdom of Egypt and the end of the Akkadian empire.[141] To what extent the influence of the 4.2 ka event affects the Western Mediterranean has to be studied further. However, it appears that the effect was stronger on the African side than on the Southern Iberian Peninsula. After 4.2 ka calBP archaeological data become very scarce in Morocco which could be explained with a reduced and highly mobile population. In Spain, in contrast, fully agricultural societies develop, such as the Late Neolithic and Chalcolithic Los Millares culture, characterised by highly organised city-like agglomerations.

Occupation model

In conclusion it can be said that climate as well as climatic and environmental changes seem to have had notable impact on the run of events during the Moroccan Neolithic. While the Neolithisation itself seems to have been triggered by socio-economic factors, the end of the Early Neolithic at 6.3 ka calBP, the enforced Saharan impact during the Late Neolithic from 6.0 ka calBP onwards and the end of the Neolithic as a whole at about 4.2 ka calBP correspond closely to climate and environmental changes. The occurrence of

132 Cacho et al. 2001.
133 Bond et al. 1997; Bond et al. 2001.
134 Mayewski et al. 1997.
135 Linstädter et al. 2012b.
136 Zapata et al. 2013, Fig. 4.
137 deMenocal et al. 2000.
138 Kröpelin et al. 2008.
139 Weiss 2012
140 Staubwasser – Weiss 2006, 381.
141 Cullen 2000.

Neolithic innovations in the Western Mediterranean can be traced back to the advance of Neolithic groups at least up to the area of Valencia.[142] From here these innovations entered the Western Mediterranean where they were distributed via already existing marine Epipalaeolithic networks. Single components such as pottery and domesticated species were adopted step by step by local Epipalaeolithic groups in the continental hinterland and individually integrated and developed further. The latter is proved by the invention of very different pottery forms and decoration on the African side. The fast adoption of pottery technology in Morocco might have been favoured by a semi-sedentary way of life of the local foragers. Livestock keeping and the cultivation of crops and legumes did not become the dominant mode of subsistence during the Moroccan Early Neolithic. Instead, these technologies were attached to the existing hunter-gatherer economy to the end that a quite diversified subsistence strategy may allow best to cope with the uncertainties of a semi-arid environment.[143]

These Early Neolithic groups with their broad spectrum economy and characterised by *Cardium*-impressed pottery seem to disappear at the end of the 7th millennium calBP. Pottery decorated with so-called "herringbone" motives, made using single comb impressions, now occur all over the territory of today's Morocco. Only a few things are known about the economy of these groups. Distribution of the sites and pottery decorations together with associated finds of ivory from the cemeteries of Rouazi and El Kiffen or the cave sites of Kef el Baroud and Grotte des Idoles[144] suggest a Saharan origin of these features. The desiccation of the Sahara at the end of the so-called African Humid Period (AHP) may have forced people to leave their territories towards more favourable habitats such as the Atlantic or Mediterranean coasts. Anyhow, adapted to more arid environments even the Mediterranean zone under its now deteriorated conditions was still an utilisable habitat for their supposed way of life.

The occurrence of bell beakers at about a dozen sites again indicates a closer connection to the European continent from 4.5 ka calBP onwards. A few copper objects and painted pottery complete the picture. This phase of intercontinental contact lasts only 300 years, because after 4.2 ka calBP archaeological data become very scarce. It can be assumed that the fatal 4.2 ka RCC-event with its dramatic consequences in the Eastern Mediterranean had an impact also on the Western Mediterranean.

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