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Middle Holocene hunting and herding at Gueldaman Cave, Algeria: An integrated study of the vertebrate fauna and pottery lipid residues

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ABSTRACT

Pathways to food production in Holocene north Africa are complex and varied and, for the human groups living there, are likely heavily influenced by varying factors such as local ecosystems and available resources. Molecular and isotopic analysis of absorbed food residues from 140 pottery vessels from Neolithic Gueldaman Cave site confirms that the exploitation of domesticated animals (sheep and goat), for their carcass fats, and their secondary products, e.g. dairy, began in Mediterranean north Africa in the 5th millennium BC. Findings from organic residue analyses are confirmed by the slaughter profiles from the faunal assemblage which suggest a mixed meat/milk economy.

1. Introduction

It has long been known that pathways to food production in Africa are complex and varied. In Holocene north Africa, the adoption of domesticates and the existence of pastoralism became an established and widespread way of life long before the domestication of plants, which occurred much later (c. 4000 BP; Gifford-Gonzalez, 2005; Garcea, 2006). Here, it seems likely that the development of subsistence strategies would have been heavily shaped by the unstable, often marginal environments that north African hunter–gatherers lived in. Then, predictable access to resources would have been their major concern, rather than the intensification of yield more applicable to early farmers in the Levant (Marshall and Hildebrand, 2002). The 'patchy spread of food production' in Africa is known, where, in contrast to European prehistory, African hunter–gatherers and food producers (pastoralists, agriculturists) continued to co-exist (Marshall and Hildebrand, 2002). It is likely that spatial variation in climatic and environmental conditions, together with availability of food resources, dictated whether managing livestock or hunting, or combinations thereof, took place.

This is demonstrated by the three distinct regions in Holocene north Africa, each of which follows separate pastoral trajectories: 1) Mediterranean north Africa including the Maghreb, 2) The Nile Valley and the adjacent dry hinterlands, and 3) Saharan Africa from west of the Nile to West Africa (Gifford-Gonzalez, 2005). In Saharan Africa, pastoralism spread unevenly from the eastern Sahara to the Acacus (Libya) and Tibesti (Chad) massifs between *c.* 7000–5000 cal BP. Early Holocene patterns of plant use persisted and Saharan pastoralists still hunted and fished (Smith, 1980; Gautier, 1987; Marshall and Hildebrand, 2002; Lucarini, 2014). In contrast to drying Saharan environments, the Sudanese Nile offered more reliable, fertile resources. Pastoralists utilised large semi-permanent camps such as at Esh Shaheinab and Geili, and domesticates, mainly cattle, were dominant at sites such as Kadero *c.* 5000–4000 BP, where wild plants were also intensively exploited (Gautier, 1984; Caneva, 1988; Krzyzaniak, 1991; Haaland, 1992, 1995; Marshall and Hildebrand, 2002).

Significantly, the prehistory of Mediterranean north Africa follows a different trajectory. In recent years several research projects investigating the 'Neolithisation' of this part of north Africa have added significantly to our understanding of the region. However, our knowledge of the cultural processes, and its spatiotemporal extent, leading to the adoption of Neolithic innovations such as the exploitation of domesticates, is still fragmentary. Both the geographic extent and chronology of the Neolithic period in Mediterranean north Africa are not fully understood, primarily due to a sparse and fragmentary archaeological record, with many areas of the region being unexplored (Linstädter, 2008; Lubell et al., 2009; Lucarini, 2013).

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In the eastern Maghreb, the Capsian period, denoted by broad-spectrum hunting and gathering strategies, ends late, at around 7000 cal BP. The Capsian culture is followed by the Neolithic of Capsian tradition (Néolithique de Tradition Capsienne) although the extent to which Neolithic economic practices (such as herding) are adopted by the later Capsian groups remains unresolved (Roubet, 2001; Rahmani, 2004; Linstädter, 2008). Located in eastern Algeria and southern Tunisia, in the regions of Constantine, Gafsa and Tebessa, our understanding of the diet and subsistence practices of these groups is limited to the site of Grotte Capéletti in the Aurès Mountains, Algeria. Here, at *c.* 6800 cal BP, the people practiced transhumance as part of a pastoral lifestyle, exploiting domesticated cattle, sheep and goats (Roubet, 2001, 2003; Lubell et al., 2009).

The analysis of organic residues absorbed within the fabric of ceramic vessels, using molecular and isotopic techniques, has been shown to be a powerful tool both in the investigation of past diet and subsistence practices and in the reconstruction of animal management practices (e.g. Copley et al., 2003; Craig et al., 2005; Evershed et al., 2008; Outram et al., 2009; Dunne et al., 2012). Organic residue analysis has allowed the identification of terrestrial animal fats as proxies for carcass processing and secondary product exploitation, aquatic products, plant oils and waxes denoting vegetable and plant oil consumption and beeswax, resins, tars and bitumen used in a wide range of technological and cultural activities (e.g. Heron et al., 1994; Dudd and Evershed, 1998; Stern et al., 2003, 2008; Hansel et al., 2004; Cramp et al., 2011; Salque et al., 2013).

Although domesticated animals have been identified in the Mediterranean African Neolithic the inception of dairying practices and the spatiotemporal extent of their exploitation for dairy products is not known. The use of secondary products e.g. milk, blood, wool and traction, which can be obtained from domestic animals through their lifespan, marks an important step in the history of domestication (Sherratt, 1981, 1983) and is of considerable interest in reconstructing past diets as there are major economic and nutritional gains from using these animals for their milk and other products (e.g. Holmes, 1970). Significantly, as well as providing an important source of calories, milk and milk products provide a dependable and renewable source of foodstuff – they are 'lifetime products'.

As discussed, the three distinct pastoral trajectories in Neolithic north Africa are known, despite this, the timing and extent of the inception of dairying practices in north Africa and the development of 'secondary products' economies are still poorly understood in comparison to what we now know of the first appearance of milking in the Near East (Evershed et al., 2008). Significantly, the exploitation of domesticates for their carcass and dairy products at Takarkori rockshelter, in Saharan Africa, *c.* 7000 cal BP (5th millennium BC), was identified for the first time based on the $\delta^{13}C$ and $\Delta^{13}C$ values of preserved fatty acids from pottery residues (Dunne et al., 2012, 2013). These findings demonstrated an extensive processing of dairy products in pottery vessels in the Libyan Sahara during the Middle Pastoral period (*ca.* 7200–5800 BP, 5200–3800 BC), suggesting a full pastoral economy as the cattle were intensively exploited for their secondary products. Of note are the range of different forages the animals subsisted on, either composed completely of C_3 plants, varying combinations of C_3 and C_4 plants to a diet comprising wholly C_4 plants, suggested that Saharan pastoralists were practising differing pastoral modes of subsistence during this period residues (Dunne et al., 2012, 2013). This insight into the palaeoecology of the region can help us understand the relationships between people and their environment, particularly, as in this instance, over a period of significant climatic and environmental change.

2. Gueldaman Cave

The rich and diverse archaeological record uncovered during recent excavations at Gueldaman Cave, Algeria demonstrates its potential as a key site for understanding the North west African Neolithisation process (Kherbouche et al., 2014). This has provided a unique opportunity for a programme of organic residue analysis to apply molecular and isotopic techniques to the analysis of absorbed food residues extracted from Neolithic ceramic vessels from the site. This will help elucidate diet and subsistence practices in the Neolithic period of Mediterranean north Africa, provide insight into the possible inception of dairying practices and contribute to broader understandings of the differing pathways to food production in the region.

2.1. Gueldaman Cave – geographical, geological and historical settings

Adrar Gueldaman, from the Berber for mountain (Adrar) and devoted to the god of waters (Gueldaman) is an eastern Mediterranean ridge situated in the western Tellian Babors in the Tell Atlas mountains, Algeria. The site of Gueldaman (GLD1) is located on this ridge (Fig. 1A), at 507 m altitude, in a large karst network together with five other caves, two of which, GLD2 and GLD3, also contain deposits of prehistoric origin (Kherbouche et al., 2014).

GLD1 was first excavated by de Beaumais and Royer (1926) and mounds of spoil from these excavations remain in situ, mostly alongside their trenches within the cave (Kherbouche et al., 2014). Although not chrono-stratigraphically detailed, de Beaumais and Royer interpreted the site as Early Neolithic through finds of polished bone tools and axes, human and faunal remains, potsherds and some lithics (flint and quartzite). Four seasons of excavations, from 2010 to 2013, together with a full examination of the 1926 spoil heaps, have now been undertaken by the Centre National de Recherches Préhistoriques, Anthropologiques et Historiques (CNRPAH), Algeria.

The GLD1 cave comprises a 6 m semi-circular opening, facing southeast, inside, a 10 m high and 6 m wide dome shaped corridor leads to the main space ("Grande Salle") which is about 80 m long (Fig. 1B). In 1926, de Beaumais and Royer described the maximum depth of deposit as 5 m; however, excavations in 2010 revealed greater depth with the bedrock still not reached. New excavation focused first on two small areas in sectors S2 and S3 (Fig 1B and C) but the potential surface area for investigation covers 1000 m^2, consequently, exploration of a larger horizontal area began in 2013 (Kherbouche et al., 2014).

Large amounts of charcoal were found in the stratigraphical sections of both S2 and S3 areas, throughout the entire sequence, suggesting significant anthropogenic activity in the cave (note: correlation between layers and archaeological units is shown in Table 1). The first, well-dated, North African hearth structure of Neolithic date was discovered in S2 (Fig. 1B), at the top of layer UA1, the oldest level at 7022 cal BP (Table 1, SacA36981). It has an almost circular shape surrounding a high and horizontal concentration of calibrated stones on a charcoal bed, possibly suggestive of a type of cooking grill. Several bones were found both inside and outside the structure (Fig. 1D).

Several wood charcoals of 0.5–1.5 cm length from sections S2 and S3 were radiocarbon dated by the LSCE laboratory in Gif-sur-Yvette, France; dates are shown in Table 1. The chronostratigraphy of the first 12 layers in S2 is known with quite good precision, but it is important to note that layer 13 (UA1) is only dated at its top, at 1.47 m, in S2 and at 1.9 m in S3 and not at its bottom which is 30 cm deeper, at least in S3. As a consequence, it is possible that the