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Fish and salt: The successful recipe of White Nile Mesolithic hunter-gatherer-fishers

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ABSTRACT

In prehistoric hunter-gatherer-fisher communities, demographic growth and a more sedentary life-style are usually associated with locally concentrated food resources. Technologies believed to have been employed for preserving excess food resources include, among many others, salting, smoking, and/or sun-drying of fish and meat. However, direct proof of salting is often lacking, as salt is highly soluble. We present here the first robust evidence of the earliest known examples of fish salting from Middle Mesolithic structures at an archaeological site in Central Sudan (7th millennium BC). A multidisciplinary approach was applied, including a contextual geoarchaeological study (field analysis; micromorphological and scanning electron microscopy), a mineralogical-microstructural analysis of salt crystallization (X-ray diffraction, scanning electron microscopy), and a chemical analysis of salt concentration (ionic chromatography) in the soil in which salted fish bones have been found. The results indicate that salting fish with the aim of preserving it was common at the site of Al Khiday since the Middle Mesolithic and this habit cannot be related to post-depositional precipitation due to aridification of the area. A clear-cut emphasis on fishing characterized the economy of the human population of the time. This foraging system, together with salting and storing fish seems to be closely connected with its nearly sedentary status.

1. Introduction

Practices which enhance the possibility of storing food against future periods of shortage, to preserve it in the case of over-production, and to transport it to other residential locations, are thought to have reduced the need for residential mobility (Binford, 1980; Testart, 1982; Yesner, 1980; Zeder, 2012). Most of the theoretical analyses of settlement patterns, demography and economy, including food storage and delayed-return strategies in prehistoric societies, are based on ethnographic analogies (Bettinger, 2001; Finlayson, 2009; Kuijt, 2008; Testart, 1982). However, when dealing with the variability and specific constraints of archaeological data (Rowley-Conwy, 2001) this approach may lead to misleading oversimplifications. Direct proof of food conservation, especially fish, based on archaeological evidence and supported by scientific analyses, is scarce. Technologies adopted by ancient communities intensively exploiting marine, lacustrine or riverine aquatic resources, have thus been hypothesized by deductive reasoning (Sordoillet et al., 2018; Bar-Yosef Mayer, 2013; Cannon and Yang, 2006; Deith, 1989; Glykou, 2014; Mylona, 2010; Sakaguchi, 2009; Van Neer, 2004; Van Neer et al., 2005; Vermeersch

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et al., 2000; Zohar and Cooke, 1997; Zohar et al., 2001).

The oldest evidence of smoking fish dates back to the late Palaeolithic (13000-12000 BC) of Makhadma 2 and 4 in Egypt (Van Neer, 1994; Van Neer et al., 2000), and the oldest indications of possible fish fermentation come from Norje Sunnansund, an early Mesolithic site (ca. 7000 BC) on the south-eastern coast of Sweden (Boethius, 2016). Archaeozoological studies indicate early intensive fish curing, salting and/or smoking at Mesolithic sites in the eastern Mediterranean islands from Sicily to Cyprus, and the coastal Levant (8th-7th millennium BC) (Cassoli and Tagliacozzo, 1995; Mylona, 2014; Zohar et al., 2001). As elsewhere, fish processing for storage in the Mesolithic of central Sudan has been hypothesised earlier, according to indirect evidence (Peters, 1995).

We present here mineralogical, geochemical and archaeological data on fish remains attesting to the oldest use of salt for fish conservation by an early Holocene hunter-gatherer-fisher community along the White Nile River in the Sudan. At the Al Khiday Mesolithic sites (~7000–6000 BC) in central Sudan, there was a large emphasis on fishing since the Early Mesolithic (~7000–6750 BC), as attested by the large quantities of fish remains (Salvatori et al., 2014; Williams et al., 2015; Linseele and Zerboni, in press; about 90% of more than 15000 bones studied so far). The predominant taxon is clariid catfish (Clariidae) (according to the context, about 50–80% of the total number of identified fish bones). Size reconstructions show that most individuals had Standard Lengths (length from the tip of the snout to the beginning of the tail) of 40–60 cm and more. This indicates that people were probably mainly fishing at the beginning of the flood season, when these fish must have been easy to catch in shallow waters (Van Neer, 2004).

The archaeological record also contains harpoons (Fig. 1) as part of the fishing gear, although most equipment was probably made of perishable materials (e.g., nets and baskets). This fishing-based economy is linked to the geographic location of sites on the western bank of the White Nile, on the edge of a wetland area (Williams et al., 2015; Zerboni, 2011). The salt (halite, NaCl) on fish bones of some pits in site 16-D-4B (~6440–6250 BC) at Al Khiday (Fig. 1), discovered during stable isotope studies on human and animal bones for dietary and environmental reconstructions (Iacumin et al., 2016), was investigated to define the occurrence, nature and origin of this mineral phase. The data confirm the world's oldest evidence of fish salting, add new information on food storage in prehistoric societies with access to rich natural resources and, more in general, highlight some archaeological and anthropological implications concerning the lifestyle of Early Holocene human groups along the Nile Valley.

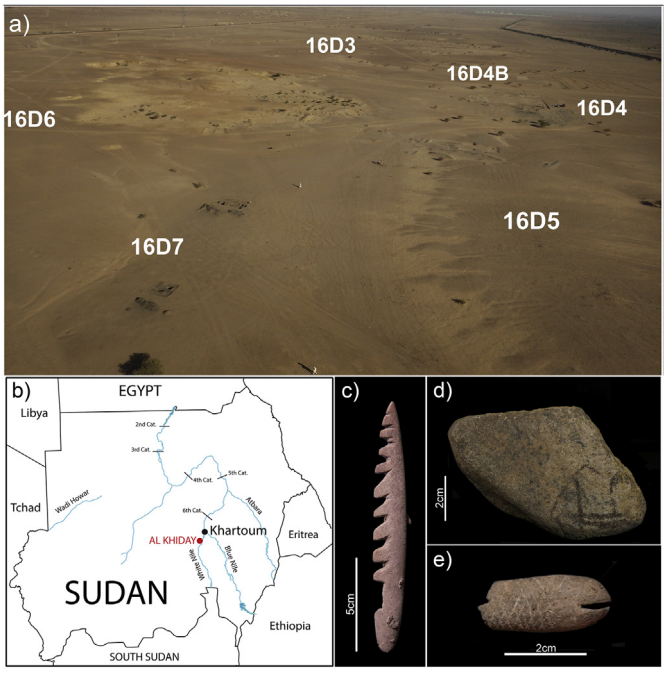

Fig. 1. Al Khiday sites and archaeological materials related to the fishing activity. a) Oblique aerial view of the sites at Al Khiday (the image is a courtesy of Yves Guichard; it horizontally covers a distance of about 600 m); b) geographic location of the Al Khiday sites; c) harpoon realized from a large animal bone found at site 16-D-4; d) sandstone pebble with a painted boat sketch from the Middle Mesolithic site 16-D-5; e) fragmentary decorated bone in the shape of a fish from site 16-D-4.

2. Al Khiday Mesolithic sites

The central Sudan Mesolithic, also known as Khartoum Mesolithic, as defined by Anthony J. Arkell (1947, 1949), is one of the several communities of pottery bearing hunter-gatherer-fishers living in the Early Holocene (Budja, 2006; Cohen, 2013; Eerkens and Lipo, 2014; Jordan and Zvelebil, 2009; Piezonka, 2012; Speth, 2010; Wang et al., 2015). During the last sixty years, several Khartoum Mesolithic sites have been discovered and partially excavated in central Sudan (Ali Hakem and Khabir, 1989; Caneva, 1983, 1991; Clark, 1989; Cremaschi et al., 2007; Elamin and Mohammed-Ali, 2004; El-Anwar, 1981; Gatto, 2006; Haaland and Magid, 1995; Fernández et al., 2003; Jesse, 2000, 2003; Khabir, 1987; Krzyżaniak, 2002; Marks and Mohammed-Ali, 1991; Salvatori et al., 2011; Salvatori and Usai, 2008; Suková and Varadzin, 2012, 2014; Usai and Salvatori, 2005), indicating prolonged exploitation of the banks and inner lands of the main Nile, Blue Nile and White Nile, as well as the banks of other active Early Holocene rivers like the Wadi Howar and Wadi Muqadam (Hosfield et al., 2015; Jesse, 2000; Smith, 1998). Unfortunately, mainly because of post-depositional processes, the lack of stratified anthropogenic deposits (Salvatori, 2012; Usai, 2014) has hampered any reconstruction of settlement systems and material culture variations in the time-span covered by the Early Holocene hunter-gatherer-fishers of central Sudan. This situation also explains the lack of detailed information on of the Khartoum Mesolithic in the theoretical debate on hunter-gatherer-fisher communities (Shirai, 2013).

Only recently have some stratified Khartoum Mesolithic sites (16-D-5, 16-D-4, 16-D-4B and 16-D-3) been located and excavated along the western bank of the White Nile, about 25 km south of Omdurman in the area of Al Khiday (Salvatori et al., 2011, 2014, in press; Zerboni, 2011, 2014). These sites cover a period of more than one thousand years (Table 1, Fig. 2) and include two settlements (16-D-5, 16-D-3), a multiphase cemetery used as settlement functional area during a Middle Mesolithic phase (16-D-4) (Salvatori et al., 2011, 2014), and a second functional area (16-D-4B) (Fig. 1). While these sites cover the time-span between the Early and Middle Mesolithic, a Late Mesolithic phase, dating from about 6000 to 5250 BC, has been identified in at least three sites about 10 kilometres north-west of Al Khiday, far from the Nile and very near seasonal ponds (Williams et al., 2015). These large sites, one of which (10-W-4) contains semi-subterranean elliptical huts of about 7 × 4 m (Salvatori et al., 2011; Salvatori and Usai, 2008), have been interpreted as seasonal campsites, with a reappraisal of residential mobility behavior, perhaps also due to the environmental changes after the climatic crisis of 6200 BC (Alley, 2007; Berger and Guilaine, 2009; Bonsall et al., 2002; Gatto and Zerboni, 2015; Lal et al., 2007; Morrill and Jacobsen, 2005; Overpeck and Cole, 2006; Vermeersch et al., 2015; Walker et al., 2012; Weninger et al., 2009, 2014; Zerboni, 2013).

The Early Mesolithic, attested at sites 16-D-5 and 16-D-3 and