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Prehistoric dark soils/sediments of Central Sudan; case study from the Mesolithic landscape at the Sixth Nile Cataract

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ABSTRACT

The so-called "lake or swampy" dark colored deposits along or to the west of both the White and Main Niles, which were not historically inundated by the Nile as a whole, have been recorded recently in association with Mesolithic occupation. What are the possible formation processes of these deposits and what is their potential for understanding the environmental record in relation to Mesolithic occupation? New insight into this issue might be brought to the forefront by the findings in the Rocky Cities area at the south-western edge of Jebel Sabaloka by the Sixth Nile Cataract in central Sudan. The study deposits were evaluated in terms of sedimentology, micromorphology, chemical composition, grain size and magnetic parameters. The properties detected in the study section correspond to no less than three different phases of development. The lowermost part represents a saprolite horizon of granitic rocks exposed to weathering during the wet period, which resulted in alkaline conditions (1st phase of formation process). The occurrence of shells of *Bulinus forskalii* retrieved from the uppermost layer suggests that there was an anoxic environment in the past, which may be linked to the conditions of the present-day Sahel and subsequent attraction of this area for occupation during the Mesolithic period. Deposition of the acidic colluvia from the surrounding granitic rocks in this environment resulted in post-depositional processes involving Fe and Mn impregnation, leading to the black coloring (2nd phase of the formation process). The third phase of the formation processes is connected with the development of recent aridisols.

1. Introduction

Since 2011, detailed explorations by the Czech Institute of Egyptology in Prague have been conducted in the western part of Jebel Sabaloka (Suková and Cílek, 2012) with a special focus on the remains of intensive human occupation during the Mesolithic (ca. 9000–5000 cal BC) and Neolithic (ca. 5000–3000 cal BC) periods (Suková and Varadzin, 2012). The occurrence of dark brown/olive deposits detected in the close surroundings of Mesolithic sites in the Rocky Cities area in the north/western foothill zone of the mountain suggested the possible presence of an organic-rich environmental archive related to swamps, lakes or paleosols. This instigated a more detailed paleopedological investigation despite the lack of an evident interrelation between the Mesolithic remains and in situ black deposits/soils. What is really known about such types of deposits along the Nile?

The dark brown deposits were previously mentioned by a few authors, mainly in the context of so-called clay pans, mudflats, swamps or lakes (Williams et al., 2015; Williams and Jacobsen, 2011) at varying elevations above the modern Nile (or Blue or White Niles). Most of the sites, including Esh Shawal, Tagra, Shabona and El Khiday, are located on the White Nile, approximately 2–6 m above the recent high flood level, with the pre-dam located on sediment from White Nile inundation (Williams et al., 2015). There is one exception documented by Williams et al. (2015) and Williams and Jacobsen (2011). They introduce what they call "shell bearing clay pans" located at Wadi Mansurab, approximately 15 km west of the lower White Nile, south of Khartoum. The site is located 400–420 m above the Alexandria datum (Williams et al., 2015) or approximately 20–40 m above the unregulated present-day Nile flood level. The infill of the pans displays a layer of dark olive deposits. The shells found near the surface were dated to 9.9–7.6 ka, suggesting wetter conditions in this part of Sudan. These suggestions regarding wetter conditions near the Nile in the Early and Middle Holocene are supported by the mapping of the 450 km^2 paleolake fed by an overflow channel from the Main Nile (Williams and Jacobsen,

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2011; Williams et al., 2015) and by the latest findings at Mograt Island (Dittrich et al., 2015) and the El Ga′ab depression (Yahia, 2012).

The black deposits of Sabaloka may represent another potential environmental archive in the form of relict soils and paleosols. Soils in Sudan have largely been neglected in this study because of their lower utility for agricultural development. A unique investigation into the varying degree of pedogenesis and relative denudation was conducted by Buursing (1971) through his excavation of soil profiles on terraces of varying ages along the Nile between Khartoum and Atbara, which showed clear developmental characteristics based on the terrace ages. The youngest soils, those on Buursink's terrace I, lying 3–5 m above the low Nile water level, are clayey and do not show a significant horizonation or development of a stone pavement. Those on terrace II, approximately 11 m above the low Nile level, are sandier with a development of either a B or even Bt horizon. This terrace also begins to show evidence of significant deflation through the relatively shallow or completely absent A horizon and incipient development of a desert pavement, the stones of which lack any varnish. Terrace III is the oldest, at approximately 17 m, and contains soils developed in sandy to gravelly matrixes, the presence of Bt horizons despite a coarse texture, and well to moderately established desert pavements with a high degree of stone varnish. This allows comparative dating of the landscapes based on surficial development but also highlights the loss of information from the upper soil column due to aeolian erosion. Riverine soils in central and southern Sudan at El Bouga, near Atbara and Ed Dueim along the White Nile, were briefly discussed by Greene (1948), who showed a textural variation between the finer textured parent materials derived from the White Nile and the coarser material downstream of the confluences of the Blue Nile and Atbara with the White and Main Niles, respectively. A detailed study of the soils in Gezira was presented by Williams et al. (1982), who demonstrated the critical pedological differences between soils generated from parent material derived from the White versus Blue Niles. The dominant soil textures are clays with loams in areas of higher elevation, such as along levees or aeolian dunes. Differences emerge in the chemical characteristics, with the soils to the west containing higher salinity from the enriched waters of the White Nile, while those to the east, whose parent material and moisture are derived from the Blue Nile, have far lower salinity levels.

Our knowledge of the depositional and pedogenic history of these black deposits is incomplete, although they may be a potential source of environmental information illuminating the occupation strategies of Mesolithic populations. The main aim of this paper is, therefore, to describe and interpret the recently identified and surprisingly extensive relics of dark deposits/soils found in the close surroundings of the Mesolithic occupation sites. The main issues addressed include determining whether this material represents relict soils or paleosols and whether these are organic rich deposits, as well as defining the formation history of these local deposits and how they may be linked with similar localities in association with Mesolithic sites along the Nile.

2. Geological and geographical setting

Jebel Sabaloka is situated approximately 80 km north of the confluence of the White and Blue Nile Rivers and the capital of Sudan, Khartoum (Fig. 1). Jebel Sabaloka rises distinctively above the surrounding flat landscape, which is composed of Nubian sandstones, with a relative difference in elevation of approximately 150 m. The origin of the rounded Jebel Sabaloka structure is volcanic (Almond and Farouk, 1993; Whiteman, 1971). The Nile River has cut a deep and narrow valley into these resistant rocks with a narrow floodplain (Berry and Whiteman, 1968; Said, 1993; Lisá et al., 2012). Of the two main centers at Sabaloka, the large Cauldron Complex is composed of a subsided block of basement overlain by up to 2 km of volcanic rock

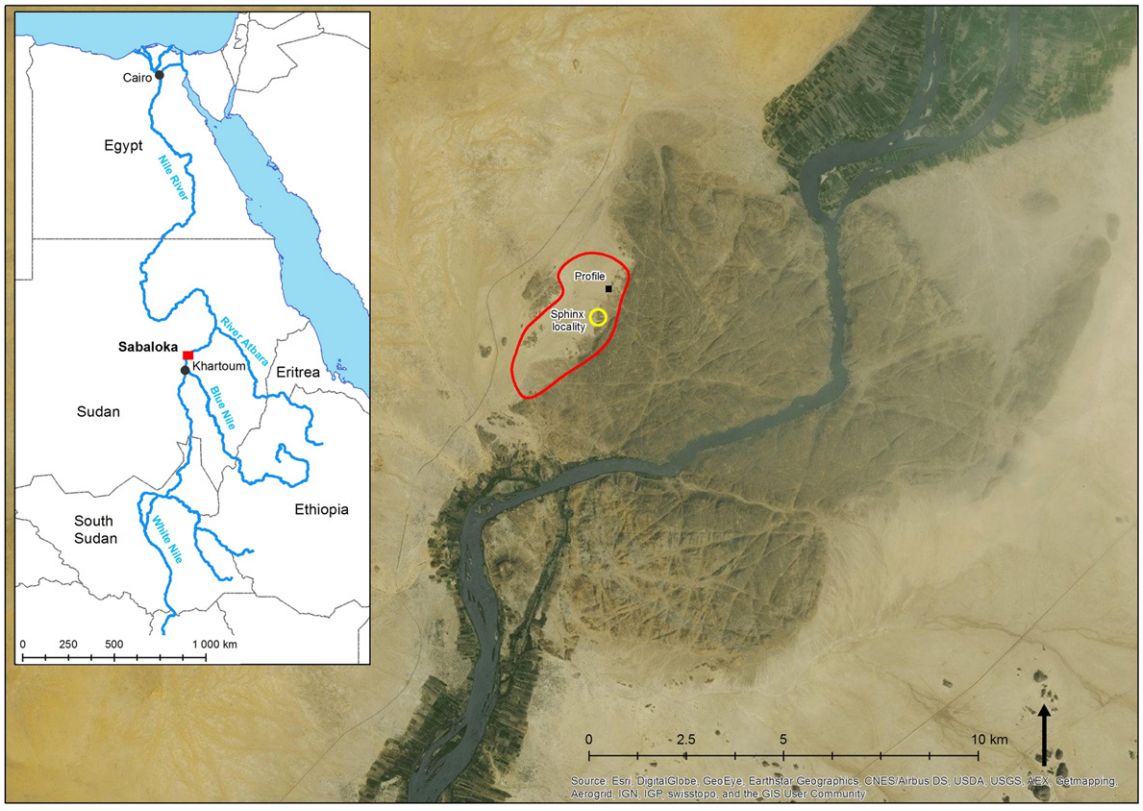

Fig. 1. The location of the study area in the area of Nile catchment, together with orthophoto map of south eastern edge of Sabaloka and highlighted concentration of Mesolithic findings (yellow circle), the appearance of dark soil (red circle) and location of the study section (black dot). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)