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Earth, wind, and fire: ethnoarchaeological signals of Hadza fires

Carolina Mallol [a,b,*], Frank W. Marlowe [b,c], Brian M. Wood [b], Claire C. Porter [b]

[a] *CNRS, UMR 6636, MMSH, 5 rue du Château de l'Horloge, BP 647, 13094 Aix-en-Provence, France*
[b] *Department of Anthropology, Harvard University, 11 Divinity Avenue, Cambridge, MA 02138, USA*
[c] *Department of Anthropology, Florida State University, 1847 West Tennessee Street, Tallahassee, FL 32306, USA*

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Abstract

We present the preliminary results of an interdisciplinary ethno-geoarchaeological project aimed at characterizing sedimentary aspects of recent combustion structures through soil micromorphology to obtain empirical parameters with which to interpret archaeological features. Micromorphological analyses of five different types of fires made and abandoned by the Hadza of Tanzania were performed and compared with ethnographic descriptions. Their anthropogenic nature, burning intensity and type of fuel used were identified based on the composition and optical features of the microscopic components of the combustion structure. The data provided elements to assess the preservation potential of open air fires and our ability to interpret their function. The life history of two of the fires was reconstructed: a sleeping fire showed evidence of a pre-existing trampled surface, and a communal cooking fire showed evidence of the scooping out of ashes for maintenance. These findings substantiate the important contribution of ethnoarchaeological research conducted jointly with soil micromorphology in discovering cues of human behavior preserved in the sedimentary record.

Keywords: Ethnoarchaeology; Ethno-geoarchaeology; Soil Micromorphology; Fire; Combustion structure; Hadza; Hunter-gatherer

1. Introduction

The goal of this paper is to assess the prospects for tracing the sedimentary components of controlled use of fire in the past. The archaeological manifestation of a combustion structure, often detected from the presence of a delimited zone of reddened or ashy sediment, might include burnt bones, artifacts, artificially arranged stones or concentrated charcoal fragments. For their purely anthropogenic nature, these items enclose behavioral information including technical and functional aspects of the combustion structure, its duration of use and its life history. Some studies on this topic have been concerned with the burnt items found within the combustion structure, analyzing their spatial distribution (Vaquero and Pastó, 2001) or their physical and chemical properties (Stiner et al., 1995). Others have focused on the properties of the burnt sediment, using various geophysical and geochemical techniques (Barbetti, 1986; Bellomo, 1991, 1993; Karkanas et al., 2002; Rudner and Sumegi, 2002; Schiegl et al., 2004).

We apply the technique of soil micromorphology, which entails the study of microscopic components and structures of soils and sediments aimed at the reconstruction of events. The changes caused by fire occurring in the top few centimeters of a burnt soil or sediment are nonreversible. Thus, when this top layer is preserved, micromorphological analysis can potentially answer questions concerning the kind of fuel employed, the function of the combustion structure, the temperature reached, the number of burning episodes represented, the effects on the surrounding sediments, and the degree of post-depositional reworking (Courty et al., 1989). Experimental soil micromorphology has yielded numerous contributions to the characterization of combustion features (Courty et al., 1989; Macphail et al., 2004; Wattez, 1992). This technique has also been previously applied to archaeological combustion

* Corresponding author. CNRS, UMR 6636, MMSH, 5 rue du Château de l'Horloge, BP 647, 13094 Aix-en-Provence, France.
E-mail address: mallol@mmsh.univ-aix.fr (C. Mallol).

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structures, successfully distinguishing single burning events from multiphased hearths (Meignen et al., 1989; Wattez, 1992), in situ hearths from secondary ash dumps (Schiegl et al., 2003) and domestic hearths from burned stabling layers (Macphail et al., 2004).

Most of the micromorphological case studies analyze Middle or Upper Palaeolithic sites, which have abundant evidence of combustion structures (Meignen et al., 2001, 1989; Schiegl et al., 1996, 2003; Vallverdú, 2001; Wattez, 1992; Weiner et al., 2002). The technique has not been used to investigate earlier sites, such as early Palaeolithic hominin sites in Africa, where the evidence is more scant and the main problem is to distinguish between natural and anthropogenic fires (see James (1989, 1996) for a review of the evidence). Nonetheless, the potential of soil micromorphology in such cases has been demonstrated (Goldberg et al., 2001; Weiner et al., 1998).

We focus on contemporary fires made by the Hadza of Tanzania (for ethnographic background and studies of Hadza behavioral ecology, see Marlowe, 2002, 2003, 2004 and Wood, 2006). Through an ethno-geoarchaeological approach, we developed an experiment coupling sedimentary information obtained from soil micromorphology from different types of Hazda fires with ethnographic descriptions. The Hadza live in open air camps, and the sedimentary signatures of their refuse could provide referential inferences with which to interpret archaeological contexts from similar settings, such as in prehistoric open air sites. The Hadza make fire for many reasons, which we have classified into the following scheme (Table 1): (1) household hearths in camp; (2) sleeping fires inside their huts; (3) temporary communal cooking hearths in camp; (4) tuber roasting fires away from the camp; (5) meat cooking fires away from the camp; (6) special monkey roasting fires; (7) torch making fires to get honey away from the camp; (8) fires to light cigarettes; (9) night and day ambush hunting hearths; (10) fires for straightening arrows and curving bows; (11) burning grass fires.

Ethnographic observations show that ephemeral surface fires may prove difficult to detect after the wind blows the remains around. On the other hand, when the earth is scooped out very deeply and fires burn for a long time, it is easier to detect and recognize as human controlled actions, possibly many years or millennia afterwards. To provide empirical data on this question, we collected and analyzed sediment samples from recently abandoned Hadza fires, which allowed us to investigate and document the effect of these fires on their corresponding sedimentary substrates.

There are few examples of studies using an ethnoarchaeological approach to soil micromorphology with the goal of obtaining reference material on anthropogenic fires (Goldberg and Whitebread, 1993; Wattez, 1992). We analyzed samples from five Hadza combustion structures of different known location, function and duration. Our data allow us to compare the effects of outdoor fires vs. fires in a semi-sheltered space, cooking fires vs. sleeping fires, and very brief vs. prolonged burning events. Such distinctions have not been previously documented in micromorphological terms. The absolute age since abandonment of each of the sampled combustion structures varies: some samples were collected a few days after the burning event and others up to 1 year later. Thus, our data also provide information on the relative effect of taphonomic agents such as wind, rainfall and invading roots over time, offering an insight into the preservation potential of such combustion structures.

2. Methods

Two of us (C.P. and B.W.) collected the micromorphological samples from the following different types of Hadza fires.

(1) *An impala burning fire*. The fire was burning for about 20 min, and was sampled 10 days later.
(2) *An open air cooking fire by a hut*. The fire was burning continuously for 4 months, and was sampled 1 year later.
(3) *A sleeping fire at the entrance of the same hut* (*2 samples*). The fire was burning continuously for 4 months, and was sampled 1 year later.
(4) *A tuber roasting fire*. The fire was burning for about 15 min, and was sampled 1 day later.
(5) *An open air two-family cooking fire*. The fire was burning for 3 months, and was sampled 2 months later.

In each case, sampling involved cutting out small (approximately 7 cm × 4 cm × 4 cm) blocks of sediment from the abandoned combustion structure. This was achieved by gently removing and quickly wrapping the block of sediment in toilet paper and then packing tape. In some occasions, where the substrate was too loose to be removed in one piece, it was necessary to remove the sediments by softly hammering a tin can into the combustion structure.

Where possible, the samples were carefully collected exactly at ground level so as not to miss any fraction of the combustion structure. The substrate of the sampled areas is an acidic, dry, sandy terrain. Details on the morphology and ethnographic observations of each type of fire will accompany the micromorphological descriptions in the Section 3 of this paper, and summaries of all the data are presented in Tables 3 and 4.

The micromorphological samples were processed at the Geoarchaeology Laboratory of P. Goldberg, Boston University, where they were oven dried, hardened with a non-saturated mix of polyester resin and styrene, and cut into 1 cm slabs for thin section preparation. Thin sections of 7 cm × 5 cm and 30 microns in thickness were manufactured by Spectrum Petrographics Inc. They were observed under a polarizing microscope at 40, 100 and 200 magnifications and described following the standard guidelines of Stoops (2003) with reference to Courty et al. (1989) and Wattez (1992), who in a comprehensive analysis of experimental, archaeological and ethnoarchaeological samples, obtained a series of control parameters for the analysis of anthropogenic combustion structures based on the optical characteristics of different sedimentary components at different burning intensities (Table 2).