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Dental microwear texture analysis of Neandertals from Hortus cave, France

Analyse de la texture des de la micro-usure dentaire chez les Néandertaliens de la grotte de l'Hortus, France

Frank L'Engle Williams[a,*], Jessica L. Droke[b], Christopher W. Schmidt[c], John C. Willman[d,e], Gaël Becam[f], Marie-Antoinette de Lumley[f,g]

[a] *Department of Anthropology, Georgia State University, 33 Gilmer Street, Atlanta, GA 30303, USA*
[b] *Department of Anthropology, University of Wyoming, Laramie, WY 82071, USA*
[c] *Department of Anthropology, University of Indianapolis, Indianapolis, IN 46227, USA*
[d] *IPHES, Institut Català de Paleoecologia Humana i Evolució Social, 43007 Tarragona, Spain*
[e] *Àrea de Prehistòria, Universitat Rovira i Virgili (URV), 43002 Tarragona, Spain*
[f] *UMR 7194 CNRS, HNHP, MNHN/UPVD/CERP de Tautavel, 66720 Tautavel, France*
[g] *Institut de paléontologie humaine, 75013 Paris, France*

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ABSTRACT

The dental microwear textures of six individuals from Hortus cave, France are compared to Neandertals from different ecological zones and time periods. Molar Phase II facets were scanned using white-light confocal microscopy and scale sensitive fractal analysis yielded enamel surface textural characteristics. The juvenile Hortus III and the older adult Hortus XI exhibit relatively low anisotropy (*epLsar*) and textural fill volume (*Tfv*) and are distinct from young adults with higher values. These differences may be related to age, such that only young adults were engaged in the mastication of tough, fibrous vegetation, whereas Hortus XI (50+ years) and Hortus III (6.5–7.9 years) did not. Sub-Phase Vb Hortus individuals exhibit reduced dietary hardness (*Asfc*) suggesting a greater reliance on soft foods, like meat. Differences between individuals from Hortus cave correspond to both sub-phase variation in climate and intrinsic lifeways.

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RÉSUMÉ

La texture des microtraces d'usure dentaire de six individus provenant de la grotte de l'Hortus (France) est comparée à celles de Néandertaliens provenant de différentes zones écologiques et ayant vécu à différentes périodes chronologiques. Dans ce cadre, les facettes des molaires de la phase II ont été scannées au moyen d'un microscope confocal à lumière blanche, et une analyse fractale sensible à l'échelle a fourni les caractéristiques texturales de surface de l'émail. Le spécimen juvénile Hortus III et l'adulte

* Corresponding author.
E-mail address: frankwilliams@gsu.edu (F.L. Williams).

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le plus âgé Hortus XI présentent une anisotropie (*epLsar*) et un volume de remplissage textural (*Tfv*) relativement faibles, et sont distincts de ceux des jeunes adultes ayant des valeurs plus élevées. Ces différences peuvent être liées à l'âge : c'est ainsi que les jeunes adultes se sont engagés dans la mastication de la végétation fibreuse dure, au contraire d'Hortus XI (50 ans et plus) et d'Hortus III (entre 6,5 et 7,9 ans). Les individus de la sous-phase Vb de l'Hortus témoignent d'une consommation d'aliments durs réduite (*Asfc*), suggérant une plus grande dépendance vis-à-vis des aliments mous, comme la viande. Les différences entre les individus de la grotte de l'Hortus sont liées à la variation de la sous-phase du point de vue du climat et des modes de vie intrinsèques.

1. Introduction

Hortus cave is positioned between the piedmont region south of the Languedoc Mountains of the Massif Central and the Mediterranean Sea, about 30 km northwest of Montpellier, France (Lumley, 1972, 1973). Although the cave was known for generations, it was first excavated in 1906–1908. Between 1949 and 1954, late Bronze Age deposits were identified. Five large-scale excavations were conducted between 1960 and 1964 under the direction of Henry de Lumley. During this interval, the remains of between 20 to 33 Neandertals, as well as Mousterian tool assemblages, Pleistocene fauna and palynological remains were recovered.

The dietary proclivities of these Neandertals have been previously reconstructed using faunal remains (Pillard, 1972) and inferred from the tools used to process them (Lebègue, 2012; Lebègue et al., 2010; Lumley and Licht, 1972). Additional research has documented enamel chipping and lithic-induced cultural striations on the anterior teeth of the Neandertals from Hortus that indicate extensive participation in non-masticatory (e.g., "stuff-and-cut") behaviors (Estalrrich and Rosas, 2015; Lumley, 1973). However, this is the first study aimed at reconstructing the dietary signatures of the Neandertals from several phases and sub-phases of the site using dental microwear texture analysis (DMTA). The DMTA dietary signatures of the inhabitants of Hortus cave are inferred through comparisons with a geographically extensive sample of Middle Paleolithic Neandertals and Holocene humans.

1.1. Cave stratigraphy and anthropogenic activity

The earliest evidence of human modification of the environment at Hortus cave exists in Phase I and II, which is subsequent to Marine Isotope Stage (MIS) 5e. The stalagmitic floor dates from MIS 5e, but not the deposition of the cavity. All layers, from Phase I to Sub-Phase Vc, include Mousterian and Mousterian-like artifacts (Lumley, 1972, 1973). By Phase III and a part of Sub-Phase IVa, human modification of the cave would become more regular (Lebègue et al., 2010) and is characterized by a typical Mousterian industry (Lebègue, 2012; Lumley, 1973; Lumley and Litch, 1972). These temporary hunting camps were likely to have been of a short duration and indicate a near exclusive focus on ibex hunting and processing by hunters rather than the entire social group (Lebègue et al., 2010; Pillard, 1972). This type of occupation was eventually replaced with a seasonal exploitation of the site whereby a greater emphasis was placed on the movement of the group rather than just the hunters (Lebègue et al., 2010), coinciding with an environmental shift from more humid to predominantly dry vegetation (Lumley, 1972, 1973, 1976). Sub-Phase IVb and Phase V show evidence of a diversity of activities as opposed to solely the butchering of animals. These include hearths that have been repeatedly used (Lebègue et al., 2010). Sub-Phase IVb and Phase V represent temporary camps that were economically self-sufficient and occurred during a single season. The presence of children and adults of different ages suggests a small social unit or "micro-band" during these phases (Lebègue et al., 2010).

Whereas Mousterian tools are found throughout the MIS 3 deposits, Neandertal remains are only found in the more recent levels, including Sub-Phase IVa, IVb, Va, Vb and Vc. Besides two neonatal parietal fragments, all the dental remains were found *in situ* within the phases. One exception is Hortus VI, a left mandibular third molar (M_3), which lacks provenience (Lumley, 1973; Tables 2–3). Hortus VI was discovered in 1964, which postdates the excavation of the other remains recovered between 1960 and 1963 (Lumley, 1972, 1973).

The climate of Sub-Phase IVb was cold and dry while Sub-Phase Va and Sub-Phase Vb experienced extreme cold and aridity (Lumley, 1973). The phases also preserve slightly different tool types, which has implications for the foods consumed (Table 1). Sub-Phase IVb is associated with a typical Mousterian assemblage whereas, Sub-Phase Va and Vb are characterized by Mousterian tools infused with denticulates suggesting smaller food items may have been processed (Lumley, 1973). When the landscape was increasingly opened by continued drying during MIS 3, groups began to settle in the vicinity of Hortus cave for a longer duration and subsequently carried out a more diversified set of activities related to their subsistence strategies and diet.

1.2. Paleoecological reconstruction

The five large stratigraphic layers (or phases) at Hortus cave record cycles of cold, alternating between more and less intense, combined with variation in levels of humidity and increasingly arid conditions. The major phases are interspersed between short interphases that exhibit a greater resemblance to temperate climates (Table 1). Paleosols evince a paleoclimate that was relatively cold

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