

Supplementary Online Material (SOM):

Dental macrowear and cortical bone distribution of the Neanderthal mandible from Regourdou (Dordogne, Southwestern France)

Luca Fiorenza ^{a, b, *}, Stefano Benazzi ^{c, d}, Ottmar Kullmer ^{e, f}, Giulia Zampirolo ^c, Arnaud Mazurier ^g, Clément Zanolli ^h, Roberto Macchiarelli ^{i, j}

^a *Department of Anatomy and Developmental Biology, Monash University, Melbourne VIC 3800, Australia*

^b *Earth Sciences, University of New England, Armidale NSW 2351, Australia*

^c *Department of Cultural Heritage, University of Bologna, Ravenna 48121, Italy*

^d *Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Leipzig 04103, Germany*

^e *Department of Paleoanthropology, Senckenberg Research Institute and Natural History Museum Frankfurt, Senckenberganlage 25, 60325 Frankfurt a. M., Germany*

^f *Department of Paleobiology and Environment, Institute of Ecology, Evolution, and Diversity, Johann Wolfgang Goethe University, Max-von-Laue-Str. 13, 60438 Frankfurt, Germany*

^g *UMR 7285 CNRS, Institut de Chimie des Milieux et Matériaux, Université de Poitiers, 86073 Poitiers, France*

^h *UMR 5288 CNRS, Université Toulouse III-Paul Sabatier, France*

ⁱ *UMR 7194 CNRS, Laboratoire HNHP, Muséum national d'Histoire naturelle, 75116 Paris, France*

^j *Unité de Formation Géosciences, Université de Poitiers, 86073 Poitiers, France*

* Corresponding author.

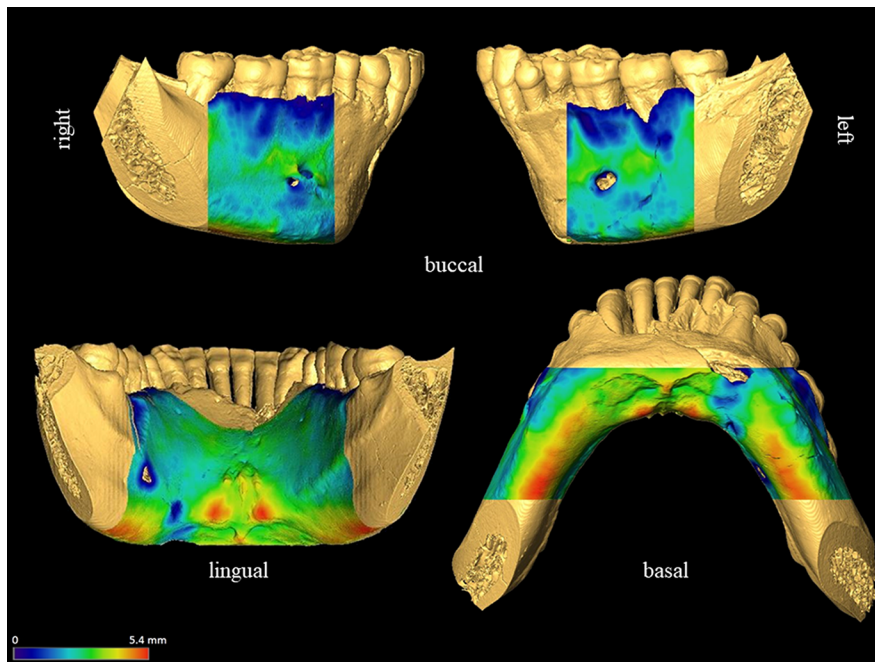
E-mail address: luca.fiorenza@monash.edu (L. Fiorenza).

SOM S1

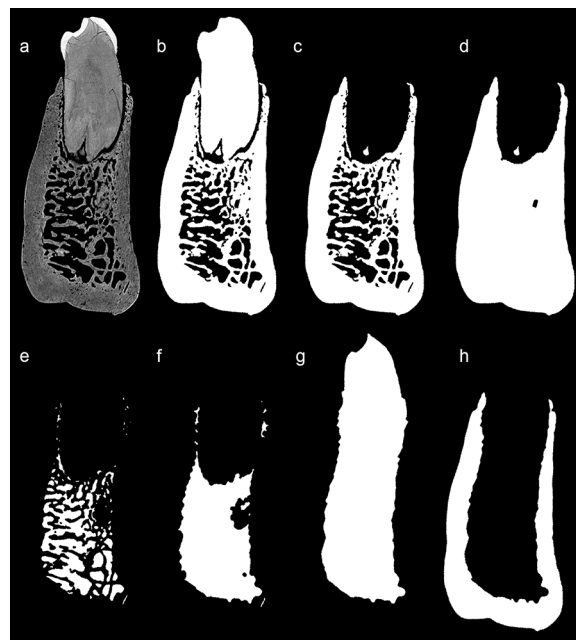
Cortical bone distribution

As cortical and trabecular bone tend to show the same gray levels (SOM Fig. S2a), we carried out an image processing procedure following the protocol established by Roerdink and Meijster (2000) aimed at granting their distinction. The procedure was developed through the software packages Avizo v.9.5 (Terro Fisher™-FEI, Hillsboro, Oregon, USA) and ImageJ (Schneider et al., 2012) according to the following steps (SOM Fig. S2):

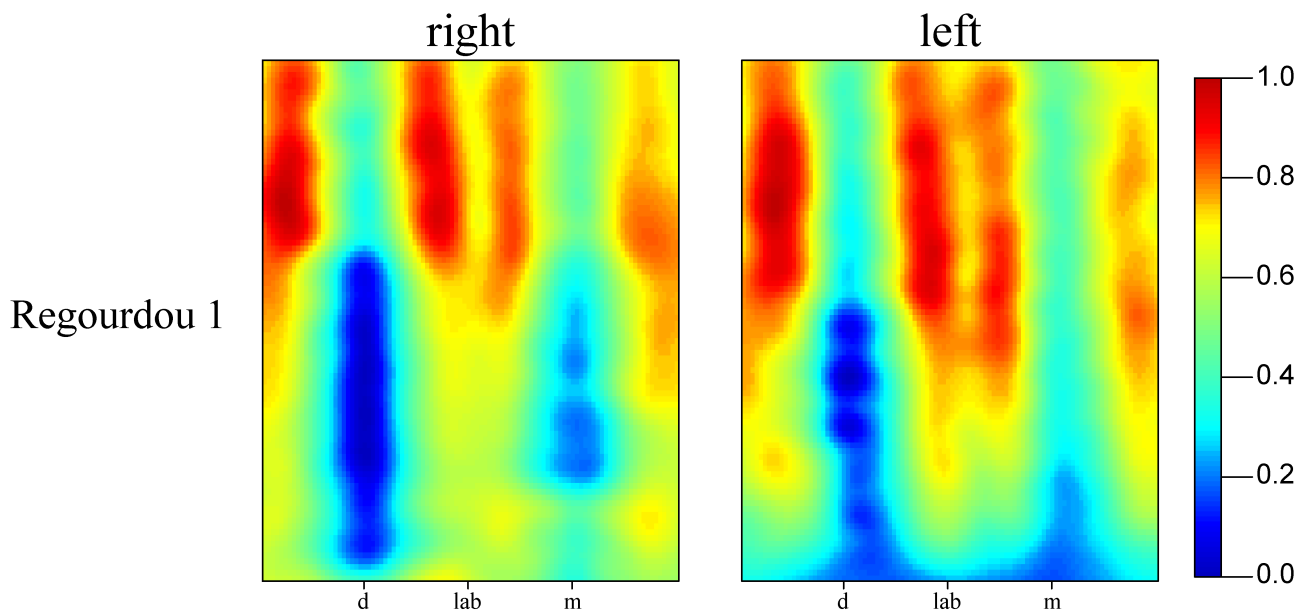
- (i) Watershed segmentation of bone and teeth vs. air. This step needs a preliminary coarse thresholding by boundary to define one bone-teeth marker and one marker for the surrounding and enclosing air. It is followed by the 3D shrinking of the markers and, finally, by flooding the unlabelled volumes by the extension of this eroded markers until the phase boundaries which have been enhanced with the gradient image computed in 3D. This segmentation procedure allows is not affected by possible local variation of the gray levels (Fig. S2b).
- (ii) Manual extraction of the teeth in 2D–3D through the Segmentation Editor of Avizo, making use of the air layer between bone and teeth (SOM Fig. S2c).
- (iii) Filling of air inside the mandibular portion through the combination of mathematical morphology operators (i.e., erosion, dilation, closing; Soile, 2013; SOM Fig. S2d).
- (iv) Extraction of the inner air by subtraction of step 2 result (binning image without teeth) from step-3 result (filled mandibular portion; SOM Fig. S2e).
- (v) Filling of the voids corresponding to the trabecular bone with a morphological closing of step 4 followed by the filling of the remaining holes inside the white part by a geodesic dilatation of the complement image (Soile, 2013; SOM Fig. S2f).
- (vi) Addition of the radicular dentine (extracted in step 2) and the air layer between bone and teeth to the step 5 results.
- (vii) Manual correction in the Segmentation Editor (SOM Fig. S2g).
- (viii) Use of Boolean Operator in order to only extract the cortical bone, i.e., the part from the step 3 result (filled mandibular portion) not included in the step 7 result (SOM Fig. S2h).



SOM Figure S1. SR- μ CT-based map of cortical bone thickness topographic distribution of the Regourdou 1 mandible in buccal (both sides), lingual and basal views obtained by semiautomatic segmentation (Volpato et al., 2011). Periosteal-endosteal thickness gross variation rendered by a chromatic scale increasing from thinner dark blue (0 mm) to thicker red (5.4 mm). Images not fully to scale.



SOM Figure S2. Schematic illustration of the image processing steps (a to h) used in this study for extracting on each virtual slice of the portion C_1 – M_1 of the Regourdou 1 mandible the endosteal boundaries of the cortical bone shell. See SOM S1 for a detailed description of the analytical steps.



SOM Figure S3. Standardized morphometric maps of radicular dentine thickness variation for the 15–85% root length portion of the right and left I₂ of the Regourdou 1 mandible. Each map is set within a grid made of 90 columns (X) running along the distal (d), labial (lab), and mesial (m) aspects of the root and of 100 rows (Y). Topographic thickness variation rendered by a chromatic scale increasing from thinner dark blue (0) to thicker red (1).