Microwear analysis of *Mammuthus meridionalis* (Nesti, 1825) molar from Campo del Conte (Frosinone, Italy)

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SUMMARY: Tooth microwear caused by the abrasiveness of vegetables and especially the phytoliths of grasses has been studied by means of the SEM. A *Mammuthus meridionalis* molar from the Campo del Conte locality has shown the presence of specific wear patterns that appear to depend on the masticatory surface and mechanical masticatory forces. Scratches are more than pits and their number increases towards the tooth front. The microwear pattern of the *Mammuthus meridionalis* molar from Campo del Conte falls in the grazers domain, where scratches are more than pits, showing dietary adaptation rather rich also in graminacae or vegetables containing a rather large amount of phytolithes.

1. Introduction

The alimentary habits of large mammals can be deduced from the microwear tracks on tooth enamel examined under the Scanning Electron Microscope (SEM). Pioneering works by Resenberg (1978), Walker *et al.* (1978) and Tedford (1988) showed different wear patterns, related to different kinds of food and diet.

As pointed out by Solounias *et al.* (1988), in browsers the microwear tracks are represented by more pits and fewer scratches, while in grazers more scratches, fewer pits and scanty cross scratches are found. Mixed feeders, that alternate seasonally, regionally or occasionally their diet, have an average percentage of pits and scratches between browsers and grazers.

Basically, the differences of enamel microscopic scars depend on the abrasive power of various kinds of vegetation (especially on the different occurrences of phytoliths of grass) as well as on the direction of stress forces, necessary for food breakage, that are applied by masticatory muscles. Despite the large amount of studies on the elephant molars, the microwear analysis of enamel are still almost unknown (Palombo *et al.* 2000). Elephants exhibit a quite unusual manner of food comminution, depending on the wideness of masticator surface and on the high number of enamel bands of upper and lower molars, that meet together mesially in power stroke.

In order to evaluate the validity of microwear analysis on elephant molars, this study was conducted on several enamel points of one last molar. The sample used comes from a sedimentary sequence outcropping at Campo del Conte in the lower Sacco valley (Frosinone, southern Latium).

The sequence was deposited over a time span of approximately 1 Ma, in a predominantly fluvial environment. The basal terms can be ascribed to the Late Lower Pleistocene on the basis of the occurrence of a representative of *M. meridionalis* characterized by fairly advanced molar characters.

2. Materials and Methods

A very well preserved *M. meridionalis* last upper molar was studied (Fig. 1). This specimen is made up of +16 laminae, of which 8-8.5 were in use. The morphological and biometrical characteristics of the specimens suggest an advanced specimen of *M. meridionalis.* (Palombo *et al.,* in press).

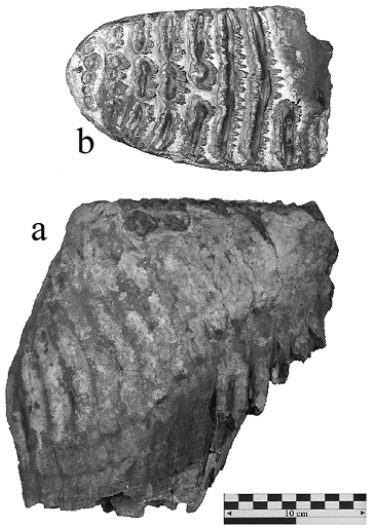

Fig.1 - *Mammuthus meridionalis* (Nesti 1825) from Campo del Conte, Early Pleistocene, M^3 in labial (a) and occlusal (b) view.

To obtain the casts for analysis, the enamel surface was first repeatedly washed with deionised water. After drying, each lamella was covered with vinyl polysiloxane impression material (Elite H-D Putty soft setting, Zhermack, Italy). The first mold was peeled off and discarded with the impurities that eventually were not removed by deionised water. The second mold was used in the microwear analysis with hydrophilic vinyl polysiloxane impression material (Elite H-D Super Light Fast Setting, Zhermack, Italy). Poliuretan casts were made from each mold using "Quartz Die" (Zhermack, Italy).

The casts were subsequently sputter-coated with gold and were examined with the SEM. Each lamella cast was individually studied. Photomicrographs were taken at ×25, ×200 (Figs. 2, 3) and ×500.

The length and width of each scar were recorded and analysed by means of the specific microwear image analysis software (version 4.0.) prepared by Ungar (2001). Since scars vary in length, the ratio of four to one (length to width) was used to subdivide the original number of scars into pits and scratches.

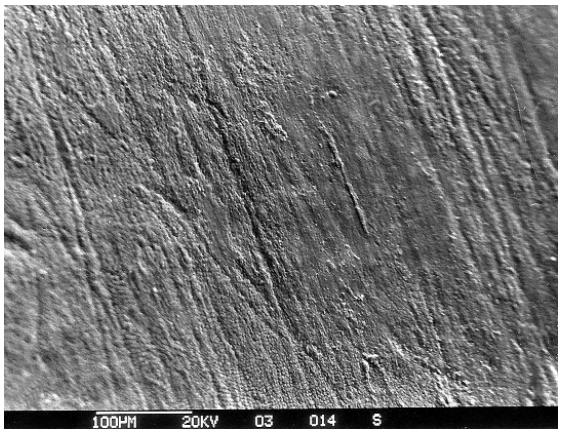

Fig.2 - Photomicrograph (× 200) of microwear on the 3rd lamina of M^3 from Campo del Conte.

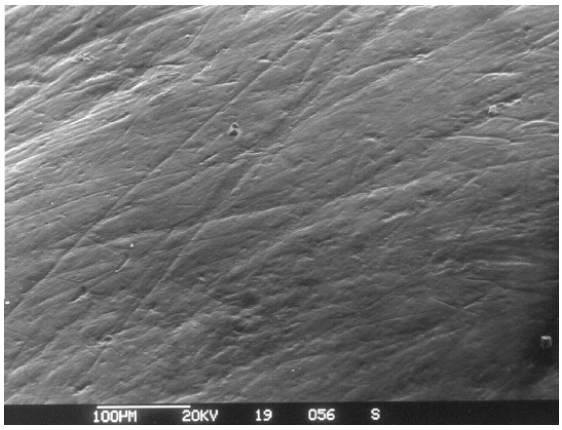

Fig.3 - Photomicrograph (×200) of microwear on the 6th lamina of M³ from Campo del Conte.

Scars were categorized as pits if the ratio was less than four to one, and as scratches if the ratio was greater than four to one (Solounias & Moelleken 1992). For each photomicrograph, the average number of pits and scratches, percentages of pits and scratches were calculated.

3. Results and Discussion

Several casts from anterior to posterior lamellae of the tooth were examined. The data for each photomicrograph (×200) can be summarized in percentages of pits and scratches. So, the range variation in the percentage of pits and scratches in relation to their position on the masticatory surface has been analysed. Moreover, for each photograph, the microwear features have been carefully studied.

From the percentage values of pits (average value = 26.4%) and scratches (average value = 73.6%), a clear predominance of the latter, starting from the posterior part with 63.2 % towards the 82.2 % in the anterior part can be clearly seen.

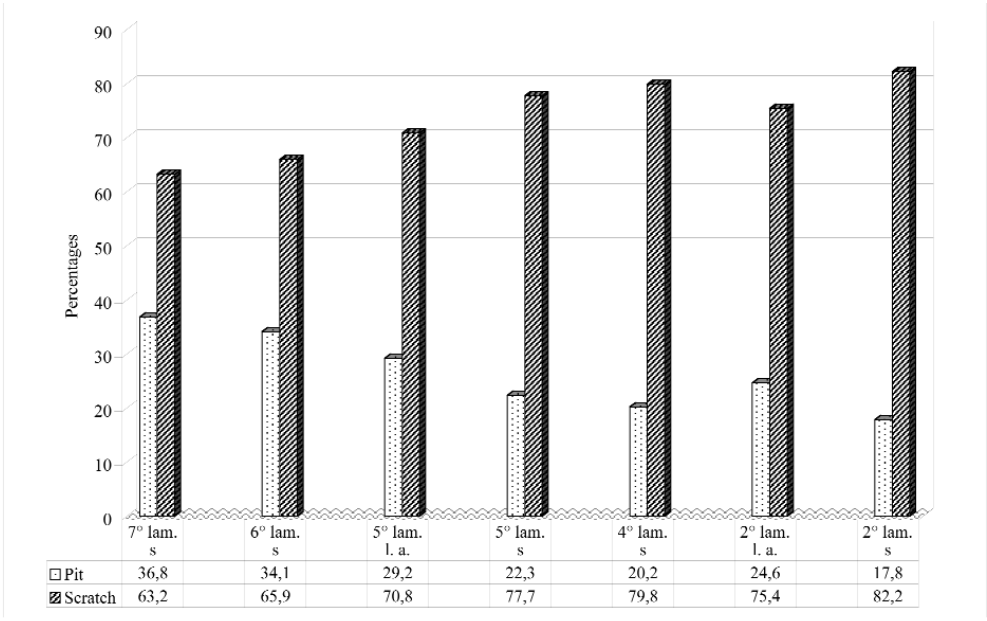

Fig.4 - Istogram showing scratch and pit percentages from posterior to anterior M³ occlusal surface.

At the same time, the percentage of scratches increases on the worner lamellae (Figs. 4, 5). This feature can be explained by considering stronger mechanical masticatory forces, in a transversal direction, applied on the anterior and middle part of the molar occlusal surface. Moreover, the scratches, everywhere considered on the masticatory surface, always prevail.

The study of the photomicrographs allowed the observation that the 3rd lamella, out of 8, shows, on its anterior occlusal surface (Fig. 2), a prevalently parallel patterns (still visible at ×500), even if there are also cross scratches on the upper occlusal surface; beside, it is also visible the prismatic structure of the enamel. On the 6/8 lamella (Fig. 3), in the anterior occlusal surface, deeper cross scratches of a rilevant lenght, along with shorter and lighter ones were observed. On this area of occlusal surface a parallel pattern of the scratches were not observed.

4. Conclusion

The microwear values of *Mammuthus meridionalis* molar from Campo del Conte fall in the grazers domain, where scratches are more than pits, showing a dietary adaptation, rather rich also in graminacee or vegetables containing a rather large amount of phytolithes. Moreover, it was observed that the scratches increase towards the tooth's front. In elephants, differently from what was reported for other herbivores, the total number of cross scratches doesn't seem important in order to identify their alimentary habits. The occurence of scanty cross scratches at major magnification seems to be consistent with this hypothesis.

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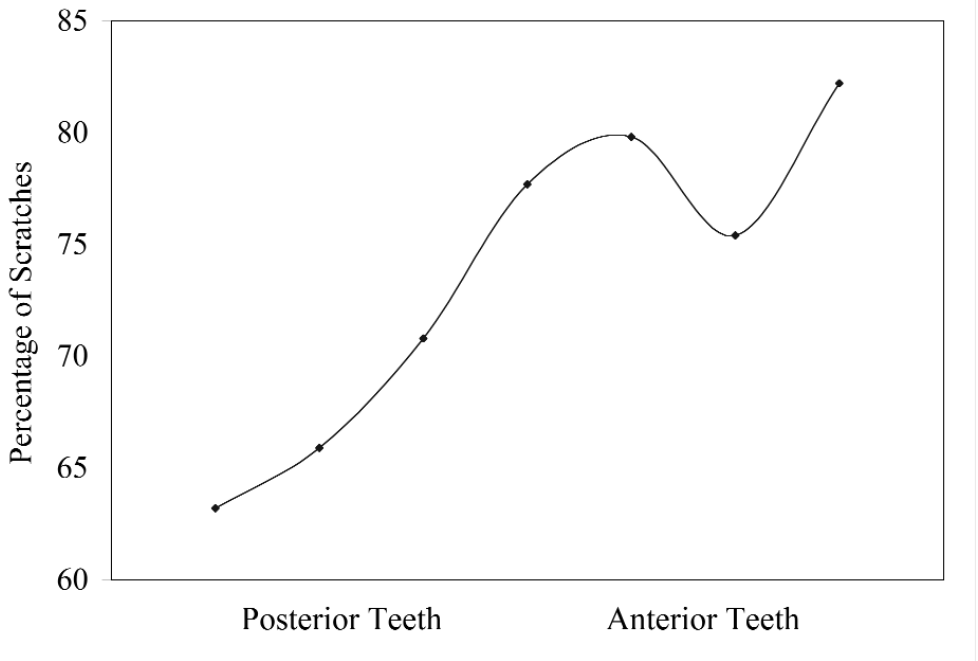

Fig.5 - Linear graphic showing scratch percentages from anterior to posterior M^3 occlusal surface.

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6. References

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