| ESRF | **Experiment title: Phylogeny of contemporary and fossil primates, a non-destructive study of teeth structure for the knowledge of the Anthropoids origin.** | **Experiment number**: SC 918 |
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| **Beamline**: ID 19 | **Date of experiment**: from: 28/09/01 to: 02/10/01<br>from: 16/02/02 to: 17/02/02 | **Date of report**: 20/02/02 |
| **Shifts:** 15 | **Local contact(s)**: Dr. Elodie Boller | *Received at ESRF:* |


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**Report:**

During the beamtime we have been allocated, we could examine 74 samples of present and fossil primates' teeth by microtomography on the ID 19 beamline.

The results of this experiment are very good. We can differentiate enamel and dentin very easily for all present teeth. For fossil ones, the results depend on the site where the fossils come from. For the great majority of the fossils, the results are good, but for about ten of them, we cannot easily separate enamel and dentin. However, it seems that it should be possible, thanks to experiments in phase contrast, to improve the visibility of the enamel-dentin junction for most of these fossils. The fact that enamel and dentin cannot be separated on these samples is probably due to the fossilization. Indeed, the mineralization of the dentin depends on the physical and chemical conditions of the site. For some sites, the dentin will be as mineralized as the enamel, so it becomes very difficult to distinguish enamel and dentin just by microtomography in absorption and whithout using the phase contrast.

These results allow us to make 3D reconstructions of these teeth and to separate in 3D enamel and dentin. With that, we can calculate the volume of enamel and dentin, and surface of the dentin-enamel junction (fig. 1a, 1b, 1c). These three measurements allow us to calculate the relative thickness of enamel in 3D. This calculation is more precise than the usual method of Martin in 2D on a defined plan (Martin, 1985). This kind of measurements is very important for the study of primates' phylogeny.

Furthermore, we can form a graph with the repartition of the enamel cap on the dentin on the entire tooth, after having readjusted the tooth according to Martin's plan. Apparently, these graphs are very dependent on the teeth types, so, they can bring very interesting informations. For example, with this method, we have shown that a fossil tooth of a Miocene Hominoid from Thailand should belong to a direct ancestor of actual Orang-utang (fig. 2a, 2b) (Jaeger *et al*. in prep.).

3D reconstructions also allow measurements which were impossible before without cutting the teeth, like the disposition of the cusps calculated on the dentin, the dentin penetrance in the enamel cap, or the depth of the natural fissures in the enamel (fig. 3).

With microtomography, we can virtually reconstruct fragmented fossils and explore the intern anatomy, for example in order to examine the disposition of the roots of the teeth or the thickness of the cortical bone, without destroying rare samples (fig. 4). This last point is very important. Indeed, the non-destructive approach of the microtomography permits to obtain a lot of material for these studies, because there is no risk for the fossils. We can also compensate the deformations of the fossils in order to have better 3D reconstructions.

This experiment produced so good results that they will help us to obtain more fossil and present material from all over the world. Moreover, we will probably obtain fossils of Anthropoids from Myanmar, which usually cannot leave this country. These fossils are very important for the knowledge of the geographic origin of the Anthropoids' group to which we belong. That is why we will submit a new proposal in a few weeks, in order to get more data.

MARTIN, L. B., 1985. Significance of enamel thickness in Hominoid evolution, Nature, 314, p. 260-263.

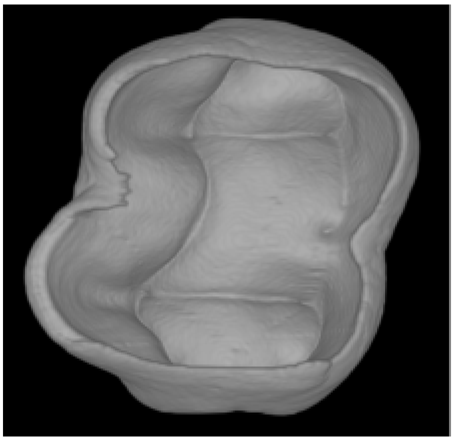

fig 1a : enamel cap of a lower molar of an actual baboon. (viewed from below)

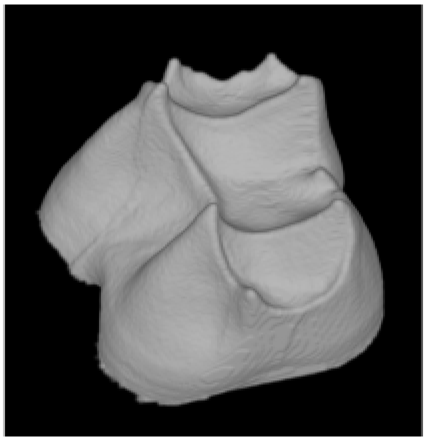

fig 1b : isolated dentin of the same tooth.

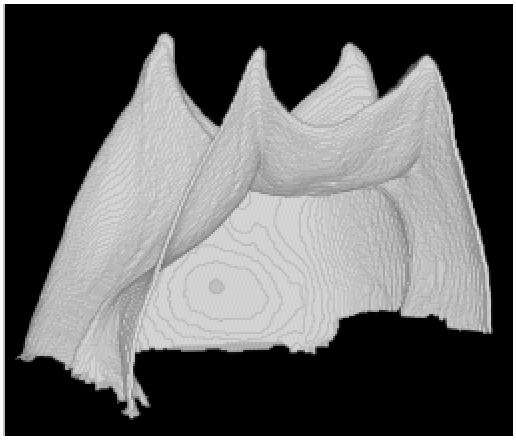

fig 1c : enamel-dentin junction extracted from the same data set.

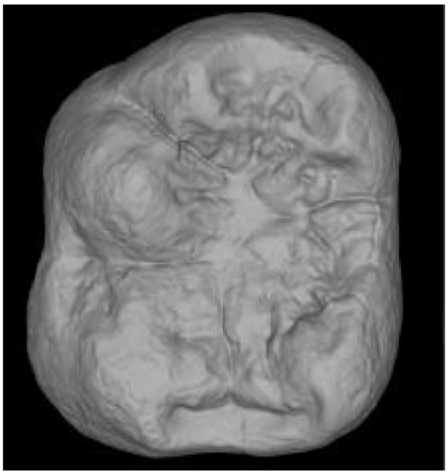

fig 2a : lower molar of a fossil Miocene Hominoïd from Thailand

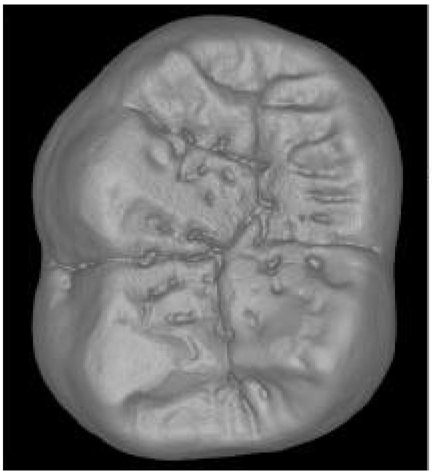

fig 2b : lower molar of an actual Orang-utang

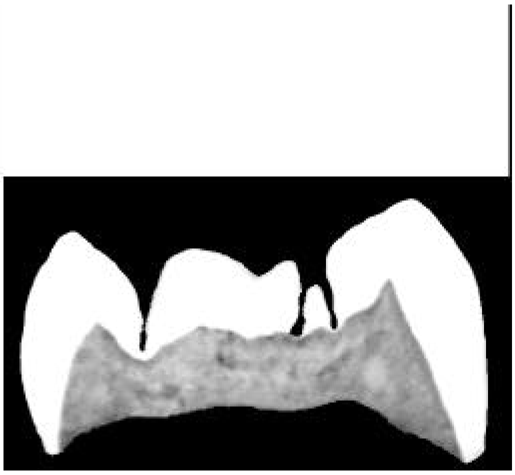

fig 3 : virtual vertical cut in a human molar showing very deep natural fissures in the enamel

fig 4 : internal anatomy of a Lemur fossil mandible from Thailand showing roots' disposition.