Microwear, Microscopy, and Isotopes: Mineralization and Growth Rates of Hypselodont Cheek Teeth of Notoungulates

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Hypsodonty in mammal teeth is considered an adaptation to grazing and open habitat feeding. Diets of grass tend to be highly abrasive, and taller teeth compensate for faster wear, ensuring that the grazer's teeth will remain functional for the duration of the animal's life. A further adaptation to gritty foods is the development of rootless, ever-growing teeth, termed hypselodonty. Incisors of gnawing mammals like rodents are typically hypselodont (as well as cheek teeth in many groups), but no extant ungulates possess hypselodont cheek teeth. Many notoungulates, a group of extinct South American ungulate mammals, possessed hypselodont incisors and cheek teeth, leading to interpretations that all were grazers. Mesowear and microwear analyses, however, have provided varying dietary evidence for hypselodont notoungulates. We hypothesize that hypselodonty was retained in notoungulate lineages that were formerly grazers, but that later shifted to browsing diets, and that hypselodont browsers had slower tooth elongation rates than their grazing ancestors. To test this hypothesis, we estimated rates of elongation in notoungulate teeth. First, using serial isotopic analysis, we measured the distance between consecutive peaks or troughs in annual cycles of oxygen isotopic values, providing an estimate of annual growth. Second, using scanning electron and optical microscopic analyses of cross-sections of tooth enamel, we determined the daily periodicity for perikymata ("growth lines") on the surface of teeth. Perikymata continue through the tooth enamel as Striae of Retzius (SoR). It was found that smaller angles between the SoR the enamel-dentine junction are indicative of greater tooth elongation rates.

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