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The Diet of Sauropod Dinosaurs: Implications of Carbon Isotope Analysis on Teeth, Bones, and Plants

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SAUROPODS WERE MEGAHERBIVORES that fed predominantly on nonangiosperm vegetation such as gymnosperms, sphenophytes, and pteridophytes. In this chapter, the potential of carbon isotope ($\delta^{13}C$) analysis in skeletal apatite for inferring the diet and niche partitioning of sauropods was tested. The carbon isotope composition of food plants is transferred with a metabolic offset to higher trophic levels along the food chain, which suggests that differences in isotopic composition of sauropod food plants can be used to infer sauropod feeding behavior. For this purpose, the $\delta^{13}C$ values of sauropod bones and teeth, primarily from the Late Jurassic Morrison Formation, USA, and the Tendaguru Beds, Tanzania, East Africa, were analyzed, as were the leaves of extant and fossil potential sauropod food plants such as *Araucaria*, cycads, ferns, horsetails, and ginkgo. The metabolic carbon isotope fractionation between diet and enamel apatite estimated for sauropods is 16‰. By means of this fractionation, a diet based only on terrestrial C_3 plants can be reconstructed for sauropods. Therefore, sauropods did not ingest significant amounts of plants with high, C_4 plant-like $\delta^{13}C$ values such as marine algae or C_4 plants. However, plants that used crassulacean acid metabolism for biosynthesis and possibly freshwater aquatic plants may have contributed to the diet of sauropods. A more detailed discrimination of exactly which type of food plants was consumed by sauropods based on apatite $\delta^{13}C$ values alone is difficult because taxon-specific differences between C_3 plants are small and not well constrained. Mean enamel $\delta^{13}C$ values of sympatric sauropods differ by approximately 3‰, which may indicate a certain niche partitioning. Differences in mean $\delta^{13}C$ values for the living representatives of potential sauropod food plants suggest that a differentiation between low-browsing taxa feeding on ferns or horsetails with lower $\delta^{13}C$ values and high-browsing taxa feeding on conifers with higher $\delta^{13}C$ values might be possible.

Sauropod Feeding Behavior: What Do We Know?

Sauropod dinosaurs are one of the most successful groups of dinosaurs in terms of taxon longevity (Late Triassic to Late Cretaceous), taxonomic diversity, and geographic distribution (Dodson 1990; Wilson 2002; Rees et al. 2004; Upchurch et al. 2004; Barrett & Upchurch 2005; Sander et al. 2010a). They reached their highest abundance and diversity during the Jurassic, and as megaherbivores, they had an important influence on terrestrial ecosystems (Upchurch & Barrett 2000). Sauropods lived in a gymnosperm- and pteridophyte-dominated environment with a variety of conifers, as well as some ginkgoes, cycads, ferns, seed ferns, and horsetails (Plate 4.1) that potentially constituted the major sauropod food plants (Coe et al. 1987; Tiffney 1997; Rees et al. 2004; Hummel