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Diets and environments of Columbian and pygmy mammoths: Isotopic evidence from southern California and the Northern Channel Islands

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Pygmy mammoths (*Mammuthus exilis*) are believed to have evolved from and coexisted with Columbian mammoths (*Mammuthus columbi*) on the island of Santarosae (now the Northern Channel Islands). The ecology of these species on Santarosae is not yet well explored, despite its significant relevance to the question of how climate and habitat change may have factored into the extinction of the Late Pleistocene megafauna. This study examined the stable isotope compositions of mammoth tooth enamel samples from the Northern Channel Islands (NCI) and Rancho La Brea (RLB) to investigate species and site differences in diets and environments. The $\delta^{13}C$ values indicate that these latest Pleistocene mammoths had typical C_3 diets, except for two pygmy mammoths from the Northern Channel Islands and one mainland Columbian mammoth from RLB which may have ingested significant amounts of C_4 (or CAM) plants or fed on C_3 plants experiencing severe water stress. On Santarosae, there does not seem to be a difference between pygmy and Columbian mammoth diet reflected in enamel carbon isotope ratios. The $\delta^{18}O$ values of paleo-water reconstructed from enamel $\delta^{18}O$ values are on average lower than the average amount-weighted $\delta^{18}O$ values of modern precipitation in southern California, suggesting wetter conditions or more winter precipitation in the latest Pleistocene than today. The average mean annual precipitation (MAP) amounts reconstructed from the enamel $\delta^{13}C$ values range from 179 to 1459 mm/yr at the NCI and from 5 to 404 mm/yr at RLB. The lower estimates from RLB are inconsistent with the inference from the $\delta^{18}O$ data, likely due to consumption of small amounts of C_4 and/or CAM plants by many of the mammoths analyzed from RLB, resulting in an underestimate of MAP at this locality. Relatively large intra-tooth $\delta^{18}O$ variations (~2-5‰) suggest a hydroclimate with a strong rainfall seasonality. Cluster analysis reveals four groups with distinct enamel $\delta^{13}C$ and $\delta^{18}O$ values (Fig. 1), which suggests a possible temporal difference between groups representing drier and wetter climates. Radiometric dates are recommended for future work to place these diet and environment changes in proper chronological context.

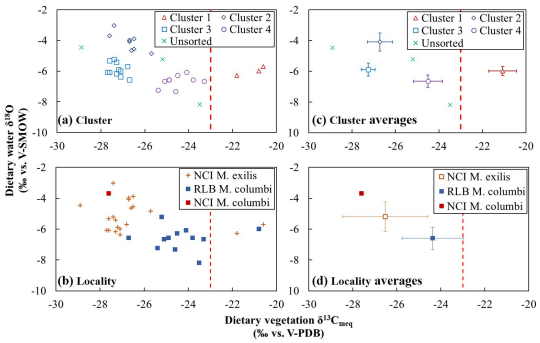

Figure 1. Reconstructed dietary vegetation and water isotope composition by (a) cluster, (b) locality, (c) cluster averages, and (d) locality averages.