Paleoecological Applications of XRF Data: Sr/Ca ratio variation in a modern rainforest and correlations with primate diets

Paleoecologists seek to reconstruct the diets and habitats of extinct species using the comparative method: comparing patterns in data from known, modern habitats to similar data preserved in the fossil record. Trace element data collected through non-destructive XRF analysis is an extremely promising technology for such reconstruction efforts, as one of the largest hurdles in paleoecological work is the frequent need to destroy rare fossils (for example, for ICP-MS analysis) in order to conduct studies. The present study seeks to quantify inter- and intra- species variation in strontium-calcium (Sr/Ca) ratios of fruits and leaves collected within a modern Ugandan rainforest as well as Sr/Ca ratios in the teeth and bones of the primates that live there (chimpanzees, red colobus monkeys, black and white colobus monkeys, baboons, and guenons). Our goal is to construct a comparative model for the eventual interpretation of fossil data, including paleo-forest habitat reconstructions and primate dietary niche analysis. Our data comprise vegetation samples collected from Kibale National Park, Uganda between 2014-2017, including a reference data set of 25 plant samples measured through ICP-MS analysis. We use these reference plant samples used to build a plant-specific calibration for the analysis of additional samples. We then examine if systematic Sr/Ca differences exist in the environment between plant parts (ex: fruits and leaves), tree species, canopy heights, and sun exposure. We correlate these systematic Sr/Ca differences in the environment with fauna dietary preferences to predict dietary niches. This study serves three primary purposes: first, it tests the accuracy and precision of XRF analysis as a method for quantifying elemental concentrations within modern plant samples; second, it identifies predictable patterns in the elemental profiles of plants in a modern rainforest; third, it correlates those differences with faunal dietary preference and niche space, which strongly suggests this method could be applied to fossil data for reconstructing similar ecological parameters.