Revealing paleoecology, paleobiology, and mammalian responses to climate change through geochemistry and dental microwear

Larisa R. G. DeSantis
Department of Earth & Environmental Sciences, Vanderbilt University, Nashville, TN, USA

Integrating Dental Microwear Texture Analysis (DMTA) and geochemical tools such as stable isotope analyses will advance our understanding of paleoecological dynamics, globally. At the coarsest level of resolution, the use of both stable isotopes and DMTA can distinguish between the consumption of C_3 grass, C_3 browse, C_4 grass, and/or C_4 browse, particularly critical in regions such as Australia or prior to the C_4 grassland expansion, as stable isotopes can not distinguish between grass vs. browse when both contain similar isotopic signatures. Additionally, DMTA has the potential to provide further resolution as to intricate dietary niches of mixed feeders, frugivores, carnivores, and/or the relative proportion of grit consumption in more arid ecosystems. Unlike traditional microwear analyses which rely on identifying microwear features such as pits and scratches from two-dimensional images, DMTA uses white-light confocal microscopy and scale sensitive fractal analysis to assess three-dimensional surfaces using a repeatable and automated method of quantifying microwear features that minimizes observer bias. Geochemical data can be used to identify the dietary niches of herbivorous and carnivorous taxa, inferring how mammals alter their diets temporally, spatially, and/or in response to potential climate change. Additionally, ^{13}C deplete carbon values can indicate the presence of dense forests while oxygen isotopes can be used to infer changes in aridity. Collectively, the integration of geochemical tools with DMTA can clarify the paleoecology of diverse mammals through time. Case studies from both herbivorous and carnivorous mammals from Australia and North America will demonstrate ways in which we can use these tools to better understand mammalian paleoecology, paleobiology, and responses to past climate change.