Beta diversity, climate, and topography across an early Eocene landscape

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The Early Eocene Okanagan Highlands fossil sites of far-western North America present a unique opportunity to examine the effect of climate on diversity. Although it spans the height and decline of the Early Eocene Climatic Optimum – the warmest time of the Cenozoic – this was an upland of cool mean annual temperature (MAT) values, as in the modern temperate zone; however, multiple biotic indicators suggest that climate was equable (low temperature seasonality), as in the modern tropics, a combination of factors contrary to the usual pattern in the modern world. Here, we examine insect beta diversity across this region. Just over four decades ago, Janzen hypothesized a relationship in the modern world between dispersal, topography, climate, and latitude. He proposed that while warm valleys and cool mountain passes in seasonal temperate regions have a temperature overlap at least part of the year allowing dispersal of organisms adapted to valley climates, the same elevation difference in the equable tropics shares no common temperatures, and so constitutes a physiological dispersal barrier resulting in higher overturn of species across the landscape, i.e., increased beta diversity. Montane regions in the globally less seasonal Eocene should then show such high beta diversity even in higher latitudes, which we test in six localities representing a thousand kilometer transect of the early Eocene Okanagan Highlands of southern British Columbia, Canada and northern Washington, USA. Here, we present our analyses of insect beta diversity among these communities in a variety of taxa that includes herbivores, active predators, parasitoids, fungivores, and detritivores. We find that beta diversity was indeed high. This supports the idea that overall global diversity was elevated in the Eocene relative to the modern world, as suggested by a recent study of mid-latitude Eocene alpha diversity.