72-11 - A NEW WORKING MODEL FOR CO-EVOLUTION OF PLANT AND ANIMAL SPECIES ON THE BAJA CALIFORNIA PENINSULA FROM GENOMIC AND GEOLOGIC DATA

Sunday, September 22, 2024
4:25 PM - 4:40 PM
303A (Anaheim Convention Center)

Abstract

For nearly 30 years, biologists have documented a striking pattern of intra-species genetic divergence on the Baja California peninsula in dozens of disparate species. Evolutionary theory predicts that when such a pattern is shared among species the cause is extrinsic (e.g., environmental, climatic, physiographic, geological). The leading hypothesis within biological literature has been that genetic divergence was facilitated by flooding across the central peninsula by a seaway between ~3-1 Ma, resulting in separation of northern and southern populations. However, new detailed geologic mapping from the Baja GeoGenomics consortium reveals evidence for continuous terrestrial environments during the last ~30 Myr in a ≥40-km-wide ~E-W region of the central peninsula that straddles the modern-day crest, conclusively refuting the seaway hypothesis. Through integration of tectonic, volcanic, and sedimentological evidence with genomic (DNA) and gene expression (RNA) data for plants and animals, we are developing a new working model for Earth-life evolution on the peninsula over the last ~5 Myr. In this model, rift-related uplift drives the growth and dissection of topography, causing increased microenvironmental heterogeneity that populations differentially adapted to in the north and south. This is evidenced by widespread, statistically significant niche divergence in populations between northern and southern Baja in 21 studied taxa. This pattern is supported by strong differences in gene expression in northern and southern populations of two lizard species, particularly in genes relating to metabolism, which may indicate different diet or energy requirements between the regions. Habitats in the north and south then shifted due to glacial and interglacial periods, indicated by hindcasting the estimated niche conditions of those 21 taxa. With ongoing analyses, we expect to find genomic signatures of differential natural selection and adaptation within these species due in part to monsoon-driven rainfall differences. The significance of this work is twofold: it demonstrates the importance of incorporating geological data into evolutionary hypotheses and it cautions how mis-assigning cause-effect relationships in individual Earth-life systems can bias our fundamental understanding of how Earth processes shape biological evolution writ large.

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MIOCENE TECTONIC AND STRATIGRAPHIC EVOLUTION OF THE CENTRAL BAJA CALIFORNIA PENINSULA AND RAPID MARINE FLOODING INTO THE GULF OF CALIFORNIA AT CA. 6.3 MA ***(Invited)***

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