Macroevolutionary and biogeographic response of marine plankton to Cenozoic climate evolution

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The origin and maintenance of the latitudinal biodiversity gradient (LBG) remains relatively obscure, especially with respect to past and future climates. LBG studies typically adopt a species-based-perspective, rather than a functional or trait-based one, especially in paleontological studies. Unlike species, which are evolutionarily ephemeral, functional groups can be consistent across an entire clade's history, providing broader perspectives on biotic and abiotic processes.

Using Triton, a global dataset of Cenozoic macroperforate planktonic foraminiferal occurrences, we contextualize changes in functional diversity, paleolatitudinal specialization, and community equitability across the Cenozoic using network analyses. We identify: 1. specialized morphological communities in the aftermath of the Cretaceous-Paleogene extinction, 2. global ecological specialization of communities during the Early Eocene Climatic Optimum, 3. an increase in specialized morphological communities which precede losses in diversity by millions of years in response to Antarctic glaciation initiation, 4. global morphological specialization and richness change ~19 Ma, coeval with pelagic shark extinctions and changes in ocean nutrient dynamics, and 5. a significant delay between niche exploitation and diversification as bipolar ice sheet expansion triggered global paleoceanographic change.

Overarchingly, we find that the functional responses of communities to large-scale Cenozoic climate events are separated from richness loss/gain, revealing novel structural changes important for understanding how marine ecosystems respond to global change in past, present and future oceans.