

Miocene cyclopid copepod from a saline paleolake in Mojave, California

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There are remarkably few direct fossil records of Copepoda, which implies that current estimates of the lineage divergence times and inferences on the historical biogeography remain highly dubious for these small-sized crustaceans. The Cyclopidae, a predominantly freshwater copepod family with 1000+ species and distributed worldwide, has no fossil record at all. Recent collections from the middle Miocene Barstow Formation in Southern California resulted in ample material of finely preserved cyclopid fossils, including both adult and larval stages. To document the antennular setation pattern in the adult and copepodid instars we used a coding system that is coherent between sexes and developmental stages. The majority of the cyclopid fossils, coming from saline lake environment, represent the modern genus *Apocyclops*, a euryhaline, thermophilic group occurring both in the New World and Old World. A new species *Apocyclops californicus* is described, based on the short medial spine and spiny ornamentation of the free segment of leg 5, spinule ornamentation of pediger 5, and well-developed protuberances of the intercoxal sclerite of leg 4. The presence of antennal allobasis and the features of the swimming legs unambiguously place the Miocene *Apocyclops* in the *A. panamensis*-clade, a predominantly amphi-Pacific group. The middle Miocene fossils with clear affinities to a subgroup of *Apocyclops* imply an early Miocene or Paleogene origin of the genus. Based on the geographic patterns of the species richness and morphology in *Apocyclops* and its presumed closest relative, genus *Metacyclops*, we hypothesize that: (i) the ancestor of *Apocyclops*, similar in morphology to some cave-dweller *Metacyclops* occurring today in the peri-Mediterranean region, might have arrived in North America from Europe via the Thulean North Atlantic bridge in the late Paleocene–early Eocene; (ii) Eocene termination of the Thulean land connection might have resulted in the divergence of *Apocyclops* from the *Metacyclops* stock.

Key words: Copepoda, Cyclopidae, ontogeny, biogeography, saline lake, Miocene, Barstow Formation, amphi-Pacific.

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