Paleolake salinity evolution in the Qaidam Basin (NE Tibetan Plateau) between ~42 and 29 Ma: Links to global cooling and Paratethys sea incursions

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Global cooling, the early uplift of the Tibetan Plateau, and the retreat of the Paratethys are three main factors that regulate long-term climate change in the Asian interior during the Cenozoic. However, the debated elevation history of the Tibetan Plateau and the overlapping climate effects of the Tibetan Plateau uplift and Paratethys retreat makes it difficult to assess the driving mechanism on regional climate change in a particular period. Some recent progress suggests that precisely dated Paratethys transgression/regression cycles appear to have fluctuated over broad regions with low relief in the northern Tibetan Plateau in the middle Eocene–early Oligocene, when the global climate was characterized by generally continuous cooling followed by the rapid Eocene–Oligocene climate transition (EOT). Therefore, a middle Eocene–early Oligocene record from the Asian interior with unambiguous paleoclimatic implications offers an opportunity to distinguish between the climatic effects of the Paratethys retreat and those of global cooling.

Here, we present a complete paleolake salinity record from middle Eocene to early Miocene (~42-29 Ma) in the Qaidam Basin using detailed clay boron content and clay mineralogical investigations. Two independent paleosalimeters, equivalent boron and Couch's salinity, collectively present a three-staged salinity evolution, from an oligohaline–mesohaline environment in the middle Eocene (42–34 Ma) to a mesosaline environment in late Eocene-early Oligocene (~34–29 Ma). This clay boron-derived salinity evolution is further supported by the published chloride-based and ostracod-based paleosalinity estimates in the Qaidam Basin. Our quantitative paleolake reconstruction between ~42 and 29 Ma in the Qaidam Basin resembles the hydroclimate change in the neighboring Xining Basin, of which both present good agreement with changes of marine benthic oxygen isotope compositions. We thus speculated that the secular trend of clay boron-derived paleolake salinity in ~42-29 Ma is primarily controlled by global cooling, which regulates regional climate change by influencing the evaporation capacity in the moisture source of Qaidam Basin. Superimposed on this trend, the Paratethys transgression/regression cycles served as an important factor regulating wet/dry fluctuations in the Asian interior between ~42 and ~34 Ma.