The Cenozoic Asian aridification has been related to the retreat of the Paratethys, the uplift of the Tibet, and/or global cooling. However, the details of the mechanisms responsible for this paleoclimate shift remain poorly constrained. Modern observations indicate that interactions between mid-latitude westerlies and the Pamir-Tian Shan Mountains significantly impact hydroclimate patterns in central Asia today, and may have played an important role in driving Asian aridification during the Cenozoic. However, the timing when this topographic-atmospheric framework was established remains poorly constrained.

Here, we present magnetostratigraphy, U-Pb geochronology, thermochronology, paleoclimatology, stable carbon and oxygen isotope geochemistry, and climate modelling techniques to the Cenozoic sedimentary sequences in the Tajik Basin. Our results show that: 1) the penultimate and ultimate retreat of the Paratethys from central Asia occurred at ~41 and ~37.4 Ma, respectively; 2) the Pamirs have experienced active deformation and accelerated exhumation during the late Oligocene to early Miocene; 3) the windward (western) side of the Pamir and Tian Shan has been characterized by a wetter climate changes, whereas, the leeward (eastern) side of the orogen has been characterized by more arid conditions since the Late Oligocene; 4) This distinct east-west hydroclimate differences, when integrated with climate modeling results, suggests that at least part of the Pamir-Tian Shan mountains had reached elevations ≥ 3 km and acted as a moisture barrier for the westerlies since ~25 Ma. We suggest that the interactions between the westerlies and the Pamir-Tian Shan orogen played an important role in driving Asian aridification since the Late Oligocene.