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Tracking climate changes in the Gulf of California and the Eastern Tropical Pacific Ocean during the past 18,000 yr

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The location, sedimentology, and oceanographic characteristics of the southern Gulf of California make it suitable for investigating the Quaternary climate changes of the Eastern Tropical Pacific Ocean (ETPO). We investigate changes in precipitation, ocean patterns and variations in paleoproductivity in the Eastern Tropical Pacific Ocean related to insolation, migrations, and dynamics of the of Intertropical Convergence Zone (ITCZ), the North America Monsoon (NAM), and inter-hemispheric teleconnections. Proxy records are obtained from sediments in the marginal Alfonso Basin, situated in the southwestern sector of the Gulf of California near its junction with the Pacific Ocean. The age model was based on eleven radiocarbon dates, the MARINE 20 calibration curve, and a reservoir age of 253 + 18 years.
High-resolution records of elemental geochemistry, magnetic properties, and radiolarian assemblages are used to track climate changes in the tropical climate system at millennial and centennial time scales over the past 18,500 yr. Geochemical and magnetic proxies revealed an increase of precipitation at ~17,500 and 16,536 yr, in the Bolling Allerod (from ~14,988 to 14,057 yr), and during the early Holocene. Humid conditions predominated between ~7,404 and 5,200 cal yr BP. Records indicate a climatic shift at ~4,860 cal yr BP, suggesting increased aridity and the strength of winds to continue through the late Holocene. Roughly 4000 cal yr BP the productivity increased as a result of the intensification of the winds. Paleoprecipitation changes are associated with ITCZ latitudinal migration and the NAM responding to insolation changes during the Holocene. Aeolian and fluvial inputs, marked by variations in Ti, K, Fe, Zr/Ti and magnetic properties, indicate that precipitation-controlled changes in summer monsoon rainfall primarily forced terrigenous supply throughout the mid-Holocene. We propose that these conditions arise from the northern hemisphere's high insolation at low latitudes, with the average position of the ITCZ migrating northward. Development of the NAM amplifies the seasonality and promotes increased precipitation during summer seasons.
During the late Holocene, terrigenous input appears mainly controlled by the intensification of the NW winds. The record indicates a drop-in precipitation and abrupt enhancement of Aeolian activity.

Radiolarian assemblages reveal the upper layers of two water masses (TSW and GCW), suggesting that the advection of coastal currents and mesoscale features controlled these conditions. The dominance of *Phormostichoartus corbula, Lithomelissa thoracites*, and *Arachnocorallium calvata*, surface dwellers species reveal the Gulf of California Water and relatively high productivity during the BA, and in the transition to the middle to late Holocene, *Botryostrobus aquilonaris* suggests that during the deglaciation, (~17,468 to 15,426 yr), and at ~12,604 yr the occurrence of the California Current in the Alfonso Basin. *Tetrapyle octacantha* group represents the dominance of Superficial Tropical Water in the Alfonso basin, associated with conditions of marked stratification in the water column and oligotrophic conditions in the superficial layer during the Holocene Climatic Optimum and the Medieval Warm Period. which fluctuated due to variations in mesoscale gyres and also coastal upwellings off the western coast could contribute.