How the Tibetan uplift affects evolution of westerly circulation

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As an important part of the global climate system, the westerly wind drives the mid-latitude surface currents, regulates the exchange of heat, water vapor, and carbon between the ocean and the atmosphere, and influences regional and global climate change.

On seasonal to orbital timescales, the westerlies shift pole-ward during warm periods and equator-ward during cold periods in both hemispheres. However, how the westerlies shift on tectonic timescales and whether large-scale topographic changes, especially the uplift of the Tibetan Plateau, influence the evolution of westerly circulation remain largely unknown.

Recently, a research team led by Prof. Wan Shiming from the Institute of Oceanology of the Chinese Academy of Sciences (IOCAS) has reported the northward shift of the Northern Hemisphere westerlies in the early to late Miocene and its links to Tibetan uplift.

The study was published in *Geophysical Research Letters* on Sept. 16.

The researchers reconstructed long-term dust deposition records of the Northwest Pacific Ocean since ~23 million years ago (Ma) by investigating the Sr-Nd isotope composition and accumulation rate of the siliciclastic fraction of sediments from Deep Sea Drilling Project Site 296 in the Philippine Sea, combined with a matching eolian flux record at Ocean Drilling Program Site 1208.
Siliciclastic sediments at both sites were the product of two-member mixtures of volcanic materials from Northwest Pacific arcs and eolian dust from Asian deserts. The eolian dust was mainly transported from the Taklimakan Desert by the westerlies.

Furthermore, the researchers found that the ratio of eolian fluxes at Site 296 to Site 1208 gradually decreased from about 10 at the early Miocene to one near 9 Ma and stayed at around one since then.

After eliminating aridity and paleographic changes, the results showed that the Hemisphere westerly winds shifted northwards after 23 Ma from 30°N and reached a position similar to the modern one (~40°N) by ~9 Ma, after which they remained relatively stable on million-year timescales.

Based on numerical simulations of the influence that Asian orogeny has had on the westerlies and the uplift history of the Tibetan Plateau, the researchers argued that Tibetan uplift since at least the early Miocene had begun to drive the northwards shift of the Northern Hemispheric Westerlies until ~9 Ma.

"We reconstructed the long-term evolutionary history of the Northern Hemisphere westerlies since the early Miocene for the first time, which is important for understanding the tectonic-climate linkage between the evolution of the global climate system and Tibetan uplift," said Prof. Wan.
