

THE MID-LATITUDE WESTERLIES, ATMOSPHERIC CO₂ AND CLIMATE CHANGE DURING THE ICE AGES

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ABSTRACT

An idealized general circulation model is constructed of the ocean's deep circulation and CO₂ system that reproduces the main features of glacial-interglacial CO₂ cycles, including the tight correlation between atmospheric CO₂ and Antarctic temperatures, the lead of Antarctic temperatures over CO₂ at terminations, and the shift of the ocean's ¹³C minimum from the North Pacific to the Atlantic sector of the Southern Ocean. The model is based on a new idea about the nature of the glacial-interglacial cycles in which the driving force is independent of the orbital forcing and is not in the ocean. The key to glacial-interglacial transitions, we claim, is a relationship between the mid-latitude westerly winds, atmospheric CO₂, and the mean state of the atmosphere. Cold glacial climates seem to have equatorward-shifted westerlies, which allow more respired CO₂ to accumulate in the deep ocean. Warm climates like the present have poleward-shifted westerlies that flush respired CO₂ out of the deep ocean.