Multiple-Proxy Lacustrine Record of Moisture Transport over Western North America from 24,000 to 12,000 YBP, Lake Estancia, New Mexico

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Abstract

Pluvial Lake Estancia in central New Mexico experienced large and rapid fluctuations in surface area and elevation during the build-up to and termination of the last glacial maximum (LGM). Due to continuous groundwater discharge, a minimum pool covering about 400 square kilometers was maintained in the central basin until about 12,000 years ago, ensuring a continuous depositional sequence even during low stands of the lake. Surface runoff from the surrounding drainage basin, resulting in high stands of the lake, is manifested by stream channels that terminate near the high shorelines and deltaic deposits in near-shore localities, by increased quantities of detrital quartz grains, and by growth pulses in populations of ostracodes in basin-center settings. Time-series of detrital quartz and ostracode-species abundance reveal several major episodes of stream discharge and freshening, separated by about 2,000 years, in the period 24,000-12,000 YBP. Mass balance calculations support the physical evidence for increased precipitation and input of surface water during freshening and expansion of the lake. Preliminary stable-isotopic and trace-metal ratios of ostracode valves from the interval 20,000-18,000 YBP indicate that climatic shifts toward effectively drier conditions occurred as rapidly as shifts toward increased precipitation. Changes in $\Delta 180$ suggest significantly different isotopic compositions for waters entering the lake during freshening and drawdown events, with more negative values corresponding to reduced surface runoff, lake drawdown, and a higher proportion of input to the lake from ground water. The sensitive response to fluctuations in climate by several independent proxies at Estancia show that transport of Pacific moisture over western North America changed dramatically during the last Ice Age, perhaps comparable to the large and rapid changes in climate documented from high-latitude ice and North Atlantic marine sediments for the LCM and its transitions.

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