

**Isotopic Evidence for Hydrologic Change Related to the Westerlies in SW Patagonia, Chile  
During the Last Millennium**

Christopher M. Moy<sup>a\*</sup>, Robert B. Dunbar<sup>a</sup>, Patricio I. Moreno<sup>b</sup>, Jean-Pierre Francois<sup>b</sup>, Rodrigo Villa-Martínez<sup>c</sup>, David M. Mucciarone<sup>a</sup>, Thomas P. Guilderson<sup>d</sup>, and René D. Garreaud<sup>e</sup>

<sup>a</sup> Dept. of Geological and Environmental Sciences, 450 Serra Mall, Braun Hall (Bldg. 320), Stanford University, Stanford, CA 94305-2115 USA;

\*Corresponding author e-mail: moyc@stanford.edu; Fax: +1-650-725-0979; Phone: +1-650-380-0395

<sup>b</sup> Dept. of Ecological Sciences and Institute of Ecology and Biodiversity, Universidad de Chile, Las Palmeras 3425, Ñuñoa, Santiago, Chile; and Centro de Estudios del Cuaternario (CEQUA); pimoreno@uchile.cl; geofrancois@gmail.com

<sup>c</sup> Centro de Estudios del Cuaternario (CEQUA), Avenida Bulnes 01890, Punta Arenas, Chile; rodrigo.villa@umag.cl

<sup>d</sup> Center for Accelerator Mass Spectrometry, Lawrence Livermore National Laboratory, P.O. Box 808, L-397, Livermore, CA 94550 USA; tguilderson@llnl.gov

<sup>e</sup> Dept. of Geophysics, Universidad de Chile, Blanco Encalada 2002, Santiago, Chile; rgarreau@dgf.uchile.cl

Keywords: Southern Hemisphere Westerlies, Hydrologic Balance, Little Ice Age, Medieval Climate Anomaly, Southern Patagonia, Chile, Stable Isotopes

For Re-Submission to Quaternary Science Reviews-01/21/08

## Abstract

The southern hemisphere westerly winds influence the spatial distribution of precipitation in southern South America and play a significant role in the global carbon cycle, yet little is known about how this important atmospheric circulation feature has varied in the past. Here we present a sediment core record of late Holocene variability from Lago Guanaco, a small closed-basin lake located in Torres del Paine National Park, Chilean Patagonia. The park is located in the core of the modern wind field and variations in the intensity of the atmospheric circulation directly influence the hydrology of this region. We combine stable isotopic measurements of biogenic carbonate and bulk organic matter to identify two periods of increased evaporation between 900-550, and ~400-50 calendar years before present (cal yr BP). The first interval is coincident with the Medieval Climate Anomaly (MCA) while the more recent period is broadly coincident with the timing of the Little Ice Age (LIA). During the LIA interval, we observe simultaneous monotonic increases in the  $\delta^{18}\text{O}$  of biogenic carbonate and *Nothofagus dombeyi*-type pollen, which we interpret as an indicator of significant changes in the intensity of the southern westerlies during the last millennium. The isotopic and palynological variations in the Guanaco record are coincident with geochemical variations found in an Antarctic ice core record from Siple Dome, suggesting that the signal preserved in Lago Guanaco is regional rather than local, and that the LIA intensification was accompanied by a poleward shift in the southern margin of the westerlies. In addition, we interpret four periods of increased lake productivity centered on 900, 650, 500, and 200 cal yr BP from simultaneous increases in the  $\delta^{13}\text{C}$  of bulk organic material and biogenic carbonate. These increases in lake productivity are most likely tied to increases in summer temperatures.