



## **Inorganic geochemical analysis of Lago Puyehue sediments (Chile, 40°S): Reconstruction of the Late Quaternary paleoclimate variability and influence of the volcanic activity on paleoclimate proxies**

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Several recent studies have demonstrated that climate records from Antarctic ice cores are clearly asynchronous with the rapid changes of the Northern Hemisphere. However, paleoclimate data from the rest of the Southern Hemisphere yield conflicting interpretations of interhemispheric synchrony/asynchrony of the climate system. In order to better constrain the paleoclimate history of southern South America since the Last Glacial Maximum, we investigated the sedimentary record of Lago Puyehue, located at the northern boundary of the southern westerly wind belt in the volcanically active region of mid-central Chile (40°S). In this work, we present inorganic geochemical data obtained on a 11m long sediment core taken in Lago Puyehue at 48m depth. To better understand the complete watershed - lake basin system, we also analyzed river sediments and soil samples.

The results demonstrate that the sedimentation in Lago Puyehue operates as a 2 end-members system composed of: (1) biogenic particles, which are represented by the biogenic silica content of the sediment (0-44%) and highly correlated to the organic matter concentration; and (2) terrigenous particles, which are represented by the Al, Ti, Fe and to a lesser extent Sr concentrations. Temporal variations of these 2 poles with time evidence that, since the Last Glacial Maximum, the Chilean Lake District was characterized by 2 main abrupt climate changes superimposed on a long term climate evolution: (1) the end of the Last Glacial Maximum at 17.3 cal. kyr. BP, marked

by an abrupt increase in biogenic silica concentration and interpreted as an increase of lake paleoproductivity related to warmer temperatures and possibly to a higher nutrient supply due to the melting of the Northern Patagonian Ice Cap and (2) a 13.1-12.3 cal. kyr. BP cold event characterized by a high terrigenous supply and by low biogenic silica concentrations. This Southern Hemisphere climate change precedes the Northern Hemisphere Younger Dryas cold period by 500 to 1000 years.

A deeper geochemical investigation reveals that some of the sedimentary geochemical proxies usually used for paleoclimate reconstructions are partly affected by the volcanic activity of the area. For example, the Zr/Al and Zr/Ti ratios, which are generally used as proxies for the grain-size of the detrital fraction of the sediment (and hence for quantifying the energy of the aeolian and/or fluvial source) significantly increase between 7 cal. kyr BP and 3.5 cal. kyr BP, as well as between 1.5 cal. kyr BP and the present. The chemical paleoweathering proxy Rb/Sr increases concomitantly. These variations seem to occur during periods of higher volcanic activity (number and thickness of the tephra layers) and can be explained by the rejuvenation of the fresh volcanic material available for erosion in the lake watershed (high Rb/Sr, Zr/Al and Zr/Ti ratios).

This work demonstrates that the interpretation of sedimentary geochemical proxies in volcanically-active regions can be biased by past volcanic events. Only an integrated study of the lake basin, lake watershed and regional volcanic activity can provide all the clues necessary for an accurate paleoclimate reconstruction.