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Late Holocene climate variability of Northern Patagonia reconstructed by a multi-proxy analysis of Chilean fjord sediments (44-47°S)

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High-resolution paleoclimate data from the Southern Hemisphere are essential to improve the understanding of the interhemispheric pattern of paleoclimate changes. Due to their intermediate location between the terrestrial and marine realms of southern South America, the sediments deposited in the fjords of Southern Chile have the potential to record paleoclimate changes and paleoceanographic conditions at high resolution since the end of the last glaciation. In this project, four ~2m long gravity cores, collected along a N-S transect at the outer part of the Chilean fjords between 44°S and 47°S, were studied by a multi-proxy sedimentological and geochemical approach. According to AMS radiocarbon measurements on remains of terrestrial organic matter, the cores span the last 1400 to 2600 years. To better understand the spatial variability of the sedimentation and to characterize the marine and terrestrial end-members of the sediment, we also analyzed several surface and river samples. The multi-proxy analysis includes high resolution XRF core scanning (ITRAX core scanner) with calibration of the data by ICP-AES, grain-size, magnetic susceptibility, loss-on-ignition, bulk and clay mineralogy, and elemental and isotopic composition of the bulk organic matter (C/N, d13C, d15N).

The analysis of the surface and river samples demonstrates that the terrestrial end-member of the sediment is characterized by high concentrations in iron, titanium and olivine, low d13C values and high C/N ratios. Therefore, these proxies allow us to estimate the proportion of terrestrial constituents in the sediment cores and then to

reconstruct the intensity of the terrestrial runoff which is directly linked to the amount of precipitation in the Andes.

Depending on their location, the sediments collected in the Chilean fjords are more or less sensitive to the numerous parameters affecting the sedimentary processes within the fjords (climate, productivity, volcanic activity, glacial advances, etc). Of particular interest for our study is sediment core PC29A, which is located in front of a river that drains into the Quitralco fjord, and which is therefore very sensitive to changes in the terrestrial runoff. Between 750 and 1350 AD, this core shows low Ti concentrations, high Rb/Sr ratios and high excess (biogenic) silica concentrations, evidencing dry climate conditions and high biogenic productivity during the Medieval Warm Period (MWP). The high TOC values and the low C/N ratios between 1100 AD and 1400 AD are in good agreement with a high marine productivity at the beginning of the second millennium. Around 1500 AD, the Fe and Ti concentrations increase significantly and the TOC values decrease, evidencing higher terrestrial inputs and therefore wetter climate conditions until the beginning of the 20th century. This wet period probably represents the local signature of the Little Ice Age (LIA), which seems to be characterized in southern Chile by an intensification of the Westerlies along a wide latitudinal range.

These data demonstrate that the MWP and LIA are global climate events, not only restricted to the Northern Hemisphere.