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Testing the potential of stable iron isotopes from laminated lake sediments as a novel palaeoclimate proxy (IRONLAKE)

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The IRONLAKE project aims to develop the utilization of iron isotopes measured on laminated lake sediments as a novel high-resolution tool to infer changing redox conditions in relation to changes of temperature and wind through time. This is based on the hypothesis that stronger winds and higher temperatures impact the redox conditions by forcing either mixing or stratification (oxic or anoxic conditions, respectively). Changes in these parameters might in turn be reflected in the deposition of specific Fe-phases in the sediments and in their Fe isotopic signatures. The project is carried out on sediment cores from the ferrogenic Lago Fagnano (Tierra del Fuego, Argentina), which exhibits characteristic iron-rich laminae. This lake is sheltered from anthropogenic influence due to its remote location and its sedimentary archive sensitively recorded temperature and wind changes throughout the Holocene.

Here we present first results of micro-facies analysis by thin section microscopy and X-ray-fluorescence elemental scanning, which help to understand the general sedimentological and geochemical processes and, specifically, possible seasonal/climatic variations influencing the formation and deposition of iron-bearing minerals in Lago Fagnano. A further step addresses the specific influence of microbial communities on the laminated iron-rich sediment of Lago Fagnano, to constrain the effects of syngenetic and diagenetic processes on iron isotopes. This also allows a better understanding of iron deposition and preservation in lacustrine environments in relation to climatic and geomicrobiological processes. The gained knowledge will then be linked with mineral-selective iron isotope measurements. This approach will allow to (1) better understand the formation of Fe phases in lakes in relation to diagenetic, microbial, climatic and environmental changes, and to (2) test the sensitivity of iron isotopes as a proxy for past wind and temperature changes.