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Carbon and oxygen isotopes of sedimentary cellulose from Laguna Azul reflect hydrological variations in the Patagonian steppe of southern Argentina since AD 600

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Laguna Azul is a permanently water filled crater lake of 56 m max. water depth located in the semi-arid Patagonian Steppe (Santa Cruz, Argentina) about 40 km northwest of the Strait of Magellan. Mayr and coworkers (2005) showed that carbon isotope values of bulk sedimentary organic matter can be used as indicator for lake level variations of Laguna Azul. The specific causes for the identified lake level high and low stands of the last millennium remained, however, unresolved. An isotopic survey of modern lake waters and precipitation revealed a strong dependence of the oxygen isotope composition of precipitation in the region on the moisture source area, i.e. from westerly directions crossing the Andes or from easterly directions from the Atlantic (Mayr et al., 2007). We wanted to test if this information can be used in a combined carbon and oxygen isotope approach to further verify the origin and mechanisms of hydrological variations in the Patagonian Steppe region.
To this end we investigated two gravity cores retrieved from Laguna Azul in 2002 from about 27 and 50 m water depth with a total length of 118 (AZU 02-2) and 97 cm (AZU 02-4), respectively. To provide sufficient dry sediment, sedimentary cellulose was extracted from consecutive 2 cm slices following the CUAM method (Wissel et al., 2008). Carbon and oxygen isotope analyses of the cellulose followed standard on-line methods using an elemental analyser and a high temperature pyrolysis oven, respectively.
Despite very low cellulose contents (<0.25 %) it was possible to determine the cellulose carbon and oxygen isotope composition of both cores continuously. The carbon isotope composition of cellulose correlates with the respective values of bulk organic matter, however, did not reveal an isotopic difference between littoral and profundal cores. The oxygen isotope composition of cellulose from both cores reveals an anti-correlation (r = -0.6) with the respective carbon isotope values of cellulose. The anti-correlation is interpreted as the dependence of the lake level of Laguna Azul on surplus moisture from the Atlantic region. According to this interpretation, lake level high stands were reached around AD 600 and AD 1850 while lake level low stands are indicated around AD 750 and AD 1650. These results indicate that despite the dominating influence of the Westerlies moisture transported by the infrequent Easterlies play a key role for the local water balance in the eastern part of the Patagonian steppe.

References:
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