



Multiproxy Holocene paleoclimate records from the southern Peruvian Andes – what new can we learn from the stable carbon isotope composition of high altitude organic matter deposits?

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Interpretation of the Central Andean paleoclimate over the last millennia still represents a research challenge demanding deeper studies [1,2]. Several high-resolution paleoclimate proxies for the last 10,000 years have been developed for the northern hemisphere. However, similar proxies are very limited for South America, particularly for high altitudes where, for example, tree-ring chronologies are not available and instrumental records are very limited. Consequently, our knowledge of high altitude climate changes in arid regions of the Peruvian Andes mainly relies on ice-core and lake deposit studies.

In our study, we used a new alternative proxy for interpretation of palaeoclimate conditions based on a peat core taken from the Carhuasanta Valley at the foot of Nevado Mismi in the southern Peruvian Andes (15°30'S, 71°43'W, 4809m a.s.l.). The stable carbon isotope composition ($\delta^{13}\text{C}$) of *Distichia* peat reflects mainly the relative variation of the mean air temperature during subsequent growing seasons [3], and allows reconstructions of palaeotemperature changes. In contrast, peat organic carbon concentration (C % wt) records mainly wetness in the valley, directly corresponding to the changes in runoff in the upper part of the catchment.

The most prominent climate changes recorded in the peat over last 4ka occurred between 3040 and 2750 cal. yrs BP. The initial warming turned to a very rapid cooling to temperatures at least 2°C lower than the mean for the Late Holocene. Initially drier conditions within this event turned to a short wet phase after 2780 cal. yrs BP, when the temperature increased again. This event coincides with significant changes in peat and ice core records in the Central Andes that match the timing of the global climate event around 2.8 cal. ka BP. Climatic conditions in the study area became relatively dry and stable after the event for about 800 years. Highly variable temperatures and humidity prevailed during the last 2000 years, when an extended warm and relatively humid period occurred between 640–155 cal. yrs BP, followed by predominantly colder and drier conditions [4].

Our study demonstrates how the $\delta^{13}\text{C}$ value and carbon content variations in *Distichia* peat can be interpreted and used for verification of other multiproxy records, particularly these which are challenging for accurate dating.

[1] Stansell, N.D., Rodbell, D.T., Abbott, M.B., Mark, B.G., 2013. Proglacial lake sediment records of Holocene climate change in the western Cordillera of Peru. *Quat. Sci. Rev.* 10, 1–14.

[2] Engel Z., Skrzypek G., 2014. Reply to the comment by A. Sáez et al. on Climate in the Western Cordillera of the Central Andes over the last 4300 years. *Quat. Sci. Rev.* (in press 10.1016/j.quascirev.2014.12.006).

[3] Skrzypek, G., Engel, Z., Chuman, T., Šefrna, L., 2011. *Distichia* peat - A new stable isotope paleoclimate proxy for the Andes. *Earth Planet. Sci. Lett.* 307(3–4), 298–308.

[4] Engel, Z., Skrzypek, G., Chuman, T., Šefrna, L., Mihaljevič, M., 2014. Climate in the Western Cordillera of the Central Andes over the last 4300 years. *Quat. Sci. Rev.* 99, 60–77.