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Stable carbon isotope composition of Distichia peat: calibration of a new paleotemperature proxy for high altitudes in the Andes

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Several terrestrial high–resolution paleoclimate proxies for the Holocene have been developed for the northern hemisphere. However, similar proxies are very limited for South America, particularly for high altitudes in the Andes. Here, we present results of stable isotope analyses for the *Distichia* plant, a peat-forming species that fills a similar ecological niche to that of *Sphagnum* in bogs in the northern hemisphere [1,2]. *Distichia* species are widespread across the whole Andean region, where they forms bogs up to tens of meters deep, and several thousand years old. However, as far as we know, these well-preserved organic sediments have been surprisingly overlooked, and have never been evaluated as an isotope geochemical paleoclimate archive. In our study, we examined to what extent the relative variations in stable carbon, nitrogen, and oxygen isotope compositions in *Distichia* peat samples reflect the variations in living plant samples, in order to evaluate the usefulness of *Distichia* peat for paleoclimate reconstructions.

For the initial study, we selected an area belonging to the dry puna ecoregion, a high Andean grassland (15˚20'S, 71˚44'W) in the southern part of the Western Cordillera range in Peru [2]. The eight sampling sites were located at ∼100 m intervals in bogs along the altitudinal transect between 4356 and 5049 m ASL. At each site, short cores consisting of three sections (fresh green plants, slightly decomposed plants, and peat) were sampled. All samples were collected from *Distichia*-dominated sites with similar ecological, hydrological, and topographical conditions. Therefore, the major parameter that differentiated these sampling sites was altitude. The different altitudes of the sampling sites resulted in a progressive change in the climate conditions along the transect; i.e., growing season temperatures decreased as altitude increased. We assessed two major parameters monitored at weather stations that are believed to influence stable carbon isotope composition [1,2]: temperature and amount of rainfall.

We found a significant and strong relationship between the stable carbon isotope composition of *Distichia* plants and the air temperature ($R=0.92$ $p<0.01$). In contrast, the relationship with the amount of rainfall was not statistically significant [2]. On the other hand, statistically significant correlations for the pairs of plant-peat samples among analyzed elements suggested that the peat isotope compositions were primarily determined by the isotope compositions of peat-forming plants. This implied that preservation of relative variation in plant primary isotope composition was preserved in peat. It also suggested that overall decomposition during peat formation had a minor influence on the final relative variations, at least in stable carbon isotopes in *Distichia* peat. Our calibration demonstrated that a decrease of ∼0.97‰ in the stable carbon isotope composition of *Distichia* peat reflected a 1˚C increase in mean air temperature in the growing season [2]. This relationship can be used for future reconstructions of paleotemperature variations over several thousand of years in the Andes, based on stable carbon isotope composition of plant remains obtained from peat cores.

[1] Skrzypek G., Jezierski P., Szynkiewicz A., 2010. Chemical Geology 273: 238–249.

[2] Skrzypek G., Engel Z, Chuman T., Šefrna L., 2011. Earth and Planetary Science Letters (in review).