Stalagmite records of hydroclimate from the Peruvian Andes during the last deglaciation

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The termination of the last glacial period is marked by the northward migration of the ITCZ and the weakening of the South American Summer Monsoon (SASM). The transition between the wetter glacial period and the more arid Holocene period across the South American continent is punctuated by several abrupt millennial-scale tropical hydroclimatic events. While the Northern Hemisphere temperature forcing of these millennial-scale events is generally accepted, recently, equatorial forcing mechanisms have been put forward. In particular, the dipole between northeastern Brazil and the western Andes of Peru is absent during Heinrich 1, with wet conditions recorded in both regions. To explain this anomalous atmospheric behavior, researchers have suggested changes in the ENSO and Walker circulation over South America and questioned whether the 'amount effect' relationship between $\delta^{18}O$ and precipitation persists through time. To better resolve tropical hydroclimate changes over the last glacial termination, more robust paleoclimate proxies are needed. Here, we present a new paleo-precipitation reconstruction based on trace metal (Mg/Ca, Sr/Ca, and Ba/Ca) and isotope ($\delta^{18}O$ and $\delta^{13}C$) speleothem records from Antipayarguna cave in the Peruvian Andes (3800 masl). Our records date from 2,600 to 4,700 and 7,700 to 19,000 years BP, with an average age resolution of 44 years. These records overlap the previously published speleothem records from nearby Pacupahuain and Huagapo caves. The Antipayarguna $\delta^{18}O$ data are highly correlated with southern hemisphere summer insolation and the Huascaran ice core $\delta^{18}O$ record. The Antipayarguna trace metal ratios and $\delta^{18}O$ isotope values correlate well over most of the record, suggesting that the $\delta^{18}O$ at our site reflects the amount of local precipitation. However, at the end of the Younger Dryas (11.5-10.3 ka) and Heinrich Stadial 1 (16.4-14.9 ka), there is a decoupling of these proxies. These anomalies may be due to changes in $\delta^{18}O$ caused by shifts in moisture source region or precipitation condensation factors (e.g. convergence level or subcloud evaporation). Alternatively, this could be due to a change in trace metal sources. We explore potential causes for these brief decoupling events through comparison with other paleoclimate records.