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HYDROCLIMATE VARIABILITY IN THE TROPICAL ANDES (PERÚ) DURING THE LAST 1000 YEARS FROM STABLES ISOTOPES AND TRACE ELEMENTS IN SPELEOTHEMS

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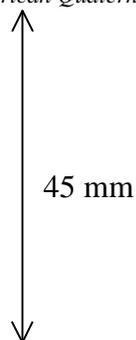
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1. INTRODUCTION

A high-resolution trace element record from a stalagmite collected in northeastern Peru, produced using a ELA-ICPMS system, is used to investigate precipitation variability on subdecadal to centennial time-scales. The observed short-term variations of Mg/Ca and Sr/Ca ratios are in general consistent with a stable oxygen isotope and carbon records from the same cave and suggest a robust link with changes in meteoric water recharge into aquifer above the cave. Therefore, the elemental ratios can be used as a proxy of monsoonal precipitation changes over near equatorial South America during the last 1000 years. The lower values of Sr/Ca and higher Mg/Ca ratios suggest an apparent wetter period than observed nowadays by other speleothem record from the same cave in the period synchronous with Little Ice Age (LIA) (Reuter et al, 2009), anyway, no sufficient data is obtained from CAS-2 to make a discussion of all this time period (LIA) and just the beginning of LIA is registered. In the other hand, the period called Medieval Climate anomaly (MCA), seems to be a relative more drier than nowadays. Forcings and mechanism related to ocean and atmospheric modes are tested in order to bring new insights in the knowledge of the South American Monsoon System.



2. STUDY AREA AND METHODS

An active growing stalagmite (CAS_2) was collected from Cascayunga cave, located in the Northeast Perú (-6.10° S; -77.24° W) Fig 1. The cave places in eastern margin of the Andes Cordilleira (830 asl.), and the sample is a ~27 cm tall stalagmite collected at environs 700 m of the cave entrance and 80 m below the surface. The present day climate in the cave site is tropical humid and the mean annual precipitation is 1572 mm/y (1963-2009), and the external mean annual temperature registered in the same station between (1963-2009); rounds about ~22.8°C with little variations of ~1°C between summer and winter season.

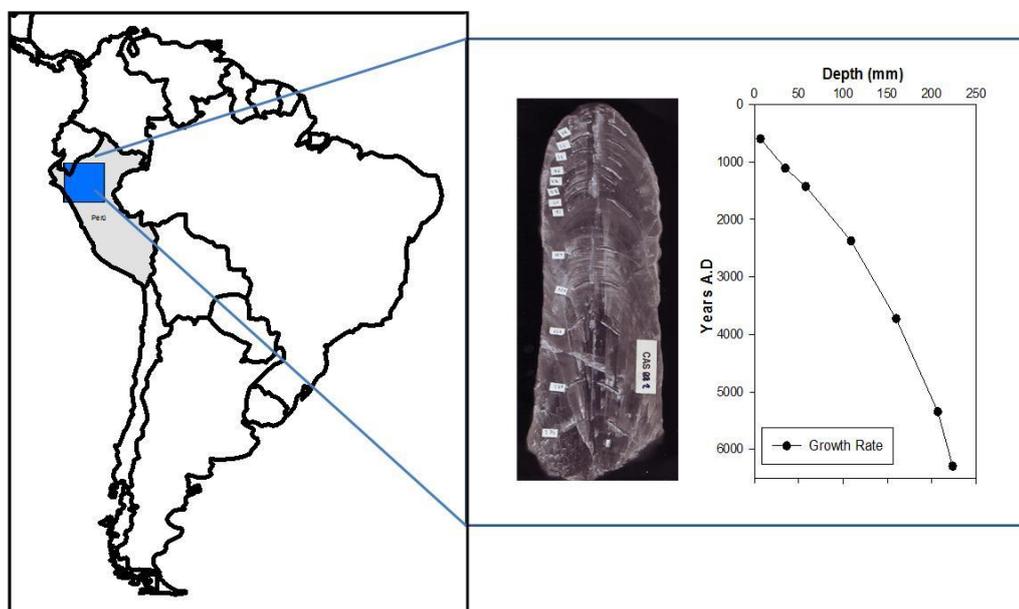
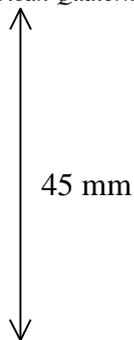


Fig 1: A) Location of Cascayunga cave in northern South America B) CAS-2 speleothem and chronological model based in U-Th ages measured in Minnessota isotope laboratory.

The age model developed for the CAS-2 stalagmite is constrained based on eight U-Th ages measured in Minnessota Isotope Laboratory (University of Minnessota) using inductively coupled plasma-mass spectrometry (ICP-MS) technique (Shen et al., 2002). The most of dates present errors of (2σ) <1%. Oxygen isotope profiles are reported as $\delta^{18}\text{O}$ relative to Vienna Pedee Belemnite Standar (VPDB). The preliminary record consists of 560 isotope analyses taken along the growth axis after every 0.4 mm, which provide a temporal resolution between 1 and 10 years (~5 years). Trace elements were analyzed using Laser ablation inductively coupled plasma carried out at the Instituto de Geologia of “UNAM” (Universidad Autonoma de Mexico). Trace element analysis of CAS2 speleothem was performed using a 30 μm laser



bean along the growing axis of CAS-2 which corresponds to subannual resolution data. Statistical analyses for evaluation of the bulk data allow us to evaluate variations, trends and cycles in the time series obtained. I will try to make comparisons with climate indexes and other proxies in order to explain possible mechanism and teleconnections related to climatic variations over the tropical eastern Andes in South America.

3. PRELIMINARY RESULTS AND DISCUSSION

The results from previous studies developed in the same cave showed that the $\delta^{18}\text{O}$ range of $\sim 2\text{‰}$ in the last 1000 years. During this period the most negative values are observed at the period LIA event and more positive values at the MCA event. The $\delta^{13}\text{C}$ values ranges approximately between -10 to -2‰ in the transition between this two periods. Carbon isotopes suggest a transition of soil coverage going from higher contribution of C4 type vegetation relative to C3 during the dryer conditions that characterized the MCA period.

The ratios of Mg/Ca ($\times 10^3$) vary from 20.38 to 38.45, with a mean value of the bulk data in order of 28.99. These values are within the range of those found similar studies on stalagmites (ex. Verheyden et al, 2000; Li et al, 2005; Cruz et al, 2007). The comparison of the running mean values of Mg/Ca and Sr/Ca ratios of the CAS_2 speleothem shows similar variations with lower resolution isotope records of $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ in the same sample. One of the possible mechanisms for the incorporation of trace elements in speleothem CAS-2 is the prior calcite precipitation in the vadose zone, which produce higher values trace elements/Ca during dryer periods (Cruz et al., 2007). However, the potential climate influence on geochemical behavior of speleothem will be discussed later in this study based on a drip water monitoring program that has been performed in caves from the same region in Perú.

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