Geophysical Research Abstracts
Vol. 14, EGU2012-10646, 2012
EGU General Assembly 2012

Monitoring tropical cave environmental parameters: Implications for palaeoclimate reconstruction

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This study presents findings from on-going surface and cave environmental monitoring at Yok Balum Cave in southern Belize. Drip hydrochemistry and cave atmosphere dynamics play key roles in calcite deposition, stalagmite growth, and climate proxy signal emplacement. An understanding of daily, seasonal, and inter-annual variability in cave hydrology and atmosphere is therefore critical information for accurately interpreting stalagmite geochemistry in terms of palaeoclimate. Ten month time series datasets of drip rates, cave air PCO_2, soil air PCO_2, cave air temperature and humidity, drip and surface water δ18O values, and meteorological data are presented here and initial relationships discussed. Initial cave air PCO_2 datasets suggest short term (daily) cave ventilation patterns exist which may be superimposed on seasonal-scale variability driven by seasonal rainfall patterns. Rainfall apparently controls soil air PCO_2 by controlling soil bioproductivity, so during the rainy season cave air PCO_2 may increase in response to an increased CO_2 flux into the cave via degassing and flow through micro-fissures. Eight actively growing stalagmites were monitored, indicating that drip hydrology varies spatially within the cave. Temperature and humidity are constant at 23oC and 100% respectively throughout the cave, year round, limiting potential kinetic fractionation of carbon and oxygen isotopes during carbonate precipitation and simplifying interpretations of climate records from stalagmites from the site. Continued environmental monitoring will yield long term datasets which may relate to multi-annual climate phenomena such as the El Niño Southern Oscillation and the North Atlantic Oscillation and provide critical data for interpreting and calibrating the records obtained from Yok Balum stalagmite samples.