Geophysical Research Abstracts,
Vol. 11, EGU2009-7994, 2009
EGU General Assembly 2009

Variability in flood frequency and mean hydrological balance in NW Iberia over the last 2 ky

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Recent GCM models (eg Scaife et al., 2008) suggest that changes in extreme events due to future anthropogenic climate change may be comparable in magnitude to those resulting from variability in NAO state between the 1960's and 1990's; however it is unclear if the changes in recent decades are related to anthropogenic activities or natural variability. Hence a better characterization of past natural variability in flood frequency and its relation to the mean hydrological state is required. For the northwestern Iberian margin, in which NAO influence on precipitation regime is significant, we have identified a new record for reconstruction of flood frequency from cave deposits for the last several thousand years and produced a record of changes in mean hydrological balance (P-E) over the last 1200 years.

In this new type of record, the flood deposits are embedded in stalagmites which are undergoing continuous growth which can be dated precisely using U-series methods. We present a record from flood deposits in stalagmites which grow continuously on the sandy channel in a dry vadose cave passage which intersects the modern river valley 4 m above the level of the river. The cave channel is periodically reactivated during high flow/flood conditions, leaving layers of detrital silicates (clays to fine sand) on the stalagmites. The detrital layers are cemented and covered with calcium carbonate as dripwater continues to feed stalagmite growth. High-resolution analysis of the Si or Al content along the length of the stalagmite using LIBS or XRF-scanner allows us to quantify the concentration of detrital flood inputs in the stalagmite calcite. From other caves without significant flood input we use hydrologically-sensitive stalagmite trace element ratios (Mg/Ca, Ba/Ca) to reconstruct changes in mean P-E.

Cycles in flood frequency are clear in stalagmite records of Si content. With our initial age model for the record of the last 1500 years, flood frequency increases progressively during the transition between the Medieval Warm Period (MWP) and Little Ice Age, and decrease since the end of the Little Ice Age. A previous period of high flood frequency appears at about 900 AD. In addition, higher frequency cyclicity is evident. If further U/Th dates confirm this chronology then this history will contrast with greater evidence for droughts in the circum-Mediterranean realm during the Little Ice Age. Mean precipitation in a more precisely dated speleothem record from Pindal Cave suggest similar trends. There is a minimum in P-E during the MWP, and progressive increase in P-E between 1100 and 1400 AD, and persistent humid conditions until the final decades of the 20th century. This pattern contrasts with that inferred for northern Scotland by Proctor et al and may be consistent with a shift to NAO negative conditions for several centuries around the time of the LIA.