"How climatic changes, occurring during the last ~190 ka in the N of Mexico (Naica, Chiuhahua), controlled the formation of gigantic cave crystals"

Three hypogenic caves within the Naica mine of Mexico (Cueva de los Cristales -- CLC, Ojo de la Reina -- OR, and Cueva de las Velas -- CLV) host spectacular gypsum crystals up to 11 m in length. These caves are close to another shallow cave of the area (Cueva de las Espadas -- CLE), with which they cover a 160 m-deep vertical section of the local drainage basin. Similar to other hypogenic caves, all these caves lack a direct connection with the land surface and should be unrelated with climate.

A record of multi-technique fluid inclusion data and pollen spectra from cave and mine gypsum indicates surprisingly that climatic changes occurring at Naica could have controlled fluid composition in these caves, and hence crystal growth. Microthermometry and LA-ICP-Mass Spectrometry of fluid inclusions indicate that the shallow, chemically peculiar, saline fluid (up to 7.7 eq. wt.%NaCl) of CLE could have formed from evaporation, during a dry and hot climatic period. The fluid of the deep caves was instead of low salinity (~ 3.5 eq. wt.% NaCl) and chemically homogeneous, and was poorly affected by evaporation. We propose that mixing of these two fluids, generated at different depths of the Naica drainage basin, determined the stable supersaturation conditions for the gigantic gypsum crystals to grow. Fluid mixing was controlled by the hydraulic communication between CLE and the other deep caves, and must have taken place during cycles of warm-dry and fresh-wet climatic periods, which are known to have occurred in the region.
Pollen grains from a 35 ka-old gypsum crystal of CLC corresponds to a fairly homogenous catchment basin made of a mixed broadleaf wet forest, which suggests precipitation during a fresh-wet climatic period and confirms our interpretation of the fluid inclusion data. The unusual combination of geological and geochemical factors of Naica suggests that other hypogenic caves found elsewhere may not host similar crystals. However, this work shows that fluid inclusions and pollen spectra represent a useful tool for cave studies in general, and if used in future studies might be essential to unravel the mechanisms of hypogenic deposition."