



## **A speleothem record of climate of the last millennium in Southeast Spain**

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We report a paleo-climatological study of Southern Spain using an actively growing stalagmite (“Zerolin”) collected in the Cave of Ardales (Málaga) in 2007. U-Th dates indicate that the speleothem began forming 1000 years ago with an average growth rate of 200 microns per year. Clear annual laminae couplets composed of porous white layer and denser darker layer are present in portions of the stalagmite. The thickest laminae couplets reflect times when the stalagmite had the highest growth rate and coincide with the beginning of the Little Ice Age; we interpret these as periods of more humid climates which maintained active dripping and stalagmite growth in both the winter and summer seasons. During dry periods, the dry season laminae is condensed or suppressed.

The stalagmite is fed by fracture flow in the dolomitic bedrock. In times of drought, the drip interval can be longer than 20 minutes which would be expected to produce extensive prior calcite precipitation on the cave ceiling. Low Sr/Ca ratios between 1200 and 1700 AD coincide with thickest laminae and may reflect low PCP and more humid conditions. Mg/Ca ratios are more complex to interpret because LA-ICPMS data reveal high contribution of Mg from detrital phases, which may be transported preferentially through the fracture during high flow periods. The magnitude of annual Mg/Ca variation clearly exceeds that which could be attributed to PCP. Although the stalagmite does not have annual laminations during the last two centuries, within the precision of existing U/Th dates we conduct an evaluation of the multidecadal scale proxy response during the period of instrumental climate observations of the region to more carefully establish the best proxies for aridity and humidity.