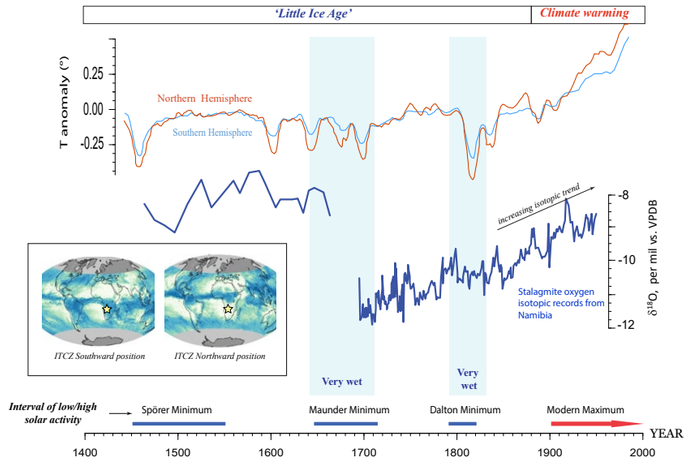
Stalagmite reveals climate changes clues in northeast Namibia, Africa

Dr Ny Riavo Voarintsoa and her colleagues are looking at past climatic histories in northeast Namibia through the geological record (paleoclimate) in order to predict how this area may be affected in the future by climate change.

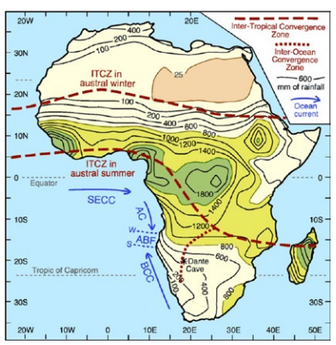
Africa is home to varied climate systems, with the wettest part of the continent being where trade winds meet, at a tropical rain belt near the equator called 'Inter-tropical Convergence Zone' (ITCZ).

In southwest Africa, climate of northeastern Namibia is sensitive to changes associated with the ITCZ. It is prone to desertification in dry years. Looking at past climatic histories through the geological record (paleoclimate), we can predict how this area may be affected in the future by climate change. A more accurate prediction consists of filling gaps in Namibia's paleoclimate records. Dr Ny Riavo Voarintsoa and her colleagues have helped to do so through careful paleoclimatic analysis of a stalagmite from Dante Cave, to find out about patterns of past dry and wet periods in the region.



Stalagmite oxygen isotopic records from northeast Namibia (yellow star in the map), put in perspective versus global climate temperature anomaly (source Neukom et al., 2014, Nature Clim. Change) and intervals of low/high solar activity. Please refer to Figure 5 of Voarintsoa et al. (2017) for details. The two maps, used for reference here, are from NASA Earth Observatory, in which darker blue shade indicates regions of higher rainfall.

Increasing oxygen isotopic trend starting from 1750 to 1950 is coeval with the global increase in temperature.



Climatic map of Africa showing the position of the ITCZ during winter and summer. For details, please refer to Figure 1 of Voarintsoa et al. (2017).

LITTLE ICE AGE AND MODERN CLIMATE WARMING

One of these periods was the Little Ice Age (LIA), marked by exceptionally low temperatures and possibly low solar activity in the Northern Hemisphere (NH) during the 16th-mid 19th century. It brought about humidity in the Southern Hemisphere since the ITCZ migrated southwards in response to the cooling of the NH. Thenceforth, it moved relatively northward, leaving the region with warmer and drier climate.

STALAGMITE SECRETS

Stalagmites may tell us about past environmental histories through their stable isotopes, petrography, and mineralogy, as Voarintsoa commented: "Stalagmites can be dated with precision and accuracy", and our team members, including Hai Cheng and Lawrence Edwards, are leading experts on it. Voarintsoa's team analysed the uppermost part of a stalagmite from Dante Cave, focusing on a small time-frame, to see how cooling impacted northeastern Namibia between AD 1400 and 1950. The team confirmed the stalagmite age using the uranium-thorium pair method while comparing stable isotopes, petrographic, and mineralogical results with established temperature and solar activity data.

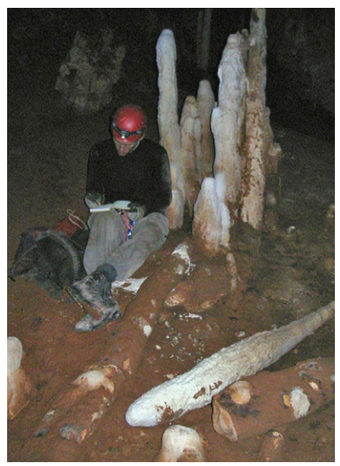
Stalagmites can be dated with precision and accuracy.

WHAT THE RESEARCHERS UNCOVERED

The team successfully married a link from changing climate and rainfall patterns in northeastern Namibia, with solar activity and global temperature change. They showed that during low levels of solar activity and global cooling, like during the LIA, there were wetter periods in northeastern Namibia, due to a movement of the ITCZ to the southwest. After 1715, warming coincided with the northeasterly movement of the ITCZ, causing reduced rainfall of the summer rainfall zone of southern Africa in more recent years.

IMPLICATIONS FOR THE FUTURE

Voarintsoa noted a finding of "an increasing oxygen isotopic trend starting from 1750 to 1950 that is coeval with the global increase in temperature". This warmer climate in the NH may have induced warmer, drier conditions in northeast Namibia, as the ITCZ shifted northwards. This implies that with further warming trends in the high latitude regions of the Northern Hemisphere, northeast Namibia may become even warmer and drier in the future.



Photograph of Stalagmite DP1 lying in the Purgatory Room of Dante Cave, with Ben Hardt for scale (photograph by Eugene Marais).

Photo Credit: Michael Lukas

Behind the Research

Dr Ny Riavo Voarintsoa

E: nyriavo.voarintsoa@gmail.com **T:** +972 5867 68916
W: www.voary.com @nyr_voarintsoa

Research Objectives

Dr Ny Riavo Voarintsoa and her colleagues are looking at past climatic histories in northeast Namibia through the geological record (paleoclimate) in order to try to predict how this area may be affected in the future by climate change.

Detail

Current Address:
The Fredy & Nadine Herrmann Institute of Earth Sciences
The Hebrew University of Jerusalem
Edmond J. Safra Campus
Jerusalem, Israel. 91904

Bio
Ny Riavo Voarintsoa (aka. Voary) obtained her PhD degree in Geology from the University of Georgia in 2017. Her study focused on reconstructing environmental and climate changes throughout history in Southern Africa and Madagascar using stalagmites. Currently, she is a post-doctoral fellow at the Hebrew University of Jerusalem and has recently been awarded a Marie Curie Fellowship to undertake research in her home country, Madagascar.

Funding
Schlumberger Foundation Faculty for the Future to Ny Riavo G. Voarintsoa
NSF 0002193 to George A. Brook
Natural Science Foundation of China Grant NSFC 41230524 and NSFC 41731174 to Hai Cheng.

Collaborators
- George A. Brook
- L. Bruce Railsback
- Fuyuan Liang
- Eugene Marais
- Benjamin Hardt
- Hai Cheng
- R. Lawrence Edwards

References

Voarintsoa, N. R. G., Brook, G. A., Liang, F., Marais, E., Hardt, B., Cheng, H., Edwards, R. L., and Railsback, L. B. (2017). 'Stalagmite multi-proxy evidence of wet and dry intervals in northeastern Namibia: Linkage to latitudinal shifts of the Inter-Tropical Convergence Zone and changing solar activity from AD 1400 to 1950'. *The Holocene* 27;3: 384-396. doi:0959683616660170.

Personal Response

How can your findings from northeastern Namibia contribute to our understanding of the future impact of climate change on other regions of the planet?

"Climate change is worrying us all. If considering the last couple centuries of records, the increasing oxygen isotopic trend found in our stalagmite records agrees with the observed reduced precipitation in the summer rainfall zone of southern Africa. It is intriguing to see that such observed changes appear to align with the global increase in temperature (see for example recent reports from IPCC aiming at limiting global warming to 1.5°C). This finding could suggest that global warming predictions in the next century could suggest drier climate in Namibia, and in other regions with similar climatic conditions."

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