

# SISAL Phase 2: Towards a global compilation of speleothem trace element records



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Accurate model projections of future regional hydroclimate require validation against paleoclimate records. Speleothems, with their strong age control and multiple proxies, are a promising archive for this purpose (Bühler et al. 2021). During Phase 1 of the Speleothem Isotope Synthesis and Analysis working group (SISAL; [pastglobalchanges.org/sisal](http://pastglobalchanges.org/sisal)), members of the group published a database containing nearly 700 speleothem isotope records, 500 of which have standardized age models (Comas-Bru et al. 2019). Data-model comparisons utilizing the database have yielded promising results, while stressing that more information from cave monitoring and additional proxies are needed to constrain the interpretation of isotope records, and to provide independent paleoenvironmental information. To address these gaps, the working group aims to expand the database with trace elements and monitoring records during Phase 2 (2020–2023).

This first workshop of Phase 2 was designed to:

- assess the spatial and temporal distribution of trace element data;
- formulate targeted research questions;
- discuss best practices for measurements, data standardization, reduction, and uncertainty estimates; and
- design the first steps for plans to augment the SISAL Phase 2 database with process-based modeling of the climate–karst–cave system.

The Jerusalem workshop was fully hybrid, with "handshake" sessions organized to connect working groups from the Asian, Australian, and American time zones with the Eastern Mediterranean and European time zones. Fourteen participants, including two senior researchers, and 12 early-career researchers (ECRs, including Master students,

PhDs and postdocs) from 10 countries attended the workshop in person. About 10 additional participants joined online.

On day 1 of the workshop, SISAL members joined the hosting researchers from the Institute of Earth Sciences at the Hebrew University of Jerusalem for a departmental symposium. The symposium hosted 21 speakers (eight talks and 13 short "elevator pitches"). Six senior scientists in the field of karst and climate research presented their research alongside 14 ECRs. In-person audience attendance averaged around 40, and over 60 participants joined online throughout the day.

On day 2, Dr. Nikita Kaushal presented an update of the SISAL Phase 2 work to date on monitoring, trace elements, and long-term data stewardship. This included the datasets identified by the regional coordinators (Fig. 1), database structure, data and metadata fields, quality control, and proposed timelines. Dr. István Hatvani presented the new graphical user interface (GUI) to increase accessibility to the existing SISAL database. The group then brainstormed potential research questions and assigned teams to explore each question. The emerging main research questions included potential proxy system models to bridge the gap between rainwater and speleothem isotopes, and how to find robust regional hydroclimate proxy mechanisms targeting the divalent trace element replacing calcium in speleothem carbonate. Given the time-intensive nature of input to the monitoring database, it was decided that the data input would be targeted and project-specific.

On day 3, the group put most effort into data input and quality control, creating a wish list for metadata, and listing potential datasets for upload. Finally, on day 4, the last work

day, the participants were introduced to the karst hydrology model designed by Kübra Özdemir Çalli and Prof. Andreas Hartmann. For the remainder of the workshop, participants circulated between breakout sessions focused on the main research questions from day 2.

On the last day, participants enjoyed a geological field trip to the Soreq Cave, led by Drs. Miryam Bar-Matthews and Avner Ayalon from the Geological Survey of Israel. Later, Prof. Mordechai Stein guided the group to the Dead Sea rift, valley, and lake.

With the workshop concluded, the SISAL working group now has focused research questions that will guide the data collection. Research group leaders were assigned, and a timeline for achieving the goals of the working group was established. SISAL Phase 2 coordinators welcome new volunteers to help in data curation and join the different projects planned for the upcoming months; if interested, please contact SISAL at [sisal.sc2@gmail.com](mailto:sisal.sc2@gmail.com).

## ACKNOWLEDGEMENTS

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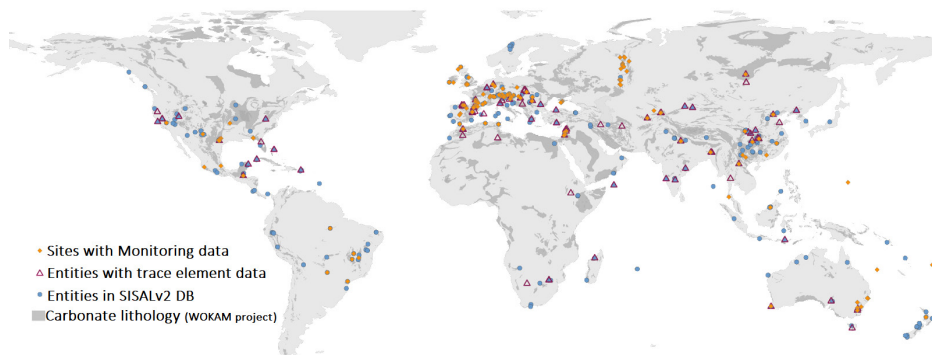
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**Figure 1:** Sites with monitoring data (SISALv2 and [cavemonitoringgroup.wordpress.com](http://cavemonitoringgroup.wordpress.com)) and entities from the SISALv2 database with trace element data superimposed in all SISALv2 entities (blue). The map is modified from The World Karst Aquifer Map (Goldscheider et al. 2020).