

Salt caves of “Mt Sedom”, continuation of documentation and studies of the salt caves of Mount Sedom (Dead Sea, Israel)



Contents

Introduction	2
Geology and speleogenesis of Mount Sedom	3
Research history	4
The new survey of Sedom cave	4
Participants and tasks	5
Materials and methods	7
New discoveries	7
Final results	9
Peteq cave	10
Participants	11
Presentations and publication	12
Budget	13
Sponsors	13
Photos	14

From 10 to 18 March 2023, the 3rd International Expedition to the salt caves of Mount Sedom, organized by the [Israeli Speleological Association](#) (ISA) and sponsored by the [European Speleological Federation - Fédération Spéléologique Européenne](#) and [KORDA'S](#) took place.

The expedition's main objectives were to re-survey Sedom and Peteq cave systems as the old maps were from the 80ties. Both of the caves are located on the eastern side of Mount Sedom and both caves have an outlet to the Dead Sea.

Introduction

Mount Sedom is a salt diapir, about 11 km long and 2 km wide. It is located on the western side of the great rift valley, on the shores of the southern peninsula of the Dead Sea, Israel. Mt. Sedom rises ~250 m above its base (~160 m below main sea level).



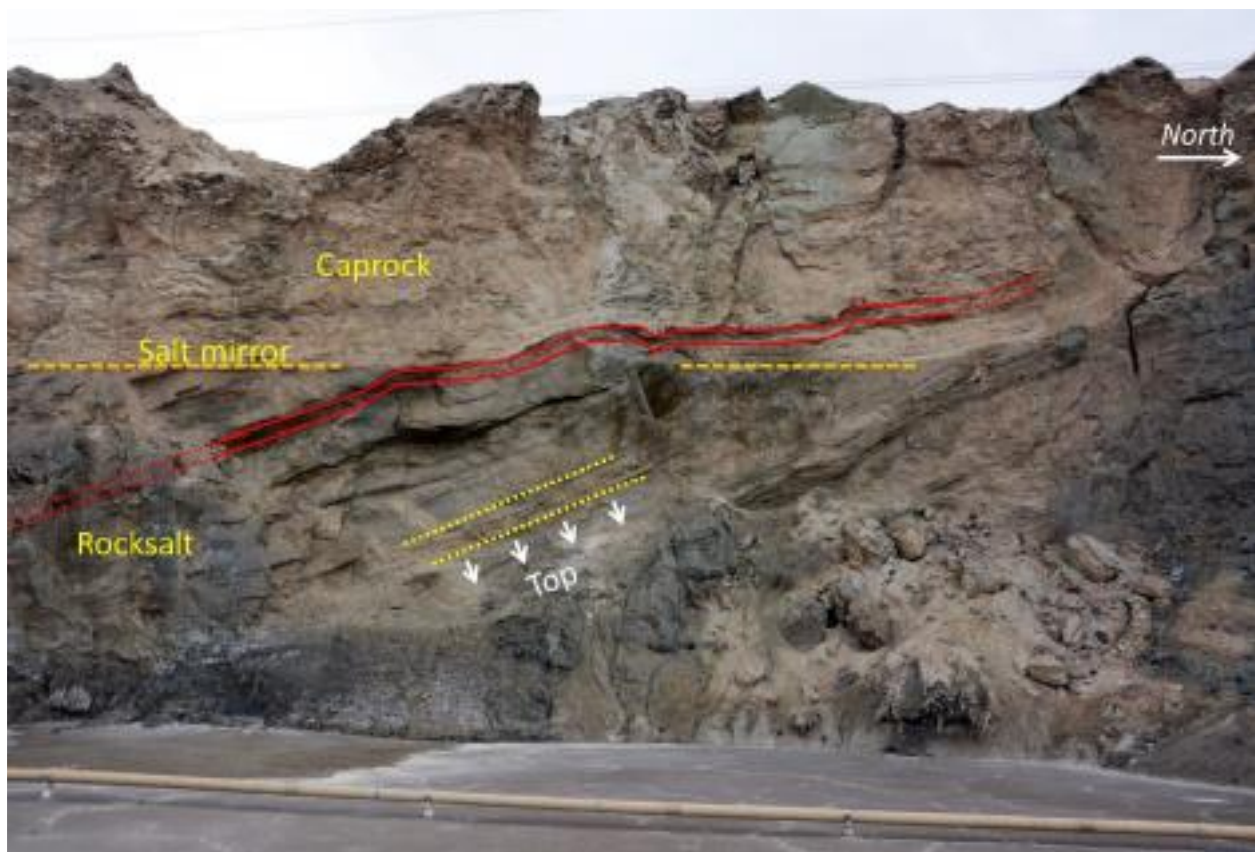
Such phenomenon of this magnitude is extremely rare. Because of the solubility of the salt rock underground cavities are quickly formed, and the mountain is full with them. Some of the caves are amongst the biggest underground salt systems in the world.

The area was surveyed and studied mainly by Israeli researchers. In 2018 and 2019 two international expeditions were held under the motto "Project: Malham - the longest salt cave in the world". Those expeditions joined the efforts of participants in the preparation of a new map of the Malham salt cave, that led to the survey of the longest known salt system in the world – the only one with more than 10 km of total length.

Geology and speleogenesis of Mount Sedom

The salt bedrock of Mt. Sedom was deposited in an elongated lagoon, within the tectonically subsiding Dead Sea rift, into which seawater penetrated through the Yizre’el and Bet She’an valleys during the late Miocene. During later stages of the Dead Sea fault development, the salt deposits were overlaid by a thick overburden, comprising mainly sedimentary fill of fluvio-lacustrine origin. The diapir is located above a north-south–striking fault (Sedom fault), which runs parallel to the elongated Sedom diapir. This suggests that salt migration and piercing took place along the track of the Sedom fault. There is evidence of diapir uplift activity in Sedom diapir as early as the mid-Pleistocene (*Weinberger et al., 2006*). However, Mt. Sedom relief started to develop during the latest Pleistocene (*Frumkin, 1996*), when the southern part of the diapir extruded above the local water table. The earlier stage of the diapir uplift occurred under terminal lakes, which occupied the Dead Sea Transform since the late Neogene. Salt dissolution in the lake water led to accumulation of a 40 m thick layer of insoluble materials that covers the salt rock (cap rock layer).

Two factors protecting the salt rock from total dissolution are – the cap rock covering the salt, and the aridity of the area. The salt layers deposited in a “Sedom lagoon”, a water body that was connected to the Mediterranean Sea about 8 million years ago. The weight of the rocks above creates a pressure that forces the salt to flow up along the basin wall, creating a salt diapir (intruding structure).



The mountain is an outcome of this massive force, and it keeps rising approximately 1 cm per year. The annual precipitation in the mountain area is about 50 mm, which appears as short but dramatic rainstorms. These storms turn into flash-floods.

During rainstorms, surface runoff develops in the cap rock surface. Such events are rare and occur only a few times a year, mostly during spring and fall and occasionally during winter. Runoff permeation from the surface into the salt formation beneath the cap rock leads to the formation of underground channels. They exhibit a characteristic structure consisting of a vertical shaft that links the surface with underground sub-horizontal passages that run along the watercourse. The passages typically meander and occasionally run in straight sections along fracture lines. A continuous uplift of the salt diapir (~10mm/year), and a historic drop of the drainage base level (the southern Dead Sea basin) led to abandoned cave levels and down-cuts to younger levels.

Part of the water is drained from the mountain on the surface, but most of the water is drained through the cap rock into the salt layers forming underground channels (allogenic karst).

Under these conditions, deep channels or passages with several levels formed, with shafts or collapses that connect different levels. More than 220 caves have been documented in Mt. Sedom to date, amounting to about 40 kilometres of passages. Most caves have an inlet only, so that runoff entering the caves eventually seeps down to groundwater. In rare cases, seepage is small, and underground salt-saturated lakes form instead. About 15% of the caves have traverse structure, with outlets in Mt. Sedom flanks: The Dead Sea on the eastern side and Amiaz plane on the western side.

Research history

The existence of salt caves in Mt. Sedom was reported already in the 1950's and 60's, but there had been no organized survey or information about the caves. Since the early 80's, cave surveys were made at the mountain, mainly by the Israel Caves Research Centre (I.C.R.C). The method used for surveying during the 80'-90', was to follow streams with significant drainage basin. Therefore, small and local openings were missed. The current method includes a full survey of the entire area (caves and surface).

About 200 caves, with more than 35 km of passages, are known today at the mountain's boundaries. 84 of the caves were found at the last decay, during a new survey of the mountain. Several known caves were remapped, due to changes that occurred following the initial discovery or according to better mapping tools that are in use today.

That include Malham cave, the longest salt cave in the world and the only one that exceeds the 10 km threshold. The formation of such a long cave is made possible by the arid conditions, which on one hand are sufficient to dissolve the salt rock, while on the other hand the process is slow and does not lead to rapid erosion of the entire salt outcrop. Such conditions make Mt. Sedom an ideal location for development of large salt caves, with 10 caves greater than 1 km in length.

The new survey of Sedom cave

After the successful completion of Malham mapping project the focus went to a nearby cave Sedom, which also has a huge potential to become one of the longest in the world. According to the old map from the 80ties, Sedom cave has total length of 1799 m.

Participants and tasks

The team was formed mainly from the highly skilled with mapping and surveying cavers. People from 8 countries – USA, Bulgaria, Hungary, UK, France, Czech Republic, Germany and of course Israel joined the expedition.



Team - 1st day of the expedition. Photo: Ágnes Berentés

The base camp was located on the top of the mountain in vicinity to the upper entrances of the cave and about 1-hour walking distance from the main entrance.

Expedition members had 2 main tasks:

1. Surveying the cave.
2. Surface survey to locate possible connections.

The in-cave survey was split into 5 sections and each section was surveyed by different team.

- The Fox branch was given to the British team.
- The main branch to the Israeli team.
- The Singing bat active branch to the Bulgarian team
- The Abandoned Fox branch to the American team.
- The Tlula Branch was given to the Hungarian team.

Each section was marked with a different letter and the connection stations had a special mark. In the first few days the task was to map the main branches, without going into side galleries, just leaving a question mark and returning when the map of the main branch is completed.

Then the following days were devoted to clearing the question marks.



Surface explorations. Photo: Ágnes Berentés

During the survey, 9 entrances to the cave were found. One of them is the outlet of the cave and the remaining 8 are inlets through vertical shafts. The surface team found only 6 of the pits and 2 are still only found from the inside.



*Vertical shaft in Sedom cave.
Photo: Ágnes Berentés*

Materials and methods

Standard mapping of caves is a slow, difficult and complicated process. With the advent of electronic mapping the accuracy in taking and processing the data is significantly improved, and the process of preparing an electronic map of the cave is facilitated.

During expedition all cave measurements and mapping were performed by teams, using paperless survey method: DistoX2 in combination of TopoDroid. Then the last proceedings were done with [Therion](#) (open-source cave surveying software) and Adobe Illustrator.



On the left: Mapping upper levels of Sodom cave. Photo: Ágnes Berentés

On the right: Mapping bat channel of Sodom cave. Photo: Yoav Negev

New discoveries

After the completion of the main branches mapping the focus went on new leads. In mount Sedom it is most common to find new leads on upper levels. Those upper levels are actually abandoned streams, where the water used to flow thousands of years ago.

Expedition members found many new leads almost on every branch. As the limited time of the expedition, we didn't have time to follow many of them to their end and they will remain for a future expedition.

The surface team also checked a few additional pits which currently has no connection to the main Sedom cave system and they are defined as new discoveries of separate caves. Among them is a newly discovered and very interesting cave named Erzsébet cave. The cave is 60 meter deep with a complex structure including both vertical and horizontal passages.



Vertical shaft in Erzsébet cave, Mount Sedom. Photo: Ágnes Berentés

It is so close to Sedom cave that we hoped to find a connection but so far couldn't find one. One very narrow lead still need to be checked.

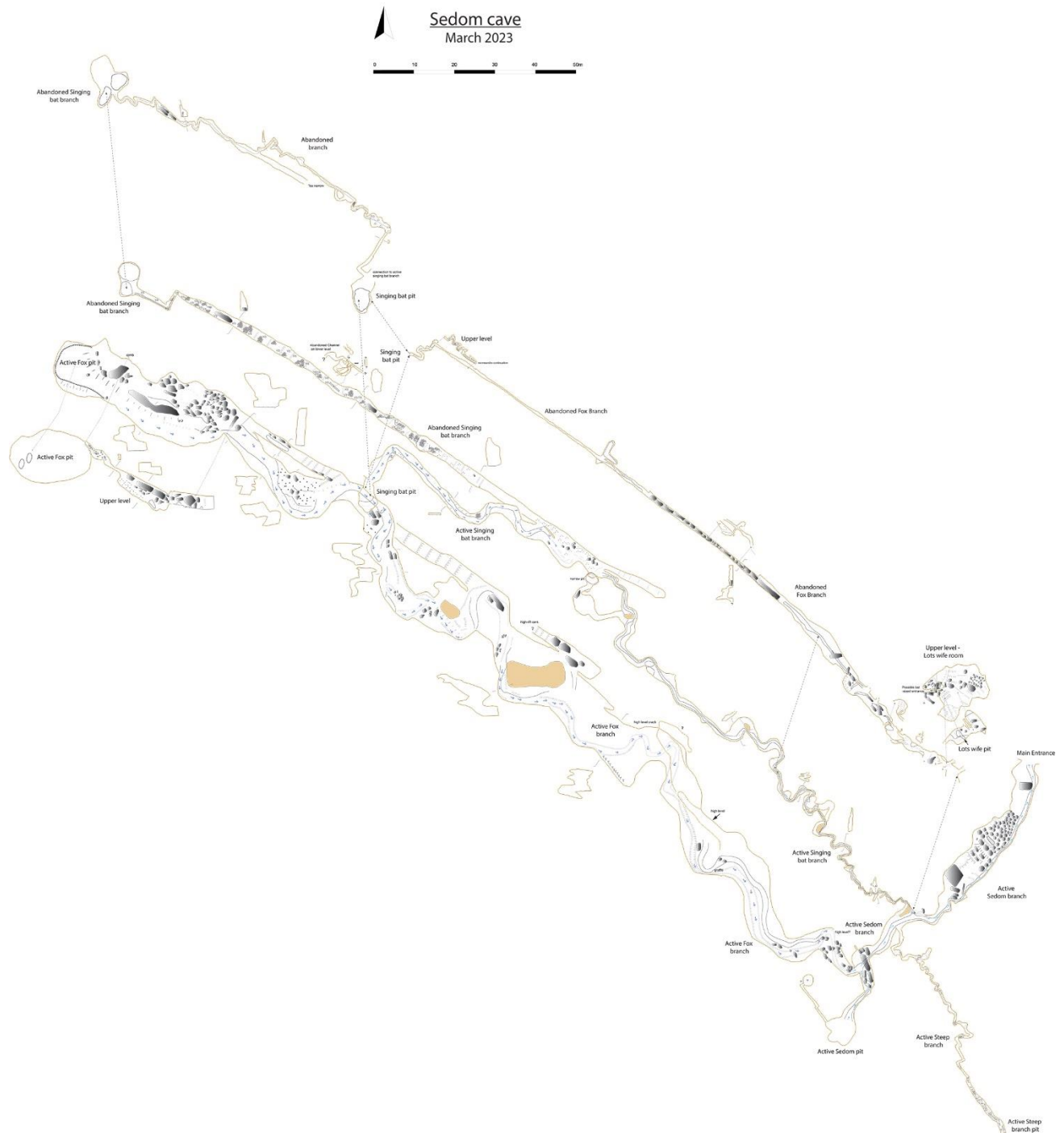


*Abandoned channel in Erzsébet cave, Mount Sedom.
Photo: Yoav Negev*

Final results

During the expedition, about 2.7 km were surveyed, new passages and new entrances were found (currently 9 in total) – some of them were surveyed, the others remained as an objective for future explorations. Sedom cave is an amazing and complicated maze system with galleries on different levels – in some parts more than 5.

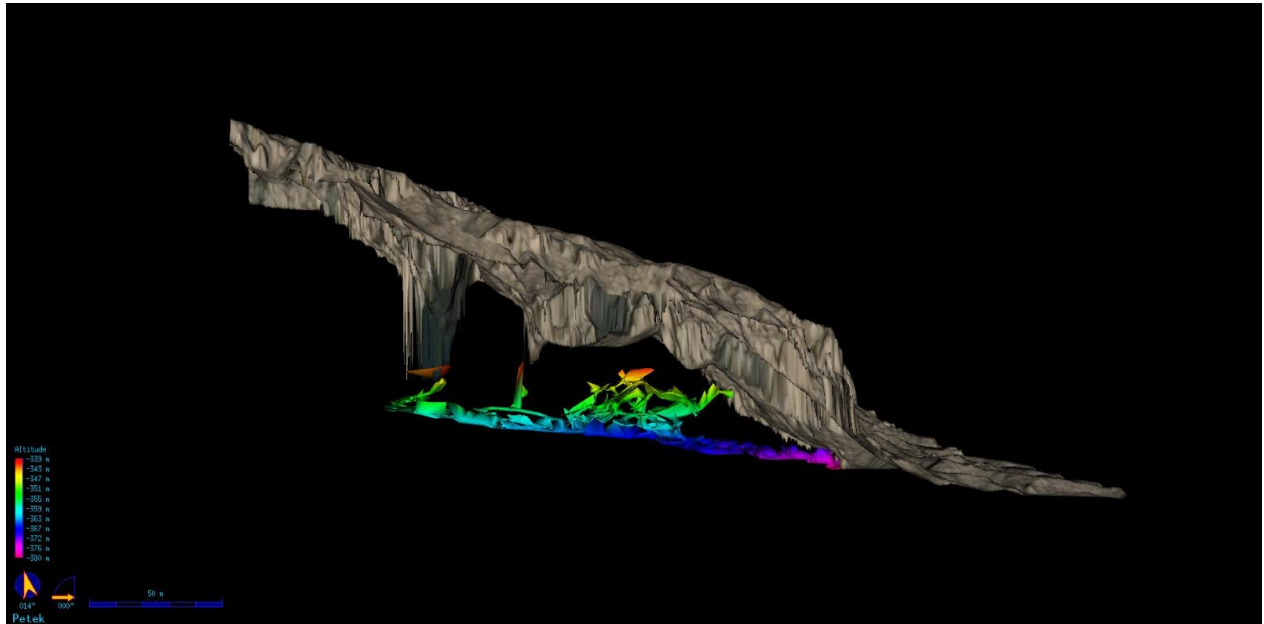
It is one of the most active caves on the mountain. It changes every year as winter flash floods are going through it and dissolves the salt. Many new leads are still with question mark and needs inspection and surveying.



Peteq cave

The other object of expedition was surveying of Peteq cave as the old map contains only the main branch and the main pit with a current total length of ~200 m. Last winter a side gallery was discovered with significant continuation that still needs much more exploration. This side gallery also contains beautiful and rare formations such as huge cubical salt crystals and beautiful salt stalactites.

After the mapping total length of the cave is 966 meters with still unmapped parts.



Participants

Cavers from 8 countries – USA, Bulgaria, Hungary, UK, France, Czech Republic, Germany and of course Israel joined the expedition.

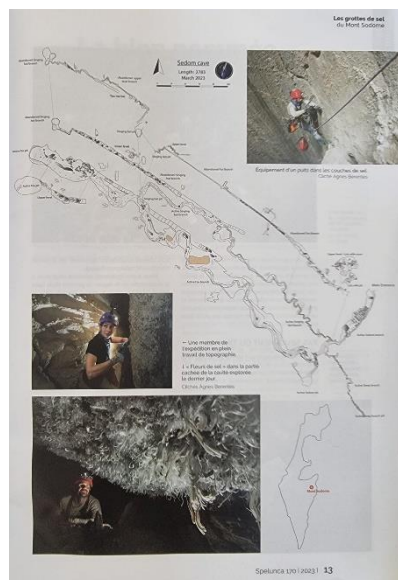
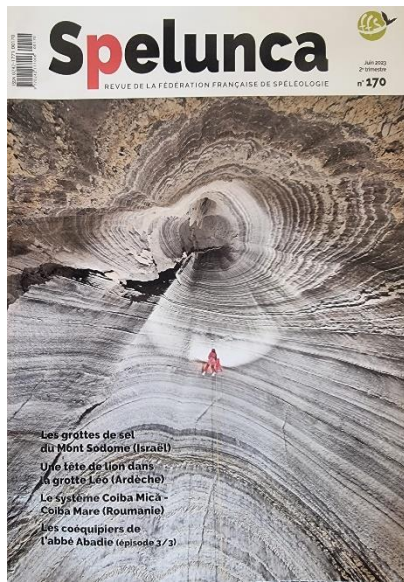
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Presentations and publication

Presentation about salt caves in Mount Sedom was done during Euro Speleo Forum in Breitscheid, Germany 2023.

Article about the expedition was published in French Magazine Spelunca.



Budget

International flights	6 800 €
Land transportation (rent a car, fuel, other)	500 €
Accommodation, food	3 800 €
T-shirts, buffs, stickers	600 €
Other costs	150 €
Total cost in Euro	11 850 €

Sponsors

The expedition was supported by the [European Speleological Federation - Fédération Spéléologique Européenne](#) and FSE official partner [KORDA'S](#).

Special t-shirts were prepared for the participants of the expeditions with the logos of main sponsors and organisers.



Organizers of the expediting thanks to all participants, to [Israeli Speleological Association \(ISA\)](#), [European Speleological Federation - Fédération Spéléologique Européenne](#) and [KORDA'S](#) for the provided equipment and help.

Photos

Last day of the expedition participants visited spectacular caves in the area and photographers did special photo trip.



Last day of the expedition. Photo: Philippe Crochet



Amazing cubical salt crystals. Photo: Ágnes Berentés



Beauty of the salt. Photos: Ágnes Berentés