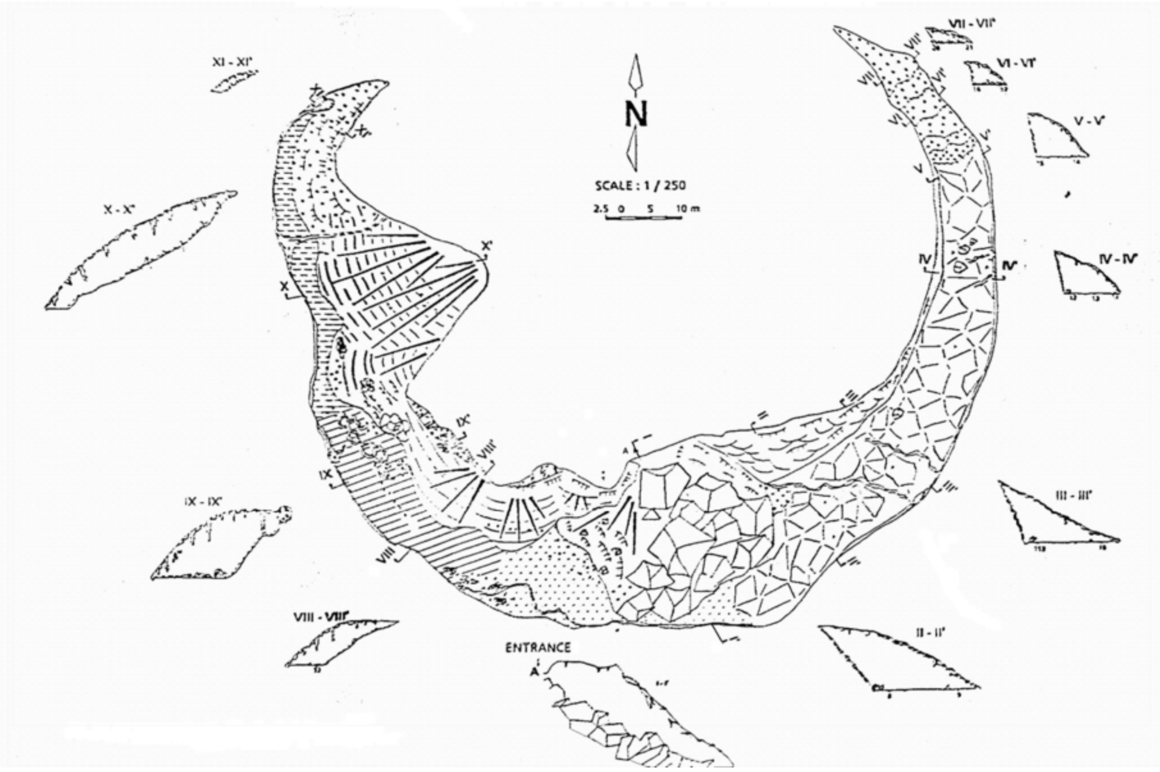
Fig. 1. Detailed plan and cross-sections of Sannur Cave prepared in 1993 and published by Günay et al. (1997). The shape and form of the cave is most unusual.



SANNUR CAVE – THE PROBLEMS OF OPENING A REMARKABLE CAVE IN EGYPT'S EASTERN DESERT

- Greg Middleton

Fig. 2. The western gallery is chock full of massive stalagmites and columns in an impressive range of colours; the ceiling is a billowing mass of crystal growths punctuated by innumerable stalactites.

In November 2003 I was asked by the Egyptian Department of Nature Protection, part of the Egyptian Environmental Affairs Agency, to advise on the opening of Sannur Cave to visitors. The only information I had on the cave was Bill Halliday's article on it in the Jan. 2003 issue of *NSS News* (Halliday 2003).

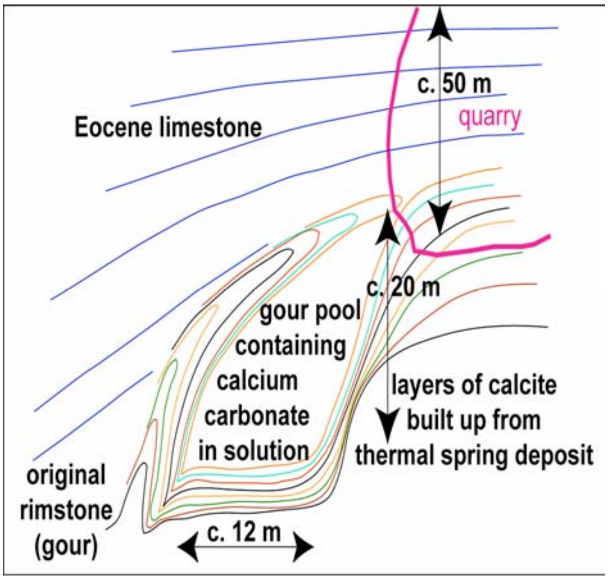
Within a couple of weeks I was in Cairo discussing what was required with the Director of the Nature Conservation Sector of the Egyptian Environmental Affairs Agency, Dr Moustafa M. Fouda and the General Manager Protected Areas, Wahid Salama. The next day I was on my way to the cave with EAA Geologist, Ahmed Salama, and Prof. Mohamed El-Malky of the Institute of Environmental Studies and Research.

BACKGROUND

It seems Sannur Cave was discovered when a 'Egyptian alabaster' quarry broke through its roof in the early 1990s. The quarry operators, suspecting the cave might be considered a greater asset than the quarry, seem to have kept quiet about it as long as they could, but eventually word of it leaked out, the quarry was closed and the area around it was made a protected area, in 1992 according to the official version (Dept. of Nature Protection 2002a) – but perhaps as late as 1998 (Halliday 2002). Indicative of the time lapse is the fact that the quarry floor is now at least 3 metres below where the cave was broken into.

Normally alabaster refers to fine grained calcium sulphate or gypsum but the term "Oriental or Egyptian Alabaster", was introduced before 1904 for the crystalline calcium carbonates of the Nile Valley (Philip et. al. 1991).

Fig. 3. Possible mode of formation of Sannur Cave as an exterior gour which roofed over to create a chamber, later covered by limestone during the Eocene.



The formation of this 'alabaster' is generally accepted as being due to the action of underground carbonated and/or thermal water along faults and fractures with recrystallisation filling fractures and cavities. The surrounding region is almost entirely composed of Middle and Upper Eocene limestones (around 40-50 million years old) with some interbedded shales. The area has been subject to palaeo-karstification processes between the Eocene uplift and Pliocene times.

SANNUR CAVE AND ITS FORMATION

The cave was examined and surveyed in 1993 by a joint Egyptian-Turkish team and they produced a very fine map of the cavern (Fig. 1) (Günay et al. 1997). They were non-committal as to its mode of formation, saying only:

In order to verify and justify models for the origin and paleo-environmental evolution of the cave, some further detailed investigation is needed in the cave. … More information about the depth and extension of the cave beneath the present floor will help in justifying the speculations about the origin of the cave. (Günay et al. 1997, p. 262)

Not knowing much about caves, the Egyptian authorities called upon a US speleologist who has taken a particular interest in Middle East caves, Dr Bill Halliday, for advice as to its significance. In 2002 he inspected the cave and concluded, on the basis of its form and structure, and similarities to a smaller cave of the same form in Idaho, USA, that Sannur Cave is actually a giant roofed gour – in fact, the biggest known (Halliday 2003).

Halliday (2003) described the cave as:
" … an impressive, flat floored chamber 275 metres long and 20 m high at the entrance. Massive speleothems and curving walls partially demarcate eastern and western galleries. Both ends taper and slope slightly upward. The inner wall of the crescent is almost vertical. The cave's roof is almost horizontal at the inner wall, then curves downward to meet the floor as much as 40 feet away. … The cave's speleothems are its great glory, They range from mammillaries and towering stalagmitic columns [Fig. 2] *to glistening thickets of intricate crystalline "popcorn" and tiny glassy helictites. Stalactites vary from large tapered forms to soda straws. Some have secondary coatings of various thickness. Others are so glassy that they appear monocrystalline."*

In Halliday's view this is no ordinary solution cave; it was constructed on the surface by the growth of a huge rimstone basin or gour which curved around an ancient thermal spring deposit. I have tried to illustrate this process with a diagram (Fig. 3). One difficulty is explaining why the space which became the cave did not fill with sediment or calcite during the 40 million years when the 50 m of limestone was being deposited on top of it.

PROBLEMS WITH OPENING THE CAVE

Whatever its mode of formation, Sannur Cave is undoubtedly a spectacular cave, by far the most outstanding in Egypt, and it is understandable that the EEAA wishes to open it to the public. The cave itself poses few problems: it would not be difficult to construct a stairway up to the entrance, then 20 m down to the floor and then a (removable) walkway on the floor around the curve of the chamber (keeping the floor deposits intact). The only problem with lighting is that the site is far removed from the grid but generation on site is quite feasible – or powerful torches could be used.

The real problems are external to the cave itself. To reach the site I travelled over two days, stopping overnight at Beni Suef, 140 km south of Cairo along reasonable roads. Beyond that however, there are no real roads. The last 70 km is through desert, requiring four-wheel drive and a good knowledge of the country (with a GPS just to make sure). The local government has indicated it will provide a road to the cave/quarry; this is essential before any further development can take place.

The major difficulty, however is posed by the very quarry which led to the cave's discovery. The hole in the earth is approximately 50 m in diameter (it is close to being round) and 50 m deep – with a near-circular column in the centre rising right to the original surface. Quarrying has clearly followed the most valuable stone with no regard for the resulting configuration. This has left massive overhangs around the perimeter (and on parts of the central column), extending out about 9 metres above where the cave entrance has broken through. It is difficult to imagine a more potentially dangerous structure. Fig. 4 is a composite made up of a number of photos in an effort to capture the view up from the quarry floor.

Five possible scenarios for making access safer have occurred to me:

1) The removal of all overhanging walls, taking these back to at least vertical faces – and preferably a few degrees beyond. This would be very expensive and any such works would pose some threat to the cave. However, if funds allowed, it appears to be the safest long term measure to make the pit safe.

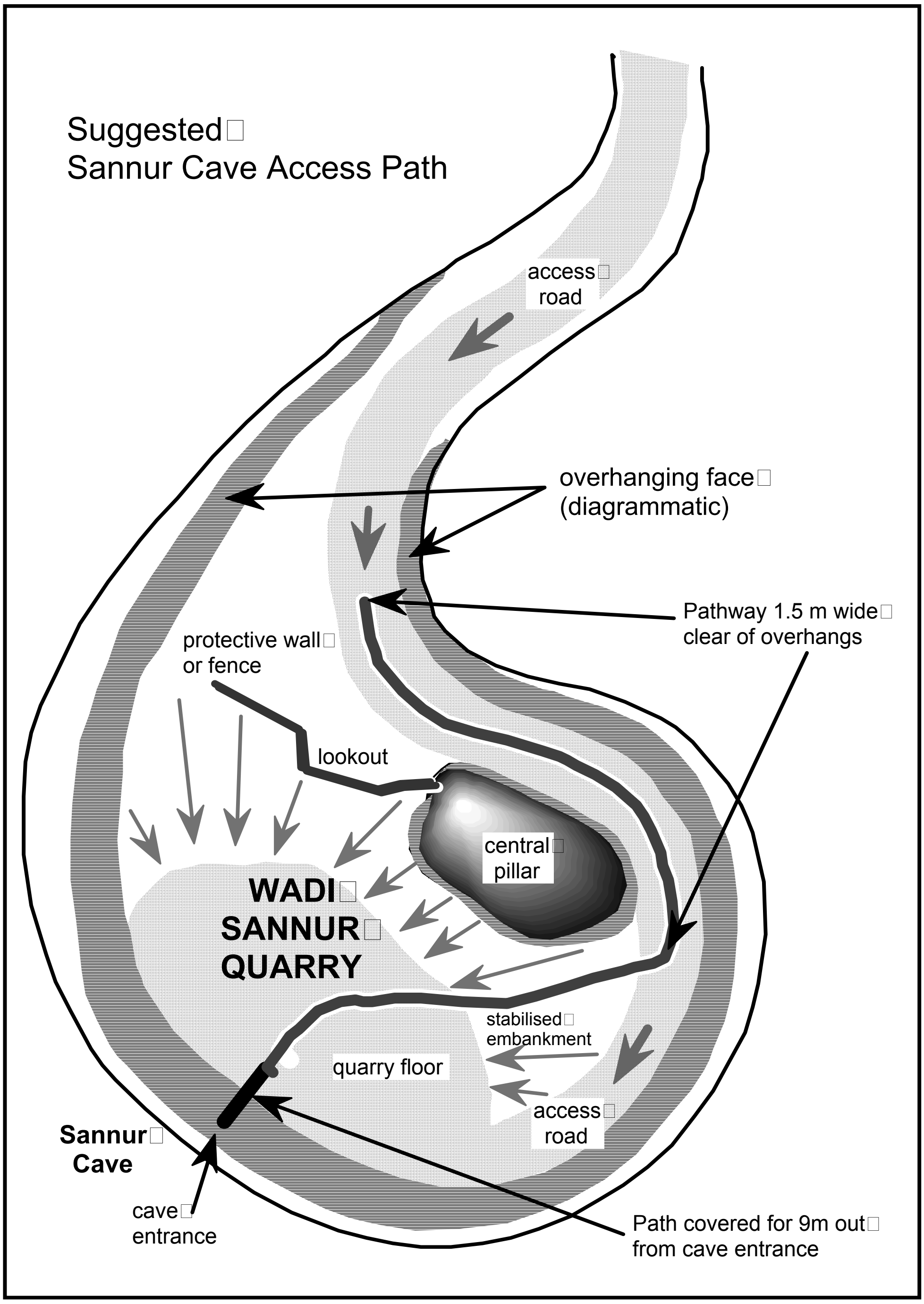
Fig. 4. Photo-montage of Sannur Quarry, looking up from the quarry floor. The faces overhang all around, extending out as far as 9 m in places. The access road comes from the right, leading down to the floor.

2) Build a strongly reinforced vertical spiral staircase from the surface above the cave to the quarry floor as close as possible to the cave entrance and a reinforced covered walkway across to the entrance. Problems with this approach include the high cost, the problem of starting the structure on top of a huge overhang and the aesthetics. I conclude this option is undesirable and impractical.
3) Dig an inclined tunnel directly into the cave from the surface some distance away from the quarry. The main problem with this option would be the very high cost and it would still leave the quarry in danger of collapse. It is presumed to be impractical and probably inadequate.
4) Rig a network of protective high-tensile steel cables and mesh, vertically and/or horizontally, to catch any falling rock. Halliday (2002) drew attention to the fact that "horizontal wire nets are used successfully at the bottom of world-famous Mococha Chasm in the Czech Republic" and this technique is also employed in front of the temple grotto on Mount Sanbang, Jeju Island, South Korea. In the case of Sannur such a structure would be very extensive, difficult to construct without further destabilising the quarry walls and not at all aesthetically satisfactory. If removal of the overhangs is not considered feasible, however, this technique might at least be considered for the large overhang above the actual cave entrance.
5) Construct a path down into the quarry not directly under any overhanging wall – see Figure 5. This would be feasible, low cost and would remove concern about rocks falling directly onto people. Substantial walls would need to be built on both sides of the path (to a height of, say, one metre) to prevent fallen boulders from rolling onto the path. Finally, unless protective steel mesh is installed (as per option 4), a heavily reinforced covered walkway would need to be built out from the entrance 8 to 10 metres to give protection from the large overhang above the cave. While the cost of this option is much lower than any of those above, and the aesthetic impacts would be unfortunate, its greatest drawback is that it would probably be inadequate to protect visitors in the event of a massive collapse.

A further safety issue relates to the edges of the pit on the surface. Currently there is no fence or sign warning of this undercut 50 m drop! A massive berm has been constructed around the pit in order to try to stop water flooding into the quarry and cave in the event of heavy rain. As a high priority a fence or wall should be constructed on the surface, immediately inside the berm to prevent anyone approaching the edges of the pit. Warning signs should also be posted, prohibiting climbing on the wall or fence.

The Authority is so keen to see the cave opened it has published a full colour brochure (Dept. of Nature Protection 2002a) and a 16 page full colour bilingual booklet (including 5 inverted photos of the massive speleothems) (Dept. of Nature Protection 2002b). Perhaps these are a little premature in view of the difficulties of getting to the cave, and the safety issues surrounding access to it. The provision of safe access to Sannur Cave will indeed be a major challenge for the managers of this extraordinary karst site.

Fig. 5. Suggested plan for a 'safe' access path through the existing quarry to Sannur Cave



Indicative diagram only. Not to be used to scale measurements .
Based on plan prepared by Cairo University Centre for Environmental Hazard Mitigation 2002

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