UMM JIRSAN: ARABIA'S LONGEST LAVA-TUBE SYSTEM

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Abstract
This system is located in Harrat Khaybar Lava Field, 130 km north of Medina in the Kingdom of Saudi Arabia. The system consists of three lava-tube passages separated by two collapses and measures 1481.2 m in length with a typical passage height of 8-12 m and a maximum passage width of 45 m. Sediment covering the cave floor was measured at 1.17 m deep.

Wolves, foxes, swifts and snakes inhabit or use the cave. Caches of human and animal bones are found in many places, lying on the surface of the floor sediment. Carbon dating revealed that various human skull parts are from 150 to 4040±30 years old and the oldest animal bone dates 2285±30 years BP.

Many basalt fragments of a size and shape useful for gouging or scraping were found inside the longest cave passage, about 180 m from the closest entrance. It is conjectured that older bones and tools might lie beneath the sediment and digging under the guidance of an archeologist is recommended.

Umm Jirsan is one of at least 40 strings of collapses appearing on the most accurate geological map of Harrat Khaybar. Some of these strings are over 15 km long, suggesting that other, much longer lava tubes may be found in this area.

1. Introduction

Al-Malabeh et al. (2006) reported that Al-Fahda Cave in Jordan had been surveyed with a total passage length of 923.5 meters. This was, at the time, the longest known surveyed cave on the Arabian Peninsula. In 2007, Umm Jirsan Lava-Tube System in Saudi Arabia was found to be 1481.2 meters long with features of possible archeological significance. Mapping and limited studies of Umm Jirsan System were carried out by members of the Saudi Geological Survey and the author during five days.

Fig. 1: Location of Harrat Khaybar Lava Field in Saudi Arabia

2. General Description

Umm Jirsan System is located near the center of Harrat Khaybar Lava Field (Fig. 1), which lies due north of Al Madinah (Medina) in western Saudi Arabia. These lavas have an area of approximately 12,000 square kilometers and are mildly alkaline with low Na and K content and include alkali olivine basalt (AOB), hawaiite, mugearite, benmoreite, trachyte and comendite. The age of Khaybar lavas range from ~5 million years old to historic (Roobol and Camp, 1991). The age of the lava flow in which Umm Jirsan is found has not been determined, but volcanologist M.J. Roobol suggested it may be three million years BP (Roobol, 2007).

A map of the Umm Jirsan System is shown in Figure 8. The main passages of the system extend east and west of Collapse 1, which measures 89 m long by 55 m wide with a depth of 13 m and which is shown in Figure 2. A breakdown slope on the south side of this collapse supports a narrow path from the surface to the floor. In many places along this path, the basalt has been polished, perhaps by the feet of human or animal visitors.

Fig. 2: Collapse 1, with a view of the entrance to the west passage.

The entrance to the east passage (shown in the enlarged segment of Fig. 8) measures 10 m high and 35 m wide. A shallow water channel can be seen along the north wall of the entrance room and mounds of rock-dove guano along the opposite side. Sediment covers the original floor of the cave. This was found to be 1.17 m deep at station 3, with the measurement taken in the center of the passage. North of station 4, much of the surface of the passage floor takes the form of mounds roughly 15-30 cm in diameter and varying in height. XRD analysis showed one of them to be composed principally of quartz, albite and kaolinite as well as nontronite, biotite, microcline and augite with traces of saponite, montmorillonite and hematite. A number of these mounds are shown in Figure 3.

Fig. 3: Mounds on the floor of the east passage.

Lava stalactites as well as gypsum and calcite formations are found in several parts of the passage. The maximum height of the passage is 12 m and the maximum width 45 m. The length of the passage is 948.6 m. An air temperature of 24° C was recorded at station 5 on May 18, 2007.

The west passage has only one entrance (shown in Figure 4) and measures 341 m in length with a maximum passage width of 45 m and maximum height of 12 m. Lava levees are prominent in this section of the system and the sediment mounds are notably lacking. Moist spots are found in both of the cave's long passages, with evidence of water flow particularly noticeable in the east passage. A third passage, 34 m long with a maximum of 20 m wide and 4 m high connects Collapse 2 to Collapse 3.

Fig. 4: A human figure provides scale in the entrance to the west passage.

3. Bones and Coprolites

Coprolites and guano indicate that wolves, foxes, hyenas, rock doves, bats, sheep or goats and swifts have inhabited the cave at some point in its history. Note that coprolites are indicated in the Figure 8 map by icons representing the animal which produced the coprolite. Swifts (possibly *Apus pallidus*) and bats (not identified) were seen in the west passage of the cave and a swift nest measuring 9 cm in diameter was found on the passage floor. Animal sounds thought to be wolf growls were noted in this same passage. Recently made fox and snake tracks were seen in the east passage.

Bones, presumably carried in by predators, were found throughout the cave but were particularly concentrated at the extreme western end of the system in the same place (the Wolf Den) where growls were heard. From among many bones lying on the surface, a human skull, two human skull-cap fragments (Fig. 5), one particularly large animal bone and one springy, curved stick were collected, removed from the cave and radio-carbon-dated. The results are shown in Table 1. One of the human skull fragments was dated at 4040±30 years BP and the still unidentified animal bone (Fig. 6) was found to be 2285±30 years old. Since these items were found lying on the surface of the sediment layer covering the original floor, it is speculated that still older human and animal remains might be found by excavations carried out by competent investigators.

Fig. 5: Fragments of two human skull caps found in the Wolf Den in the west passage.

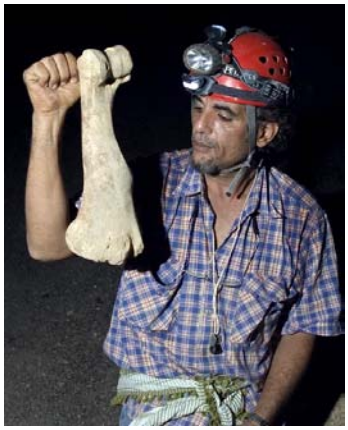

Fig. 6: This bone, over 2000 years old, is still awaiting identification.

Sample record index No.: 2334

Job number: NB-186?RMF-1/2007

No.	Sample name	Lab. No.	Age ^{14}C (BP)	Calibrated age range 68.2%	Calibrated age range 94.5%
1	OO.STK.1	GdA-1155	300±25	1522AD (50.0%) 1574AD 1627AD (18.2%) 1646AD	1495AD (69.9%) 1602AD 1616AD (25.5%) 1651AD
2	OO.SKU.1	GdA-1156	150±30	1670AD (12.8%) 1695AD 1727AD (29.3%) 1779AD 1799AD (7.9%) 1813AD 1854AD (4.3%) 1867AD 1918AD (13.9%) 1943AD	1667AD (16.3%) 1709AD 1718AD (31.5%) 1784AD 1796AD (30.3%) 1890AD 1910AD (17.3%) 1951AD
3	OO.SKU.2	GdA-1157	4040±30	2618BC (5.6%) 2609BC 2598BC (1.4%) 2595BC 2583BC (19.3%) 2560BC 2537BC (41.8%) 2491BC	2832BC (2.2%) 2821BC 2631BC (93.2%) 2474BC
4	OO.SKU.3	GdA-1158	3410±30	1749BC (68.2%) 1668BC	1867BC (2.8%) 1848BC 1774BC (92.6%) 1624BC
5	OO.BON.1	GdA-1159	2285±30	399BC (56.9%) 360BC 274BC (11.3%) 260BC	404BC (60.7%) 352BC 295BC (33.0%) 228BC 221BC (1.7%) 211BC

Table 1: Radio-carbon dates for items collected in the Wolf Den, courtesy of Radiocarbon Laboratory, Gliwice, Poland.

4. Tool-Shaped Basalt Fragments

At station 5 in the east passage, 180 m east of Entrance Collapse 1, up to 20 fragments of basalt were found lying on the surface within one meter of one another. These items either had a point at one end or a sharp edge on at least one side. Most of them ranged in length from 7 to 13 cm and were of a shape which fits comfortably in the human hand. A typical sample is shown in Figure 7. So far, no sign of chipping has been detected in these items, but the concentration of so many fragments usable as tools in one small area, raises the question of whether primitive people without tool-chipping skills may have gathered usefully shaped fragments of basalt (the most common rock in the area) for use as simple tools, perhaps for removing meat from bones. It should be noted that thin layers of basalt naturally spall off the cave walls in Umm Jirsan. Breaking these plates may have provided cave visitors with a source of fragments from which to select simple tools. No search for similar sites has yet been undertaken in the Umm Jirsan System, nor has digging been undertaken.

Fig. 7: One of many pointed or sharp-edged basalt fragments found near station 5.

5. Stone Walls

The remains of a stone wall bisect the short passage between Collapses 2 and 3 at its narrowest point. What appear to be the foundations of a rectangular stone building were found at the east end of the east passage. It should also be noted that the breakdown slope on the south side of Collapse 1 may have been reshaped by human hands in order to accommodate the footpath. None of these things have been investigated by experts.

5. Conclusions and Suggestions

Umm Jirsan appears to be significant not only because of its size but also for its archeological potential. Although the cave was mapped and a few studies were carried out, much remains to be done: the age of the cave has yet to be determined; archeologists have yet to visit the cave; investigations of what lies beneath the surface of the sediment should be carried out; biologists, micro-biologists and mineralogists ought to do a preliminary study. The few such studies undertaken in other lava caves in Saudi Arabia have resulted in the discovery of artifacts, bones and a human skull (Pint, 2006) and cave minerals rare enough for Saudi Arabia's Ghar Al Hibashi to be included among the world's top ten volcanic caves for hosted minerals. (Forti et al., 2004).

In addition, a search for other lava caves in the area should be undertaken. Roobol and Camp (1991) show at least 40 strings of collapses on Harrat Khaybar, some of them up to 15 kilometers long. The existence of intact lava tubes between the Umm Jirsan collapses suggests that other, longer volcanic cave systems may be found in the same lava field.

At present, no Saudi organization has plans to continue vulcanospeleological studies in Harrat Khaybar, but proposals from non-Saudi entities for organizing and financing such studies might be accepted by Saudi universities or the Saudi Geological Survey.

6. Acknowledgements

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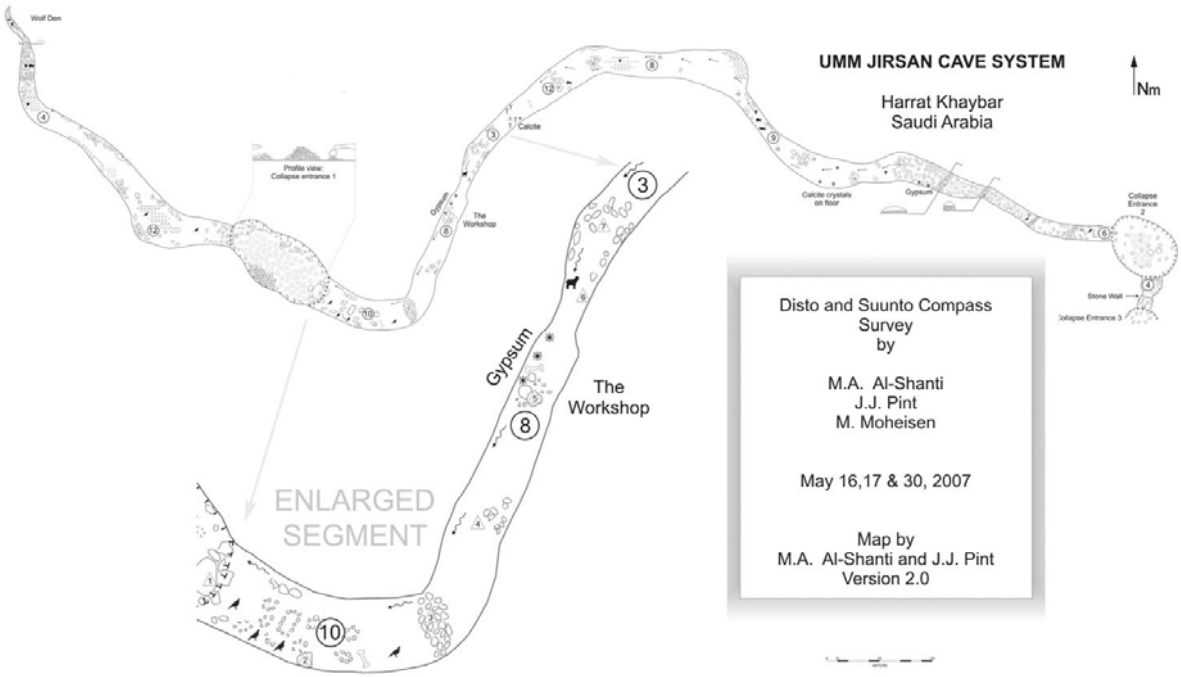

Fig. 8: Map of Umm Jirsan Lava-Tube System with inset showing a portion of the east passage.

7. References

AL-MALABEH, A., FREHAT, M., HENSCHEL, H., KEMPE, S. (2008): Al-Fahda Cave (Jordan): The Longest Lava Cave Yet Reported from the Arabian Plate. *Proceedings of the X, XI, and XII International Symposia on Vulcanospeleology,* AMCS, p. 201-208.

FORTI, P., GALLI, E., ROSSI, A., PINT, J., PINT S (2004): Ghar Al Hibashi Lava Tube: The Richest Site in Saudi Arabia for Cave Minerals. *Acta Carsologica* **33**, 190-205.

PINT, J. (2006): Vulcanospeleology in Saudi Arabia. *Acta Carsologica* **35**, 107-119

ROOBOL, M.J. (2007): personal communication to author.

ROOBOL, M.J. AND CAMP, V.E. (1991): *Geologic map of the Cenozoic lava field of Harrats Khaybar, Ithnayn, and Kura, Kingdom of Saudi Arabia.* Saudi Directorate General of Mineral Resources Geoscience Map GM-131, with explanatory text, 60 p.