Speleothems in Gneissic Caves of Sri Lanka

Weliange W.S[1] & Pathmakumara Jayasingha[2]

[1]*Postgraduate Institute of Archaeology, 407, Bauddhaloka Mawatha, Colombo 7, Sri Lanka.*
[2]*Research Laboratory, Central Cultural Fund, No 11, Colombo 07, Sri Lanka*

Corresponding author; wasanthaweliange@yahoo.co.uk

Abstract

Speleothems are mineral deposits found in caves and karsts, which are classified and named, based on the type of formation, mineral constituents and morphology. Limestone caves are famous since its speleothems are made up of various carbonate compounds. Most of the caves of Sri Lanka have been formed in high grade silicate rocks commonly known as Gneisses. Chemical weathering of silicate rocks are different. Therefore speleothems in gneissic caves are unique. Under the auspicious of the Post Graduate Institute of Archaeology, about 10 gneissic caves located in Rathnapura, Kuruwita, Ruwanwella and Mahiyanganaya areas in Sri Lanka were investigated. Discovered speleothems were mainly stalactites, stalagmites, and flowstone and in addition curtains, ridges and rim pools like structures were also recorded. Comparative analyses showed that the caves located in wet zone are more prone to form speleothems than the dry zone caves. In the dry-zone of Mahiyanganaya, Keragoda Galge Cave (07°26'.43.53" N; 081°05'31.5"E) showed no spelothems of any kind. Most of the stalactites recorded in studied wet zone caves have similarities such as conical and bubble shapes with reddish brown to black tones. Spelothems were always found in clusters on a crust of about 1-2cm thick. Flowstones of studied wet zone caves were white, yellowish, and black in color. Stalagmites were not taller than 5 cm. Speleothems are collected by visitors as souvenirs therefore education and protection are important. Chemical compositions of the gneissic spelothems are not yet known and further studies are required.

Keywords; Sri Lanka, High Grade Silicate rocks, Caves, Gneissic speleothems

Introduction

Recognition of the importance of speleothems (stalagmites, stalactites, and flowstones) as an archive for paleo-environmental changes has increased over the last three decades since the early studies of Hendy and co-workers on the isotopic composition of cave carbonates (Hendy and Wilson, 1968; Hendy, 1971). Speleothems provide detailed information on climate variations on annual to millennium time scales (Burns et al 1998; 2001; 2002; Fleitmann et al 2003a; 2003b; 2004; Neff et al, 2001). It has found that speleothem calcite mainly reflects three parameters such as amount of precipitation, the source of moisture, and evaporation at a particular time (Burns et al 1998; 2001; 2002; Fleitmann et al 2003a; b; 2004). Speleothems are particularly well suited for dating through the application of U-series Thermal Ionization Mass Spectrometry back to 350 ka (Li et al., 1989), as they generally behave as closed systems since deposition.

The method of speleothem pollen analysis was pioneered in Belgium (Bastin, 1978). It has been demonstrated that well preserved pollen may be successfully extracted from speleothems in sufficient quantities to allow palaeo-environmental reconstruction (Lauritzen et al., 1990).

Some speleothems, e.g. the cobweb stalactites (Aubrecht et al., 2008) represent mostly inorganic precipitates, encrusting various structures, such as spider threads. There are also large inorganically precipitated stalactites and flowstones.

Microbial origin of the siliceous speleothems was recognized by previous workers (Forti, 1994; Lévillé et al., 2000; Willems et al., 2002; Urbani et al., 2005). Phototrophic organisms – diatomaceans – were also found to contribute to formation of similar speleothems in Japan and USA (Kashima et al, 1987). Presence of phototrophic organisms associated with speleothems has been reported by various authors (Vincent and Roy 1993., Kylin, 1937., Golubic, 1976., Whitton, 1987., Friedman, 1955).

Cave science is new to Sri Lanka and preliminary investigations about speleothems were done in several caves in wet and dry zone of Sri Lanka. All studied caves were formed in gneissic rock formations and therefore speleothems are not such attractive like in limestone caves. This is the first attempt to describe speleothems of Sri Lanka.

Area of the study

For the study different types of caves were selected and most caves were located in wet zone of the country while only two of them were located in intermediate zone in central highland. Rathnapura and Ruwanwella cave systems are characterized by high rain fall during most of the time of year from monsoons and intermonsoons. The annual rain fall ranges between 2500-3000mm and temperature varies from 25-30c. Both of the study sites of wet zone are characterized by mountain ranges. General trend of these mountains are in north-south direction. The area is also distinguished by tropical natural vegetations, cultivations and home gardens. The area around Dambana belongs to intermediate zone where rain fall and temperature show intermediate characteristics, but this area mostly experiences dry climate. In contrast Dambana is situated in low land area where small hill clusters and isolated hills are dominant. The vegetation is specified with dry zone forests, home gardens and chena cultivations.

Table 3. List of names, district, geographical position and the height above average mean sea level in feet.

Name of the Cave	Position	zone	amsl (ft)
Rathanapura District			
Batathota Crack 1	06°49'49.71"N,080°22' 26.33" E	Wet	798
Batathota Crack 2	06°49'49.71"N,080°22' 26.33" E	Wet	790
Sthreepura Tall triangle Cave	06°49'54.6" N, 080°22' 27.8" E	Wet	1059
Sthreepura Guhawa Cave	06°49'54.6" N, 080°22' 27.8" E	Wet	1059
Divaguhawa Lena Cave in Kuruvita	06°49'50.1" N, 080°22' 23.8" E	Wet	835
Vavul Guhava Cave in Kosgala	06°43'31.5" N, 080°20' 34.6" E	Wet	486
Pelpola Lena Cave in Kehelowitagama	06°41'26.4" N, 080°19' 22.1" E	Wet	340
Kegalle district			
River-cave in Nikawalamulla	07°02'54.3" N, 080°14' 38.9" E	Wet	476 ft
Hakurugala Raja Maha Viharaya Cave	07°01'54.6" N, 080°14' 36.0" E	Wet	125 ft
Diya-Pihilla Guhawa Cave	07°01'53.4" N, 080°14' 36.3" E	Wet	304 ft
Crack-Cave in Nikawalamulla	07°01'57.9" N, 080°14' 43.3" E	Wet	496 ft
Yahal Lena Cave in Nikawalamulla	07°02'04.3" N, 080°14' 38.9" E	Wet	-
Badulla District			
Keragoda Galge Cave in Dambana	07°26'. 43.53" N, 081°05' 31.5" E	Intermediate	467 ft
Wiweka Cave Dambana	07°24'. 53.40" N, 081°06' 48.30" E	Intermediate	436 ft
Cave of Velaudan	08°01'. 01.30" N, 081°21' 53.40" E	Dry	133 ft

Method of documentation

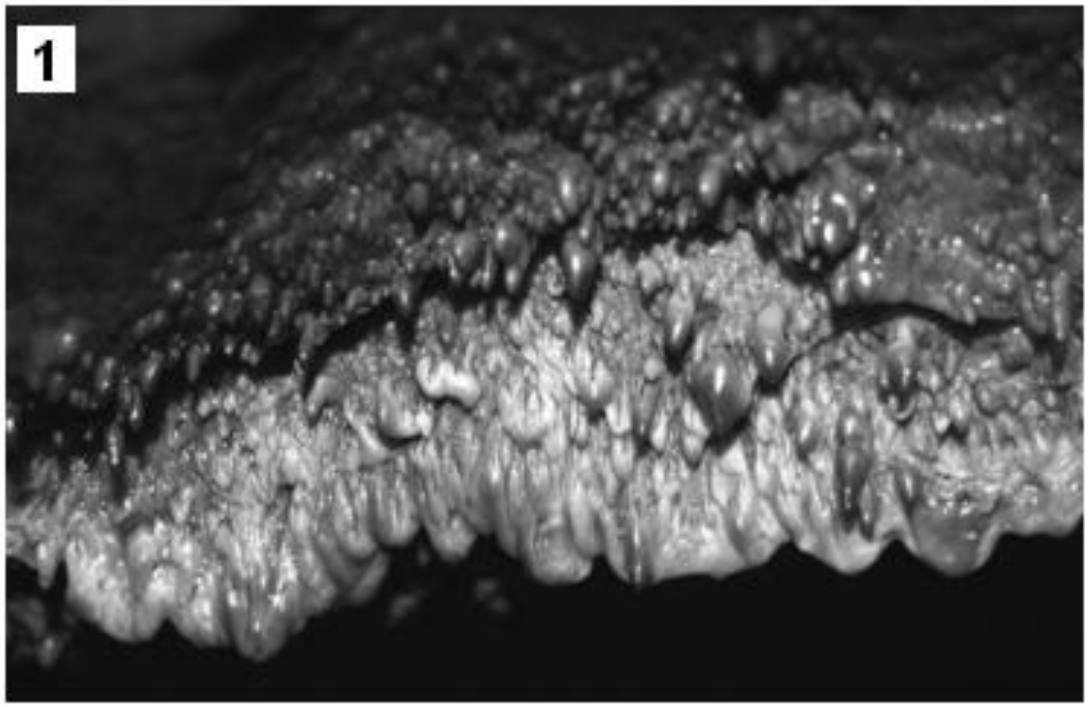
Cave interior were thoroughly investigated with headlamps and hand held torches. All speleothems and other structures were photographed. An attempt was made to describe the colors and its variations, morphological features and also to describe the location of deposition etc.

Among all the caves investigated hollow caves such as Sthreepura and Kosgala Wavul Lena cave shows the great diversity and abundance of speleothems. These hollow caves had stalagmites, stalactites and flowstones but in inconspicuous scale unless you watch them carefully with bright torch lights. The colors of the speleothems were ranged from reddish-dark brown, yellowish-orange, grey shades, and black. Plate 1 to 12 shows some of the speleothems found in the studied caves.

Rock shelters situated in the wetzone of the country such as Divaguhawa Lena Cave in Kuruvita, Hakurugala Raja Maha Viharaya Cave in Nikawalamulla and Crack-Cave in Nikawalamulla had few with less abundance. In the intermediate zone caves such as Keragoda Galge Cave in Dambana and Wiweka Cave in Dambana no such speleothems were found during our examinations. But it is also possible further exploration could find some of them in difficult to access places.

Conclusions

For the first time speleothems of gneissic caves were recorded in Sri Lanka with photographic illustrations. Although small in scale these speleothems could be used in reconstructing the paleo-climatic events if properly studied. Therefore we hope to study the spelothems in details in the future. Studying chemical composition would be an essential part in studying speleothems at the very step.



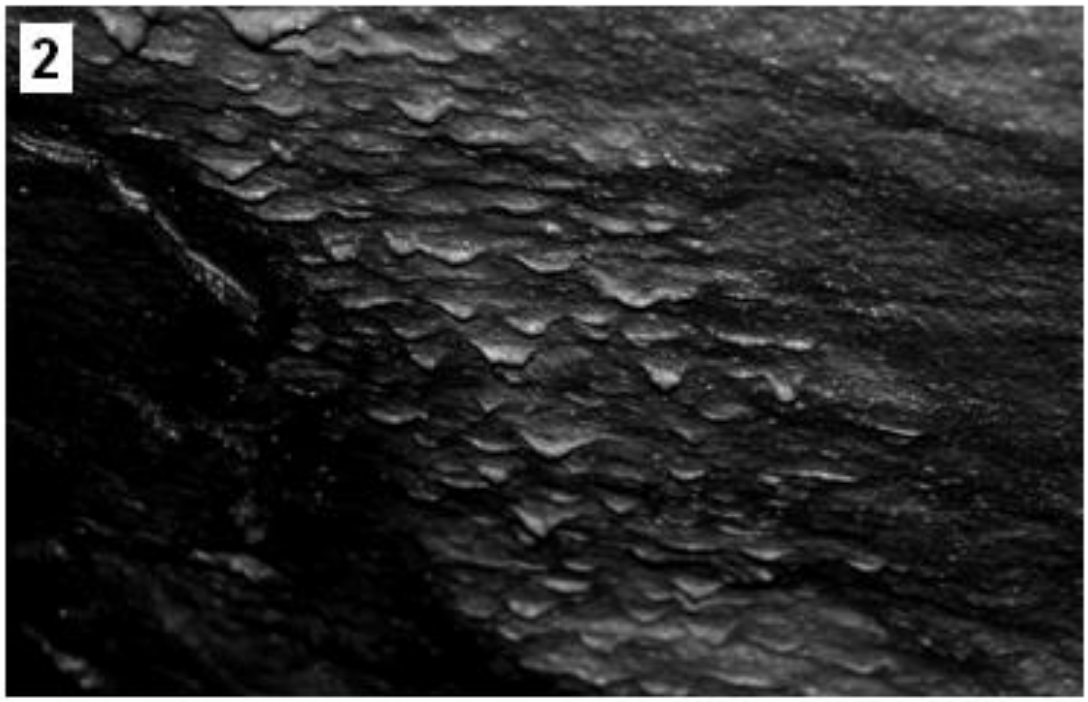
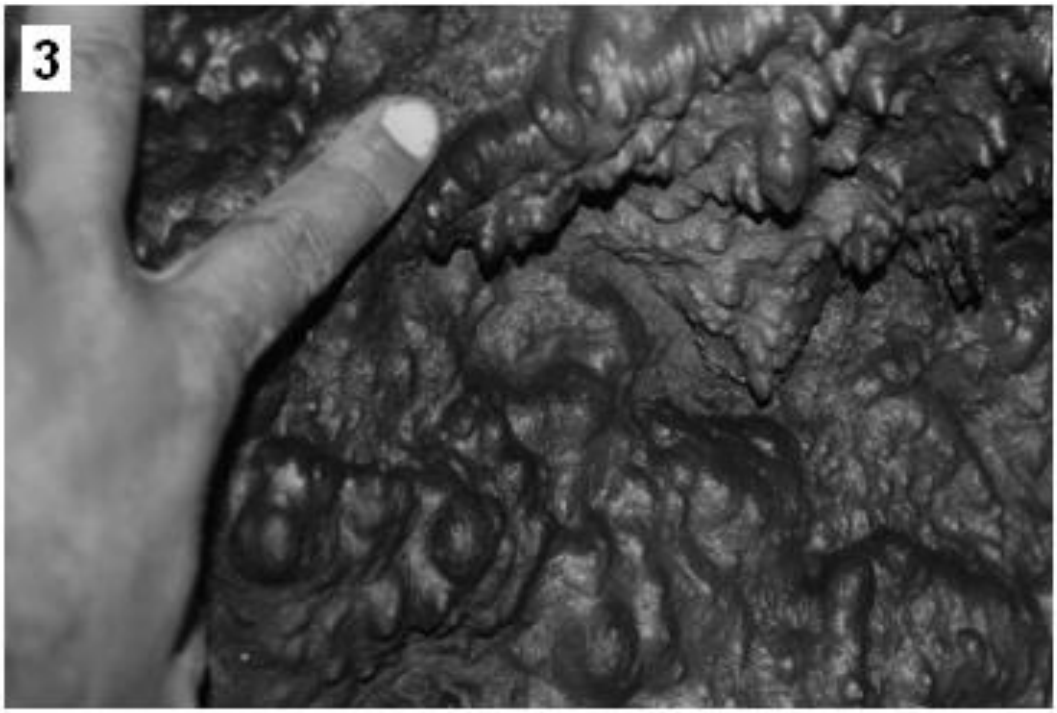


Plate 1. About 3 feet long and 3-4 inches at the tallest place, yellow to reddish brown deposition found in the roof of the Kosgala Wawul Lena Cave in Kehelowitagama.

Plate 2. about 3 square feet area of the slanted roof was covered with this flowstone type deposition at the Kosgala Wawul Lena Cave in Kehelowitagama.



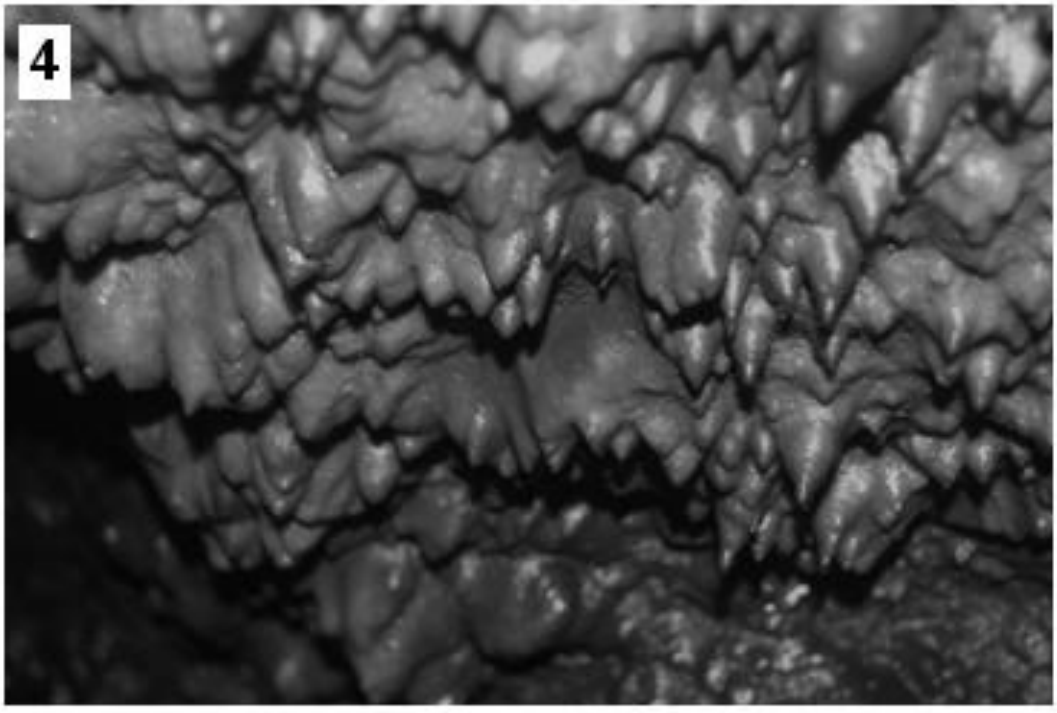


Plate 3. About 2-3 square feet area of the roof of the Kosgala Wawul Lena Cave in Kehelowitagama was found to be deposited with this type of speleothems. Color pattern dark brown.

Plate 4. A closer photograph taken from another angle of the Figure 3.

Weliange W.S. & Pathmakumara Jayasinghe. 2010. (Accepted) *Gneissic speleotherms in Sri Lanka.* National Archaeological Symposium 2010.

Plate 5. A reddish brown deposition inside Kosgala Wawul Lena Cave in Kehelowitagama.

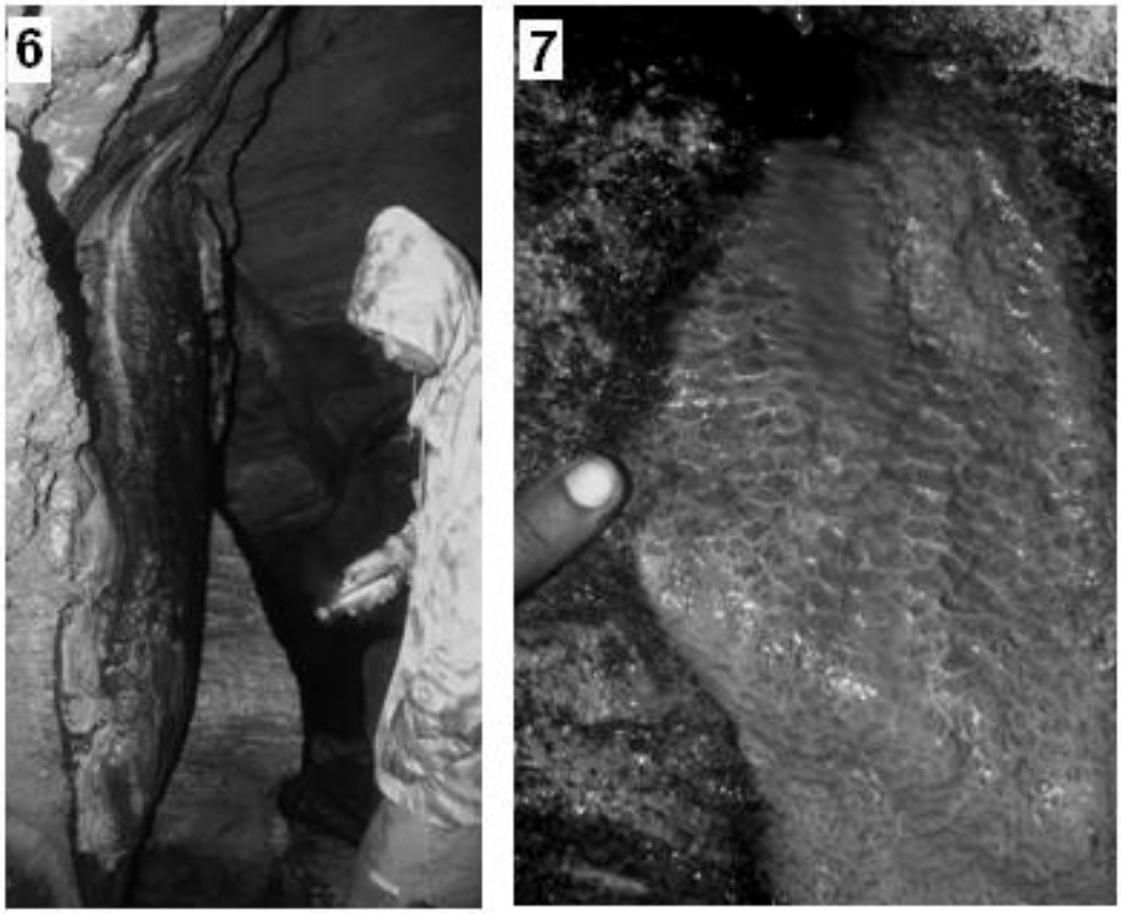


Plate 6. About 5 feet tall and mainly black color flowstone found in Sthreepura Lena Cave in Kuruwita.

Plate 7. Orange color flowstone with rim pool like structures found in the Sthreepura Lena Cave in Kuruwita.

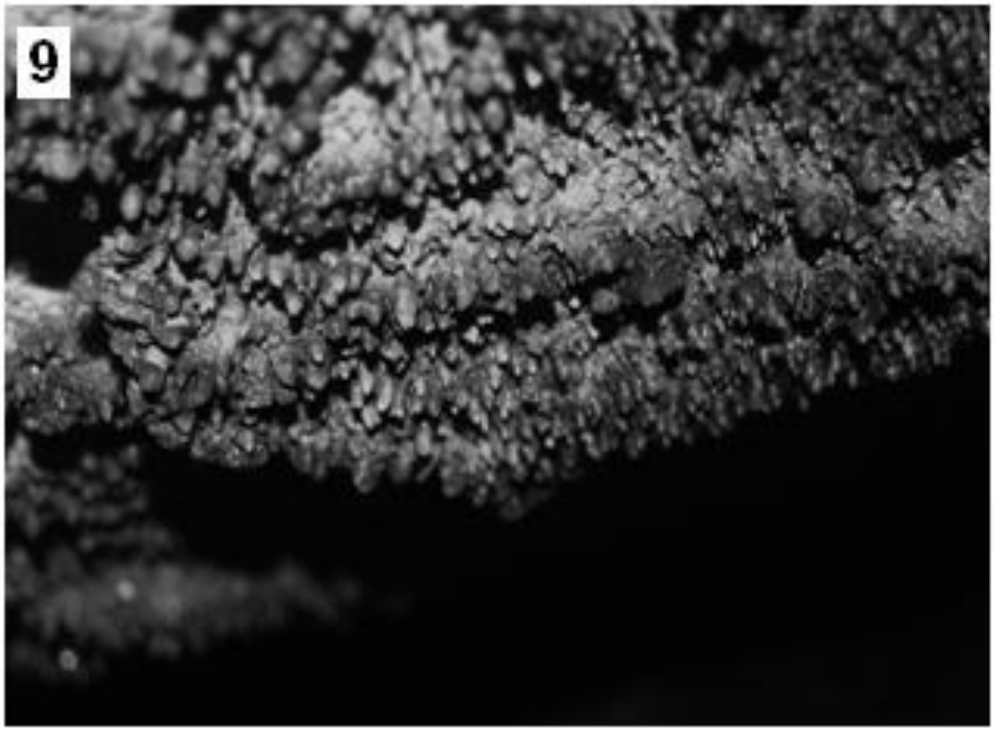


Plate 8. Dark brown stalagmites found in the roof of the Sthreepura Lena Cave in Kuruwita.

Plate 9. Grayish color coral shape stalagmites found in the Sthreepura Lena Cave in Kuruwita.

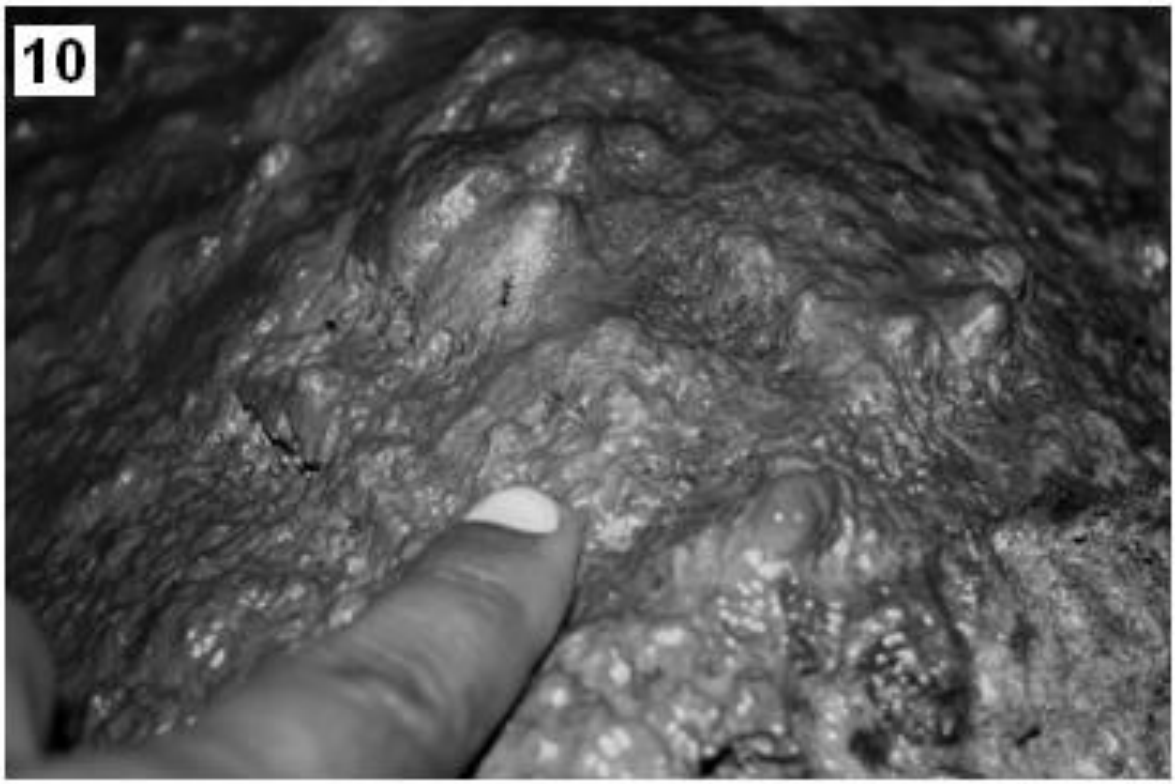


Plate 10. A stalagmite found in the Sthreepura Lena Cave in Kuruwita.

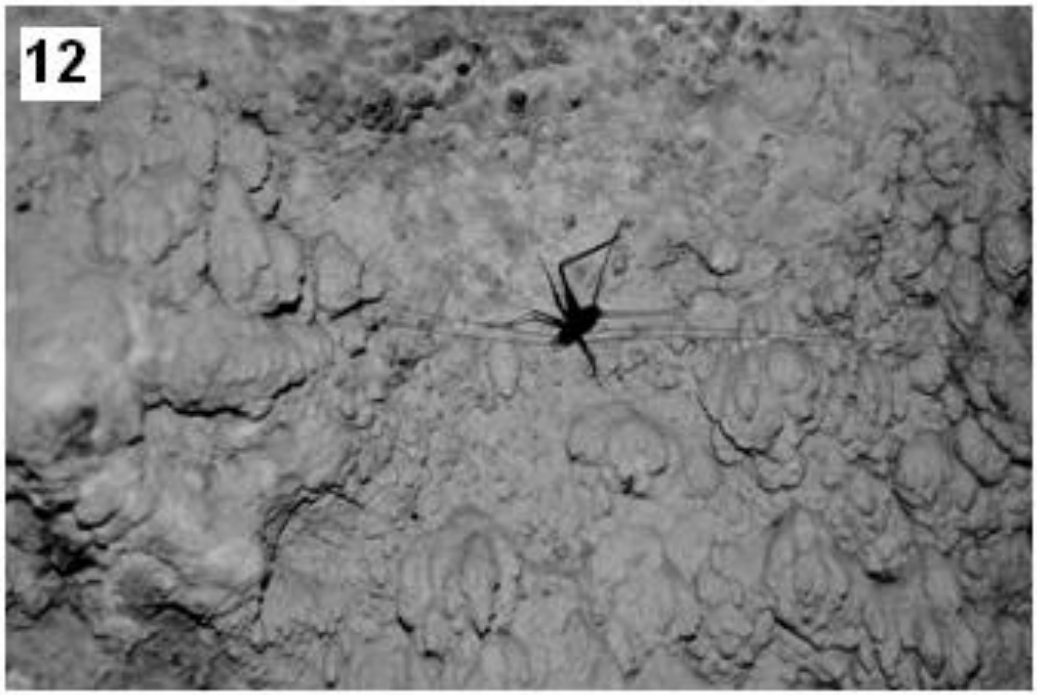


Plate 11. These yellow-brown depositions found in the Yahal Lena Cave in Nikawalamulla look like hanging flower buds.

Plate 12. The entire roof of the Yahal Lena Cave in Nikawalamulla is filled with this type of depositions. A cave cricket is sitting on that.

Acknowledgement

The authors are thankful to Professor Nimal De Silva; the Director of the Postgraduate Institute of Archaeology for providing funds and the villagers who guided us into the dark spaces beneath the surfaces. Professor Gamini Adikari provided overall supervision for the study. Professor Raj Somadewa is acknowledged for providing us equipment and comments. The administration staff of the PGIAR helped us for smoothed functioning of the project.

References

Aubrecht, R., Brewer-Carías, Ch., Šmída, B., Audy, M. & Kováčik, Ľ., 2008: Anatomy of biologically mediated opal speleothems in the world's largest sandstone cave Cueva Charles Brewer, Chimantá Plateau, Venezuela. – Sed. Geol., 203, 3-4, 181-195.

Bastin, B, 1978. Annales de la Societe Geologique de Belgique, 101, 13-19. Burney DA & Burney L, *New Phytologist*, 124, 523-535, (1993).

Burns, S.J., Fleitmann, D., Matter, A. Neff, U. and Mangini, A. (2001). Speleothem evidence from Oman for continental pluvial events during interglacial periods, Geology, 29: 623-626.

Burns, S.J., Fleitmann, D., Mudelsee, M., Neff, U., Matter, A. and A. Mangini (2002). A 780-year annually resolved record of Indian Ocean monsoon precipitation from a speleothem from south Oman, Journal of Geophysical Research-Atmospheres, 107 (D20), art. no.-4434.

Burns, S.J., Matter, A., Norbert, F. and Mangini, A. (1998). Speleothem-based paleoclimate record from northern Oman, Geology, 26: 499-502.

Fleitmann, D., Burns, S. J., Neff, U., Mudelsee, M., Mangini, A., Matter, A. (2004). Paleoclimatic interpretation of high-resolution oxygen isotope profiles derived from annually laminated speleothems from Southern Oman. Quat. Sci. Rev., (in press).

Fleitmann, D., Burns, S.J., Mudelsee, M., Neff, U., Kramers, J., Mangini, A. and Matter, A. (2003a). Holocene forcing of the Indian monsoon recorded in a stalagmite from Southern Oman, Science, 300, 1737-1739.

Fleitmann, D., Burns, S.J., Neff, U. Mangini, A. and Matter, A. (2003b). Changing moisture sources over the last 330,000 years in Northern Oman from fluid-inclusion evidence in speleothems, Quat. Res., 60: 223-232.

Forti, P., 1994: Los depositos quimicos de la Sima Aonda Superior y de otras cavidades del Auyán-Tepui. Venezuela. Bol. SVE, 28, 1-4.

Friedman, I., 1955: *Geitleria calcarea* n.gen. et n.sp., a new atmophytic lime-encrusting bluegreen alga. – Bot. Not., 108, 439-445.

Golubic, S., 1976: Organisms that build stromatolites. In: Walter, M.R. (ed.): Stromatolites. Developments in Sedimentology 20, – Elsevier, 113-126.

Hendy, C.H. (1971). The isotopic geochemistry of speleothems, I: The calculation of the effects of different modes of formation on the isotopic composition of speleothems and their applicability as palaeoclimatic indicators. Geochimica et Cosmochimica Acta, 35: 801-824.

Hendy, C.H. and Wilson, A.T. (1968). Palaeoclimatic data from speleothems. Nature, 219: 48-51.

Kashima, N., Teruo, I. & Kinoshita, N., 1987: Diatom, contributors of coralloid speleothems, from Togawa-Sakaidani-do Cave in Miyasaaki prefecture, Central Kyushu. – Japan Int. J. Spel., 16, 95– 100.

Kylin, H., 1937: Über die Farbstoffe und die Farbe der Cyanophyceen. – K. Fysiogr. Sällsk. Lund, Förh., 7, 131-158.

Lauritzen SE, Løvlie R, Moe D & Østbye E, 1990. *Quaternary Research*, 34, 306-316.

Léveillé, R.J., Fyfe, W.S. & Longstaffe, F.J., 2000: Geomicrobiology of carbonate–silicate microbialites from Hawaiian basaltic sea caves. – Chem. Geol., 169, 339-355.

Li W-X., Lundberg J, Dickin AP, Ford DC, Schwarcz HP, McNutt R & Williams D, 1989. *Nature*, 339, 534-536.

Urbani, F., Compère, Ph. & Willems, L., 2005: Opal-a speleothems of Wei-Assipu-Tepui, Roraima Province, Brazil. – Bol. SVE, 39, 21-26.

Vincent, W.F. & Roy, S., 1993: Solar ultraviolet-B radiation and aquatic primary production: damage, protection, and recovery. – Envir. Rev., 1, 1-12.

Whitton, B.A. (1987): The biology of *Rivulariaceae*. In: Fay, P. & van Baalen, C. (eds.): The cyanobacteria – a comparative review. – Elsevier, 513-534.

Willems, L., Compère, Ph., Hatert, F., Puclet, A., Vicat, J.P., Ek, C. & Boulvain, F. (2002): Karst in granitic rocks, South Cameron: cave genesis and silica and taranakite speleothems. – Terra Nova, 14, 355-362.