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A METEORITE FALL IN THE ANURADHAPURA DISTRICT OF SRI LANKA: EVIDENCE OF PUTATIVE BIOLOGICAL STRUCTURES AND THE RELEVANCE TO PANSPERMIA

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ABSTRACT

We show that a recent fall of meteorites in Sri Lanka on 8 December 2013 following a witnessed fireball contains biological structures including acritarchs and diatom fossil fragments that are indigenous to the stones. SEM images together with EDX analysis show the structures are carbonaceous, and similar to organic structures found in stratospheric dust and meteorites. X ray diffraction analysis in powdered samples show evidence of very little or no quartz, and unidentified XRD peaks point to the presence of non-terrestrial mineral phases. These discoveries are consistent with the hypothesis of cometary panspermia.

Keywords: Anuradhapura Meteorites, Microfossils, Diatoms, Acritarchs, Comets, Panspermia

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1. Introduction

On the 8th December 2013, close to the peak of the annual Taurid meteor shower, fragments of meteoritic stones were recovered from a newly planted paddy field in Thambuttegama, in the district of Anuradhapura in Sri Lanka. This latest shower of meteorites occurred almost exactly one year after the December 2012 fall at Aralaganwila (Polonnaruwa) about which extensive reports have been published in (Wickramasinghe et al, 2013a,b; Wallis, et al, 2013; Hoover et al, 2013). The geographical proximity of the two locations may at first sight give cause for concern, but natural events if they are well attested and documented, must merit investigation and inquiry in their own right.

While it is true that very few meteor showers have been reported to result in direct recovery of meteorites, this may well depend on both geographical latitude and the presence or otherwise of occasional large bolides torn off from a parent comet. The location on the Earth as well as peculiar atmospheric conditions could also play a role. The stratosphere is nearly twice the height near the equator than in temperate latitudes, and the meteorology associated with an island like Sri Lanka close to the equator could well offer better scope for the safe transit of small porous cometary bolides.

The events of 8 December 2013 are well documented by numerous eye witness accounts as well as in local media reports. At 20.30 hrs local time people in the vicinity of Thambuttegama (Anuradhapura) saw meteors above the NE horizon and one of these appeared to break up into a twinkling mass like a firework descending to the ground. The radiant of the Taurids at this time can be shown to fit the hypothesis that this was indeed a bolide derived from the Taurid meteor stream. At sunrise on the following day (9th December 2013) farmers found their newly planted paddy fields splattered with strange-looking stones, some appearing to be burnt. There were also reports of strong aromatic odours that persisted in the area for several hours, consistent with evaporation of volatile organics. Fig 1 shows that location of the site of the fall on a map of Sri Lanka as well as a photograph taken by a newspaper reporter who arrived at the site.

Fig. 1 Location of Thambuttegama on the map (yellow star), and a picture of farmers in the field picking meteorite fragments (hereinafter called the Anuradhapura meteorites).

Figure 2 shows a few of the pieces sent to us for examination.

Fig 2 Sample of Anuradhapura meteorites

2. SEM examination of the Anuradhapura meteorites

On inspection the stones are found to be porous with a general appearance very similar to the Polonnaruwa meteorites of a year ago. Our working hypothesis is that they both emanated from debris of Encke's comet which forms the Taurid meteor stream. These stones, which we shall call the Anuradhapura meteorites, were examined at SLINTEC using a Hitachi SU6600 Analytical Variable Pressure FE-SEM. Hitachi SU 6600 is a versatile SEM allowing observation of a wide range of materials at high resolution. It utilizes advanced Variable Pressure (VP) technology and an improved Schottky field emission electron source that provides exceptional imaging characteristics and high probe current with great stability. Interior samples of the meteorite were mounted on aluminum stubs and sputter-coated with gold before introducing into the chamber.

A wide range of putative biological structures were discovered, including remnants of fossil diatoms, acritarchs as well as cyanobacterial filaments. These are very similar to structures found in the Murchison and Orguel meteorites (Rozanov and Hoover, 2013). Many of the biological structures found in the Anuradhapura stones bore strong similarities to those reported in the Polonnaruwa stones (Hoover et al, 2013, Wickramasinghe et al, 2012). Spot EDX analysis of the putative biological structures showed a deficit of nitrogen which is supportive of our hypothesis.

Figures 3 shows a sample of the structures that were found, many being deeply interwoven and intertwined into the rock matrix, thus showing they are not contaminants. The spherical and oval shaped structures resemble objects which were identified as acritarchs both in stratospheric dust and in meteorites (Harris et al, 2002; Rozanov and Hoover, 2013). Other

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carbonaceous structures include what appear to be diatom frustules and meshes as well as cilia. A more complete catalogue of the structures we found is being currently compiled (Damayanthi et al, in preparation).

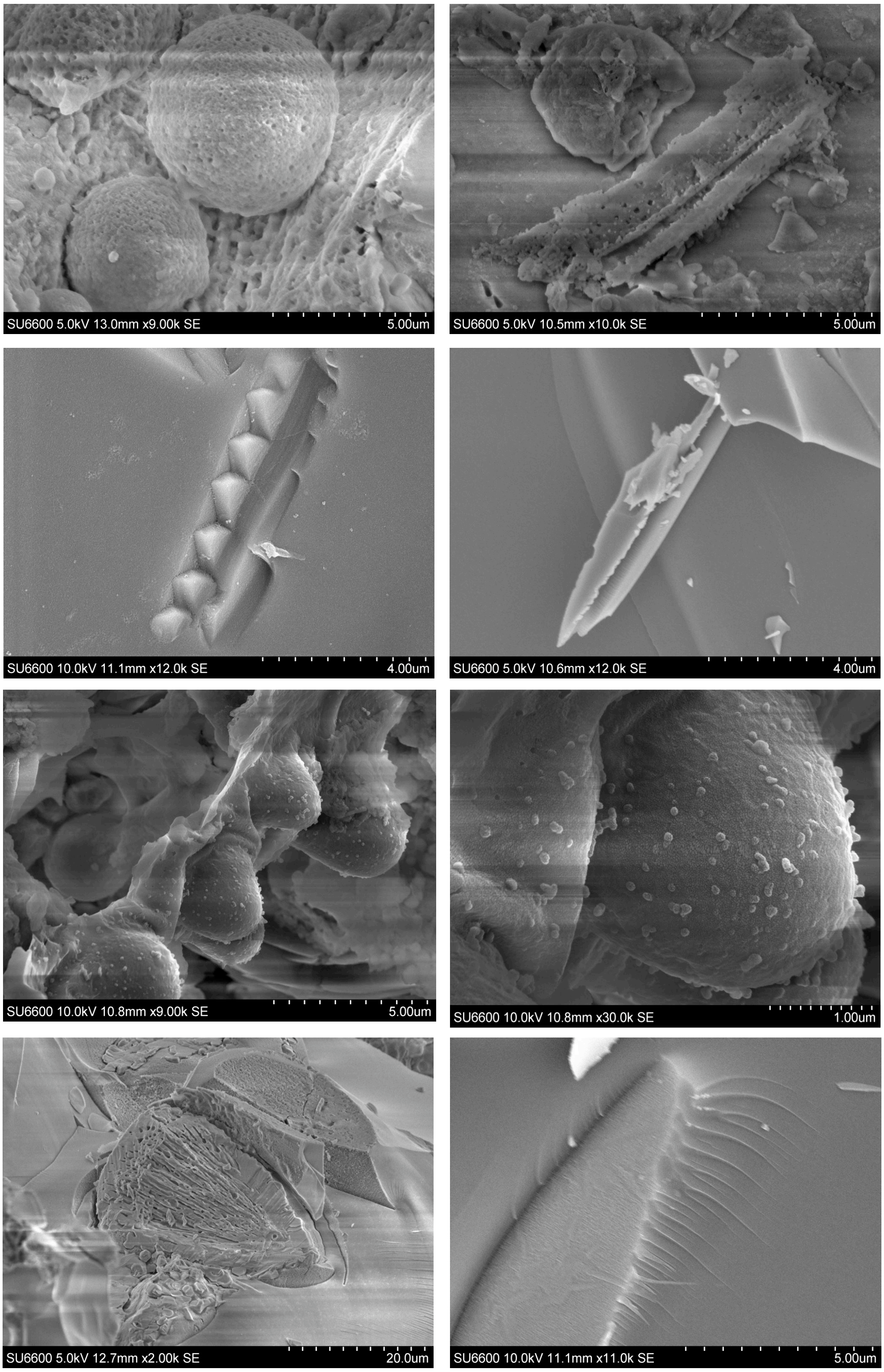

Fig 3: SEM images for interior sites of meteorite sample showing complex biological structures.

Figure 4 shows the EDX analysis of the structure on the bottom right frame of Fig. 3 which demonstrates clearly the carbonised nature of the biological fossil.

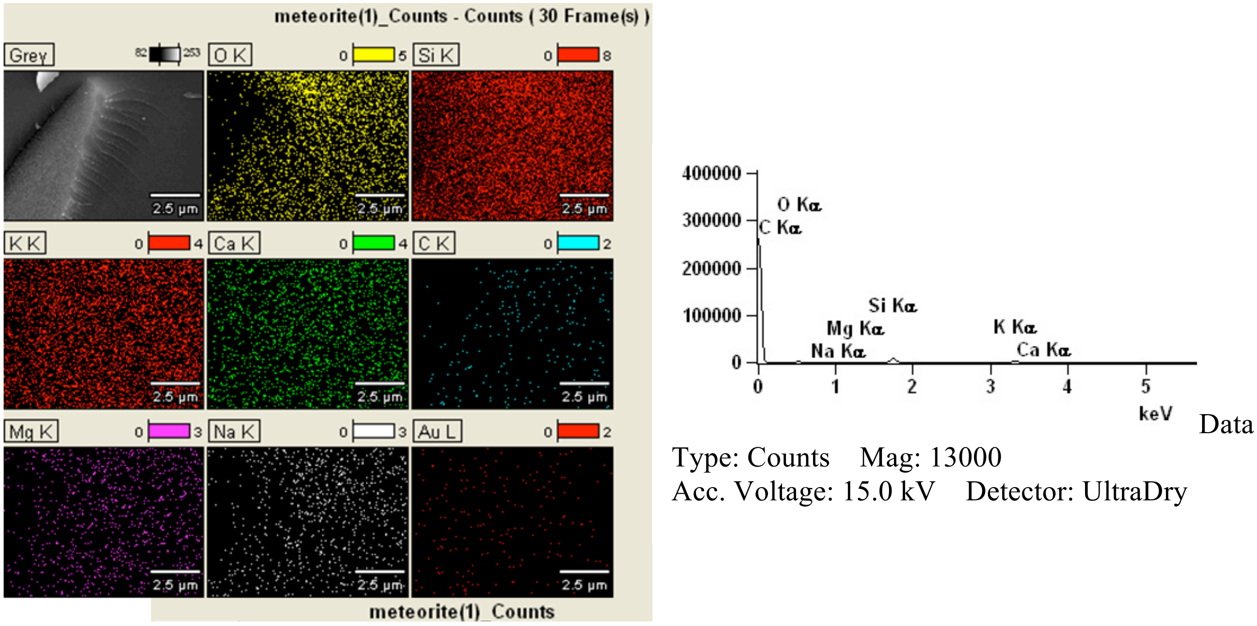

Fig.4: The EDX spectral imaging of the Anuradhapura meteorite

The Anuradhapura meteorites (like the Polonnaruwa meteorites) do not resemble any terrestrial stone that could have lain anywhere near the paddy field. Nor do they fit to any category of the presently classified carbonaceous meteorites. EDX of regions lying well clear of the putative fossils show the profile represented by the counts shown in Table 1:

Table 1: EDX counts of regions of the meteorite lying clear of putative carbonized fossils

Element Line	Net Counts	Net Counts Error	Weight %	Weight % Error	Atom %
C K	713	+/- 70	7.88	+/- 0.39	14.05
O K	9980	+/- 210	34.05	+/- 0.36	45.58
Na K	1036	+/- 180	1.20	+/- 0.10	1.12
Mg K	1167	+/- 226	0.72	+/- 0.07	0.63
Si K	64877	+/- 616	36.90	+/- 0.18	28.14
Si L	0	+/- 26	---	---	---
K K	15058	+/- 466	14.25	+/- 0.22	7.81
K L	0	+/- 124	---	---	---
Ca K	4372	+/- 374	5.00	+/- 0.21	2.67
Ca L	0	+/- 54	---	---	---
Total			100.00		100.00

A dominance of silicon and oxygen is seen, which can be understood on the basis of the high cosmic abundance of silicon which may be reflected in some cometary bodies (Hoyle and Wickramasinghe, 2000). For higher atomic weight elements e.g. iridium, EDX counts do not yield any useful information.

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3. X-ray Diffraction Studies

To determine the crystallographic configurations of the elements we proceed with X-ray diffraction analysis of the samples. The sample was centrifuged in distilled water to remove loose contaminants, dried and then crushed to powder form for XRD analysis. X-ray diffraction was carried out using Bruker D8 Focus Powder X-ray Diffractometer with Cu K α radiation at 40kV and 40mA, between 3 and 80 ° 2θ and, the result of which is shown in Fig. 5 and Fig. 6.

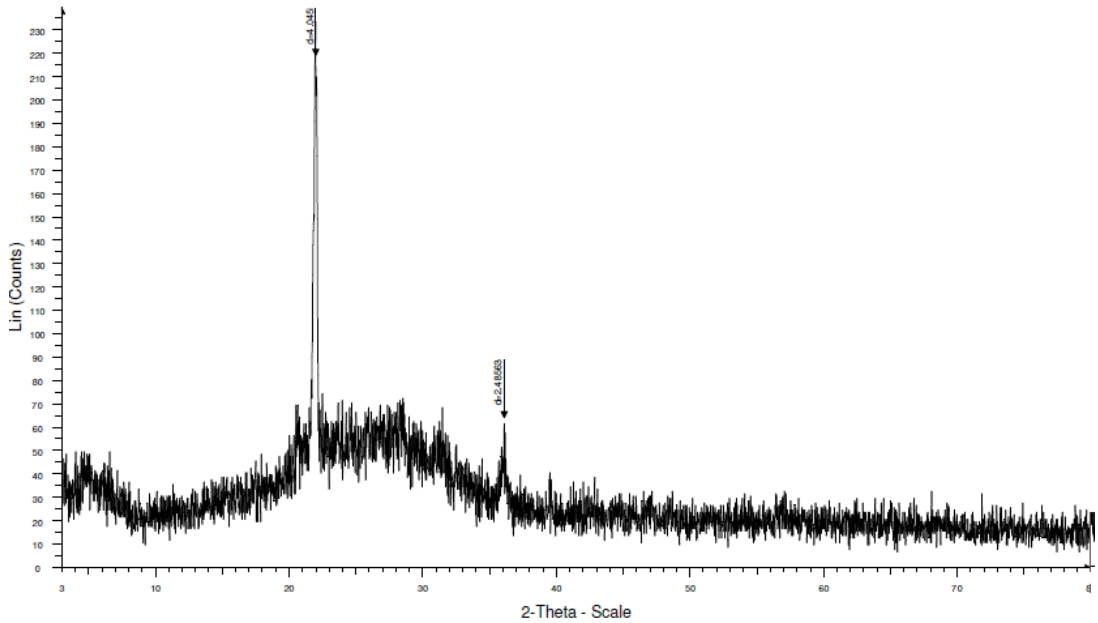

Fig 5. X ray diffraction spectrum of powdered Anuradhapura meteorite

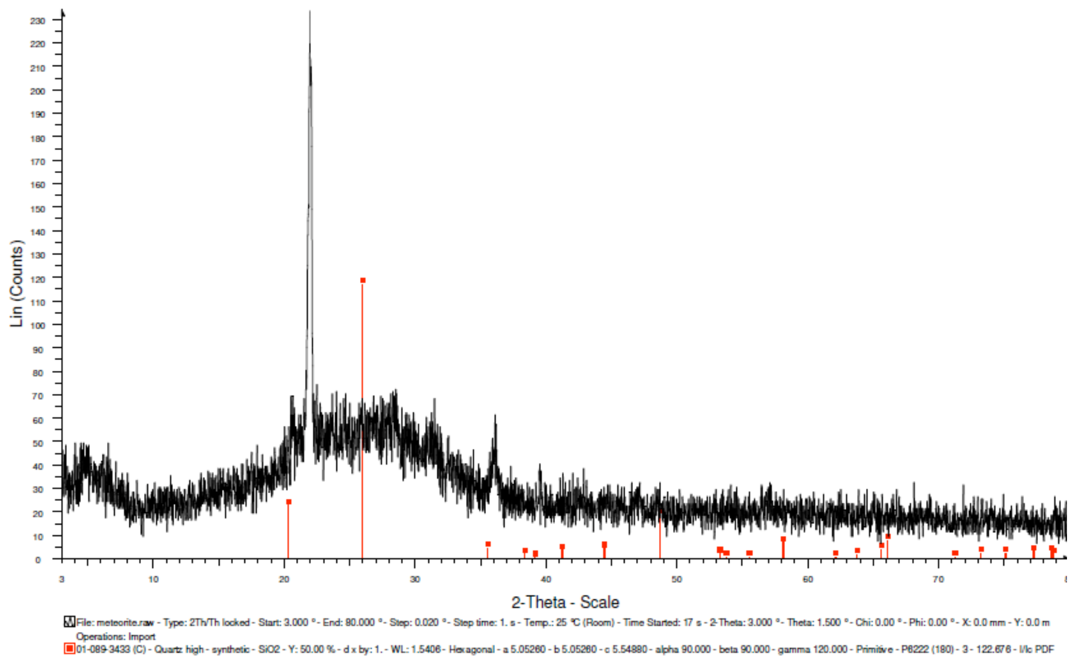

Fig. 6. X-ray diffraction spectrum overlapped with quartz peaks in ICDD database

From Fig. 6 we note that quartz was not found in the sample to any significant extent, thus confirming that the material is not similar to any terrestrial silica-bearing stone. Moreover, the distinct unidentified peaks in the XRD spectrum point to inclusion of mineral phases that are not commonly found in terrestrial rocks. These facts corroborate our identification of the Anuradhapura stones as a hitherto unclassified type of meteoroid.

4. Concluding remarks

We note by way of conclusion that the biological entities found in the Anuradhapura meteorites bear a striking similarity to some of the structures found in the Polonnaruwa meteorite as well as in stratospheric dust (Harris et al, 2002) and carbonaceous meteorites (Rozanov and Hoover, 2013). This can be seen by comparing the images in Fig.7 with those in Fig. 3.

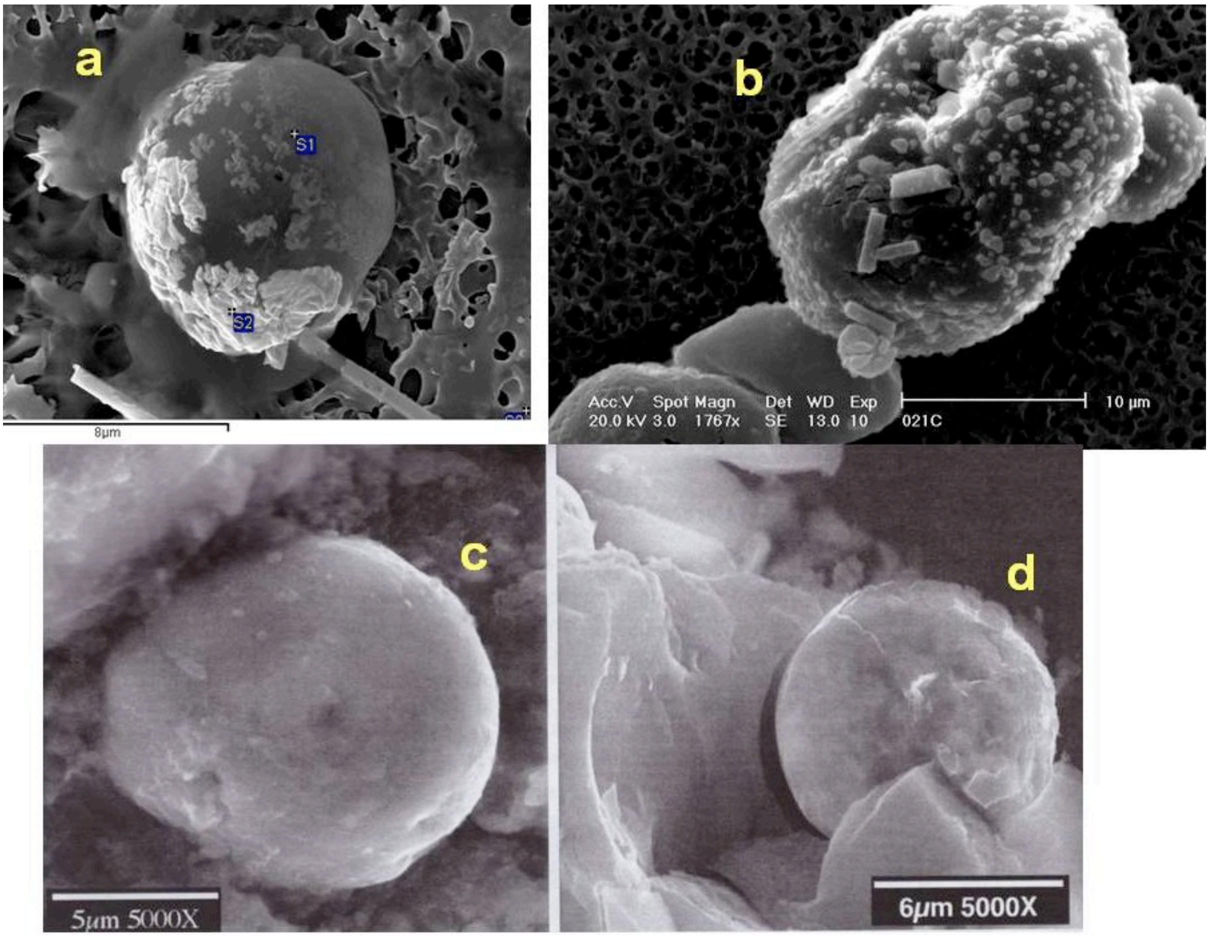

Fig.7 Frames a and b are examples of putative acritarchs in stratospheric meteor dust collections of January 2001 (Harris et at, 2002). Frames c and d are from a freshly fractured surface of the Murchison meteorite (Rozanov and Hoover, 2013).

We conclude by remarking that if the space origin of the Anuradhapura stones is accepted, the implications for the Hoyle-Wickramasinghe cometary panspermia theory (Hoyle and Wickramasinghe, 1982; Gibson et al, 2011; Wickramasinghe, Wickramasinghe and Napier, 2010) would be profound. Biology can no longer be regarded as being indigenous to the Earth. Life is a cosmic phenomenon and the universe teems with life. It is ironical that the strongest evidence for this potentially historic conclusion fell by chance on two of the most famous ancient cities in the native country of the present authors.

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