Microfossils, Biomolecules and Biomarkers in Carbonaceous Meteorites:

Evidence for the Existence of Extraterrestrial Life

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ABSTRACT

Well-preserved, mineralized remains of large filaments and mats with undeniably biological features have been discovered by Field Emission Scanning Electron Microscopy (FESEM) studies of the freshly fractured interior surfaces of diverse carbonaceous meteorites. FESEM images and EDS data for the meteorite filaments and a wide variety of living and fossil cyanobacteria and other microorganisms will be presented. Recognizable biological features described include evidence of cells, cell-wall constrictions and specialized cells used by gram-positive bacteria for nitrogen fixation (heterocytes); evidence of reproduction, motility and attachment (baeocytes, hormogonia, coiled empty sheaths and fimbriae). Sizes and the size range of these filaments are shown to be confined to those of well-known genera and species of cyanobacteria and sulphur bacteria.

Some scientists have advanced the hypothesis that these filaments are modern biological contaminants that invaded the meteorites since they arrived on Earth. To evaluate the validity of this hypothesis, studies of the filaments have been carried out using Energy Dispersive X-Ray Spectroscopy (EDS). The filaments typically have chemical compositions similar to that of the meteorite rock matrix indicating they are indigenous. Furthermore, the meteorite filaments are typically found to have nitrogen levels below the sensitivity of the EDS detector (<0.5% atomic). Nitrogen is essential for life and it is found in all amino acids, proteins, DNA and RNA molecules of every living cell. After death, nitrogen slowly returns to the atmosphere over geological time scales (millions of years). EDS investigations of hair and tissues of 5,000 year old Egyptian mummies and of 40,000 year old Woolly Mammoths have shown them to contain nitrogen at levels similar to living organisms (~2 to 18% atomic). Hence, the absence of detectable levels of nitrogen in the meteorite filaments provides clear and convincing evidence that they are not the remains of microorganisms that entered these stones after they were observed to fall in 1864 (Orgueil meteorite) and 1969 (Murchison meteorite).

The conclusion that the filaments are not modern bio-contaminants is further supported by data on biomolecules and chemical biomarkers obtained by other meteorite researchers. Independent studies have established that the CI1 and CM2 carbonaceous meteorites contain indigenous and extraterrestrial biomarkers (e.g., breakdown products of chlorophyll - prophyrins, pristine, and phytane) and a subset of life-critical biomolecules (e.g., 8 protein amino acids, 3 nucleobases of DNA and RNA nucleobases, etc.). Chlorophyll has never been detected and the missing protein amino acids, sugars and nucleobases provide clear and convincing evidence that the filaments are not modern contaminants. Hence, it is concluded that the filaments are the remains of ancient extraterrestrial life forms that were present in the meteorites when they entered Earth's atmosphere.