Heat Producing Elements and Microfossils in the Polonnaruwa Meteorite: "Wet Panspermia" and the Cosmic Distribution of Biospheres

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Where, when and how life originated represent some of the most perplexing questions of Science. The widely accepted paradigm that Earth-life arose on Earth is based on the ancient Aristotelean doctrine of spontaneous generation dating back to the 3rd century BCE. It was revived into its modern context by Haldane and Oparin at the turn of the 20th century, and its empirical basis rests on the 1952 Miller-Urey Experiment which showed simple racemic amino acids (D/L=1)could form by electric arc discharge into a simulated prebiotic, early Earth atmosphere. At the time, the incredible complexity of polymeric biomolecules (e.g. DNA, RNA, proteins, enzymes) comprised of homochiral amino acids, sugars and other metabolites required for life was unknown. The fact that life appeared on Earth soon after the crust cooled enough to permit liquid water Oceans was not understood. It was thought that full details of the first appearance *in situ* of living cells would soon be revealed and the "Panspermia" hypothesis advanced in 1903 by Arrhenius and re-introduced by Hoyle and Wickramasinghe in the 1980's in a modern astronomical context would be finally rejected. Evidence for biomolecules in interstellar and cometary dust led Hoyle and Wickramasinghe to revive the Panspermia hypothesis that life originated elsewhere in the Cosmos and was delivered to Earth from Space. This is consistent with the Vernadsky concept of the eternity and cosmic status of life and the Biosphere even on the cosmological level. Discoveries since the early 1960's have provided evidence for microfossils and complex biomolecules in carbonaceous meteorites, but those were often attributed to abiotic processes or terrestrial contaminants. Recent SEM studies in the US, UK and Russia have revealed well-preserved diatoms, cyanobacteria, prasinophytes and magnetotactic bacteria in the Polonnaruwa (Low-Density Ungrouped), Murchison (CM2) and Orgueil (CI1) carbonaceous meteorites that are thought to be remnants of comets or low-density carbonaceous asteroids such as 162173 Ryugu (Cb-type) and 101955 Bennu (B-type). EDS measurements of N<0.5% and O/C ~ 0.1 to 0.2 for cyanobacterial filaments and diatoms in these stones indicates diagenetic conversion to kerogen and establishes that these forms are indigenous and ancient and consequently cannot be interpreted as modern biological contaminants. This provides direct observational evidence for the existence of extraterrestrial life and support for the "cometary panspermia" model. The James Webb Space Telescope (JWST) recently detected Dimethylsulfide (DMS) in the Hycean Exoplanet K2-18 b. DMS is a biogenic cleavage product of Dimethylsulfoniopropionate (DMSP) released only by complex metabolic pathways using the DMSP lyase enzyme that is found in diatoms, cyanobacteria and many other marine phytoplankton. DMS has been detected on Mars in the Orgueil meteorite and samples returned from asteroid Ryugu. Extraterrestrial purine and pyrimidine nucleobases and chiral amino acids have been found in the Orgueil, Murchison and many other carbonaceous meteorites. Our recent ENAA analysis at JINR of the fossil-rich Polonnaruwa meteorites has revealed Rare Earth Elements and astonishingly high levels of Heat Producing Elements (^{40}K, ^{238}U, ^{242}Th) HPE's Radiogenic HPE's with half-lives of billions of years are responsible for heating the crust of the Earth. Planetary HPE's provides a "Wet Panspermia" mechanism in which water can be maintained in liquid state for billions of years beneath the icy crust of Pluto and rogue planets in deep space far away from a star or giant planet. On these distant sites replication, growth and death of living organisms could continue just as has occurred in deep oceans of Earth for ~ 3.8 billion years. Unicellular and even multicellular life could exist on an astronomical scale and thrive beneath the icy crusts of Moons, Comets, Exoplanets or Rogue Planets and the interplanetary, interstellar or intergalactic tranfers of intact Biospheres may be the inevitable consequence of the dynamical evolution of galaxies.