Statistical Analyses of Modern and Fossil Micro-algal Populations: Astrobiological Implications

Evan J. Cholfin
Department of Earth and Space Sciences
University of California, Los Angeles
595 Charles Young Drive East, Box 951567, Los Angeles, CA 90095-1567
USA
echolfin@ucla.edu

Three statistical tests, as outlined by Schopf (1976), are applied to quantitatively compare phenotypic variation of cellular diameter in populations of spheroidal modern algae and cyanobacteria, and spheroidal microfossils from the Bitter Springs Formation, Central Australia, ~850 Ma. Schopf's (1976) interpretation has been confirmed for five strains of algae (*Asterococcus superbus*, *Chlorella vulgaris*, *Chlorococcum echinozygotum*, *Chlorella stigmatophora*, and *Distigma levis*) and four strains of cyanobacteria (*Gloeocapsa alpicola*, two strains of *Gloeocapsa sp*., and *Chroococcus turgidus*) that monospecific populations, composed of vegetative cells, can be expected to (1) be unimodal and exhibit low to moderate standard deviations (a coefficient of variation on the order of 10 to 25%); (2) closely approximate arithmetic-normal, Gaussian distributions; and (3) exhibit a relatively low Divisional Dispersion Index (generally well less than 7 or 8 and commonly about 4). Twelve colonies of Bitter Springs microfossils examined have been divided into five groups based on similarities in diameter range. These five groups exhibit coefficients of variation ranging from 9–13%, closely approximate a Gaussian distribution, and exhibit DDIs ranging from 3–5 (3–4, excluding outlier cells), consistent with a biologic interpretation. In conjunction with previously accepted lines of evidence for authentic fossils (including indigenousness, syngenicity, and other aspects of biogenicity), such statistical analyses may prove useful in future astrobiological studies of any putative spheroid microfossils of extraterrestrial origin.