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New discovery of 3.0 Ga microfossils: Evidence for the early diversification of Earth's life

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The early evolution of Earth's life has been envisaged by ancient fossil records, though the fossil bacteria were seldom reported from the pre-2.8 Ga strata with an exception of ~3.5 Ga biota including cyanobacteria-like forms (Awramik et al., 1983; Schopf 1993). The next oldest equally diverse fossil biota is ~2.6 Ga example (Altermann and Schopf, 1995). Thus, the time gap between these deposits is enormous and inferred course of earliest evolution is still highly speculative. I report here the new discovery of dense population of cellularly preserved carbonaceous microfossils from the 3.0 Ga chert, Western Australia. The fossil biota includes coccoids consist of solitary or paired cell-like units encompassed by a common envelope. They have been suffered from several geothermal overprints such as permineralization, graphitization, pyritization, and oxidation, but are still structurally preserved in fine-grained silica matrix. On the basis of their size distribution, the coccoid microfossils consist of more than three species. Their morphological variations can be generally explained by degradational process of cytoplasm and by different divisional stages. The morphology of the microfossils are closely similar to those exhibited by some extant bacteria including chroococcalean cyanobacteria and coccoidal sulfur-oxidizing bacteria, though the cell diameters of the microfossils are quite large (up to ~0.1 mm). Thus, the precise taxonomy of the coccoid microfossils is uncertain. However, their relatively large size of the cell and the colonial ensheathed morphology imply that they are relatively late-branching prokaryote probably in the domain Bacteria or possibly eukaryote. This new discovery fills in the significant time gap of the fossil records between ~2.6 and ~3.5 Ga, and substantiates the early diversification of Earth's life.