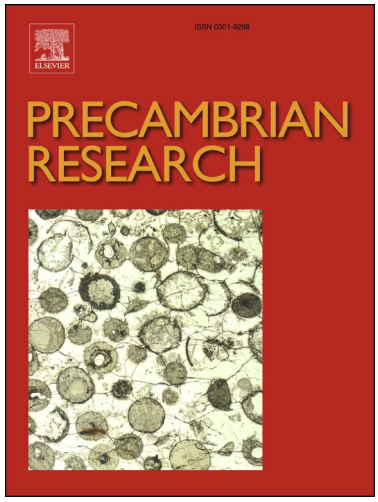

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Cellular taphonomy of well-preserved Gaoyuzhuang microfossils: a window into the preservation of ancient cyanobacteria

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ABSTRACT

The ~1500 Ma Gaoyuzhuang microfossils, a representative Mesoproterozoic cyanobacteria assemblage, are crucial for understanding and searching for early Precambrian life on Earth. The cellular taphonomy of fossils in this assemblage is poorly known, however. Here we combined *in situ* microscopic and microanalytical techniques to study the detailed taphonomy of these microfossils. Light microscopy (LM), scanning electron microscopy (SEM) and transmission electron microscopy (TEM) observations show that Gaoyuzhuang microfossils are mainly preserved in black chert layers and that silica particles can be found within fossilized cell walls and sheaths. Raman spectra show the characteristic first-order bands (at ~1350 and ~1605 cm^{-1}) of carbonaceous material comprising microfossils, indicating that they have experienced peak temperatures of ~215 to 308 °C. Raman maps show the spatial distribution of the carbonaceous matter as well as that of the silica matrix, consistent with nano-scale secondary ion mass spectrometry (NanoSIMS) analyses. Variations in ^{13}C versus ^{12}C and ^{34}S versus ^{32}S within individual microfossils are likely the result of original differences in the isotopic compositions of cellular components. Confocal laser scanning microscopy (CLSM) analyses provide fluorescence-based 2-D and 3-D