Micro-IR spectroscopic characterization of well-preserved microfossils from the black chert, ~850Ma the Bitter Springs Formation

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Almost all of the Precambrian microorganisms have been graphitized during diagenesis and metamorphism, and have been preserved as carbonaceous matter in sedimentary rocks. The criteria for the recognition of microfossils are still under debate (Buick, 1990, Brasier et al., 2002) because of the lack of clear criteria. This study reports the approach of the spectroscopic characterization of Proterozoic microfossils by using micro-IR spectroscopy to elucidate molecular traces of life.

Filamentous, spheroidal, and form-less carbonaceous materials were used here in the well studied microfossil-bearing black chert from ~850 Ma the Bitter Springs Formation, Central Australia (Schopf, 1968; Schopf and Brasic, 1971). Raman spectra of carbonaceous matter from the Bitter Springs Formation show the ordered graphite peak around 1600cm-1 and broad disordered peak around 1350cm-1 with a shoulder (1260cm-1), indicating carbonaceous matter may be much less graphitized.

IR-mapping results revealed that the distributions of peak heights at 2920cm-1, 2850cm-1, 1560cm-1, 1400cm-1 are similar to those of carbonaceous materials. The peaks at 2920cm-1, 2850cm-1, and 1400cm-1 are due to aliphatic C-H, and the peak at 1560cm-1 can be possibly due to N-containing moieties. There is no evident difference of peak position between microfossils and form-less carbonaceous materials.

Since N is an essential molecule for proteins and nucleic acids, the consistent distribution of N with that of well preserved biological structures suggests that the 1560cm-1 bond (C-N?) can be an indicator of molecular traces of life.