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# Molecular evidence for life in the 3.46 Ba-old Warrawoona chert

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Cherts, which are amongst the oldest sedimentary rocks known on Earth, show a record of remarkably well-preserved microfossils during the Precambrian. These microstructures were first considered as fossil cyanobacteria and thus as the oldest evidence for life on Earth but this interpretation is questioned. Since the syngeneity of the soluble organic fraction remains difficult to demonstrate, the present study was focused on the insoluble organic fraction (kerogen). The latter was isolated through HF/HCl treatment from the 3.46 Ba Warrawoona chert and subsequently analysed using solid state $^{13}C$ NMR, FTIR and pyrolysis. Taken together, these techniques revealed the occurrence of unbranched long chains covalently linked to the macromolecular network of the kerogen. Low-temperature heating reveals that these chains do not correspond to trapped hydrocarbons. The lack of associated branched alkanes in the pyrolysate and the occurrence of an even-over-odd carbon number predominance in the $C_{10}$-$C_{18}$ alkanes point to a biological origin for this macromolecular organic matter. Pyrolysis also yields some sulfur-containing products, in agreement with scanning electron microscopy observations coupled with energy dispersive spectroscopy (EDS), which systematically reveal the co-occurrence of sulfur and carbon in the kerogen, possibly reflecting sulfate-reducing bacteria activity. It is usually admitted that insoluble organic matter is syngenetic with the host rock and several features of this kerogen confirm its formation simultaneously with the solidification of the siliceous matrix of the chert. These observations thus support the idea according to which life was present on Earth 3.5 Ba. ago.