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Discovery of possible microfossils from c. 3.4 Ga Strelley Pool Chert, Kelly Group, Pilbara Craton: evidence for antiquity of life and biotic diversity?

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The Pilbara Craton, Western Australia contains one of the best-preserved Archean volcano-sedimentary successions in the world and gives us the chance to search for the oldest evidence of life on Earth, although the origin of "biogenic" structures in the Archean is currently a highly controversial topic. Recently, possible biogenic microstructures were discovered in black chert of the c. 3.4 Ga Strelley Pool Chert at Mt. Goldsworthy and Mt. Grant in the northeastern Pilbara Craton. The morphologically diverse, abundant microstructures are identified in thin sections. They are surprisingly well preserved and may provide evidence for antiquity of life and biotic diversity.

The Archean sedimentary succession at the Mt. Goldsworthy – Mt. Grant region is composed of 50m thick quartz-rich clastic rocks and overlying laminated to banded chert up to hundreds meters thick. Black chert containing possible microfossils occurs at the uppermost portion of the clastic rock unit. The black chert is composed dominantly of microcrystalline quartz ($< 5\mu$m) and is locally characterized by agate-like or stalactitic texture, possibly originated from dissolution cavities, and partially displays microscopic fenestra-like structure. A few layers of black chert less than 20cm thick are inter-bedded with fine- to coarse-grained clastic rocks and evaporite; this association totals less than 5m thick and extends laterally $\sim$ 1km along strike at Mt. Grant. The black chert is evidently sedimentary in origin and is assumed to have deposited in the shallow to sub-aerial depositional environment at a coastal setting.

Four major morphological types of carbonaceous microstructures are preliminarily identified, including filamentous, film-like, spherical and lenticular to spindle-like structures. Biogenicity is inferred from their carbonaceous composition, narrow size distribution, inferred physical properties (flexible but breakable), colony-like occurrence, hollow interiors, and resemblance to modern bacteria. Bulk isotopic composition (∂^{13}C $<$ -30) also supports a biogenic origin of the component carbonaceous matter. The structures are interpreted as evidence for the antiquity of life. Furthermore, the possibility of early development of a microbial community in the shallow euphotic zone is suggested.