Precambrian Life

Precambrian = \sim 4.6 \text{ to } \sim 0.57 \text{ billion years before present}
MICROBIAL MATS: accretionary cohesive microbial communities which are often laminated and found growing at the sediment-water interface ["biofilms" are very thin cohesive microbial communities (e.g. 100-200 μm thick)].

STROMATOLITES: "fossilized" organo-sedimentary structures (often laminated) produced by sediment trapping, binding, and/or precipitation as a result of the growth and metabolic activity of microorganisms.
MICROBIAL MATS—PAST & PRESENT LOCATIONS

PRECAMBRIAN (Proterozoic)
1. Continental margins: shallow seas of uncertain salinity-global
2. [Inland springs (some geothermal) & inland water bodies]

MODERN
1. Hypersaline bays & lagoons (general absence of invertebrate grazers)
2. Intertidal flats with infrequent tidal coverage (desiccation and/or sulfide conc. intolerable for grazers)
3. Hot spring pools and drainways (temp. > 45° C with no grazers)
4. Cold aquatic habitats, often with complete freezing; absence of most grazers (e.g. Antarctic ponds)
Swiftcurrent Glacier retreating and exposing 1.3 Ga Belt Supergroup stromatolites (Glacier N.P.)

[1.3 Ga = 1.3 x 10^9 years before present]
Almost a kilometer thickness of stromatolites, Swiftcurrent area
Ancient Precambrian reef head with mud stone behind

Swiftcurrent Belt Supergroup, Glacier National Park
Different conditions for stromatolite formations

Figure 6.2.2.- General distribution of specific stromatolite types across Proterozoic carbonate platforms. (A) Rimmed shelf as a high-energy (windward) margin characterized by a barrier reef complex of strongly elongate stromatolite mounds and columns. Conical stromatolites may form below wave-base as foreslope deposits; domal stromatolites of the inner-shelf lagoon are weakly elongate to non-elongate as a result of their restricted, low-energy setting; tufas (including microdigitate stromatolites) form by precipitation of tidal flats. (B) Ramp as a moderate-energy platform. Elongation of stromatolite mounds and columns is dependent on the relative amount of wave surge and/or tidal strength; in low-energy settings, elongation is minimal. Note the decrease of stromatolite mound size toward both deeper and shallower settings; elongation may show a similar relationship (Grotzinger 1989a).
Reefhead stromatolite (with the late Bob Horodyski)

Swiftcurrent stromatolites, Belt Supergroup, 1.3 Ga
Belt Supergroup exposed

columnar

Stromatolite--

ca. 1.3 Gyr

(cm unit ruler)
Longitudinal Section of 1.3 Ga columnar stromatolites, Belt Supergroup, larger view
tops of columnar stromatolites, 1.3 Ga
FOSSIL STROMATOLITE (left, Belt Supergroup, 1.3 Ga) AND MODERN STROMATOLITE (right, Laguna Mormona, Mexico)
Section of microbial mat from Pond 4, G.N.; ~ 80-90 ppt

Contemporary “stromatolite”
FOSSIL LIMESTONE STROMATOLITES  --
TRANSVAAL SUPERGROUP,
SOUTH AFRICA  --  2.3 Ga
MODERN CARBONATE STROMATOLITES
SHARK BAY, WESTERN AUSTRALIA
FOSSIL MICROBIAL TUFTED MAT (left, Transvaal Supergroup, 2.3 Ga) AND LIVING TUFTED CYANOBACTERIAL MAT (right, ...
Chert ($\text{SiO}_2$)

Limestone ($\text{CaCO}_3$)
3.465 Ga

APEX CHERT, 3,465 ± 5 Ma, WESTERN AUSTRALIA

MEDIUM DIAMETER (2-5 μm) FILAMENTS, CYLINDRICAL CELLS

*Primaevifilum amoenum*

Fig. 8. Cellular filamentous cyanobacterium-like fossils (*Primaevifilum amoenum; Oscillatoriaceae*) from the ~3465 Ma-old Apex chert of northwestern Western Australia, Australia (Schopf 1992c, 1993).
Fig. 10. Cellular filamentous cyanobacterium-like fossils (*Primaevifilum laticellulosum*; ?Oscillatoriaceae) from the ~3465 Ma-old Apex chert of northwestern Western Australia, Australia (Schopf 1993).
~ 2.0 Ga: Gunflint (S. Canada)

MIDDLE PRECAMBRIAN
(BARGHOORN & TYLER, 1965)
"Oscillatoria"
From Bitter Springs, Australia
\(~0.8\) Ga

Incipient cell division
Bitter Springs formation, Australia
~0.8 Ga

Oscillatorian types
NOSTOC (EXTANT)

CF. NOSTOC, LATE PRECAMBRIAN, BITTER SPRINGS CHERT

\[ \sim 0.8 \text{ Ga} \]
live *Lyngbya* (cyanobacteria)

E. Siberia, 0.95 Ga
Living *Oscillatoria margaritifera*, a marine cyanobacterium
MICROFOSSILS IN *Conophyton gaubitza*
Late Precambrian, South Kazakhstan

~ 1.0 Ga
Eoentophysalis sp.
PROTEROZOIC
Sukhaya Tunguska Formation
1.0 Ga
present
Entophysalis major
HOLOCENE
(From Golubić & Hofmann, 1976, pl. 2, fig. 2)