HYPERTHERMOPHILES IN THE HISTORY OF LIFE

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To-day, hyperthermophilic ("super-heat-loving") archaea and bacteria are found within high temperature environments, representing the upper temperature border of life. They grow optimally at above 80°C and exhibit an upper temperature border of growth of up to 113°C. Members of the genera *Pyrodictium* and *Pyrolobus* even survive at least one hour of autoclaving at 121 °C, a kind of cosmic impact scenario. In their basically anaerobic environments, hyperthermophiles gain energy by inorganic redox reactions employing compounds like molecular hydrogen, carbon dioxide, sulphur and ferric and ferrous iron. Based on their growth requirements, hyperthermophiles could have existed already on the Early Earth, about 3.9 Gyr ago. Compared to all other organisms, they contain the slowest evolving small subunit ribosomal RNA`s, a kind of molecular chronometers discovered by Carl Woese. In agreement, within the phylogenetic tree of life they occupy all the short deep branches closest to the root. The archaeal *Nanoarchaeota* and *Korarchaeota* represent the deepest- branching phylogenetic lineages and therefore, extremely ancient lineages of life. Species of the *Nanoarchaeota* exhibit cell sizes of only about 400 nm. Cultivation requires the presence of specific crenarchaeal hosts. The *Nanoarchaeum equitans* genome is among the smallest known to date (490,885 base pairs). Recently, a complete genome sequence has been obtained from enrichment cultures of the *Korarchaeota*. It revealed an unprecedented heterogeneous gene complement, suggesting that they had diverged very early in the archaeal lineage. Since hyperthermophiles survive deep-freezing at -140 °C, they could have been successfully transferred to other planets through the coldness of space (e.g. within impact ejecta).