A 3.77 (or possibly 4.28) billion year history of microbial communities associated with marine hydrothermal vents

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Modern hydrothermal vents provide diverse environments for microorganisms. Here there is a large phylogenetic diversity of bacteria and archaea, occurring in a wide range habitats, from hyperthermophiles living in black smoker chimney walls, through intra- and extra-cellular symbionts in vent animals, to mat-forming colonies on hard substrates. The range of microbial physiologies is also great at vents (e.g. sulfide-oxidation and iron-oxidation), a result of the wide variety of reduced compounds available. An assumption is that similar communities of microorganisms have been present on Earth for an extremely long time, given that there is direct evidence of marine hydrothermal activity going back to the Archaean eon (which began 4 billion years ago), and the hypothesis that life may have originated in these environments. In this presentation I will review the fossil record of microorganisms at hydrothermal vents, which comes from two different rock types: volcanogenic massive sulfides (VMS), which formed at high temperature vents, and jaspers (iron-silica rocks), which formed at low-temperature, sulfide-poor vents. Occurrences of microorganisms in VMS go back to the Paleo-archaean era (3.235 billion years ago) (Rasmussen, 2000) and in jaspers to the Eo-archaean (3.770, or possibly 4.280, billion years ago) (Dodd et al., 2017), with the latter being the oldest organisms yet discovered on Earth. These very dates suggest that life may have been possible on Mars during its equivalent aged warmer period, and that life may be found at putative hydrothermal sites on the icy moons with liquid oceans (e.g. Europa and Enceladus).