TABLE 3 Microbial metabolic processes at hydrothermal vent environments

Conditions	Electron donor	Electron acceptor	Carbon source	Metabolic process	Biotopes	Thermal groups of microorganisms[a]
AEROBIC	HS^-, S°, $S_2O_3^{2-}$, $S_4O_6^{2-}$	O_2, possibly NO_3^-	CO_2	Sulfur oxidation	Diffuse-flow vent fluids, outer zone of sulfides and some basalts, microbial mats, smoker plume fluid, symbionts of tube-worms, clams and mussels, gut flora of heterotrophic macrofauna	Mesophilic bacteria (α, γ proteobacteria), ε-proteobacteria in microbial mats at vents presumed to be S-oxidizers but not yet cultured, acidophilic S-oxidizing archaea exist but not yet found in vents
	H_2	O_2, possibly NO_3^-	CO_2	Hydrogen oxidation	Diffuse-flow vent fluids, smoker plumes	Mesophilic bacteria detected by activity measurements
	Fe^{2+}, Mn^{2+}	O_2	CO_2	Metal oxidation	Diffuse-flow vent fluids, outer zone of sulfides and some basalts, microbial mats, surface of tubes and shells of some animals	Diverse mesophilic bacteria
	CH_4 and other C_1 compounds	O_2	CH_4, CH_3OH, CO, CO_2	Methanotrophy and methylatrophy	Diffuse-flow vent fluids, outer zone of sulfides, surface of tubes and shells of some animals, smoker plume fluid, symbionts for some animals	Mesophilic β-proteobacteria
	NH_4^+, NO^{2-}	O_2	CO_2	Nitrification	Limited data, diffuse-flow vent fluids	Mesophilic bacteria
	Organic compounds	O_2, NO_2^-	Organic compounds	Heterotrophy	Ubiquitous at vents	Many different genera of mesophilic and thermophilic bacteria

ANAEROBIC	H_2	S°, SO_4^{2-}, $S_2O_3^{2-}$	CO_2	Sulfur and sulfate reduction	Diffuse-flow vent fluids, sulfide structures, microbial mats, sediments (Guaymas, sedimented-ridges)	Mesophilic and thermophilic bacteria and hyperthermophilic archaea
	H_2	CO_2	CO_2, possibly formate and acetate	Methanogenesis	Ubiquitous in anaerobic biotopes	Mesophilic, thermophilic, and hyperthermophilic archaea
	H_2	NO_3^-	CO_2	Hydrogen oxidation	Diffuse-flow fluids	Identified from molecular analyses of vent samples
	Organic acids	Fe^{3+} (iron oxyhydroxides)	Organic acids	Iron reducers	Crustal fluids from new eruptions, subsurface fluids, and sediments	Mesophilic bacteria and hyperthermophilic archaea
	CH_4	SO_4^{2-}?	CH_4?	Anaerobic methane oxidation	Measured in methane hydrate sediments and from enrichment culture with high-temperature hydrothermal fluids	Evidence that the acetoclastic methanogen, Methanosarcina spp., oxidizes CH_4 anaerobically
	Organic compounds	S°, SO_4^{2-}	Organic compounds	Sulfur and sulfate reduction	Commonly isolated hyperthermophilic archaea isolated from diffuse-flow vent fluids, sulfides and guts of sulfide-dwelling animals	Mesophilic and thermophilic bacteria and hyperthermophilic archaea
	Organic compounds	Organic compounds	Organic compounds	Fermentation	Ubiquitous in anaerobic biotopes; include both obligate and facultative anaerobes	Mesophilic and thermophilic bacteria and hyperthermophilic archaea
	fatty acids, alcohols or H_2	CO, fatty acids, alcohols CO_2	CO, fatty acids, alcohols	Acetogenesis (produce acetate)	Limited data from vents	Unknown taxa at vents

[a]Mesophile, defined by their optimum growth temperature which is approximately 37°C, frequently grows from 5°C–10°C to 45°C–50°C; thermophile grows at 50°C and above; hyperthermophile grows optimally at 80°C or above. Maximum growth temperature measured for a pure culture is 113°C.