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Morphological features of microorganisms dwelling in an active low-temperature serpentinization site, Cabeço de Vide, Portugal: a possible analogue to early Mars

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Microorganisms inhabit nearly every conceivable niche on Earth where water is present, including subterrestrial hydromineral sites. Serpentinizing ecosystems have been identified as potential analogues for the origin of life on Earth and Mars, increasing the interest in their study. The mineral waters from Cabeço de Vide (CdV) are ascribed with outcropping ultramafic plutonic rocks comprising peridotites, serpentinized peridotites to serpentinites. These waters present very alkaline pH values (pH \approx 11.5) and a Na-Cl/Ca-OH *facies* as the result of present-day serpentinization at depth. Methane isotopic composition ($-24.4\text{‰} < \delta^{13}\text{C-CH}_4 < -16.5\text{‰}$ and $-285\text{‰} < \delta^2\text{H-CH}_4 < -281\text{‰}$) falls in the range of typical abiotic gas found in other serpentinizing sites, and the lack of H₂ could be attributed to its consumption by CO₂ hydrogenation to produce CH₄. Microbial samples were collected from CdV mineral waters by in-line filtration. Subsequently, the filters were sputter coated with a Cr film and observed under Field Emission Scanning Electron Microscopy with Energy Dispersive X-ray Spectroscopy. Coccoid and rod-shaped cells (\approx 1 μm) were observed infrequently, while smaller microbial cell-like structures (\approx 0.1-0.2 μm) were found forming clusters. We are presently seeking to understand whether these cell-like structures are actually life or just calcifying nanoparticles, since small sizes of microbes may have some advantages to thrive in this extreme environment. Small microorganisms were observed abundantly in other serpentinizing site, The Cedars, in Cazadero USA. Further molecular biology investigations, including metagenomic analyses, are underway to begin understanding life in this archetypal extreme environment.

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