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Diversity and niche specificity of archaea and bacteria between particle attachment and free-living phases in the Mariana Trench

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Particle-attachment is known to be an important mechanism for seeking nutrients and energy sources by microorganisms in oligotrophic aquatic systems. We have analyzed the abundance and distribution of archaea and bacteria down to 8727 meters at the Mariana Trench of the West Pacific Ocean. Archaea and bacteria in both particle-attached (PA) (> 3.0 μm) and free-living (FL) (0.22-3.0 μm) fractions decreased with depth in the top 1000 meter; below 5000 m, they tended to increase with depth until 8727 m; overall, bacteria dominated the total prokaryotic abundance with archaea accounting for about 1%. Composition of archaea was dominated by marine groups II and III Euryarchaeota in surface water and by marine group I Thaumarchaeota in all deeper waters and in both FL and PA fractions; composition of bacteria was dominated by alpha- and gamma-proteobacteria in both FL and PA fractions, paticularly below the euphotic zone. Microbial diversity decreased with depth with the lowest diversity of both archaea and bacteria occurring in the hadal zone, where they appeared to prefer to partition onto the particles. The Bray-Curtis similarity analysis showed greater variation in similarity between depths for both archaea (0.04-0.75 for FL and 0.03-0.81 for PA) and bacteria (0.22-0.70 for FL and 0.28-0.66 for PA) than between PA and FL (0.45-0.85 for archaea and 0.53-0.77 for bacteria) fractions of the same depth, indicating greater archaeal and bacterial niche separation with depth than between particle-attached and free living populations of the same depth. Our results showed that niche separation is important both vertically and between particle-attached and free-living populations down to the hadal depths.