Module 1 Origins and Earth Systems

Evidence worksheet\_01 “Prokaryotes: The unseen majority”

**Learning objectives:**

* Describe the numerical abundance of microbial life in relation to the ecology and biogeochemistry of Earth systems.

**General Questions:**

• *What were the main questions being asked?*

What is the total number, density, carbon mass, growth and turnover rates of prokaryotic organisms in aquatic, soil, and subsurface environments?

• *What were the primary methodological approaches used?*

This study is a review of other published literature. The authors presented data from other studies of aquatic, soil, and subsurface environments, and presented them in a tabular form.

The authors then extrapolate the remaining data so that values of cell densities, abundances, and carbon contents are complete for each environment. Lastly the authors conduct comparative analyses based on these data and address these questions.

• *Summarize the main results or findings.*

Total prokaryotic carbon on Earth is estimated to be 60~100% of the carbon mass found in plants.

Prokaryotes have approx. one order of magnitude more of total N and P mass than that in plants, because they contain much more N and P relative to carbon than plants do.

Total protoplasmic biomass on Earth in microbes is far higher than plants

Lower limit in prokaryotic turnover time ranges from 6-25 days to ~1000 days (1-2 thousand years for subsurface bacteria, however it is far longer than expected and is based on one sample)

0.4, 0.5, 3.4, and 170 hours avg for 4 mutations from the pool of all genes shared by marine heterotrophs (in the upper 200 m), marine autotrophs, soil prokaryotes, or prokaryotes in domestic animals

60 years avg for 5 mutations from the pool of all genes shared by all 4 groups

• *Do new questions arise from the results?*

Why is the subsurface turnover rate so slow? Which hypothesis is true: metabolic inactivity, lithotrophic metabolism, overestimation of subsurface biomass, underestimation of carbon assimilation?

How do we define species and/or taxonomic classifications given such a rapid mutation rate?

• *Were there any specific challenges or advantages in understanding the paper (e.g. did the authors provide sufficient background information to understand experimental logic, were methods explained adequately, were any specific assumptions made, were conclusions justified based on the evidence, were the figures or tables useful and easy to understand)?*

Measures of mutation rate used – could clarify what is “four simultaneous mutations in every gene shared by the populations of marine heterotrophs” a bit more.