

Biogeochemistry of ferruginous sediments from lake Towuti, Indonesia

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Microorganisms persist to great depths in the terrestrial subsurface forming, by mass, the largest component of the global biosphere. Yet, we know precious little of their metabolic activities and the resulting geochemical impacts. Lake Towuti is an ancient lake (1-4 Ma) situated on Sulawesi Island, Indonesia. Weathering of ultramafic rocks from its catchment basin delivers large fluxes of iron (oxyhydr)oxides to the lake leading to deposition of very iron rich (ferruginous) sediments. Furthermore, the dearth of sulfate in Lake Towuti offers an entirely new perspective, with more relevance to the terrestrial subsurface, than most studies of the deep biosphere, which to date have focused on marine sediments. Here, we applied a suite of geochemical analyses with marker gene, small sub-unit 16/18S rRNA, based community profiling to explore the biogeochemistry and microbiology of sediment from Lake Towuti. These analyses reveal that reactive ferric Fe appears to persist throughout the sediment core at concentrations up to nearly 2 wt. %. Such reactive Fe is abundantly available to microbial Fe reducers, and thus, its persistence throughout the sediment core suggests that Fe reduction is limited by organic matter rather than by the availability of reactive ferric Fe. We also sought to test the hypothesis that DNA would persist in Lake Towuti's sediments for 10s or 100s of thousands of years due to shielding against degradation through Fe-mineral association. We extracted DNA from samples corresponding to sediments 2000, 33000, and 60000 years old, showing that ferruginous sediments can support a diversity of relatively common microbial taxa (*Betaproteobacteria*, *Bacteroidetes*, *Actinobacteria* and uncultivated *Thaumarchaeota*). Recovery of phototrophic and eukaryotic sequences throughout the core may indicate the presence and persistence of ancient DNA for up to 60,000 yrs.