Biogeochemistry and energetics of subglacial lake Whillans

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Life on Earth flourishes in the presence of sunlight and water. However, 10% of Earth's surface is covered by ice and a growing body of evidence supports the presence of active ecosystems in subglacial environments. The lack of light energy leads to microbial metabolism and biomass being sustained through chemical energy (chemosynthesis), gained from the oxidation of inorganic substrates or detrital organic matter. Subglacial Lake Whillans (SLW), a shallow (~2 m deep) lake beneath 800 m ice cover is one of more than 400 subglacial lakes known to exist under the Antarctic ice sheet. SLW was chosen to investigate links between microbial community structure, function, and geochemistry in a deep subglacial environment. Biogeochemical parameters from the SLW water column and pore waters revealed water is primarily sourced from basal-ice melt with a minor contribution from seawater that reaches a maximum of ~6% in pore water at the bottom of the sediment core. Silicate weathering products dominate the crustal (non-seawater) component of lake- and pore-water solutes. Chemical affinity calculations performed on the aqueous chemistry data allowed the available chemical energy for potential metabolic reactions in SLW to be determined. This revealed heterotrophic metabolisms utilizing acetate and formate as electron donors yielded less energy than chemolithotrophic metabolisms when calculated in terms of energy density which supports experimental results that showed chemoautotrophic activity in excess of heterotrophic activity.