# Cryoconite geochemistry and evolution as refugia for biota

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**Introduction**

The geochemistry and microbial diversity of Antarctic cryoconites has been studied over a range of latitudes, elevations and distance from open seawater in Victoria Land; from the Darwin and Diamond Glaciers (Lat 80°S), to the upper and lower Koettlitz Glacier (Lat 78°S), and the Wright Glacier (Lat 77°S). Cryoconites are small, but numerous, aquatic aquaria enclosed in the surface ice of glaciers, which collectively make up an important part of the liquid water and biomass of inland Antarctica. They form when solar-heated surface sediments melt down into glacial ice. They may freeze solid in winter, but contain meltwater during the summer months, while retaining a partial or complete (usually 10-20cm thick) ice cover.

**Discussion of Results**

In Victoria Land, cryoconites are typically perfectly cylindrical holes, less than 1m diameter and approximately 0.5m cm deep, with highly variable geochemistry; pH ranges from <5 to >11, and conductivity from <0.005 to >4 mS/cm. Major anion dominance shifts from $SO_4$ and $NO_3$ inland, to Cl-dominated in cryoconites closer to open seawater; a trend particularly evident along the length of the Koettlitz Glacier. Isotopes (tritium, oxygen and deuterium) confirm the origin of the meltwater in the cryoconites as old glacial ice, rather than more recent surface snow.

This geochemical diversity has signifciant implications for the role of cryoconites as refugia for microbial organisms during glacial maxima. Bacteria-specific automated ribosomal intergenic spacer analysis (ARISA) of the sediments from these cryoconites indicates that bacterial diversity is affected by pH and cryoconite size. Cyanobacteria community composition, however, is not influenced by cryoconite size, pH or geographic location. This is consistent with previous observations of the high degree of tolerance of Antarctic cyanobacteria to a wide range of environmental conditions and transportation mechanisms.