Surface geochemistry of the Shackleton Glacier region, Antarctica and implications for soil habitability

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During the Last Glacial Maximum (LGM) ice-free areas along the Transantarctic Mountains were inundated by the East Antarctic Ice Sheet (EAIS). As the EAIS began to retreat, soil environments were re-exposed. Phylogenetic studies of endemic Antarctic organisms show deep evolutionary divergences indicating refugial persistence during the LGM, as opposed to recent recolonization via long distance dispersal. The abiotic factors affecting ecosystem assembly are still speculative and it is uncertain how ecosystems will respond to change in a warming future. In this work, we have measured water-soluble salt concentrations from 3 transects at 11 locations along the Shackleton Glacier (83.5°S) in the Transantarctic Mountains. This landscape represents a wide range of soil environments, particularly with respect to the age of soil surfaces (i.e. advance and retreat of the EAIS) and surface material accumulations. Major water-soluble cation (K^+, Na^+, Ca^{2+}, Mg^{2+}) and anion (F^-, Cl^-, Br^-, NO_3^-, SO_4^{2-}, PO_4^{3-}) concentrations were compared and mapped with organic carbon data. The concentrations of atmospherically derived nitrate, which accumulates on the soil surface, were compared to meteoric ^{10}Be data to establish relative "wetting ages" indicating when these soils were last exposed to liquid water. Interpolations were created to establish a habitat suitability model for areas along the Shackleton Glacier that likely host diverse life. Our results demonstrate the importance of climate in shaping soil environments and ecosystems in Antarctica.