continuous gEOPHYSICAL MONITORING OF AN ARCTIC GLACIAL FOREFIELD

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Widespread glacier retreat in the Arctic associated with climate change is resulting in rapid ecosystem changes which are not fully understood. In particular, many Arctic glaciers are retreating at unprecedented rates, exposing vast expanses of seemingly barren glacial till. Over time, soils develop from this till which support an increasing diversity of life, culminating in mature Arctic tundra ecosystem. The rate and mechanisms of this transformation are difficult to predict and model, which affects projections for the role of the Arctic with respect to the global carbon cycle, wildlife habitat, and planning of human infrastructure. To date, microbiological and geochemical sampling has been the predominate means by which to study soil evolution in the Arctic. Since microbes are generally the pioneer species after glacial retreat, sampling presents a means by which to directly observe changes in the soil composition. Weathering processes are also at play which present themselves in the geochemical sampling. However, such monitoring is limited by the costs associated with accessing the site as well as the timescales involved (in excess of 1 000 years). A chonosequence trades space for time and allows for the observation of various stages of evolution to be sampled, but seasonal variations—especially in the middle of winter—are still difficult to capture. Geophysical and remote sensing methods can complement biological and chemical measurements to better understand soil evolution in glacier forefields following glacier retreat. Electrical methods are sensitive to changes in the phase of water and hydrological phenomenon including soil drainage. Point sensors provide important information about factors critical for microbe activity including temperature and moisture content.

In this study preliminary data from long-term electrical resistivity tomography and point sensor installations at the Midtre Lovénbreen Glacier, near Ny-Ålesund, Svalbard are presented with accompanying small loop surface NMR data. The NMR data provides valuable information on liquid-phase water and calibration for the ERT data. The ERT time series has imaged numerous wetting fronts and freeze thaw cycles and variations across installations reflect compositional changes due to weathering and microbial activity, as confirmed by biological sampling. Together the data provide a previously unimaginable level of detail on soil development in the Arctic.

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