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Surface-NMR on a terminal moraine in Yoho National Park (BC, Canada) to assess storage capability

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Progressive retreat of glaciers and related hydrological processes have important consequences for the development of mountainous ecosystems. To assess these processes, it is necessary to understand headwater propagation and storage mechanisms in mountainous watersheds. Glacier terminal moraines play an important role, because they connect the glacial melt water to the streams. Unlike other geophysical techniques, the surface-NMR method offers the possibility to measure under the challenging conditions of highly resistive and blocky moraine. We have conducted a surface-NMR survey across the terminal moraine of the Opabin Glacier in the Canadian Rocky Mountains, with the objective of mapping its internal water content distribution. This environment offers ideal surface-NMR conditions: (i) strong static earth magnetic field (56 000 nT), (ii) low cultural electromagnetic noise contamination and (iii) no significant magnetic anomalies in the sedimentary composition of the moraine‘s rocks. Our recent developments in 3D electromagnetic modeling, using a hybrid finite-element – boundary-integral technique, facilitate simulation of the magnetic field flux, which is emitted by the wire antennas deployed across rugged and inhomogeneous terrain. High resolution unstructured grids are applied to sample the 3D kernel functions and perform the 2D tomographic inversion. This new approach enables investigations in highly complex environments, such as the Opabin Glacier terminal moraine. We have detected the presence of mobile water within the terminal moraine and the possibility of a water-saturated layer.