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Hydrogeophysical Survey of Groundwater Flow Pathways in an Alpine Headwater Basin

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Summary

Alpine regions of the Canadian Rocky Mountains are important sources of freshwater for the semiarid Canadian Prairies. Yet, only recently have studies demonstrated that groundwater plays an important role in storage and subsequent release of snowmelt and rain. With limited case studies available in this region, a general understanding of groundwater flow processes in the alpine zone remains elusive.

We present a new case study of a complex, first-order watershed in the Front Ranges of the Eastern Canadian Rocky Mountains. Located adjacent to the Kananaskis River Valley, this site is unique in having multiple geomorphological features in close proximity. At the glacially carved headwall of the valley, springs emerge from large talus cones, leadings to streams diverted by a complex array of moraines. These converge in an alpine meadow and lead to an ephemeral tarn lake. No surface outlet from the tarn is present, yet flow is observed from a perennial spring immediately adjacent to the lake, demonstrating the significance of groundwater flow in this system.

We employ three geophysical methods to investigate the subsurface: electrical resistivity tomography, seismic refraction tomography, and ground-penetrating radar. Combining these data sets, we establish the geometry of different hydrogeological units and delineate saturated and unsaturated zones. Finally, using the geophysical interpretations and along with geochemical sampling, we develop a preliminary model of groundwater flow routing.