

Geophysical detection of reducing springs: a new approach

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Winter House Canyon is incised into the ultramafic Tablelands Ophiolite massif in western Newfoundland. The canyon contains springs characterized by high pH, large negative Eh values and the active precipitation of carbonate. The unusual electro-chemical and magnetic properties of these springs indicates that geophysical techniques may be able to determine the extent, geometry and location of the underground streams which feed the springs. The reducing waters emerging from the springs have Eh values of ~-700 mV. As the self-potential (SP) geophysical method involves measuring electrical potential differences, the Eh contrast between the springs and the surrounding area should produce SP anomalies related to the reducing fluids percolating through the subsurface. The high alkalinity of the reducing springs is thought to be the result of active serpentinization of ultramafic rock. Since low temperature serpentinization results in the production of magnetite, there should be magnetic anomalies which correspond to areas of past and present serpentinization. Based on these considerations, a 100 m x 30 m area next to a known spring was surveyed by SP using new, low-noise electrodes built for this project, and a magnetic survey, using a fast, GPS enabled Overhauser magnetometer was carried out over an area of 1500 m x 200 m along Winter House Canyon, in an effort to locate and map the reducing groundwater. The geophysical data revealed that the known spring sites produce strong, coherent magnetic and SP responses, and a previously unknown spring was discovered based on its associated magnetic anomaly. Processing and analysis identified underlying structural elements of the ophiolite massif not visible on the exposed outcrop. Correlation of the surveys revealed sets of parallel, linear magnetic and SP anomalies. The strike of these anomalies indicates that reducing fluid is traveling within conduits which are perpendicular to the streambed and appear to predate incision of the canyon. This study presents a new exploration technique for locating new springs sites within Winter House Canyon and elsewhere in the Bay of Islands Ophiolite.

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