Electric and magnetic signatures of reducing springs at the Tablelands Ophiolite, Newfoundland, Canada

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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 produced 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 exist 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. In the survey down the canyon, a new spring was discovered at the site of a magnetic high, and future exploration targets corresponding to possible new spring sites were found. Furthermore, structural elements of the massif, not visible on the exposed outcrop, were identified. Correlation of the surveys revealed sets of parallel, linear magnetic and SP anomalies. The strike of these anomalies indicates that reducing fluid appear to follow long faults roughly perpendicular to the axis of the canyon and so at right angles to previously assumed faulting.

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