Groundwater investigation in Craftsbury, VT, using integrated geophysical technologies

By Ted Crook

Abstract. Hydrogeologic investigations commonly employ geophysical technologies to explore subsurface features without need for laborious and costly excavation. In the summer and fall of 2010 I began a project with the objective of employing geophysical technologies to identify groundwater bearing features in Craftsbury, VT. I conducted surveys using two geophysical technologies: Ground penetrating radar (GPR) and an Electromagnetic induction (EMI) profiler. The initial surveys identified a significant anomaly in the electrical properties of the underlying bedrock. EMI data revealed a long, narrow zone of contrasting high and low electrical conductivity, trending north-south along a gently sloping field. High electrical conductivity zones in bedrock can be associated with the presence of groundwater, deposits of metal ore, or some other highly conductive material including graphite. This project integrates geophysical data with observation and analysis of surface geology to determine the nature of the electrical anomaly. Results to date indicate that the responsible feature is most likely a layer of water saturated rock. Bedrock at this location is a formation of sandy, low-grade marble with interbedded phyllite; surface exposures reveal that it is highly porous rock with dissolution along preferential planes. The trend of the electrical anomaly parallels the strike of bedding planes, suggesting that they are related. Water in this soluble material would be expected to have a high concentration of dissolved ions, forming an electrolytic solution of high electrical conductivity. These results demonstrate the potential of EMI as a component of an integrated approach to identifying water-bearing geologic features. EMI equipment is increasingly portable and user friendly, making it as a useful tool for preliminary surveys in groundwater exploration.