Salinity Mapping and Cross-Sectional Imaging Beneath Rivers and Lakes

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Electromagnetic terrain conductivity mapping for the purpose of delineating co-produced salt water impact from oil and gas activities has been a common application in Alberta for over 20 years. As interest in remediating salt impacted soil and groundwater developed, conductivity information with depth was required. Over the last 10 years, 2-D and 3-D electrical imaging techniques, including electrical resistivity tomography (ERT) have been used extensively to provide delineation, in cross-section, of salt impact. Most recently, there is a strong focus on risk assessment, groundwater/surface water interaction, and surface water quality in general. These concerns demand a technique for mapping and imaging with depth inorganic contaminant impact to surface water bodies.

This talk will describe new approaches to using electromagnetic terrain conductivity mapping and electrical resistivity tomography applications to rivers and lakes. The talk will detail the use of marine "streamers" that allow the collection of several tens of kilometres of electrical imaging sections a day. Several case studies will be examined where waterborne electrical surveys have definitively identified saline discharge. It will be shown that these techniques are far more effective than water sampling as the geophysical methods "see" into the river or lake bed sediments. Identifying contaminant impact from water sampling alone is often impossible due to the small volume fluxes flowing into the large volume rivers of Western Canada. Identifying contaminant seepage into rivers and lakes using piezometers is expensive, very haphazard in approach, and often logistically impossible. Where the nature of the contaminants is organic, case studies will be provided that show how these river and lake geophysical methods can delineate geological features, such as paleochannels or bars, that may be facilitating the movement of organic contaminants. Where natural seepage is being targeted, natural salinity or even temperature differences may produce a sufficient conductivity contrast.

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Paul Bauman received his B.Sc.E. in Geological Engineering from Princeton University in 1981, and his M.Sc. in Earth Sciences from the University of Waterloo in 1989. Paul Bauman started, and continues to manage the near surface geophysics group at WorleyParsons in Calgary. The group numbers about 20 geophysicists that work on near surface applications in Western Canada, and around the world.