A soil geochemical survey of Fredericton, New Brunswick, Canada

DANIEL G. SENECHAL AND BRUCE E. BROSTER
Department of Earth Sciences, University of New Brunswick, Fredericton, New Brunswick E3B 5A3
<daniel_gilles.senechal@unb.ca>

A total of 101 locations were sampled as part of a soil geochemical survey of the downtown urban centre of Fredericton, New Brunswick. The city obtains ~95% of its potable water supply from an aquifer mostly confined by a discontinuous clay-silt aquitard underlying the urban centre. The aquitard contains “windows”, which could allow contaminates into the aquifer; hence, the focus of this study.

The area, which has been the provincial capital since 1785, occupies a broad floodplain located between the Saint John River and higher bedrock terrain to the west. Two samples were obtained at most sites, an ‘A’ sample collected at a depth of approximately 10 cm and, where possible, a ‘B’ sample collected at a depth of approximately 30 cm. Till samples were collected from areas of higher elevation where the terrain has been less disturbed by natural or anthropogenic activity. Samples <63 µm (230 mesh) were analyzed by Instrumental Neutron Activation Analysis (INAA) or Inductively Coupled Plasma Analysis (ICP) in order to determine elemental concentration for 50 elements. Five elements, As, Cr, Ni, Pb, and Zn, were found to exceed the Canadian Council of Ministers of the Environment (CCME) soil content guidelines for ‘A’ samples collected in the downtown area. For example, of this sample group 100% of the samples exceeded CCME guidelines for Cr soil concentrations, by 1.7 times the recommended limit of 64 ppm, and approximately 89% of this sample group exceeded the CCME guideline limit of 12 ppm for As soil content by 2.6 times. Concentrations of 34% of the sampled population for Pb were also found to be 2 times greater than CCME recommended soil content of 140 ppm. One particular downtown location demonstrates anomalous concentrations of all five elements and the history of anthropologic activities at that site are presently being investigated.

Topography and elemental mobility are interpreted to represent a major factor in the dispersion of the elements. The till ‘B’ samples displayed higher elemental concentrations than the ‘A’ samples; likely due to weathering and element mobility. Samples from the downtown area were collected from re-worked fluvial floodplain sediments that demonstrated much higher elemental concentrations in the ‘A’ samples in comparison to the underlying ‘B’ samples. The higher concentrations of some metals in the near-surface soils are interpreted to be caused by long-term anthropological activity in the urban centre.

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