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Tracing the contribution of large lakes to Mackenzie River discharge

J.J. Gibson, **J.-F. Hélie**

National Water Research Institute, University of Victoria, P.O. Box 1700 STN CSC, Victoria, BC V8W 2Y2 CANADA, john.gibson@ec.gc.ca, Fax: +1 (250) 472-5167, Phone: +1 (250) 472-5137

Herein we review results of isotopic and geochemical water sampling surveys conducted in the Mackenzie Basin since 1952, including new data from PARTNERS and the IAEA/NWRI network. Results from these surveys provide good examples of the complex evolution of isotopic composition of river discharge in a large, north-flowing river basin, particularly the mixing of tributary inflows and the buffering effect of the large lakes. Geographically, the most depleted isotope signatures are observed for tributaries of the Western Cordillera characterized by higher-altitude precipitation, greater snowfall, and higher runoff/precipitation ratios. In contrast, shield-dominated eastern areas and the central boreal-taiga plains tend to have enriched isotopic signatures reflecting lower altitude precipitation, and significant contributions from evaporated lake and wetland sources. Seasonality of the riverine isotopic signals is often pronounced, reflecting varying proportions of flow derived from snowmelt, groundwater, and surface waters during the ice-on, freshet, and ice-off periods. Winter drainage from Great Slave Lake may form a significant proportion of flow along downstream reaches of the river in some years, and distinguishes the Mackenzie from comparable rivers draining to the Arctic Ocean.