Geochemical proxies of North American freshwater routing during the Younger Dryas

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Proxies of deepwater formation show that a large reduction in the Atlantic meridional overturning circulation (AMOC) occurred at the start of the Younger Dryas event, suggesting that the attendant loss of ocean heat transport caused Younger Dryas cooling in the North Atlantic region. The cause of this ocean response remains unclear, however, with the leading mechanism, involving the routing of continental runoff to the St. Lawrence River, now questioned on the basis of marine and terrestrial evidence, and modeling. Moreover, the rate of the AMOC varied during the Younger Dryas which is not readily explained by the conventional routing argument. Here we capitalize on the well-known relation between river geochemistry and underlying bedrock lithology to use changes in $^{87}$Sr/$^{86}$Sr, U/Ca, and Mg/Ca measured in planktonic foraminifera tests as tracers of routing of continental runoff derived from distinct geological terranes. These data, supported by changes in planktonic $\delta^{13}$C and $\delta^{18}$O$_{\text{seawater}}$, confirm that routing of runoff from western Canadian Plains to the St. Lawrence River occurred at the start of the Younger Dryas, with an attendant increase in freshwater flux of $0.06 \pm 0.02$ Sv ($1$ Sverdrup (Sv) $= 10^6$ m$^3$ s$^{-1}$). Our data also indicate subsequent changes in the freshwater flux to the St. Lawrence River, thus explaining the variability in the overturning circulation and climate during the Younger Dryas.