Characterizing the North Saskatchewan River Watershed in Alberta using Stable Water Isotopes ($\delta^{18}O$ and $\delta^{2}H$)

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The stable isotope composition ($\delta^{18}O$ and $\delta^{2}H$) of water samples from the North Saskatchewan River was observed longitudinally from its headwaters through the Alberta-Saskatchewan border, and over a six-month period at Edmonton. Water samples were taken along the main stem and its tributaries over the course of three days (September 19 to 21, 2014) from Saskatchewan River Crossing to the Alberta-Saskatchewan border. Analyses were completed using a Picarro Cavity Ring-Down Spectroscopy L2130-i isotope analyzer. In the mountain reach, upstream of Drayton Valley the main stem has an average $\delta^{18}O$ value of -20.1 ‰ while tributaries near the junction with the main stem average around -19.0 ‰. The combination of these waters led to a value of -19.8 ‰ at Drayton Valley. In the Prairie reach, there is a downstream enrichment of the main stem to a maximum value of -19.25 ‰ near the Saskatchewan border but generally average about -19.5 ‰. Prairie tributaries have the most enriched values averaging -12.6 ‰, which is more enriched than the average meteoric value of -15.3 ‰ for September. A mixing model suggests the ~0.6 ‰ enrichment of the main stem between Drayton Valley and the Saskatchewan border reflects an ~8% contribution of more enriched Prairie tributaries. The magnitude of this addition is roughly proportional to the ~10% discharge added from these tributary water sources. Secondly, water samples were taken from the North Saskatchewan River twice weekly over a six-month period from September to February at Edmonton. There was a ~0.3 ‰ depletion of $\delta^{18}O$ observed in late November following freeze-up of the river and its tributaries. We hypothesize that this depletion in $\delta^{18}O$ is the result of decreased contributions of more enriched water from tributaries.