

Dissolved Cation and Suspended Particulate Matter Concentrations from the Mackenzie River and Estuary, Canada, September 2022: Supporting Documentation

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1 Introduction

Dissolved element concentration, salinity, and suspended particulate matter (SPM) concentration measurements of the Mackenzie River (Inuvik) and estuary (Tuktoyaktuk). River water and sediment samples were collected between the 11th and the 18th of September 2022. Individual sample locations (latitude and longitude) are provided in the data file. A modified Van DornTM depth sampler (8L) was used to collect samples from various depths within the water column using boats. A small number of samples were also collected from the shoreline. Samples were immediately filtered onshore through 0.22 µm polyethersulfone (PES) membranes using purpose-built filtration units (5 L). Cation samples were transferred into acid-cleaned high-density polyethylene (HDPE) bottles (50 mL) and acidified to a pH of 2 using single-distilled ca. 17 M nitric acid. Anion samples were transferred into clean opaque HDPE (50 mL) bottles. Suspended particulate matter (SPM) concentrations were determined using the volume of water collected and the mass of dry SPM. Salinity measurements were made using a ProDSS salinity probe (YSI). Element concentrations were determined via inductively coupled plasma mass spectroscopy (ICP-OES) on an Agilent 5100 in the Department of Earth Sciences (University of Cambridge). The precision and accuracy of dissolved element concentrations were determined via repeated measurements of certified standards (section 3). Dissolved inorganic carbon (DIC) measurements were made using a Thermo Gas Bench attached to a Thermo Scientific DELTA V isotope ratio mass spectrometer. Approximately 2 mL of orthophosphoric acid was pre-loaded into a reaction vial, before being capped and sealed. The head space was then flushed with helium gas. The sample water (1.5 mL) was injected into the vial through the butyl rubber septa using a syringe and left to react for one hour. The sample tubes were transferred to the Gas Bench and CTC CombiPal Autosampler and the resulting CO₂ in the head space was analysed. A series of standards and reference samples distributed measured during the analysis session were used to calibrate the samples to the Vienna Pee Dee Belemnite (VPDB) standard. Parameter abbreviations and units are provided in table 1.

2 Data Table Columns

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Description	Abbreviation	Unit
ID of the individual sample	ID	N/A
Date of sample collection	Date	DD/MM/YYYY
Paired ID for SPM and water	SPM_water_pair	N/A
Latitude	Lat	Decimal degree
Longitude	Lon	Decimal degree
Suspended particulate matter	SPM	mg L ⁻¹
Salinity	Salinity	P.S.U.
pH	pH	N/A
$\delta^{13}\text{C}$	d13C	‰
Alkalinity concentration, dissolved	Alk	$\mu\text{Eq L}^{-1}$
Aluminium concentration, dissolved	Al	$\mu\text{mol L}^{-1}$
Barium concentration, dissolved	Ba	$\mu\text{mol L}^{-1}$
Calcium concentration, dissolved	Ca	$\mu\text{mol L}^{-1}$
Iron concentration, dissolved	Fe	$\mu\text{mol L}^{-1}$
Potassium concentration, dissolved	K	$\mu\text{mol L}^{-1}$
Magnesium concentration, dissolved	Mg	$\mu\text{mol L}^{-1}$
Manganese concentration, dissolved	Mn	$\mu\text{mol L}^{-1}$
Sodium concentration, dissolved	Na	$\mu\text{mol L}^{-1}$
Sulphate concentration, dissolved	SO4	$\mu\text{mol L}^{-1}$
Silica concentration, dissolved	SiO2	$\mu\text{mol L}^{-1}$
Strontium concentration, dissolved	Sr	$\mu\text{mol L}^{-1}$

Table 1: Table parameters, abbreviations, and units for the data file Mackenzie_River_Data_2022.csv.

3 Standard Measurements and Uncertainties

Element	Literature ($\mu\text{g L}^{-1}$)	Study Average ($\mu\text{g L}^{-1}$)	Deviation (%)	R.S.D. (%)	Count (N)
Al	250	226	-9.6	5.4	10
Ba	250	240	-4.1	2.7	10
Ca	10000	10180	1.8	3.1	10
Fe	100	91	-8.9	15.1	10
K	1000	992	-0.8	4.7	10
Mg	2000	2074	3.7	6.1	10
Mn	50	50	-1	4	10
Na	10000	10530	5.3	9.4	10
S	10000	10048	0.5	5.8	10
Si	5000	4829	-3.4	3.3	10
Sr	250	251	0.5	2.1	10

Table 2: Repeated measurements of the SPS-SW2 standard on the Agilent 5100 (ICP-OES). SPS-SW2 standards were diluted by a factor of 10.

Element	Literature ($\mu\text{g L}^{-1}$)	Study Average ($\mu\text{g L}^{-1}$)	Deviation (%)	R.S.D. (%)	Count (N)
Al	33.8	35.4	4.8	2.5	5
Ba	14.28	14.82	3.7	2.5	5
Ca	8760	8897	1.6	1.6	5
Fe	84.3	84.2	-0.2	3.6	5
K	651	647	-0.7	5	5
Mg	2133	2233	4.7	2.6	5
Mn	2.12	2.35	10.8	3	5
Na	2760	2822	2.2	2.6	5
S	1790	1910	6.7	2.4	5
Si	2231	2406	7.9	1.1	5
Sr	40.66	41.64	-2.4	1.8	5

Table 3: Repeated measurements of the SLRS-6 standard on the Agilent 5100 ICP-OES.

Element	Literature (mg L^{-1})	Study Average (mg L^{-1})	Deviation (%)	R.S.D. (%)	Count (N)
Ca	412	451	9.6	1.4	10
K	399	426	6.8	0.9	10
Mg	1290	1365	5.8	1	10
Na	10770	11655	8.2	1.3	10
Sr	7.9	8	-4.9	2	10

Table 4: Repeated measurements of the IAPSO standard on the Agilent 5100 (ICP-OES) IAPSO standards were diluted by a factor of 35.

Sample	Alkalinity [1] (mg L^{-1})	Alkalinity [2] (mg L^{-1})	Average (mg L^{-1})	Maximum Deviation (%)
CAN22_001	2.03	1.98	2.00	1.1
CAN22_013	2.25	2.28	2.26	0.7

Table 5: Duplicate Gran titration measurements using a Hanna Instruments HI-991301 pH meter.

Parameter	Uncertainty	Unit
SPM	10	%
pH	0.01	pH
d13C	0.1	‰

Table 6: SPM, pH and $\delta^{13}\text{C}$ uncertainties.

4 Fieldwork Photos



Figure 1: Tuktoyaktuk (Northwest Territories, Canada), situated on the edge of the Mackenzie Estuary between the Mackenzie River and the Arctic Ocean.



Figure 2: Samples collected from varying depths in the Mackenzie Estuary. The modified Van Dorn™ depth sampler and attached salinity probe are shown to the right of the samples.



Figure 3: A tributary of the Mackenzie River, close to Inuvik (Northwest Territories, Canada). Samples were connected from the Mackenzie River



Figure 4: The edge of the Tuktoyaktuk Estuary, which separates the Mackenzie River from the Arctic Ocean.