

We thank Dr. Fryar for thoughtful and constructive suggestions. In the following, referee comments are shown in *italic fonts*, and our responses are shown in regular fonts.

The authors have done a commendable job of explaining seasonal and lithologic controls on groundwater flow in an alpine karst basin in the Canadian Rocky Mountains. This study stands out through its integration of multiple, complementary data sets, including continuous monitoring of stage and electrical conductivity over multiple years; development of a stage-discharge rating curve for the spring; repeated sampling for hydrochemical and isotopic analyses; tracer testing; time series analyses; and information from other sources (geologic mapping, meteorological data, and satellite imagery). The approach and findings contribute to the literature on the hydrology of alpine karst, which has been understudied outside Europe and which constitutes an important resource for human use and ecological functioning in various parts of the world.

In general, I would answer yes to all the questions posed to reviewers. I reviewed the manuscript before reading the comments already posted online. In particular, I affirm Dr. Worthington's comments on clarifying the discussion of groundwater velocity and expanding the discussion of the range of residence times in the system. My suggestions primarily address providing additional information, plus some minor editorial corrections. Note that I did not check citations against the references and vice versa.

Main comments:

line 36: Re: "the unique alpine settings offer potential advantages that are not available in lowlands"— What are these advantages? Rephrase following lines 549–551.

This refers to the dominance of snowmelt recharge as the referee points out. In addition, the barren alpine landscape allows for rapid infiltration of rain, snowmelt and runoff into the bedrock. We will add this information in the revised texts.

lines 75–76: Note that the age of the Palliser Fm. is Devonian.

We will introduce this formation as the Devonian Palliser Fm. in the revised texts.

Fig. 1 and lines 90–91: Which direction does the syncline plunge? Are conduit development and flow paths to the spring structurally controlled?

The axis of syncline plunges towards northwest. We will include this information in the revised texts.

lines 195–198: The assumption that diurnal timing of maximum snowmelt coincided with maximum air temperature seems reasonable, but I recommend citing one or more references to support this assumption.

We will include a reference (Vigna and Banzato, 2015 – suggested by Dr. Worthington in Community Comment 2).

lines 264–265: Re: "a is an empirical coefficient taking a value of 0.082 m^{-1/2} s^{-1/2} for an intermediate value of SF (= 1.4) within the expected range" — Fig. 5b shows a = 0.077. Which value is correct?

The value in Line 264 should have been 0.077. This will be corrected in the revised texts.
line 325: SO₄ should be > 99% of total anions analyzed by ion chromatography (emphasis added). HCO₃, which was analyzed by alkalinity titration, is the dominant anion in groundwater here.

In the original texts, > 99% actually referred to the total anion analyzed by both chromatography and titration. This will be clarified in the revised texts.

lines 336–337: Re: “the component associated with snowmelt recharge having a higher Ca/Mg ratio and carbonate fraction but lower ion concentrations” — the lower Ca/Mg ratio between snowmelt periods could reflect proportionally more solute contributions from dolomite, which dissolves more slowly than calcite (for example, see Barna et al., Environ. Eng. Geosci. 26(3), 2020, p. 281, and references therein).

We thank the referee for this suggestion. We will discuss the potential influence of dissolution kinetics in the revised texts.

lines 342–344: Were saturation indices for dolomite, calcite, and anhydrite calculated?

We calculated saturation indices (SI) for the three minerals for spring water samples (Lilley, 2023, MSc. Thesis, p.97) . The SI in logarithmic scale fluctuated between -3.1 and -1.9 for anhydrite, -0.8 and -1.9 for dolomite, and -0.5 and -0.1 for calcite, where the highest values occurred during winter (December – March) and the lowest values occurred during peak flow in June. This information will be added to the revised texts.

lines 345–347 and Fig. A2: How were rain and snow samples collected? Were snow samples fresh? Were steps taken to limit evaporation or sublimation, which can alter the isotopic composition? How does the LWML compare to other LWMLs from the region?

This was an omission. Collection of rain and snow samples should have been included in Section 3.2. The following will be added to the revised texts.

Rainwater was collected in a small shrubby wetland sheltered from strong winds, near the spring (point to be added to Figure 1a) using a ‘ball-in-funnel type collector’ (Prechsl, 2014) to prevent evaporation and block debris. Aggregated rainwater was retrieved once every few weeks from the sampler. Depth-integrated snow samples were collected from two locations (points to be added to Figure 1a) using a snow sampler with a 39.1 cm² cutting area (Farnes et al., 1983) and then melted in the laboratory to yield an integrated sample.

Farnes, P. E., Goodison, B. E., Peterson, N. R., & Richards, R. P. (1983). Final Report. Metrication of Manual Snow Sampling Equipment. Western Snow Conference, Reno Nevada, April 23, 1982.

Prechsl, U. E., Gilgen, A. K., Kahmen, A., & Buchmann, N. (2014). Reliability and quality of water isotope data collected with a low-budget rain collector. Rapid Communications in Mass Spectrometry, 28, 879–885.

lines 416–417: The observation “The component with low carbonate fraction represents groundwater released from over-winter storage, which is presumably in contact with evaporite deposits within the Palliser Fm.” is consistent with Barna et al. (2020, p. 281) and references therein.

We thank the referee for suggestion. We will mention the similarity between our study and Barna et al. (2020) in the revised texts.

Fig. 14: Do dashed lines on the surface represent local drainage basin divides? Note on legend.

Dashed lines represent ridges but not necessarily basin divides. We will explain this in the figure caption.

Minor edits:

lines 8, 19, 546, 565: By definition, inaccessible terrains can't be accessed. Use "remote" or "relatively inaccessible" instead.

We will change 'inaccessible' to 'remote' in the revised texts.

lines 36–37: "accumulation and melt has" should be "accumulation and melt have"

This will be corrected.

line 74: "Front Range...is" should be "Front Ranges...are"

This will be corrected.

line 128: "with a 0.45- μ m membrane filters" should be "with 0.45- μ m membrane filters"

This will be corrected.

lines 134–135: "by a cavity ring-down spectroscopy" should be "by cavity ring-down spectroscopy"

This will be corrected.

line 135: "to the Vienna Standard Mean Ocean Water" should be "to Vienna Standard Mean Ocean Water"

This will be corrected.

line 142: "and the V-SMOW" should be "and V-SMOW"

This will be corrected.

Fig. 3 caption: "Augst" should be "August"

This will be corrected.

line 206: "the kth the element" should be "the kth element"

This will be corrected.

line 273: "unlikely serve" should be "unlikely to serve"

This will be corrected.

line 305: "hereafter referred to" should be "hereafter is referred to"

This will be corrected.

line 336: "ion concentration" should be "ion concentrations"

This will be corrected.

line 355: “appear” should be “appeared”

This will be corrected.

line 423: “majority discharge” should be “majority of discharge”

This will be corrected.

lines 450–451: “the Darcy’s law” should be “Darcy’s law”

This will be corrected.

lines 455–456: “discharge...and velocity...is estimated” should be “discharge...and velocity...are estimated”

This will be corrected.

line 465: “Jennin” should be “Jeannin”

This will be corrected.

line 470: “than ~3.7 m” should be “than the value of ~3.7 m”

This will be corrected.

line 733: “mapping procedure map” should be “mapping procedure and map”

This will be corrected.

line 746: “Wavel” should be “Waveland”

This will be corrected.

line 765: “Alberta British Columbia” should be “Alberta and British Columbia”

This will be corrected.

line 775: “Tracer test” should be “Tracer tests”

This will be corrected.

line 855: “Savanna” should be “Savannah”

This will be corrected.